◥HEISE®

PTE-1
HAND HELD
CALIBRATOR

OPERATING
MANUAL
REVISION 4.6 3/2004

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Section 1.0   Introduction

Congratulations! Your purchase of the Hand Held Calibrator (HHC) calibration system equips you to perform a wide variety of pressure and temperature measurements. The general pressure and temperature measurement capabilities of the HHC are supplemented by application specific firmware as well as the availability of optional data logging capability.

The HHC is a complete pressure calibration system providing: interchangeable pressure ranges, simultaneous measurement and display of two pressure ranges, measurement and display of current and voltage. The HHC also provides the ability to perform high accuracy temperature measurement. Conversion between temperature and pressure measurement can be done in a matter of seconds and requires no tools.

A standard HHC system consists of a base unit that acts as a host for one or two Quick Select modules. The Quick Select pressure modules are interchangeable and are available in a wide variety of ranges from 0.25 inches of water to 10000 psi. A brief description of the main components of an HHC system follows. In addition, Quick Select modules are available to allow the base unit to work in conjunction with most standard RTD temperature probes and thermocouple temperature detectors.

Section 3 and its various subsections include all the information needed to begin using the HHC system for basic pressure and temperature measurement. Higher level functions are detailed in later sections of this manual. It is strongly recommended that the pertinent sections of this manual be reviewed prior to using the HHC system for higher level and application specific measurement and test activities.

Important: Failure to follow the instructions provided in this manual may result in personal injury and/or damage to the instrument, accessories, products under test or other equipment.

Section 1.3   Base Unit Overview HHC

The base unit functions as the host for the Quick Select pressure and temperature modules designated in this manual by the "GQS" prefix. Each base unit includes a keypad, microprocessor based electronics and a two line LCD display. The base unit displays the measurement data transmitted from the Quick Select module(s). Measurement outputs from two installed Quick Select modules can be simultaneously displayed. Quick Select modules for the measurement of either pressure or temperature can be plugged into either of the 2 module "bays" in the base unit. Pressure engineering

units can be independently selected from the library of twelve factory programmed or one operator designated engineering unit. Temperature measurement data can be displayed in degrees Celsius, Fahrenheit, Kelvin or Rankine. In addition, when used with the GQS-RT1 Quick Select module for temperature measurement with an RTD temperature probe, the calibrator system can display the RTD measurement in ohms. The GQS-TC1 thermocouple interface module allows measurement of mV inputs from –10 to +100 mV.

In addition to displaying two pressure measurements simultaneously the operator can elect to display pressure and temperature or the measured value from either of the two installed Quick Select modules as well as either a voltage or mA measurement. This allows for the easy calibration and test of pressure and temperature transducers, transmitters and switches.

The base unit includes a wide variety of general and application specific measurement capabilities. These capabilities allow the HHC measurement and calibration system to be used for basic pressure and temperature measurement as well as application specific pressure measurement activities. Basic pressure and temperature measurement capabilities include; max/min recall, operator programmable tare values, display hold, operator programmable damping and user selected engineering units. Application specific capabilities include; flow velocity measurement, flow volume mea-surement, leak detection, leak rate quantification and switch testing. Optional data logging, time delayed data logging and programmable alarms are also available.

Section 1.4   Quick Select Modules Overview

The Quick Select pressure module is a calibrated pressure measurement device. Quick Select pressure module units are available in a wide variety of pressure measurement ranges. The Quick Select RTD and therm-ocouple interface modules allow the HHC base unit to provide precision temperature measurement data using standard RTD (Resistance Temperature Detector) or thermocouple detectors. The GQS-RT1 module allows the HHC to function with most common platinum, nickel and copper RTDs, while the GQS-TC1 supports most common thermocouples.

The Quick Select module communicates with the base unit via a 10 pin connector. Quick Select pressure modules slide into the base unit automatically aligning the female 10 pin connector on the Quick Select pressure module with the male 10 pin connector in the base unit.

All calibration data is stored in Electrically Erasable Programmable Read Only Memory (EEPROM) resident

in the Quick Select module. As such, any Quick Select module can be used in any base unit and the measurement system will provide measurement accuracy in conformance with the published specification.

Section 1.4.1 The GQS-1 Quick Select Pressure Module

GQS-1 Quick Select pressure modules provide specialized low pressure measurement capabilities. GQS-1 Quick Select pressure modules incorporate a micro-machined silicon variable capacitance sensor.

Inside the sensor there is a micro-machined silicon diaphragm. This diaphragm is between two non-moving plates on which metal has been sputtered. The air between the diaphragm and the non-moving plates acts as an insulator.

As pressure or vacuum is applied to the sensor, the diaphragm moves changing the distance between the diaphragm and the fixed plates. This change in distance changes the capacitance of the sensor. It is this variable capacitance that is measured and correlated to pressure or vacuum during the calibration process.

The sensor is connected to an Application Specific Integrated Circuit (ASIC). This ASIC generates a linear signal ramp and applies this signal to the top plate of the sensor while an equal and opposite signal is applied to the bottom plate.

When the measured pressure is balanced, for example, when both ports are opened to atmosphere, the distance between the diaphragm and both of the fixed plates is the same. When this is the case, the signal to the top plate is capacitively coupled to the equal and opposite signal applied to the bottom plate. As a result, no signal current will flow through the center plate (diaphragm). When the diaphragm is moved off center by the application of pressure or vacuum, the excess current flows through the center plate to an input differentiator in the ASIC. The differentiator translates the frequency of the sensor output into a voltage which is scaled over the full scale range of the instrument.

GQS-1 modules are available in ranges from 0.25 inches of water through 200 inches of water. These modules can be configured to provide differential/gauge or compound pressure measurement capabilities. They are designed for use on clean, dry, noncorrosive and nonconductive gases. A complete listing of the available GQS-1 modules is provided in Appendix C.

Section 1.4.2 The GQS-2 Quick Select Pressure Module

The GQS-2 Quick Select pressure module incorporates a micro-machined piezoresistive strain gauge sensor. This technology takes advantage of the fact that, when put under stress, (as with the flexing of a diaphragm under pressure or vacuum) the resistive properties of a piece of silicon will change. In the manufacturing process resistors are deposited in a silicon substrate. The resistors are typically configured in a wheatstone bridge orientation. When positioned in this fashion, the output will be near zero when no pressure (stress) is applied and will increase in a near linear fashion with the application of pressure or vacuum. The reverse side of the substrate is etched to provide the required diaphragm thickness for the given pressure range.

When power is applied to the sensor the level of resistance across the wheatstone bridge will change in proportion to the level of pressure applied. The output from the sensor is extremely repeatable and has minimal hysteresis due to the fact that the sensor substrate is silicon. The sensor output is then amplified by circuitry within the Quick Select pressure module. The amplified output is then calibrated over the operating range of the module. Calibration coefficients for the module are stored in Electrically Erasable Programmable Read Only Memory (EEPROM) within the Quick Select pressure module.

GQS-2 modules are available in ranges from 5 through 10,000 psi. These modules can be configured to provide gauge, compound or absolute pressure measurement, as well as vacuum measurement capabilities. GQS-2 modules in range of 5 psi are designed for use on clean, dry, noncorrosive and nonconductive gases. 316 stainless steel sensor isolation is provided for ranges from 0/10 through 0/10,000 psi. A complete listing of the available GQS-2 modules is provided in Appendix C.

Section 1.4.3 The GQS-RT Quick Select RTD Interface Module

The GQS-RT1 allows the HHC base unit, when used with RTD temperature probes, to provide precision temperature measurement data. The GQS-RT1 plugs directly into the Quick Select interface module bay in the base unit. Any standard RTD probe with a Switchcraft TA4M can be plugged into the Switchcraft TA4F connector on the module. The GQS-RT1 module comes factory programmed with the curves for Pt 100 (385 & 392), Cu 10 and Ni 120 RTD probes. It supports RTDs with outputs in the range of 0/400 ohms. The GQS-RT2 is supplied factory programmed to support the Pt1000 (385 & 392) RTD. This interface module will support RTDs through an output up to 4000 ohms. The GQS-RT module can be programmed with coefficients for other RTD probes of interest and specific characteristics of a probe already included in the on-board library can be

programmed into the GQS-RT unit to provide enhanced accuracy. Each GQS-RT interface module can accommodate up to 8 different programmed RTD calibration curves. Programming of the RT module is accomplished via an optional software package and any PC compatible computer with an available standard serial communication port. See Appendix E page 75 for probe connector pin out information.

Section 1.4.4   The GQS-TC1 Quick Select Thermocouple Interface Module

The GQS-TC1 allows the HHC base unit, when used with a thermocouple interface module, to perform temperature measurement. The GQS-TC1 plugs directly into the Quick Select module bay in the base unit. The thermocouple is then attactched to the GQS-TC1 module via a male "miniature thermocouple connector."

Section 2.0   Unpacking & General Care

General instructions for unpacking and calibrator care follow.

Section 2.1   Unpacking Product Upon Receipt

Prior to removing the HHC from the packaging material inspect all cartons for shipping damage. Document any damage evident in the event that a damage claim must be made against the shipper. After inspection, remove the base unit, module(s), manual and any accessories purchased from the packaging material. Retain the packaging for use in returning the HHC to the factory for future recertification or repair.

Section 2.2   Product Storage

The product should be stored in an area that is maintained in the temperature range indicated in the storage temperature in the product specification. The storage temperature limits are -4 to + 158 degrees Fahrenheit. Storage of product in environments that will exceed these temperature limits results in significant risk of product damage. It is recommended that the product not be left in closed cars or truck cabs as temperature damage can easily occur due to the "greenhouse effect" of closed vehicles or extreme cold temperatures that can result from winter conditions.

Section 2.3   Product Cleaning

The enclosure of the calibrator is not watertight. As such, care should be taken during cleaning to assure liquid does not penetrate the enclosure for the base unit or Quick Select modules. Cleaning of the product should be done with a cloth moistened with a warm, mild detergent mixture.

Section 3.0   System Start-Up General Instructions

The HHC can perform a wide variety of simple and complex temperature and pressure based measurement, test and calibration operations. Due to the menu driven set up procedures the system can be quickly and easily configured for most any of its measurement functions. By following the steps in this section you can be ready to use your HHC to perform basic pressure and temperature measurement functions in a matter of minutes.

Section 3.1   Battery Installation

Step 1   To gain access to the battery compartment, remove the bottom end of the strap assembly by detaching the Velcro connection and pulling the bottom end of the strap from the retaining pin in the bottom of the case of the base unit.

Step 2   Open the battery compartment by sliding the battery enclosure cover out of the compartment opening. To do this press down on the circular, ribbed indentation on the battery cover while pushing the enclosure cover outward with pressure on the two standoffs located near the pin used to retain the strap on the base unit.

Step 3   Note the polarity information for installation of the two 9 volt alkaline batteries as outlined on the inside of the battery enclosure.

Step 4   Locate the two 9 volt batteries and the foam retaining spacer provided in a small plastic bag. Install these batteries as shown on the diagram in the battery enclosure. The HHC will operate for approximately 30 hours on the two 9 Vdc batteries. Alkaline batteries are recommended for use in the HHC system.

Step 5   Insert the retaining spacer between the two 9 volt batteries. This will insure that the batteries will not disconnect or be shaken loose during normal operation.

Step 6   Replace battery compartment cover by sliding cover back into position until it locks in place.

Step 7   Replace strap by threading strap through the

opening, starting closest to the battery compartment and reattaching Velcro. The strap may be adjusted in this fashion to provide for proper strap length to accommodate any hand size.

Caution: Quick Select modules should be installed with the power off on the base unit. Failure to turn the base unit off prior to changing pressure measurement modules could damage the instrument or module electronics or "lock up" microprocessor operation. If power is inadvertently left on and the base unit locks up (looses communication) after changing Quick Select modules, simply power down the unit and restart.

Refer to Section 3.5 for the procedure to remove a Quick Select module.

To insert a Quick Select module follow the process below.

Step 1   Make certain the power is off on the base unit.

Step 2   Hold the base unit, in one hand, with the keypad side down.

Step 3   Holding the Quick Select module to be installed in the other hand, align the module with the locking tab up, with the module bay on the base unit.

Step 4   Slide the Quick Select module into the base unit until the retaining/release tab pops into the square cutout in the module bay of the base unit. This will lock the Quick Select module into the base unit.

Step 5   Installation of the Quick Select module is now complete. If an GQS-RT1 or GQS-TC1 interface module is to be used plug the appropriate temperature detector into the connector on the module. To set up the HHC and temperature module combination proceed to section 16 for RTDs or section 17 for thermcouple detectors

Important Note:
If only one module is to be used, install the Quick Select System Protection module provided. Follow the same procedure to install the system protection module as that used for a standard pressure measurement module. Both module bays of the base unit should contain a Quick Select module to protect from dirt or other debris getting into the base unit assembly. If only one Quick Select pressure module is needed install the System Protection Module (part number GQS-XS) supplied with your unit at the time of shipment when using the HHC system.

After the desired Quick Select pressure module(s) or Quick Select temperature measurement interface module and probe has been installed the HHC can be started up as follows:

Turn the system power on by pressing the on/off key on the instrument's key pad.

ON
OFF

During the start up process the HHC will display the following information:

First Screen

```
firmware
version      xx.xx
```

where xx.xx is a numerical value representing the firmware revision level installed in the base unit. The firmware version is updated/changed as enhancements are added to the HHC.

Second Screen

```
Left Mod: std or enh
temperature performance
```

Third Screen

```
Range
XX and engineering unit
```

where:

xx =   the range of the installed module
     ngineering unit is the default engineering unit
for the module installed in the left bay

Fourth Screen

```
Right Mod: std or enh
temperature performance
```

Fifth Screen

```
Range
XX and engineering unit
```

where:

xx = the range of the installed module engineering unit is the default engineering unit for the module installed in the left bay

Note: GQS-2 pressure measurement modules are available with a standard calibration or an optional enhanced temperature performance calibration. Modules calibrated to provide enhanced temperature performance will provide the rated accuracy, without any additional temperature error over an operating temperature range of 20-120 degrees Fahrenheit. These modules will display:

```
enh
temperature performance
```

when powered up.

The range indication is provided in the primary engineering unit for each installed Quick Select module. Upon initial power up an HHC used with an GQS-RT1 temperature module and probe will default to displaying the ohms (resistance value) for the probe. Once set up this combination will default to the previously used temperature measurement unit, such as Celsius, Fahrenheit, Kelvin or Rankine. The primary engineering unit for a given Quick Select pressure module, along with the measurement range, is included on the module label. The information on the left side of the display corresponds with the Quick Select module installed in the left module bay and information on right side of the display corresponds with the Quick Select module installed in the right module bay. If only one module is installed the corresponding side of the display will indicate "no module" on power up.

After the third screen the HHC will commence providing pressure measurement data. The format for display of the measurement data is as follows:

```
Eng Unit Eng Unit
```
(primary engineering unit)
```
+XX.XXX  +XX.XXX
```
 (measured value with sign)

When only one module is installed, the side of the display corresponding to the side of the base unit that does not have a module will display "- - - - -"

If necessary, the HHC, used with a Quick Select pressure module, may be zeroed by pressing the Zero key prior to beginning measurement activities. Additional details on zeroing the HHC system are provided in Section 6.0 of this manual.

The HHC is now ready for basic pressure or temperature measurement. Simply connect the pressure port(s) of the Quick Select pressure module(s) to be used to the pressure source to be measured. If a gauge pressure measurement is to be made using a differential Quick Select pressure module be sure to connect the pressure to be measured to the high pressure port on the Quick Select pressure module. For temperature measurement, connect the RTD probe to be used to the Switchcraft connector on the interface module and proceed to Section 16 and 17 for instructions on setting up the calibrator for temperature measurement.

Section 3.4   Optional System Start Up Procedures

There are additional set up operations that can be performed to increase the overall capabilities of the HHC system; these include:

1 – Auto off function to protect from inadvertently leaving the HHC system on.

2 – Setting up battery level indication so that an estimate of the remaining battery life can be viewed at the push of a button.

3 – Programming the current date and time for use in date stamping data logged pressure values and starting delayed data logging activities on HHC systems with the optional data logging capability. **Current date and time information is only maintained in units with the data logging option**

4- Programming owner/operator information for display on the HHC to facilitate tracking of in-house instrumentation.

The following subsections provide information on the above listed start up procedures.

Section 3.4.1   Auto Off- Battery Save Function (BatFunc)

The HHC can be set up to automatically turn itself off if no keypad activity is detected for a 10 minute time period. This capability will protect the two 9 volt batteries from being depleted if the HHC is left on inadvertently.

The following procedure is used to activate or disable the battery save function.

Step 1 With the HHC on and reading pressure press the SET UP key.

**SET
UP**

Step 2 Using the arrow keys select the battery function submenu (designated BatFunc in the set up menu). When selected, the text "BatFunc" will flash on the display.

```
BatFunc   Percent
UserEng   H2Oref
```

Step 3 With "BatFunc" flashing press the enter key.

ENT

Step 4 Using the up/down arrow keys to select Auto Shut off. When selected the text will flash.

```
Auto Shut Off
CfgBattIndicator
```

Step 5 With the words "Auto shut off" flashing press enter to activate the battery save function.

ENT

The PTE will respond by displaying the following:

```
Auto Shut Off
Disable     Enable
```

If Enable is selected the HHC will automatically turn off if there is no keypad activity detected for a period of 10 minutes. If Disable is selected the HHC will remain on continuously until the battery voltage is no longer sufficient to power the system. The battery save mode selected is stored in Electrically Erasable Programmable Read Only Memory (EEPROM). As such it does not require reprogramming on power up.

Note: An optional AC adapter is available for long term continuous measurement activities.

Section 3.4.2   Set Up for Battery Charge Level Indication

If this function is not set up pressing the BAT CK key will provide a measurement of the remaining voltage of the installed batteries.

If the battery check function is set up, the HHC can provide an estimate of the remaining battery life. This estimate is expressed as a percentage of the expected 30 hour life of newly installed alkaline batteries. Use of non-alkaline, lithium or rechargeable batteries will render the life expectancy estimate inaccurate. **This function should be set up only when new batteries are installed.**

If this function is not set up pressing the BATCK key will provide the measured remaining voltage of the installed batteries.

To have the capability to check the estimated remaining battery life follow the steps below.

Step 1 Press the ON/OFF key on the keypad to turn the power on to the base unit.

```
ON
OFF
```

Step 2 With the HHC on and reading pressure press the battery check key, designated BAT CK.

**SET
UP**

Step 3 Using the arrow keys select the battery save function (designated BatFunc in the set up menu). When selected, the text "BatFunc" will flash on the display.

```
BatFunc   Percent
UserEng   H2Oref
```

Step 4 With the "BatFunc" text flashing press the enter key.

ENT

Step 5 Using the up/down arrow keys to select CfgBat-tIndicator to set battery level. When selected the text will flash.

```
Auto Shut Off
CfgBattIndicator
```

In response the HHC will display:

```
Battery Indicator
Disable     Enable
```

Step 6 To Enable the battery level indictor use the arrow keys to select the text Enable

Step 7 With the text Enable flashing, press the enter key.

```
ENT
```

The HHC will respond by displaying:

```
Set BattCapacity
XXXXX
```

where:

 XXXXXXXXXXXXXXXXX is a bar graph represen-tation of the remaining battery life and +X.XXV repre-sents the voltage level of the installed batteries.

Step 8 After installation of new batteries use the right pointing arrow key to index the bar graph to 100%.

>

Step 9 After the bar graph has been refreshed press the enter key.

ENT

Note: The bar graph and the estimate of the percent bat-tery life remaining will now be displayed along with the

battery voltage level when the BATCHK key is pressed.

Section 3.4.3   Low Battery Icon

The HHC provides advanced warning of a low battery condition. The icon, which looks like a miniature battery will appear and flash in the center of the top line of the display when the measured battery voltage drops to 5.7 Vdc. The calibrator will continue to function properly with the low battery icon flashing. To ensure uninterrupted measurement capability it is recommended that the batteries be replaced as soon as possible after the low battery icon appears. When the measured voltage drops to 5.5 Vdc, the low battery icon will flash on the display and the calibrator will turn itself off after 15 seconds. If the measured voltage drops to 5.4 Vdc the calibrator will not allow power up.

Summary of low battery warnings:

> 5.7 Vdc: Low battery icon appears
>
> 5.5 Vdc: Low battery icon remains on display, unit powers down after 15 seconds.
>
> 5.4 Vdc: Power up not allowed

It is estimated that the user will have between 45 and 60 minutes of battery life remaining when the low battery icon initially appears. Actual battery life remaining will vary based on tasks being performed and ambient operating temperature.

Section 3.4.4   Programming Date & Time Information

If the unit does not have the Data Logging option skip this section. The date/time function supports date/time recording capability that can be used in association with the Data Log option.

Note: HHC units without the Data Logging option have no requirement for the date time tracking and will not keep track of the date and time when powered down.

For various application oriented functions the use of a real time clock will be required. Setting the real time clock is a simple process and should be done when the HHC is received.

The real time clock may be set by following the steps below.

Step 1   With the HHC on and reading pressure press the SET UP key.

> **SET
> UP**

Step 2   Using arrow keys move through the menu selections and select "DateTime" on the LCD display.

DateTime will flash on the display when selected.

> ```
> Owner Alarm
> DateTimeRS232
> ```

Step 3   With the words "DateTime" flashing press the enter key.

> **ENT**

This will activate the date time setup screen that looks as follows:

> ```
> YYMMDDHHMMSS
> XXXXXXXXXXXX
> ```

where:

YY = the last 2 digits of the current year

MM = the month (01 for Jan. through 12 for Dec.)

DD = the day of the month
(01-31 depending on day and month)

HH = the current hour using military time where:
     0800 = 8:00 AM
     1200 = noon
     1500 = 3 PM
     2000 = 8 PM

MM = minutes (from 0 to 60)

SS = seconds (from 0 to 60)

Setting the current date and time is accomplished by using the keys with the corresponding numerical values.

From left to right enter the appropriate number in each of the field positions using the numeral keys. Once a given field has the appropriate number entered the HHC will automatically index to the next position for entry.

When completed the date/time information should look as follows:

> ```
> YYMMDDHHMMSS
> 961003111500
> ```

For a date/time of October(10), 3rd day (03), 1996 (96) at a time of 11:15 AM (1115), and 0 seconds (00).

When the correct time/date information has been entered and appears on the display press the enter key to store the time/date information in memory.

> **ENT**

Time/date information is stored in battery backed up Random Access Memory (RAM). This information should only need to be changed or reentered when a time change has occurred, the HHC is to be used in a different time zone than the one in which it was in during

initial setup or when the lithium battery used to back up the RAM needs replacement (every 1-2 years depending on the environmental conditions under which the HHC is used). RAM memory is only supplied if unit is purchased with data logging option. Time/date information is not maintained in HHC units without data log option.

Section 3.4.5   Input of Owner/Operator Information

The HHC has the ability to display, on power up, the name of the individual, department or company responsible for its use or maintenance.

The following steps are to be followed to input user (owner) data.

Step 1   With the HHC on and reading pressure press the Set Up key, designated SET UP.

**SET
UP**

Step 2   Using the arrow keys, select the Owner function from the setup menu. When selected the word "Owner" will flash on the display.

`Owner Alarm`
`DateTimeRS232`

Step 3   With the word "Owner" flashing press the enter key.

ENT

Step 4   After pressing ENT the display will read:

`Access Code?`
`000000`

Step 5   A five digit owner access code was provided with your instrument at the time of shipment. Use the number keys on the HHC to enter the Owner Access Code from left to right.

`Access Code?`
`123456`

Note: Two passwords were provided with your HHC. One password provides access to the owner programming field and the other provides access to the calibration data and recertification programming. Please be certain to select the correct password. These passwords are not interchangeable.

If, at any time during the entry process you enter a number in error, press the CE key to clear the entry and restart the access code entry process.

If the password codes have been lost, contact your calibrator supplier. The serial number of the base unit is required for the factory to provide product password information.

Step 6   With the proper access code displayed press the enter key.

ENT

If an incorrect access code is entered the HHC will respond:

`Access denied`

To restart the entry process after the "access denied" response re-enter the owner set up function through the setup menu.

Step 7   After entry of the proper access code the display will read:

`Enter owner name`
`XXXXXXXXXXXXX`

To enter a new owner name use the up and down arrows to scroll through the alphanumeric entries and the left and right arrows to move the active entry field (cursor) to the next location.

A blank can be inserted by using the down arrow with the letter A flashing on the display. Continuing to press the down arrow after the blank appears will provide access to numerical values starting at 9 and decreasing to 0. The label may contain alphabetical, numerical or a combination of both types of entries.

To review:

Up/down arrows provide access as follows:

> 0, 1, 2, 3, 4, 5,
> 6, 7, 8, 9, _, A,
> B, C, D, E, F, G,
> H, I, J, K, L, M,
> N, O, P, Q, R, S,
> T, U, V, W, X, Y, Z

By maintaining pressure on the up/down arrow the displayed number or letter will continue to change until the last character has been reached.

By pressing and releasing the up/down arrow a single step from letter or number can be accomplished.

The left/right arrow keys allow for entry of alpha numeric data in any of the available positions.

Step 8   After the desired operator information has been keyed the display will look as follows:

`Enter owner name`
`JOHN Q OPERATOR`

Step 9   After the desired owner/user information has

been entered and is displayed press the enter key.

> ### ENT

The HHC will respond:

```
JOHN Q OPERATOR
Ent=OK CE=Cancel
```

Step 10 To store the owner/user information displayed press the ENT key. Pressing the CE key will return the HHC to the pressure measurement mode. If entry of new owner information is still required restart the process as outlined in steps 1-9 above.

Owner information is stored in Electrically Erasable Programmable Read Only Memory (EEPROM). This information should only need to be changed or re-entered when the owner/user changes.

Section 3.5   Removing Quick Select Pressure or Temperature Modules

Changing Quick Select pressure modules, therefore changing the measurement ranges in use, is quick and easy. Simply follow the steps below to change Quick Select pressure modules.

Step 1 Using the on/off key on the keypad of the base unit turn the power to the base unit off.

> ### ON
> ### OFF

Step 2 With one hand, hold base unit keypad side down and press down on the square retaining tab located near the upper strap pin on the bottom of the base unit.

Step 3 Maintain pressure on the retaining tab and with your other hand firmly grasp the pressure manifold that extends from the end of the Quick Select pressure module and slide the module out of the module bay.

Important Note: Both module bays of the base unit should contain a pressure module to protect from dirt or other debris getting into the base unit assembly. If only one Quick Select pressure module is needed install the System Protection Module (part number 875X114-01) supplied with your unit at the time of shipment.

Section 4.0   Key Function Overview

The HHC has a great deal of functionality. Many of the product capabilities are activated by dedicated keys on the keypad. Other functions are either activated or set up through a set up menu activated by pressing the set up key. A brief overview of the function of each key follows

Key

Designation	Function
On/Off	Turn unit on and off.
Set Up	Provides access to set up functions for various on-board firmware functions/capabilities**.**
PORT SEL	Used to select displayed measure-ment data. Selection includes: reading pres-sure from either one or both installed sensors as well as selection of reading pressure and electrical measurements simultaneously. (See Section 5.0 for details.)
ZERO	Provides ability to zero, either one or both, Quick Select Modules. (See Sec-tion 6.0 for details.)
BAT CK	Provides graphical representation of remaining battery power levels. (SeeSection 3.4.2 for details.)
***ENG UNIT**	Used to select desired engineering unit from the following: psi, inHg, inWC, ftSW, Bar, mBar, kPa, Mpa, mmHg, cmWC, mmWC, kg/cm, user. Where "user" is an operator programmable engineering unit, allowing the display of any single engineering unit not included in the above list. (See Section 8.0 for details.)
MIN/MAX	Displays the minimum and maximum pressure values measured. (See Sec-tion 11.0 for details.)
TARE	Allows for subtraction of an operator selected value from the displayed pres-sure measurement value for one or two Quick Select pressure modules. (See Section 9.0 for details.)
FLOW	Provides ability to measure the flow of a gas in terms of velocity or volume. (See Section 14.0 for details.)
***LEAK**	**Allows testing for leaks in terms of pressure decay over time or in terms of leak rate.** (See Section 15.0 for details.)
DATA LOG	Provides set up capability for manual or (OPTIONAL)automated data log-ging. (SeeSection

Key

Designation	Function
DATA STORE	Provides ability to store measured pressure or temperature values. (See Section 22.0 for details.)
HOLD	Freezes the displayed pressure and electrical measurements. (See Section 10.0 for details.)
^	Moves cursor up.
*TRIP	Provides access to pressure
DETECT	switch testing firmware. (See Section 18.0 for details.)
<	Moves cursor to the left.
*DAMP	Activates or disables dampused to smooth displayed pressure measurement data from the effects of low level pressure transients. (See Section 12.0 for details.)
>	Moves cursor to the right.
CE	Clears previous entry.
mA/V	Changes electronic measurement display from mA to V or V to mA and can also be used to deactivate either side of the display. (See Section 7.0 for details.)
V	Moves cursor down.
*%	Converts display from pressure units to % of f.s. (See Section 13.0 for details.)
ENT	Enters input data.

Notes on key functions:

* These functions require data input through activation of appropriate input fields in the setup menu. Examples of required input data include:

For **Damping:** Level of damping desired.

For **Engineering Unit Selection:** Water reference temperature or user (non library) engineering unit entry can be selected.

For **Leak:** Type of measurement (leak rate vs pressure decay), time to monitor and for leak rate applications the volume of the vessel to be monitored.

For **% Readout:** Input zero and span, output zero and span and device type (I/P, P/I, P/P, P/E).

The required data is input through the set up functions provided by the corresponding menu options accessed and available by pressing the setup key.

Complete details of each of the above outlined capabilities is included in the section referenced after the function summary provided above.

Section 5.0   Port Select Function

The Port Select Key, designated PORT SEL, provides the ability to select either of the two installed Quick Select modules for display, both modules for display or either a pressure/temperature module on one side and a current or voltage measurement on the other side of the display. For example, if the HHC has two pressure modules installed and is reading in psi the standard display for dual pressure readout would be:

```
    PSi      PSi
    +123456 +123456
```

Pressing the Port Select key once will result in the following display change:

```
    PSi         mA
    +123456 +1.234
```

Pressing the Port Select key a second time will result in the following display change:

```
    mA          PSi
    +1.234    +123456
```

Pressing the Port Select key a third time will result in the display returning to a dual pressure readout mode. As seen below:

```
    PSi         PSi
    +123456   +123456
```

If the HHC has a temperature measurement interface module installed the same type of sequence would be followed. For example, if the HHC had an RTD interface module installed in the left module bay the following sequence would be observed as a result of pressing the PORT SEL key:

```
    °F          PSi
    +72.35    +123456
```

Pressing the Port Select key once will result in the following display change:

```
    °F          mA
    +72.35    +1.234
```

Pressing the Port Select key a second time will result in the following display change:

```
    mA          PSi
    +1.234    +123456
```

Pressing the Port Select key a third time will result in

the display returning to a readout mode featuring the measurement data from both of the installed modules. As seen below:

```
°F        PSi
+72.35   +123456
```

See 8.4 for display of pressure in two different engineering units.

See Section 7.0 for display of current and voltage measurement data.

Section 6.0   Zero Function

This section applies to pressure measurement only. The zero function does not apply to the function of temperature measurement. The tare capability will function in conjunction with temperature measurement modules. This allows for the subtracting of a displayed or operator entered temperature value from the displayed temperature measurement data. See Section 9.0 for information on the tare function.

Pressing the zero key when two Quick Select pressure modules are installed and displayed will simultaneously zero both pressure modules. In addition, each module can be zeroed independently, as outlined in the following section.

It is recommended that the instrument be zeroed prior to use or calibration.

Section 6.1   Zeroing One of Two Installed Quick Select Pressure Modules

If zeroing one of two installed modules is desired the following process should be followed:

In this example we will assume that the left pressure module is to be zeroed and the right pressure module is to be unchanged.

Step 1   Press the port select the number of times required (one or two) to deactivate the display of pressure on the side that you wish not to re-zero.

**PORT
SEL**

When set up in accordance with the requirements of this example the HHC will have the following

information on the display:

```
PSi        MA
+12345  +1234
```

Step 2   With the pressure display deactivated for the side that is not to be zeroed press the zero key.

ZERO

The HHC will respond by displaying:

```
PSi        MA
+00000  +1234
```

Step 3   To resume the display of pressure measurement data, for the pressure module not zeroed, press the port select key the required number of times (one or two) to restore the dual pressure display.

When complete the HHC will display:

```
PSi        PSi
+00000  +12345
```

Normal pressure measurement activity can now be resumed.

Section 7.0   Displaying Current and Voltage Measurements

As outlined in the previous section the port select (PRT SEL) key is used to select the information seen on the display.

The display configurations available are:

Left Side of Display	Right Side of Display
pres/temp	pres/temp
pres/temp	electrical measurement
electrical measurement	pres/temp

The pressure/temperature value on the display corresponds with the measured value of the Quick Select module installed in the module bay on the corresponding side of the calibrator.

To read a current or voltage follow the steps below.

Step 1   With the HHC on and reading pressure/ temperature set the display as outlined in Section 5.0 to display the pressure measurement of the desired module.

Step 2   With the pressure measurement, for the desired module, displayed on one side and the electronic measurement on the other press the mA/V key until the desired electrical measurement parameter appears. For example, with a pressure module installed in the left module bay, pressing the mA/V key will produce the following results:

First display when electronic measurement is initiated through the port select function:

```
PSi            MA
+123456    +1.234
```

Result from pressing mA/V key first time:

```
PSi            ———
+123456
```

Result from pressing mA/V key a second time:

```
PSi      Volts
+123456 +1.234
```

Result from pressing mA/V key a third time:

```
PSi      mA
+123456 +1.234
```

Using the combination of the port select function and the mA/V function any combination of electrical measurements and pressure measurements can be produced.

Section 8.0   Engineering Unit Selection-Pressure Measurement

The HHC is factory programmed to provide pressure measurement in 12 engineering units. These include; psi, inches of mercury, inches of water, feet of sea water, bar, mbar, kilopascal, megapascal, millimeters of mercury, centimeters of water, millimeters of water and killograms per square centimeter.

Pressure measurement data may also be displayed in a user programmable non-library engineering unit. Section 8.2 Programming a Custom (User) Defined Engineering Unit provides complete details on setting up an operator defined engineering unit.

Inch, centimeter and millimeter of water engineering units may be set up for conversion at temperatures of 4 degrees and 20 degrees C or 60 degrees F. Consult Section 8.5 H$_2$O Reference Temperature Selection to program the desired temperature for inches or centimeters of water conversions.

Section 8.1   Selecting a Factory Programmed Engineering Unit

To select an engineering unit from the on-board library follow the steps below:

Step 1   With the HHC on and displaying pressure measurement data press the engineering unit key. This key is designated ENG UNIT.

**ENG
UNIT**

The HHC will respond by displaying the engineering unit library as follows:

first screen:

```
PSi    inH9    inWC    ftSW
Bar    mBar    kPa     mPa
```

second screen:

```
mm H9cm wcmm wck9cm
user
```

The engineering unit abbreviations correspond to the following engineering units:

psi:	pounds per square inch
inHg:	inches of mercury
inH2O:	inches of water column*
ftSW:	feet of sea water
Bar:	bar
mBar:	millibar
kpa:	kiloPascals
mPa:	megaPascals
mmHg:	millimeters of mercury
cmWC:	centimeters of water column*
mmWC:	millimeters of water column*
kgcm:	kilograms per square centimeter
user:	user programmable engineering unit (see Section 8.2 for details)

*Conversion factor is programmable for temperature. Consult Section 8.5 for details.

Step 2   Using the left/right and up/down arrow keys select the desired engineering unit. When selected, the text for the desired engineering unit will flash.

```
PSi  inH9,inWCftSW
Bar  mBar  kPa  mPa
```

In the above example mBar is the selected unit.

Step 3   With the desired engineering unit flashing press the enter key.

ENT

The calibrator will respond by displaying the pressure measurement(s) in the newly selected engineering unit. If two Quick Select pressure modules are installed the output of both will be displayed in the selected engineering unit. The HHC can also display the measurement data of two installed Quick Select pressure modules in independent engineering units. Section 8.4 provides the set up procedures for dual sensor dual engineering unit operation.

Section 8.2   Setting up a Custom or User Defined Engineering Unit

The HHC has a user programmable engineering unit available. This allows for the display of pressure measurement data in an engineering unit that is not in the library of the HHC. Any unit of pressure measurement that is linearly proportional to pressure change can be programmed for use in the user engineering unit field.

For this example, the pressure measurement unit of mSW (meters of sea water) will be used as the desired user engineering unit. To set the user engineering unit to provide pressure measurement data in mSW follow

the steps below.

Step 1   With the HHC on and reading pressure press the key designated SET UP.

**SET
UP**

Step 2   Using the arrow keys select the User engineering unit option displayed as "UserEng". The text "UserEng" will flash when selected.

```
BatFunc Percent
UserEng H2Oref
```

Step 3   With the text "User Eng" flashing press the enter key.

ENT

Step 4   After pressing the enter key the HHC will respond by displaying:

```
Conv from Psi
.000000
```

Step 5   Enter the conversion factor required to convert from psi to the engineering unit desired. For conversion from psi to mSW the conversion factor is 0.684482. Enter 6 digits to provide the required resolution to support the accuracy of the HHC. A complete list of conversion factors is provided in Appendix A.

Use the number keys to enter the desired conversion factor, entering the required factor from left to right. For our example of mSW the conversion factor is 0.684482 and the display should read:

```
Conv from Psi
0.684482
```

If an incorrect conversion factor is entered press the clear entry key, designated CE, to re-initiate the entry process for the correct factor.

Step 6   When the correct numerical value appears on the display press the enter key.

ENT

After entering the conversion factor the HHC will respond by displaying:

```
Enter unit's name
_ _ _ _ _ _
```

Step 7   Enter the name of the engineering unit selected, abbreviated to 6 characters or less. For our example mSW is a 3 character abbreviation for meters of sea water. This abbreviation will fit in the 6 digit field. To enter the mSW engineering unit label use the up and

down arrow keys to increment or decrement through the alphabet/numerical values and the left and right arrows to move the active entry field (cursor) to the next location.

If needed for the desired engineering unit, a blank can be inserted by using the down arrow with the letter A flashing on the display. Continuing to press the down arrow after the blank appears will provide access to numerical values starting at 9 and decreasing to 0. The label may contain alphabetical, numerical or both types of entries.

To review:

Up/down arrows provide access as follows:

0, 1, 2, 3, 4, 5,
6, 7, 8, 9, _, A,
B, C, D, E, F, G,
H, I, J, K, L, M,
N, O, P, Q, R, S,
T, U, V, W, X, Y, Z

By maintaining pressure on the up/down arrow the display number or letter will continue to change until the last character has been reached.

By pressing and releasing the up/down arrow a single increment or decrement between letters or numbers can be accomplished.

The left/right and up/down arrow keys allow for entry of letters or numbers in any of the available label positions.

Step 8   For this example, after the engineering unit label has been keyed the display will read:

```
Enter unit's name
mSW
```

Step 9   With the desired engineering unit label displayed press the enter key.

ENT

After the enter key has been pressed the HHC will resume normal pressure measurement in the original engineering units. Instructions on how to use the custom engineering units are provided in the following section.

Section 8.3   Using A Custom Engineering Unit

After a custom engineering unit has been programmed it may be used by following the steps below. For information on programming a custom engineering unit refer to Section 8.2 Setting up a Custom or User Defined Engineering Unit.

To display pressure measurement data in the user engineering unit:

Step 1 With the HHC on and measuring pressure press the engineering unit key. Designated ENG UNIT on the keypad.

ENG
UNIT

The HHC will respond by displaying:

first screen:

```
PSi   inH9   inwc ftSW
Bar   mBar   KPa   MPa
```

second screen

```
mm H9cm wcmm wck9cm
user
```

Step 2 Using the left/right and up/down arrow keys select the word "user". When selected the word "user" will flash.

```
mm H9cm wcmm wck9cm
user
```

Step 3 With the word "user" flashing press the enter key.

ENT

The HHC will respond by displaying pressure measurement data in the following display format:

```
u_mSW u_mSW
XXXXX   XXXXX
```

where:

u_ indicates that the engineering unit in use is a user defined unit with a label of mSW

xxxxxx represents the current pressure measurement(s) in the user engineering unit.

See Section 8.4 Display of Two Engineering Units for information on how to simultaneously display the measured values from two Quick Select pressure modules in different engineering units.

Section 8.4	Display of Two Engineering Units

The HHC can display pressure measurement data from two installed Quick Select pressure modules in independent engineering units. To display two different engineering units simultaneously the following procedure should be followed.

Step 1 With the HHC on and displaying pressure measurement data from two Quick Select pressure modules press the engineering unit key, designated ENG UNIT on the keypad.

ENG
UNIT

Step 2 Using the arrow keys select either of the two desired engineering units. For this example we will select psi as one of the desired units.

With psi selected the text "psi" will flash on the display and the display will look as follows:

```
PSi inH9   inwc ftSW
Bar mBar   KPa   MPa
```

Step 3 Press the enter key to select psi.

ENT

The HHC will respond by returning to the pressure measurement mode and will display the measurement data for both Quick Select pressure modules in psi, as follows:

```
PSi     PSi
+12345 +12345
```

Step 4 Next, press the port select to deactivate the display of pressure measurement data on the side that you wish to maintain pressure measurement in terms of psi. A pressure display is deactivated when the corresponding side of the display contains milliamp (mA) data, Voltage (V) data or is blank " ------ ".
See Section 5.0 for details on the port select function.

In this case we will assume that the right side will remain in psi and our goal is to present the measurement data from the left Quick Select pressure module in bar.

Pressing the port select one time will deactivate the left pressure display converting it to a mA measurement field. Pressing the port select a second time will deactivate the right side, converting it to a mA measurement field and returning the left side of the display to the function of pressure measurement.

Since we want the right side to remain psi we will deactivate it in the psi mode by pressing the port select key once.

PORT
SEL

The HHC will respond with the following display:

```
PSi      mA
+12345  +1234
```

Step 5 With the right side deactivated from pressure measurement activities press the engineering unit key, designated ENG UNIT on the keypad.

ENG
UNIT

The HHC will respond by displaying:

```
PSi   inH9   inWC  ftSW
Bar   mBar   kPa   mPa
```

Using the arrow keys select the desired engineering unit for the left side. In this example we have opted for the engineering unit of Bar. With the Bar engineering unit selected the display will look as follows with the text "Bar" flashing:

```
PSi   inH9   inWCf tSW
Bar   mBar   kPa    mPa
```

Step 6   With the desired engineering unit selected (flashing) press the enter key.

ENT

The HHC will respond by displaying the following:

```
Bar     mA
+12345 +1234
```

Step 7   Reactivate the right side of the display for pressure measurement by pressing the Port Select key, as required.

First press of the port select key.

PORT
SEL

HHC will respond by displaying the following:

```
mA      PSi
+1234 +12345
```

Second press of the

PORT
SEL

HHC will respond by displaying the following:

```
Bar     PSi
+12345 +12345
```

Using this process, any engineering unit may be selected for display of the right or left Quick Select pressure module measurement data.

Section 8.5   Temperature Selection for H₂O Conversion Factor

The HHC includes a library of 12 factory programmed engineering units. This selection includes the engineering units inH2O, mmH2O and cmH2O. The pressure generated by a column of water will vary with the temperature of the water.

Over the years, several temperatures have evolved into industry standards. These are the conversion factors

most commonly used by manufacturers of pressure instruments when calibrating pressure measurement devices in terms of the height of a column of water. To facilitate your calibration and test of these instruments, the HHC includes 3 conversion factors for each of the water column based pressure engineering units. The conversion factors are for the temperatures of 4 and 20 degrees Celsius and 60 degrees Fahrenheit. The factory default setting is 20 degrees C.

The selection of the desired temperature for use in the conversion of water based pressure measurements can be accomplished by following these steps.

Step 1   With the HHC on and reading pressure press the SET UP key.

SET
UP

Step 2   Using the up/down and left/right arrow keys select the H2O reference option displayed as "H2Oref" in the set up menu. When selected the text "H2Oref" will flash on the display.

```
BatFunc  Percent
UserEng  H2Oref
```

Step 3   With the text "H2Oref" flashing press the enter key.

ENT

The HHC will respond by displaying:

```
H2O ref temP
20C 60F 4C
```

Step 4   Using the left/right arrow keys select the desired temperature for the conversion factor. The selected value will flash on the display.

```
H2O ref temP
20C 60F 4C
```

In the above example the conversion factor for water at 60 degrees Fahrenheit was selected.

Step 5   With the desired temperature for the conversion factor flashing press the enter key.

ENT

The selected conversion temperature will be activated and will be stored in Electrically Erasable Programmable Read Only Memory (EEPROM). It will not have to be reentered on power-up unless a change in the reference temperature is desired.

After pressing the enter key the HHC will resume basic pressure measurement.

Section 9.0   Tare Function

The HHC has the ability to tare (subtract an operator selected value) from the displayed pressure or temperature measurement value of either one or two installed Quick Select modules. This is most commonly required in applications where a pressure pre-load, as in a weighing application, must be subtracted from the displayed pressure measurement.

If the HHC is in use with two Quick Select modules, independent tare values can be entered for each of the pressure modules. If one of two installed Quick Select modules has been deactivated, meaning the measured values are not shown on the display, the calibrator will request a tare value only for the active module. To input a tare value for one or two Quick Select pressure modules follow the steps below:

Step 1 With the HHC on and displaying pressure measurement data press the tare key.

TARE

The HHC will respond by displaying the following:

        Left tare Value
        +XXXXX

If a tare value was previously programmed the HHC will display that value. If the previous tare value was zero the HHC will display the last pressure measurement value displayed prior to pressing the TARE key.

Step 2 Use the number keys to input a tare value other than the default value or to change the existing tare value. If no tare value is desired input zero (0).

Warning: Failure to enter the zero (0) will result in the HHC automatically accepting the last displayed value as the desired tare value.

        Left tare Value
        +12345

Step 3 With the desired value displayed press the enter key.

ENT

The HHC will respond by displaying the following:

        Right tare Value
        +XXXXX

Step 4 Use the number keys to input a tare value other than the default value or to change the existing tare value. If no tare value is desired input zero (0).

Warning: Failure to enter the zero (0) will result in the HHC automatically accepting the last displayed value as the desired tare value.

        Right tare Value
        +12345

Step 5 With the desired value displayed press the enter key.

ENT

Note: The measurement data on the display will flash if the HHC is operating in the tare mode.

After pressing the enter key the HHC will resume normal pressure measurement activities. Tare values may be reviewed at any time by pressing the TARE key. If the HHC is being used with two Quick Select modules and only one module has a nonzero tare value the display will only flash on the side that corresponds to the Quick Select module with the nonzero tare value.

Step 6 To exit the tare mode follow the procedures outlined in steps 1 through 5 and at the tare value prompt enter zero (0). When the tare values for both modules have been reset to zero tare mode operation will be discontinued and the display will stop flashing.

Section 10.0   Hold Function

The hold function provides the ability to freeze the displayed pressure, flow or electrical measurement values. In addition, pressing the hold key will result in an H appearing in the RS232 output data stream and will also result in a flashing H appearing on the left side of the top line of the instrument display.

The RS232 output will look as follows for a dual sensor measurement:

Normal Operation
        +1.2345 inH2O +1.2345 inH2O
        Left Min: +0.00000 Max: +1.2345
        Right Min: +0.0000 Max: +1.2345
        With Hold Function Invoked
        +1.2345 H inH2O +1.2345 inH2O
        Left Min: +xxxxx.x Max: +xxxxx.x
        Right Min: +xxxxx.x Max: +xxxxx.x

Section 10.1   Using the Hold Function

Step 1 To invoke the hold function press the hold key.

HOLD

The HHC will respond by freezing the displayed values and adding a flashing "H" that will appear in the left most position on the top line of the display.

Step 2   To exit the hold function press any key.

Note: While in the hold mode, if the RS232 interface is enabled, the HHC will continue to transmit the displayed values.

Section 11.0   Minimum and Maximum Value Tracking

The HHC monitors and stores in memory both the minimum and maximum pressure or temperature values measured. The following procedure will allow review of these values.

Step 1   To recall the minimum and maximum values simply press the key labeled:

MIN
MAX

The HHC will respond by displaying:

```
+2345     +12345
-12345    -12345
```

where: maximum values are displayed on the top line and +12345 represents the maximum value(s) measured. Minimum values are displayed on the bottom line and 12345 represents the minimum value(s) measured.

If two Quick Select modules are installed, the min/max function recalls and displays the minimum and maximum values for both modules simultaneously.

Step 2   To clear the stored minimum and maximum value press the clear entry key:

CE

Pressing any key other than the CE key will maintain the stored values in memory.

Pressing any key on the keypad will return the HHC to normal pressure measurement activities.

Section 12.0   Damping

Damping provides the ability to stabilize the displayed or transmitted pressure value by minimizing the effects of low level transients and electronic instability. Damping is most commonly used with Quick Select pressure modules to overcome the effects of pressure pulsation and vibration transmitted through the measurement media. The level of damping is established in the set up menu. Activation of the damping process is accomplished through a dedicated key on the keypad.

Damping accomplishes the stabilization of the pressure measurement value by producing an averaged pressure value which is shown on the display and available for transmission over the RS232 interface. When damping is

not activated the HHC takes a new pressure value every 130 to 240mS (~8 times per second) and updates the display. If required, this same measurement data is also transmitted over the RS232 interface.

When damping is activated the value displayed and/or transmitted is an average value. The average consists of the average of from 1-16 consecutive readings. The higher the number of readings averaged the greater the stabilization effect of the damping. The number of consecutive readings averaged is programmable, allowing the damping function to be tailored to the specific requirements of most any application.

Section 12.1   Set Up of the Damping Function

The following steps should be used to set up the level of damping desired.

Step 1   With the HHC on and reading pressure press the SET UP key.

SET
UP

Step 2   Using the arrow keys move through the set up menu and select "Dampen" on the display of the HHC. The word "Dampen" will flash on the display when selected.

```
EvntTimr Dampen
LeakRate Status
```

Step 3   With the word Dampen flashing press the enter key.

ENT

Step 4   In response to the activation of the dampening set up menu the HHC will respond by displaying the following:

```
fast <------  >
slow   X
```

Where the left most position represents zero damping (averaging of 1) and the right most position represents maximum damping (averaging of 16 readings). Starting from the left each movement of the highlighted box to the right increases the number of samples being averaged by one (1). By moving the highlighted field to the left the level of damping can be reduced.

The level of damping desired will likely vary from application to application and sensor range to sensor range. For best results, select the minimum amount of damping necessary to provide a stable display value. It is important to recognize that while damping will stabilize the displayed and/or transmitted value it will also slow down the response rate to a true pressure change. The slow

down results from the fact that an averaged value will be displayed. If the damping level is set to 16 the displayed value will represent the average pressure measurement over the previous ~2 seconds (16 readings times 130 mS/reading). Therefore, the greater the level of damping in use the greater the time lag will be between the displayed measurement and the true (not averaged) pressure measurement value.

Use the left/right arrow keys to set the desired damping level, for example, averaging 8 readings as shown here.

```
fast <———————————————————————————————>
Slow _ _ _ _ _ _ _ X _ _ _ _ _ _ _
```

Step 5   With the desired level of damping shown press the enter key to store the damping level in EEPROM.

ENT

The level of damping has now been set. Proceed to Section 12.2 for instructions on how the damping process is activated.

Section 12.2   Activating or Discontinuing the Damping Function

The following process provides step by step instructions on how to activate or discontinue the damping function.

Step 1   Once established in the set up menu the damping process may be enabled or disabled through the use of the DAMP key on the keypad. To activate/deactivate the damping function press the DAMP key on the keyboard.

DAMP

In response to pressing the DAMP key the HHC will respond by displaying:

```
damPing function
Disable Enable
```

Step 2   Using the left or right arrow select "Disable" to turn damping off or "Enable" to initiate damping. When the desired option is selected (flashing) press the enter key.

ENT

On power up the HHC will default to damping disabled. Damping must be re-initiated via the keyboard after the instrument has been turned back on. The level of damping, established in the set up menu is stored in EEPROM and, therefore, does not need to be reprogrammed after power up unless the level of damping desired has changed.

Section 13.0   Percent Function

The percent function allows the calibrator to display the output from a device under test in terms of percent error at a given percentage of the total range. This function applies to the calibration of both temperature and pressure transmitters. For example, if the HHC is being used to calibrate a 0-100 psi transmitter with a 4/20 mA output the HHC can be programmed to display the following data:

	Display
Pressure	Normal
Applied	Mode
0 psi	4 mA
25 psi	8 mA
50 psi	12 mA
75 psi	16 mA
100 psi	20 mA

The percent mode of operation allows for quick and easy determination of the level of inaccuracy of the device under calibration. For example:

If 50 psi was applied to a 100 psi device with a 0-10 Vdc output but instead of 5 Vdc the transmitter being calibrated had an output of 4.995 Vdc the HHC, when used in the percent mode, would display the following:

```
% scale % error
+50       -0.05
```

Therefore, the percent mode of operation eliminates the need for operator calculations to determine the level of accuracy of the device under test.

If the HHC is equipped with the data logging option the percent error and percent full scale information can be stored in the calibrator on-board memory. To do this follow the set up instruction provided in Section 22.5 Manual Data Logging.

Section 13.1   Set Up of the Percent Function

The percent function is set up as follows:

Step 1   With the HHC on and reading pressure press the SET UP key.

SET
UP

Step 2   Using the arrow keys select the text "PerCent" from the setup menu. When selected the text "PerCent" will flash on the display.

```
BatFunc Percent
UserEng H2ORef
```

Step 3   With the text "PerCent" flashing press the enter key.

ENT

The HHC will respond by displaying:

```
Enter input zero
.000000
```

Step 4 Using the number keys enter the lowest calibration point for the device to be tested.

For example:

For a 0-100 inH$_2$O range instrument enter zero.
For a 3-15 psi transmitter enter 3.
For a -5 to 0 to + 5 inH$_2$O transducer enter -5.
For a 0-200 degree RTD enter 0

When the desired "zero" value has been entered the display will look as follows for the testing of a 0-100 in H2O transducer.

```
Enter input zero
.000000
```

If an incorrect value is entered use the CE key to clear the entry and re-key the zero value.

With the desired "zero" value displayed press the enter key.

ENT

The HHC will respond by displaying:

```
Enter input FS
.000000
```

Step 5 Using the number keys enter the full scale range (F.S.) of the device to be calibrated. For our example of a 0-100 in H2O range instrument the display will look as follows:

```
Enter input FS
100
```

Step 6 With the desired input full scale displayed press the enter key.

ENT

The HHC will respond by displaying:

```
Enter output zero
0.0000
```

As with input zero, the output zero is the lowest output the device being calibrated will produce.

For example:

For a 0-10 Vdc output device enter zero.
For a 4/20mA output device enter 4.
For a 1-5 Vdc output device enter 1.

Step 7 With the desired output "zero" keyed in and displayed press the enter key.

ENT

The HHC will respond by displaying:

```
Enter output FS
0.0000
```

Step 8 Using the number keys enter the full scale output of the device being calibrated. For a 0-10 Vdc output device the display will look as follows:

```
Enter output FS
10
```

Step 9 With the desired full scale output displayed press the enter key.

ENT

The HHC will respond by displaying the following:

```
Device   type
I/P P/I P/P P/E
```

Using the left/right arrow keys select the appropriate device type where:

I/P is a current to pressure device
P/I is a pressure or temperature to current device
P/P is a pressure to pressure device
P/E is a pressure or temperature to voltage device

In this case we are testing a 0-100 inH$_2$O range transducer that produces a 0-10 Vdc output from zero to F.S. Therefore, the appropriate selection is P/I and the display will look as follows:

```
Device    type
I/P P/I   P/P P/E
```

Step 10 With the desired device type flashing press the enter key.

ENT

At this time the HHC will return to basic measurement activities.

Section 13.2   Use of the Percent Function

Note: The HHC must be set up so that the desired Quick Select module is active and so that the desired electronic measurement is displayed prior to entering the % mode. Consult Sections 5.0 Port Select and 7.0 Current & Voltage Measurements for setup details.

Step 1 With the percent function set up, press the % key on the keypad of the HHC to activate the percent mode

of operation.

%

Step 2 Connect the output lines from the device under test to the miniature banana jack inputs on the front of the HHC. Use the mA and COM jacks for current devices and the V and COM jacks for voltage output devices.

Step 3 Make the necessary plumbing connections using a Tee fitting to allow input of applied pressure to both the HHC and the device under test.

Step 4 Perform testing in accordance with the number of calibration points required for the device to be tested.

Step 5 To exit the percent mode press the percent key.

%

The HHC will respond by returning to basic pressure or temperature measurement activities.

<table>
<tr><td>**Section 14.0**</td><td>**Flow Velocity and Flow Volume Measurement Background**</td></tr>
</table>

The HHC used in conjunction with a pitot tube or an annubar has the ability of measuring the flow volume or flow velocity of a clean, dry gas. The HHC must be used in with a GQS-1 low differential pressure Quick Select module to perform the flow measurement function.

The accuracy of a flow measurement is a function of a number of contributing factors. These are; the basic accuracy of the differential pressure measurement, accuracy of the pitot tube or annubar in use as it relates to the K factor supplied by the manufacturer of the device and the accuracy of the correction being made for the air density. It is not possible to provide an all inclusive accuracy statement for flow measurement activities. Steps that can be taken to maximize system flow measurement accuracy include:

1 – Calculation and input of the actual air density for the media to be measured. The air density is a function of temperature, humidity, barometric pressure.

The velocity equation (ft/min) is as follow:

where:

 dpw = differential pressure in inches of water
Adw = the air density

The air density can further be calculated through employing the following equation:

$$V = 1097 \times K \times \sqrt{\frac{dpw}{Adw}}$$

$A_d = 0.07649 \times (Pa/14.73) \times [520/(T+460)]$

where:

Pa_a = the absolute pressure in duct in psia
T =   air temperature in duct in degrees Fahrenheit
Flow Volume = (velocity x duct area)/144

2 – Purchase of a characterized and certified pitot tube or annubar with a K factor determined for the specific probe to be used.

3 – Purchase of the highest accuracy differential pressure Quick Select module available.

<table>
<tr><td>**Section 14.1**</td><td>**Set Up for Flow Velocity and Flow Volume Measurement**</td></tr>
</table>

In preparation to perform flow velocity and volume measurements the operator should have the following information available for entry during the set up of the application on the HHC.

K factor   Provided by the manufacturer of the flow probe to be used.

Air density A default value has been programmed into the HHC in the event that a more accurate one cannot be calculated.

Duct area   For air volume measurement the area of the duct in which measurements are to be taken must be calculated.

A GQS-1 differential type (dual process connection) Quick Select pressure module must be used for flow measurement activities.

Basic keypad functions such as damping, tare, min/max recall, mA/V measurement display, battery check, display hold, data logging, zero and port select are available for use during flow measurement activities. Consult the appropriate sections of this manual for information on the set up and use of these product functions.

For flow measurement follow the steps outlined in the sections corresponding to the type of flow measurement (velocity or volume) to be performed.

<table>
<tr><td>**Section 14.2**</td><td>**Flow Velocity Measurement**</td></tr>
</table>

Step 1 With the HHC on and displaying pressure measurement values press the flow key.

FLOW

The HHC will respond by displaying:

```
Flow
Velocity Volume
```

Step 2 To perform flow velocity measurements select the word velocity using the left/right arrow keys. When selected the word velocity will flash.

```
Flow
Velocity Volume
```

Step 3 With the word Velocity flashing press the enter key:

> **ENT**

The HHC will respond by displaying:

```
Enter Air Density
lbs/ft3 .07480
```

Step 4 Using the number keys input the required air density value or press enter to use the 0.07480 default value.

Step 5 With the required air density value displayed press the enter key.

> **ENT**

The HHC will respond by displaying:

```
EnterFlowcoef(k)
X.XXX
```

The flow coefficient or K factor is a value specific to the pitot tube or annubar to be used. Consult the manufacturer of the annubar or pitot tube for the K factor for your flow probe. A default value of 0.6 is factory programmed into the HHC firmware. This value can be overwritten, with a K factor for the specific flow measurement probe, to optimize flow measurement accuracy.

Step 6 Connect the pitot tube or annubar to the Quick Select pressure module, as indicated in the manufacturers manual for the flow probe, high side to the high pressure port on the Quick Select pressure module and low side to the low pressure port on the Quick Select module.

Place the probe in the duct as instructed in the probe manual. The HHC will now display the measured differential pressure in terms of flow velocity (ft/min).

To Exit Flow Velocity Measurement and Return to Basic Pressure Measurement Press the Clear Entry Key (CE).

Section 14.3   Engineering Units for Flow Velocity

As with standard pressure measurement the HHC can provide flow velocity in a variety of units of measure. To select a unit of measure for flow velocity follow the steps below.

Step 1 With the HHC operating in the flow velocity mode (refer to Section 14.1 for instructions on entering the flow velocity mode) press the engineering unit key.

> **ENG**
> **UNIT**

The HHC will respond by displaying the following:

```
ft/min   ft/sec
MPH      Metersec
```

These are the 4 units of measure available for display of flow velocity.

Step 2 Using the left/right and up/down arrow keys select the desired unit of measure. When selected the unit of measure will flash. In this example the engineering unit of ft/sec has been selected.

```
ft/min   ft/sec
MPH      Metersec
```

Step 3 With the desired unit of measure flashing, press the enter key.

> **ENT**

After pressing the enter key the HHC will resume measuring flow velocity in the selected unit of measure.

Section 14.4   Flow Volume Measurement

Note: In order to do flow volume measurement you must first set up the measurement parameters required for flow velocity. Failure to do this will result in the calibrator accessing the previously stored input data on air density and K factor in the generation of the flow volume measurement.

Step 1 With the HHC on and displaying pressure measurement data press the flow key.

> **FLOW**

The HHC will respond by displaying:

```
Flow
Velocity Volume
```

Step 2 Using the left/right arrow keys select the word volume. When selected the word volume will flash.

```
Flow
Velocity Volume
```

Step 3 With the word Volume flashing press the enter key.

> **ENT**

The HHC will respond by displaying:

```
Enter Duct Area
Sq.in.  XXXXX
```

Step 4 Calculate the area of the duct for which flow volume is to be determined. The equations for area calculations are as follows:

For rectangular or square ducts:

> area (square inches) = W x H

where:

W = width of the duct in inches
H = height of the duct in inches

For round ducts:

area (square inches) = $(\pi/4)D^2$

where:

π = 3.141592
D = diameter of the duct in inches

Step 5   Using the number keys input the area value calculated in Step 4.

```
Enter Duct Area
Sq.in. 123456
```

Step 6   With the appropriate area value displayed press the enter key.

ENT

If an incorrect area value is keyed press the clear entry (CE) key to reenter the required data.

The HHC will now be set up to provide flow volume measurement data for the desired duct.

To Exit Flow Volume Measurement and Return to Basic Pressure Measurement Press the Clear Entry Key (CE).

Section 14.5   Engineering Units for Flow Volume

As with standard pressure measurement the HHC can provide flow volume measurements in a variety of units of measure. To select a unit of measure for flow velocity follow the steps below.

Step 1   With the HHC operating in the flow volume mode (refer to Section 14.4 for instructions on entering the flow volume mode) press the engineering unit key, designated ENG UNIT on the keypad.

**ENG
UNIT**

The HHC will respond by displaying the following:

```
ft3/Min ft3/sec
M3/Min  M3/sec
```

These are the 6 units of measure available for display of flow volume.

Step 2   Using the arrow keys select the desired unit of measure. When selected the unit of measure will flash. In this example the engineering unit of ft3/sec unit has been selected.

```
ft3/Min ft3/sec
M3/Min  M3/sec
```

Step 3   With the desired unit of measure flashing, press the enter key.

ENT

After pressing the enter key the HHC will resume measuring flow volume in the selected unit of measure.

Section 14.6   Simultaneous Display of Two Flow Measurements in Independent Engineering Units

The HHC can display flow measurement data from two installed Quick Select pressure modules in independent engineering units. In order to display two different engineering units simultaneously the following procedure should be followed. In this example we will assume the operator is in the flow velocity mode and would like to present the measured values in ft/min on the right side of the display and meters/second on the left side of the display.

Step 1   With the HHC on and displaying flow (velocity or volume) measurement data from two Quick Select pressure modules press the engineering unit key, designated ENG UNIT.

**ENG
UNIT**

When in the flow velocity mode the engineering unit selection is:

```
ft/Min   ft/sec
MPH      Metersec
```

When in the flow volume mode the engineering unit selection is:

```
ft3/Min ft3/sec
M3/Min  M3/sec
```

Step 2   Using the arrow keys select either of the two desired engineering units. For this example we will select ft/min first.

```
ft/Min   ft/sec
MPH      Metersec
```

Step 3   With one of the two engineering units to be used selected and flashing, in this example ft/min, press the enter key.

ENT

The HHC will respond by returning to the flow measurement mode and will display the measurement data as follows:

```
ft/Min ft/Min
+12345 +12345
```

Step 4 Next, press the port select to deactivate the display of flow measurement data on the side that you wish to maintain displayed measurement data in terms of ft/min. A pressure display is deactivated when it is replaced by a milliamp (mA), Voltage (V) or a blank (------).

See Section 5.0 for details on the port select function.

In this case we have decided that the left side of the display will be in meters/second and the right side will remain in ft/min.

Pressing the port select one time will deactivate the left pressure display converting it to an mA measurement field. Pressing the port select a second time will deactivate the right side, converting it to an mA measurement field and returning the left side of the display to the function of flow measurement.

Since we want the right side to remain ft/min we will deactivate it in the ft/min mode by pressing the port select key once.

> ### PORT
> ### SEL

The HHC will respond with the following display:

```
ft/min      mA
+12345      +1234
```

Step 5 With the right side deactivated from flow measurement activities press the engineering unit key.

> ### ENG
> ### UNIT

The HHC will respond by displaying:

```
ft/min  ft/sec
MPH     MeterSec
```

Step 6 Using the arrow keys select the desired engineering unit for the data on the left side of the display. In this example we have opted to display the flow measurement data on the left side in terms of meters/second represented by MeterSec on the display. With the MeterSec engineering unit selected the display will look as follows with the text "MeterSec" flashing:

```
ft/min  ft/sec
MPH     MeterSec
```

Step 7 With the text "MeterSec" selected and flashing press the enter key.

> ### ENT

The HHC will respond by displaying the following:

```
MeterSec    mA
+12345      +1234
```

Step 8 Reactivate the right side of the display for flow measurement by pressing the Port Select key, as required.

First press of the

> ### PORT
> ### SEL

HHC will respond by displaying the following:

```
mA          ft/min
+1234       +123456
```

Second press of the

> ### PORT
> ### SEL

HHC will respond by displaying the following:

```
MeterSec  ft/min
+1234     +123456
```

To Exit Flow Measurement and Return to Basic Pressure Measurement Press the Clear Entry Key (CE).

Using this process, any engineering unit may be selected for display of the right or left Quick Select module measurement data.

Section 14.7   Simultaneous Display of Measurement Data for Flow (Volume or Velocity) and Pressure

The HHC can simultaneously display a flow measurement from one installed Quick Select pressure module and a pressure measurement from a second installed Quick Select Pressure module. For example, the measurement of flow can be displayed in ft/min for one installed Quick Select pressure module and the second installed pressure module can be used to simultaneously display the measured value in terms of inches of water. This ability eliminates the need for "on-the-fly" change between flow and pressure measurement functions when doing airflow testing.

To set the HHC up to present simultaneous display of pressure and flow (velocity or volume) data follow the steps below.

Step 1 With the HHC on and displaying pressure measurement data from both modules, if necessary, select the desired engineering unit to be displayed for the pressure measurement. This is done by activating the Engineering Unit library accessed by pressing the ENG

UNIT key. Details on engineering unit selection are provided in Section 8.0 of this manual.

Important Note: The HHC must be set up for pressure measurement first. With pressure measurement set up, deactivate the side of the display to remain in pressure mode prior to setting up the desired flow measurement parameters. If flow measurement is set up before pressure measurement access to pressure engineering units will be lost. When set up to measure both pressure and flow engineering units for both measurements can be accessed as outlined in Section 8.4.

Step 2   Use the port select key to deselect the displayed output of pressure from the module which is to be left in the pressure readout mode of operation. When a module is deselected the corresponding side of the display on the HHC will read milliamp (mA), blank "---- '' or Volts (V).

Press the port select key one time to deselect the right module. Press the port select two times to deselect the left module.

PORT
SEL

Step 3 With the desired pressure module deselected follow the procedure outlined in Section 14.2 if the flow measurement is to be flow velocity or Section 14.4 if the flow measurement is to be a flow volume measurement.

Step 4   As outlined in Section 14.2 for flow velocity or Section 14.4 for flow volume select the desired engineering unit.

Step 5 With the display for the active flow measurement correct, reactivate the deactivated port using the port select function.

PORT
SEL

Note: The units used to express flow measurement may be changed at any time while the HHC is displaying any flow measurement data. Simply use the engineering unit select function as described in Section 14.2 for flow velocity and Section 14.4 for flow volume.

To Exit Flow Measurement and Return to Basic Pressure Measurement Press the Clear Entry Key (CE).

Section 14.8   Simultaneous Display of Measurement Data for Flow (Volume or Velocity) and Temperature

The HHC can simultaneously display a flow measurement from one installed Quick Select pressure module and a temperature measurement from a second installed

Quick Select module. For example, the measurement of flow can be displayed in ft/min for one installed Quick Select pressure module and the second installed pressure module can be used to simultaneously display the temperature measurement value in degrees Celsius or Fahrenheit. This ability eliminates the need for "on-the-fly" change between flow and temperature measurement functions when doing airflow testing.

To set the HHC up to present simultaneous display of temperature and flow (velocity or volume) data follow the steps below.

Step 1   With the HHC turned off install the required differential pressure module and temperature measurement interface module.

Step 2   Turn the HHC on.

Step 3   As outlined in Section 16 or 17 set up the temperature measurement function via the submenu accessed via the main Set Up menu. See Section 16 or 17 for instructions on setting up the HHC for temperature measurement using an RTD temperature probe.

Step 4   With the side of the display to be used for flow measurement active and reading the measured pressure from a dual process connection type Quick Select pressure module press the FLOW key.

FLOW

Proceed as directed in Section 14.2 for flow velocity and 14.4 for flow volume measurement.

Note 1: The units used to express flow measurement may be changed at any time while the HHC is displaying any combination of flow and temperature measurement data. Simply use the engineering unit select function as described in Section 14.2 for flow velocity and Section 14.4 for flow volume.

Note 2: Units for display of temperature measurement data can be changed at any time via the "RTmodule" menu in the setup menu of the calibrator.

To Exit Flow Measurement and Return to Basic Pressure Measurement Press the Clear Entry Key (CE).

Section 14.9   Simultaneous Display of Flow Volume and Flow Velocity

The HHC can simultaneously display flow measurement data from two installed differential low pressure Quick Select modules with one output displayed in terms of flow volume and the other pressure measurement displayed in terms of flow velocity. For example, the measurement of flow can be displayed in ft/min for one installed Quick Select module and ft^3/min for the second installed

module. This ability eliminates the need for "on-the-fly" change between flow volume and flow velocity measurement functions when doing airflow testing.

To set the HHC up to present simultaneous display of flow velocity and flow volume follow the steps below.

Step 1   Set the HHC up to display flow velocity or volume (refer to Sections 14.2 and 14.4 for information on setting up the HHC to perform flow velocity or flow volume testing). In this example, we will assume the HHC is starting from the simultaneous display of two flow velocity measurements. In this mode the HHC display will look as follows:

```
ft/Min  ft/Min
+12345  +12345
```

Step 2   Using the port select key, deactivate the side of the display that you wish to maintain in the current flow measurement mode. In this case we will display flow in terms of ft/min on the left side and ft3/min on the right side of the display.

**PORT
SEL**

Pressing port select once will deactivate the right side of the display from flow or pressure measurement and convert it to an mA measurement function.

```
ft/Min  MA
+12345  +1234
```

Pressing port select a second time will deactivate the left side of the display from flow or pressure measurement, converting it to an mA measurement function. The right side of the display will resume flow/pressure measurement activities. The second press of the port select key will result in the following data display.

```
M/A     ft/Min
+12345  +12345
```

In this example, since we will be leaving the left side of the display in terms of ft/min the port select key should be pressed two times to produce the display:

```
M/A     ft/Min
+12345  +12345
```

Step 3   With the desired side of the display deactivated press the flow key on the keypad of the HHC.

FLOW

The HHC will respond by displaying:

```
FlOW Velocity
velocity volume
```

Step 4   Using the left/right arrow keys select the desired measurement function.

In this case we have decided that the left side of the display will remain in the velocity mode and the right side will be changed to measure flow in terms of volume. Therefore, volume should be selected for this example.

```
FlOW Velocity
velocity volume
```

Step 5   With the word volume flashing press the enter key.

ENT

The HHC will respond by displaying:

```
M/A     ft3/Min*
+12345  +12345
```

*Refer to engineering unit selection, Section 14.5, if an alternate unit of expressing flow volume is desired.

Step 6   Press the port select key to reactivate the left side of the display for flow or pressure measurement.

**PORT
SEL**

The left side of the display will have remained in terms of ft/min. When reactivated the display will look as follows:

```
ft/Min      ft3/Min
+12345      +12345
```

The HHC is now set up for simultaneous display of flow volume and flow velocity.

To Exit Flow Measurement and Return to Basic Pressure Measurement Press the Clear Entry Key (CE).

Section 14.10   Simultaneous Display of Flow and Electrical Output Measurements

As outlined previously, the HHC can present pressure measurement data from one or two Quick Select pressure modules simultaneously. This ability also extends to the HHC's ability to display flow measurement data. In addition, the HHC can simultaneously display a flow measurement on one side of the display and a current or voltage measurement on the other side of the display. This capability can be useful in calibrating transducers and transmitters that are calibrated in terms of flow, such as 0-200 ft/minute.

To take a flow measurement and monitor the electrical output from the device under test follow the procedures below:

Step 1   Set the HHC up to function in the desired flow

measurement (velocity or volume) mode of operation. Refer to Section 14.2 for information on setting up the HHC for velocity measurement or Section 14.4 for information on setting up the HHC for volume measurement.

Step 2   Select the desired engineering units as outlined in Sections 14.3 for flow velocity and 14.5 for flow volume.

Step 3   Press the port select key.

> **PORT**
> **SEL**

The HHC will respond by changing the right side of the display from pressure/flow measurement to the display of an mA measurement. The display will continue to display the output from the left Quick Select module in terms of flow.

To read the output of the right Quick Select module in terms of flow and the electrical measurement output from the device under test press the Port Select key a second time.

Step 4   With the flow and electrical measurements appearing in the desired locations on the display the current measurement can be changed to a voltage measurement by pressing the mA/V key.

> **mA V**

Pressing the mA/V key once will change the display to "------".

Pressing the mA/V key a second time will change the display to "volts".

Step 5   Connect the Quick Select pressure module to be used to the pressure source to be measured.

Step 6   Connect the output of the device to the miniature banana jacks on the keypad of the HHC as follows:

For current output devices: use the mA and COM jacks.

For voltage output devices: use the V and COM jacks.

Percent mode operation is also available for flow test and calibration of measurement instruments. Refer to Section 13.0 for percent function set up and use information.

Section 15.0   Leak Detection Function

The HHC provides the ability to detect and quantify leaks in terms of pressure decay over time (psi change per unit of time) or in terms of leak rate (cc/sec).

In the pressure decay over time mode the HHC will monitor the desired pressure vessel for the programmed time interval and, at the end of the monitoring time period, display the measured change in pressure. In the

leak rate mode the HHC will monitor the pressure vessel over the programmed time interval and display the leak rate in terms of cc/seconds.

Use of the leak detection function requires the setup of the leak test parameters. The following procedures should be followed to set up and perform a leak test using the HHC.

Section 15.1   Leak Rate Function Setup

Step 1   With the HHC on and displaying pressure press the set up key.

> **SET**
> **UP**

Step 2   Using the arrow keys, locate and select the words "LeakRate" in the set up menu. When selected the words "LeakRate" will flash.

> `EVntTimr DamPen`
> `LeakRate Status`

Step 3   With the words LeakRate flashing press the enter key.

> **ENT**

The HHC will respond by displaying:

> `Leak Mode`
> `Rate Decay`

Step 4   Using the left/right arrow select the word Rate.

> `Leak Mode`
> `Rate Decay`

Step 5   With the word Rate flashing press the enter key.

> **ENT**

The HHC will respond by displaying:

> `Vessel Volume`
> `cu.in.  .000000`

Step 6   Using the number keys enter the volume of the vessel to be tested in cubic inches.

> `Vessel Volume`
> `cu.in.  12324`

Step 7   With the HHC displaying the required vessel volume press the enter key.

> **ENT**

Step 8   The HHC will respond by displaying:

> `Time to Monitor`
> `sec.  XXXX`

Step 9   Using the number keys enter the time interval, in seconds, over which the leak rate test is to be performed. The time interval may be from 1 to 65,000 seconds.

```
Time to Monitor
Sec. 12345
```

Step 10   With the desired test interval displayed press the enter key.

ENT

At this point the HHC will return to basic pressure measurement.

See Sections 15.3 and 15.4 for information on performing leak rate testing.

Section 15.2   Pressure Decay Test Function Setup

Step 1   With the HHC on and displaying pressure press the set up key.

SET
UP

Step 2   Using the arrow keys, locate and select the words "LeakRate" in the set up menu. When selected the words "LeakRate" will flash.

```
EvntTimr Dampen
LeakRate Status
```

Step 3   With the words LeakRate flashing press the enter key.

ENT

The HHC will respond by displaying:

```
Leak Mode
Rate Decay
```

Step 4   Using the left/right arrow select the word Decay.

```
Leak Mode
Rate Decay
```

Step 5   With the word Decay flashing press the enter key.

ENT

Step 6   The HHC will respond by displaying:

```
Time to Monitor
Sec. XXXX
```

Step 7   Using the number keys enter the time interval, in seconds, over which the pressure decay test is to be performed. The time interval may be from 1 to 65,000 seconds.

```
Time to Monitor
Sec. 12345
```

Step 8   With the desired test interval displayed press the enter key.

ENT

At this point the HHC will return to basic pressure measurement.

See Sections 15.3 and 15.4 for information on performing leak rate testing.

Section 15.3   Sensor Selection; Rate or Pressure Decay Tests

In order to perform leak testing the desired Quick Select pressure module must be monitored by the HHC system. The following provides information on activating the desired pressure module for leak test applications:

With Two Quick Select Pressure Modules Installed

If two pressure modules are installed and the output of both are displayed, the HHC will default to the left pressure module.

If two Quick Select pressure modules are installed and one of the two modules is deselected, meaning the measurement values of that module are not shown on the display, leak testing will use the active pressure module to perform the leak test measurements.

The port select key (PORT SEL) is used to select or deselect a module. When a pressure module is deselected the corresponding side of the display will indicate one of the following: mA, Volts or "------".

If only one Quick Select pressure module is installed the HHC will default to the installed pressure module for leak test measurements.

Section 15.4   Performing Leak Rate or Pressure Decay Tests

Leak rate and pressure decay tests can be performed as follows:

Step 1   With the HHC on and reading pressure connect the pressure port of the selected pressure module to the vessel to be monitored. If the pressure module incorporates a differential pressure sensor use the High pressure port for the test procedure.

Step 2   For Pressure Decay   Select the desired engineering unit to be used as described in Section 8.

For Leak Rate   All leak rate measurements are made in cc/seconds and require no selection at this point.

Step 3   Pressurize the vessel to the required level for the test and allow vessel pressure to stabilize from the effects of sudden pressure increase or decrease.

Step 4   Press the key designated LEAK on the keypad

of the HHC.

LEAK

The HHC will display:

```
Timing eng unit
sec XXXX
```

where:

Timing indicates that the HHC is timing the desired monitoring interval.

sec = the remaining time left to be monitored.

eng unit = the engineering unit in use for the selected module.

xxxxx = the current pressure measured by the selected pressure module.

For Pressure Decay Testing – at the end of the test the HHC will display the following:

```
Eng Unit Decay
CCCC      XXX
```

where:

Eng Unit = the engineering unit of the measured value.

cccc = current pressure measurement for the selected pressure module.

xxxx = the measured pressure change during pressure decay test.

For Leak Rate Testing – at the end of the test the HHC will display the following:

```
Eng Unit cc/sec
CCCC      XXX
```

where:

Eng Unit = the engineering unit of the current pressure measurement value.

cccc = current pressure measurement for the selected pressure module.

xxxx = the measured leak rate over the test interval.

To resume basic pressure measurement press the clear entry (CE), enter (E) key or any of the four arrow keys. Pressing any function key will activate that selection. For example, pressing the engineering unit select key (ENG UNIT) will activate the engineering unit selection program.

Important Note: After completing leak testing the HHC will display pressure measurement data for the module that was used in the testing process and will display "--

--- " on the other side of the display. If a second module is installed in the other sensor bay it can be re-selected using the port select function (PORT SEL) as detailed in Section 5.0.

Section 16.0   Temperature Measurement using RTD Probes

The HHC can be used with most standard RTDs (Resistance Temperature Detectors) to provide precision temperature measurements. An GQS-RT type Quick Select module is needed in order for the HHC to perform temperature measurement with an RTD. The GQS-RT provides the interface between the calibrator base unit and the RTD probe. There are two GQS-RT Quick Select modules available in order to provide support for the most common RTD resistance levels.

The capabilities of the modules are summarized below:

GQS-RT1 Quick Select Module

Pt 100
(385 & 392): –200 to 550° C: $\pm$0.15° C
550 to 850° C: $\pm$0.2° C

Ni 120: 80 to 260° C:$\pm$0.1° C

Cu 10: 70 to 150° C:$\pm$0.6° C

Ohms: _____ +0.01% reading +0.02 ohms

GQS-RT2 Quick Select Module

Pt 1000: 184 to 275° C: $\pm$0.15° C

Ohms: _____ +0.01% reading +0.2 ohms

Engineering Units:
Fahrenheit, Celsius, Kelvin, Rankine or ohms

Ohms Measurement Range:
GQS-RT1 module: 0/400 ohms
GQS-RT2 module: 0/4000 ohms

The interface module incorporates a Switchcraft TA4M type connector and requires an RTD with the appropriate Switchcraft TA4F meeting connector. The connector is available through the supplier of your calibrator.

Section 16.1   Setting Up the Calibrator for RTD Temperature Measurement

Step 1 With the instrument off install the appropriate GQS-RT Quick Select RTD interface module. Instructions for installation of a Quick Select module

Step 2 Connect the desired RTD probe to the Switchcraft connector on the module

Step 3 Turn the calibrator on by pressing the On/Off key.

ON
OFF

Step 4 To access the temperature setup menu press the Set up key.

SET UP

Step 5 Use the downward pointing arrow to access the following selection screen

```
Calib RTModule
dP Meas*TCModule
```

* dp Meas is an optional feature that allows for the subtraction or addition of the measurement value of one sensor from the measurement value of the other sensor. If the calibrator was not ordered with this option it will NOT appear on the screen.

Step 6 As required, using the left/right and up/down arrows select the text "RTmodule". The text RTmodule will flash when selected.

```
Calib RTModule
dP Meas
```

Step 7 With the text "RTmodule" flashing press the enter key.

ENT

The calibrator will respond by displaying:

```
Probe Connection
2W    3W    4W
```

This represents the configuration of the RTD to be used, where the number equals the number of wires the RTD uses. Note: The use of a 4 wire RTD is recommended for optimum accuracy.

Step 8 Using the left/right arrow keys select the appropriate configuration for the RTD probe to be used. In the example below the 4 wire configuration was selected.

```
Probe Connection
2W  3W    4W
```

Step 9 With the desired wiring configuration selected press the enter key.

ENT

The calibrator will respond by displaying the available units of measure as follows:

```
Engnring Units:
°C   °F   K   °R
```

Step 10 Using the left/right arrow keys select the desired engineering unit for the measurements to be made. In the example here the measurements will be

made in degrees Celsius.

```
Engnring Units:
°C   °F   K   °R
```

Step 11 With the desired engineering unit selected and flashing press the enter key.

ENT

The calibrator will respond with the following display:

```
Probe: 12345678
P&a = 385    RO = 1000
```

On initial use the first selection and the corresponding probe will appear selected. Use the arrow keys to select the desired coefficients from the available factory programmed curves. The GQS-RT1 is pre-preprogrammed for the following RTDs:

Position	Probe	
1	α385	–200/850
2	α392	$\angle$200/850
3	Ni Minco	(Ni 120Ω)
4	Cu 10 ohm	
5-8	available for programming using the optional calibration and programming software for the GQS-RT1 module.	

Important Note: The GQS-RT1 is compatible with RTD probes with output resistance values of between 0 and 400 ohms. Use of the module with higher resistance RTD probes will result in diminished accuracy and possible damage to the module electronics.

The GQS-RT2 is pre-preprogrammed for the following RTDs:

Position	Probe	
1	α385	–200/850
1	PT 1000	
2-8	available for programming using the optional calibration and programming software for the GQS-RT2 module.	

Important Note: The GQS-RT2 is compatible with RTD probes with output resistance values of between 1000 and 4000 ohms. Whereas this module will function with lower resistance RTDs accuracy will be greatly diminished. In addition, use of the module with higher resistance RTD probes will result in diminished accuracy and possible damage to the module electronics.

Step 12 Using the left/right arrow keys select the RTD probe type for the measurements to be made. In the example here the measurements will be made in using the PT 100 type 385

```
Probe: 12345678
P&a385  RO = 100
```

```
Resolution:
1  .1    01    0.001
```

Step 13 With the desired probe type selected and flashing press the enter key.

ENT

The calibrator will respond by displaying the following:

```
Resolution:
1 .1    .01    0.001
```

The maximum resolution that the combination of the Calibrator base unit, RTD interface module and probe can support can be determined as follows:

The resolution of the RTD module is 0.001% of the full scale resistance of the reference resistor used in the module. The GQS-RT1 incorporates a 400 ohm reference resistor and the GQS-RT2 incorporates a 4000 ohm reference resistor.

Using the GQS-RT1 as the example the maximum resolution is:

> 0.001% of 400 ohms
> = 0.00001 x 400 = 0.004 ohms

For a PT 100 the temperature resolution can be determined as follows:

0.004 ohms/(100 ohms x 0.00385 ohms/degree C) = 0.008 degrees C (approx 0.005 degrees F)

Therefore, rounding to the next highest digit results in a resolution of 0.01 degrees C.

The resolution supported for the factory programmed RTDs can be found below:

Using the RT-1

Probe Type   Resolution
Pt 100   0.01 degrees C or F (385 & 392)

Ni 120   0.1 degrees C or F

Cu 10   0.1 degrees C or F

Using the RT-2

Probe Type   Resolution
Pt 1000   1.0 degrees C or F

Resolution must be selected in conjunction with the full scale ohms output for the RTD probe to be used.

Step 14 Select the desired resolution using the left/right arrow keys. In this case, since we are using the Pt100 RTD with a maximum resolution of 0.01 degrees C the 0.01 option has been selected

Step 15 With the desired resolution selected and flashing press the enter key.

ENT

The calibrator will briefly show internal limit settings and will then commence temperature measurement.

The measurement parameters can be changed at any time through the activation of the RTmodule set up menu.

Section 16.2	Calibrating/Programming the GQS-RT RTD Interface Module

The GQS-RT can be programmed in the field. Programming, calibration adjustment or recertification can be accomplished with the Calibration Programming Utility disk. Please note, in order to improve the accuracy of the measurement system it will be necessary to generate a significant number of very accurate temperature calibration points using precision temperature baths. In general, the simplest way to enhance the accuracy of the temperature measurement is to simply re-zero the probe while immersed in an ice bath.

Section 17.0	Thermocouple Interface Module

The Thermocouple Interface Module allows the hand-held calibrator base unit (equipped with firmware version 3.01 or later) to read the input from a thermocouple temperature measuring device. The calibrator offers the following features for thermocouple measurement:

• Selectable units of measure

• Direct millivolt readout for any type of thermocouple

• Choice of internal or external refernce junction

• Selectable resolution, or "auto" mode

• Programming to allow readout in temperature units for the following 8 thermocouple types:

Type	Materials
J	Iron & Copper-Nickel (Constantan)
K	Nickel-Chromium & Nickel-Aluminum
T	Copper & Copper-Nickel (Constantan)
E	Nickel-Chromium & Copper-Nickel (Constantan)
R	Platinum-13% Rhodium & Platinum
S	Platinum-10% Rhodium & Platinum
B	Platinum-30% Rhodium & Platinum – 6% Rhodium
N	Nickel-Chromium-Silicon & Nickel-Silicon-Magnesium

Section 17.1   Thermocouple Measurement Set Up

Step 1   To begin measurement with a thermocouple, first attatch the thermocouple to a male "miniature thermocouple connector." Please note that connectors are specifically manufactured for each thermocouple type and will be marked accordingly. Failure to use the properly mated connector will result in additional inaccuarcy.

Step 2   Turn the calibrator off. Install the thermocouple interface module into either of the modules bays in the top of the calibrator. Now install the thermocouple into the interface by inserting the male blades of the miniature connector into the slots in the receptacle located on the top of the thermocouple interface module.

Step 3   Turn the base unit on

When the display has completed the "power up" cycle, press the "set up" key.

SET
UP

Using the arrow keys, select the words "TC Module"

        TC Module

press the "enter" key.

ENT

If two thermocouple interface modules have been installed, the calibrator will require a selection as to which side (left or right) the current programming cycle is to be applied. The display will read:

        SELECT   MODULE
        LEFTRIGHT

Using the left or right arrow keys, select the module to be programmed and press the "enter" key.

ENT

(**Note:** If only one thermocouple interface module is installed, the left/right selection identified in the previous step will not appear. The process will begin with the selection of engineering units identified below.)

The calibrator will display:

        Engnring units:
        Oc OF Ok OR mV

Using the left or right arrow keys, select the desired unit of measure, and press enter. (Selection of the millivolt readout will instruct the calibrator to display the voltage within the thermocouple circuit. The internal reference junction cannot be applied in this mode.)

No further base unit programming will be required. If the millivolt mode has been selected, the programming cycle will end when the "enter" key is pressed, and the calibrator will begin to display the real-time millivolt measurement from the thermocouple circuit.

ENT

The top display will now indicate the choices for the thermocouple types. In addition, the lower line of the display will indicate the 2 types of metal which comprise the thermocouple type which is currently flashing. (By selecting a thermocouple type, the calibrator will access the factory programmed coefficients which will allow the calibrator to display in a unit of temperature measurement).

        TC: JKTERSBN
        Fe — Cu/Ni

Using the left or right arrow keys, select the type of thermocouple that has been installed,and press the "enter" key.

ENT

The display will now indicate the resolution choices.

        Resolution
        1 .1 .01 auto

Using the left or right arrow keys, select the degree of resolution closest to the working tolerance for the type of thermocouple that has been installed or select the "auto" mode (which will allow the calibrator to automatically adjust the display to the greatest significant resolution), and press the "enter" key.

ENT

The calibrator will now display the choices for the reference junction.

        Ref Junction:
        auto manual

By selecting the "auto" mode, the calibrator will utilize the internal thermistor/resistor based on the reference junction that is resident inside the interface module.

The "manual" mode allows for the use of an external reference junction. A stable temperature reference, usually in the form of an ice bath, is required.

Using the left or right arrow keys, select the desired reference junction and press the "enter" key.

ENT

If the "auto" mode was selected, the calibrator will now return to real-time measurement mode, displaying the temperature measurement from the thermocouple and

the reading from the other module bay, if a module or an interface module has been installed.

If the "manual" mode was selected, the calibrator must be programmed with the reference temperature of the external reference junction. the display will read"

```
Ref  temperature
```

(A value may already be programmed, or the calibrator may display ".0000." Entering a new value will over write these existing numbers.)

Program in the new temperature value of the external reference junction, using the number keys on the keypad. (The value that is being programmed should be referenced to the same unit of measure that was selected for the readout).

Press the "enter" key.

ENT

The calibrator will now return to the real-time measurement.

When the base unit is turned off and turned on again, it will have "remembered" the selections that were made during the previous entry process, and default to those parameters (refer to Appendix C for specifications).

Section 18.0   Pressure and Temperature Switch Testing

The HHC can be used to test pressure and temperature switches. On board firmware provides the ability to verify switch trip points, reset point and to test the deadband of a pressure switch. To perform these type of tests follow the procedures as outlined in the subsections of Section 18.

The switch testing process incorporated in the HHC firmware looks for a change of state that produces a change of greater than either 2 volts or a 2 mA across the corresponding miniature banana jacks. The banana jacks are located on the bottom of the keypad on the HHC. Prior to initiating these test procedures the required electrical set up should be configured to provide the necessary signal levels.

Section 18.1   Setting Up the HHC for Testing of Pressure and Temperature Switches

The following procedure outlines the set up requirements for the test of pressure and temperature switches.

Step 1   With the HHC on and reading pressure or temperature, in accordance with the type of switch to be tested, press the Port Select key, designated PORT SEL, the required number of times to leave activated the Quick Select module being used for the test function and

deactivate (convert the display to mA, "------" or Volts) the other side of the display.

PORT
SEL

Step 2   Press the mA/V key as required to change the electrical measurement parameter to that to be used for the switch test. Switch to Volts if the change of state will be greater than 2 Volts; switch to mA if the change of state will be greater than 2 mA.

mA
V

Step 3   Connect the switch electronics with a current or voltage source, as required, to provide the required greater than 2 Vdc or greater than 2 mA change in state. Be certain that the change in state to be generated corresponds to the electrical measurement (mA or V) set up on the display of the HHC.

Step 4   Connect the output signal of the switch to the miniature banana jacks on the front of the HHC as outlined below.

For voltage: volts (V) jack and common (COM).

For current: milliamps (mA) jack and common.

Step 5   Connect the switch to a controlled pressure/vacuum source to generate the required level of pressure or vacuum to trip the switch.

Step 6   Proceed to Section 18.2 for trip detect testing or to Section 18.3 for deadband testing.

Section 18.2   Test of Switch Trip Point

Step 1   With the HHC on and reading pressure or temperature press the trip detect key on the keypad.

TRIP
DET

The HHC will respond by displaying the following:

```
Disable   Manual
Deadband
```

Step 2   Using the left/right and up/down arrow keys selected the word manual will flash.

```
Disable   Manual
Deadband
```

Step 3   With the word "manual" flashing press the enter key.

ENT

Step 4   Gradually increase the pressure, vacuum or temperature until the display of the HHC indicates that a

change of state has been detected. When the switch has tripped the HHC will display:

```
Eng Unit Tripped
+12345    +vvvvv
```

where:

- Eng Unit is the pressure or temperature engineering unit in use
- Tripped indicates the pressure switch has tripped
- +12345 represents the pressure or temperature at which the switch tripped
- +vvvvv is voltage value

Step 5 To perform additional trip tests press any key and the trip detect system will be rearmed.

Step 6 To discontinue the switch testing process press the trip detect key.

**TRIP
DET**

The HHC will respond by displaying:

```
Disable   Manual
Deadband
```

Step 7 Using the left/right and up/down arrow keys select the word disable in the menu selection. When selected the word disable will flash.

```
Disable    Manual
Deadband
```

Step 8 With the word "disable" flashing press the enter key.

ENT

The switch test operation has now been terminated.

Section 18.3   Switch Deadband Testing

Step 1 With the HHC on and reading pressure or temperature press the trip detect key on the keypad.

**TRIP
DET**

The HHC will respond by displaying the following:

```
Disable Manual
Deadband
```

Step 2 Using the left/right and up/down arrow keys select the word deadband in the menu selection. When selected the word deadband will flash.

```
Disable Manual
Deadband
```

Step 3 With the word "Deadband" flashing press the enter key.

ENT

Step 4 Gradually increase or decrease, as required, pressure, vacuum or temperature until the display of the HHC indicates that a change of state has been detected. When the switch has tripped the HHC will display:

```
Eng Unit Tripped
+12345 +vvvvv
```

where:

- Eng Unit is the pressure or temperature engineering unit in use
- Tripped indicates the pressure or temperature switch has tripped
- +12345 pressure at which the switch tripped
- +vvvvv is voltage value

Step 5 To perform a deadband test, maintain the pressure/vacuum or temperature and power applied to the switch and press any key to rearm the trip detection system.

**TRIP
DET**

Step 6 Gradually allow the pressure/vacuum or temperature level applied to the switch to return to the starting point.

Step 7 When the HHC detects a reset of the switch the HHC will respond by displaying:

```
Deadband +XXXXXX
+YYYYYY +ZZZZZZ
```

where:

      xxxxxx is the measured trip point
      zzzzzz is the measured reset point
      yyyyyy is the measured deadband value

Step 8 To perform additional deadband tests press any key and the trip detect system will be rearmed.

Step 9 To discontinue switch testing press the trip detect key.

**TRIP
DET**

The HHC will respond by displaying:

```
Disable Manual
Deadband
```

Step 10 Using the left/right and up/down arrow keys select the word disable in the menu selection. When selected the word disable will flash.

```
Disable Manual
Deadband
```

Step 11 With the word "Disable" flashing press the enter key.

ENT

The switch deadband test operation has now been terminated.

Section 19.0   RS232 Interface General Information

To simplify the interface of the HHC with your computer, recorder, data acquisition hardware or dumb terminal two standard operating modes for the RS232 interface are available. A third RS232 operating mode, ISO1745, is included on the menu options. This mode is only used in uploading data from the optional data logging memory and in factory calibration, set up and repair activities.

To configure the RS232 interface on the HHC for the requirements of your input device, first determine the interface requirements of the device. Then using the RS232 setup feature configure the RS232 interface on the HHC, following the steps below:

Pin out information follows. A standard RS232 cable, to connect the calibrator to a 9 pin serial port on a computer, is available from your calibrator supplier. An adaptor to connect the calibrator to a 25 pin serial connection on a computer is also available. The RS232 connector is located above the AC adapter input on the right side of the calibrator when looking down at the calibrator with the keypad up in the normal operating orientation.

RS 232 Connector

Pins 5 4 3 2 1

Pins Pin Function 8 7 6
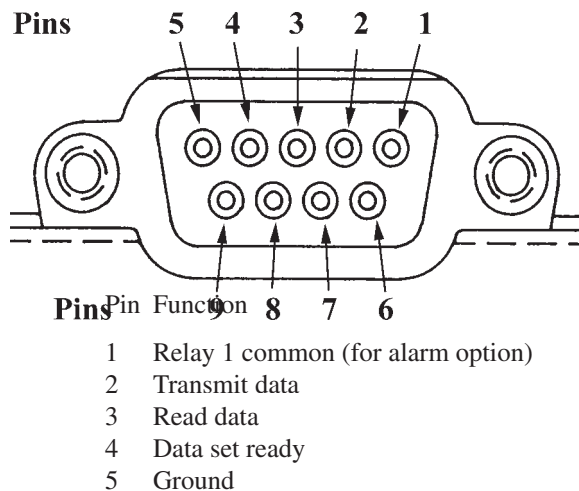
Pin	Function
1	Relay 1 common (for alarm option)
2	Transmit data
3	Read data
4	Data set ready
5	Ground
6	Data transfer ready
7	Relay 1 normally open (for alarm option)
8	Relay 2 common (for alarm option)
9	Relay 2 normally open (for alarm option)

Section 19.1   Configuring RS232 Interface for Use with a Dumb Terminal

To communicate with the HHC through the use of a dumb terminal set the terminal up as follows:

Select baud rate to be used: 300, 1200, 2400 or 9600
Select communications (com) port: 1 or 2
Set data bits to: 8
Set stop bits to: 2
Set parity to: None
Flow control: None

Section 19.2   RS232 Configuration Options

The HHC has two communication formats for operator use. These communication formats will appear as selection options during the set up of the RS232 interface. A third mode of RS232 communication, ISO1745, is listed in the menu selections and is only used for up loading data stored in the optional data logging memory to a computer and factory calibration, setup and repair activities. An overview of the features of these formats follows.

Section 19.2.1   RS232 Interface ISO1745 Operating Mode Overview

The ISO1745 mode of operation is used to interface the HHC with the upload program provided to export data logged values into a P.C. compatible computer. If your calibrator is equipped with the optional data logging capability, consult Section 24 of this manual and supplemental manual provided with the software package for directions on the use of the ISO1745 mode for data transfer to an IBM compatible personal computer. Units not equipped with the data logging option are not supplied with the upload program disk or supplemental manual.

Section 19.2.2   RS232 Interface Journal Mode Overview

This mode allows the HHC to be interfaced to an RS232 compatible printer or other device where a steady, timed data output is required. When the journal mode is selected the HHC will transmit the current pressure measurement(s) as shown below:

$+0.005$ in.H_2O $+0.0000$ psi
Left Min: $+0.0045$ Max: $+0.0053$
Right Min: $+0.0000$ Max: $+0.0000$

$+0.003$ in.H_2O $+0.0000$ psi
Left Min: $+0.0032$ Max: $+0.0049$
Right Min: $+0.0000$ Max: $+0.0000$

+0.003 in.H$_2$O   +0.0000 psi
Left Min: +0.0033   Max: +0.0035
Right Min: +0.0000   Max: +0.0000

Each data set consists of three (3) lines. The first line displays the current measurement data as seen on the instrument display. This line will display the pressure, flow, temperature or electrical measurement in the selected units of measure. Engineering units may be changed from the keypad as outlined in the engineering unit section of this manual, Section 8.0, while the RS232 interface is in use. In addition, the HHC can be changed from pressure to flow measurement while the RS232 interface is in use.

The second line displays the minimum and maximum values stored in memory for the left sensor module since the last time the memory locations were cleared.

The third line displays the minimum and maximum values measured by the right sensor since the last time the minimum and maximum pressure values were cleared from memory.

In the journal mode the RS232 interface will output the data as outlined above at a regular interval. The interval is selected in the RS232 setup procedure and may be from 1 second to 65,000 seconds.

Section 19.2.3   RS232 Interface Inquiry Mode Overview

When the RS232 interface of the HHC is set up in the inquiry mode the HHC transmits the data string shown below in response to an operator selected inquiry character.

```
+0.003 Eng Unit
+0.0000 Eng Unit
```

The first value represents the measurement value displayed on the left side of the display and includes the selected unit of measure. The second value represents the measurement value displayed on the right side of the display, including the selected unit of measure.

Section 19.3   Setup of the RS232 Interface in the Journal Mode

To use the RS232 interface in the Journal Mode follow the steps below.

Step 1   With the HHC on and reading pressure press the set up key.

**SET
UP**

Step 2   Using the arrow keys move through the menu selections and select "RS232" on the display of the HHC. The text "RS232" will flash on the display when selected.

```
Owner Alarm
DateTime RS232
```

Step 3   With the text RS232 flashing press the enter key.

ENT

This will activate the RS232 setup options sub menu.

The first screen that appears after selection of RS232 from the main setup menu is:

```
RS232 interface
Disable Enable
```

The RS232 interface must be enabled (activated) for the HHC to communicate with any RS232 device.

When the RS232 is not in use it is recommended that the RS232 interface be disabled to conserve on power use and maximize battery life.

Step 4   Use the arrow keys to select Enable (activate) and press the enter key.

```
RS232 interface
Disable Enable
```

Step 5   With the word Enable flashing press the enter key.

ENT

Step 6   After selecting "Enable" the HHC will respond with the following display.

```
Baud Rate
9600 2400 1200 300
```

The current baud rate selection will flash on the display.

Step 7   Using the left/right arrow keys select the desired baud rate. The selected baud rate will flash on the display.

```
Baud Rate
9600 2400 1200 300
```

In the above example the baud rate 9600 has been selected.

Step 8   With the desired baud rate flashing press the enter key.

ENT

After the desired baud rate has been entered theHHC will display:

```
Disable ISO1745
Journal Inquiry
```

Step 9   Using the arrow keys select the word Journal. When selected the word Journal will flash.

```
Disable ISO1745
Journal Inquiry
```

Step 10 With the word Journal flashing press the enter key.

ENT

The HHC will respond by displaying the following:

```
Report Interval
XXXXXX
```

Step 11 Using the number keys enter the desired interval, in seconds, between data transmissions. The interval may be any value from 1 second to 65000 seconds. In the example below the HHC is being instructed to transmit a set of readings every 600 seconds (10 minutes).

```
Report Interval
600
```

Step 12 With the desired time interval displayed press the enter key.

ENT

The HHC will respond by displaying:

```
End Of message
CrLf  Prog
```

Step 13 Select the desired end of message character. For data transmission to a screen on a dumb terminal the CrLf (carriage return/line feed) is the most common option. If the data output is to be transmitted into a database or spreadsheet program the end of message character must be selected in accordance with the requirements of the application software. Proceed to Step 16 to input a custom end of message character.

Step 14 To use CrLf as the end of message character use the arrow keys to select the text "CrLf". When selected the text "CrLf" will flash.

```
End Of message
CrLf  Prog
```

Step 15 With the text CrLf flashing press the enter key.

ENT

The HHC will return to pressure temperature measurement and will transmit data to the terminal, acquisition device, computer or recorder as programmed. While communicating, engineering units may be changed or the HHC may be changed between basic pressure measurement and flow measurement.

Important Note: Invoking set up functions or dedicated keypad functions will temporarily suspend the transmis-

sion of data during the setup process. For most functions data transmission will resume when the set up is complete. However, the RS232 interface must be re-enabled via the RS232 set up process to re-initiate data transmission after either automatic data logging or leak detection functions are activated.

Step 16 To select a programmable end of message character use the arrow keys to select the text "Prog".

```
End Of message
CrLf  Prog
```

Step 17 With the text Prog flashing press the enter key

ENT

The HHC will respond by displaying:

```
EOM Character
XX.XX
```

Step 18 Using the number keys enter the decimal code for the desired end of message character. A list of the decimal codes for the available ASCII characters can be found in Appendix B.

Step 19 With the decimal representation of the desired ASCII character displayed press the enter key.

ENT

The HHC will return to the operation of pressure measurement and will transmit data to the terminal, acquisition device, computer or recorder as programmed. While communicating, engineering units may be changed or the HHC may be changed between basic pressure measurement and flow measurement.

Important Note: Invoking set up functions or dedicated keypad functions will temporarily suspend the transmission of data during the setup process. For most functions data transmission will resume when the set up is complete. However, the RS232 interface must be re-enabled via the RS232 set up process to re-initiate data transmission after either automatic data logging or leak detection functions are activated.

Section 19.4   Setup of the RS232 Interface in the Inquiry Mode

To use the RS232 interface in the Inquiry Mode follow the steps below.

Step 1 With the HHC on and reading pressure press the set up key.

SET
UP

Step 2 Using the up/down and left/right arrow keys

move through the menu selection and highlight the text "RS232" so that is flashes on the display.

```
Owner Alarm
Date Time RS232
```

Step 3   With the text "RS232" flashing press the enter key.

ENT

This will activate the RS232 setup options sub menu.

The first screen that appears after the selection of RS232 from the main setup menu is:

```
RS232 interface
Disable Enable
```

The RS232 interface must be enabled (activated) for the HHC to communicate with any RS232 device. When the RS232 is not in use it is recommended that the RS232 interface be disabled to conserve on power use and maximize battery life.

Step 4   Use the arrow keys to select the word Enable. When selected the word Enable will flash.

```
RS232 interface
Disable Enable
```

Step 5   With the word Enable flashing press the enter key.

ENT

Step 6   After entering the Enable option the HHC will respond with the following display.

```
Baud Rate
9600 2400 1200 300
```

The currently selected baud rate will be flashing.

Step 7   Using the left/right arrow keys select the desired baud rate. The selected baud rate will flash on the display of the HHC.

```
Baud Rate
9600 2400 1200 300
```

In this above example the baud rate 9600 has been selected.

Step 8   With the desired baud rate selected and flashing press the enter key.

ENT

Step 9   After the desired baud rate has been entered the HHC will display:

```
Disable ISO1745
Journal Inquiry
```

Step 10   Using the arrow keys select the word "Inquiry," when selected the word will flash.

```
Disable ISO1745
Journal Inquiry
```

Step 11   With the word Inquiry flashing press the enter key.

ENT

The HHC will respond by displaying the following:

```
Inquiry Char.
XX.X
```

Step 12   Using the number keys enter the desired end of message character in decimal code. A list of the available ASCII characters and their corresponding decimal codes is provided in Appendix B. The inquiry character acts as a signal to the HHC to transmit a data set. The inquiry character is transmitted to the HHC from the computer or other device controlling the data transmission activities. Select an inquiry character to be used in programming as the transmission prompt.

Step 13   With the decimal representation for the desired inquiry character displayed press the enter key.

ENT

The HHC will respond by displaying:

```
End Of message
CrLf Prog
```

Step 14   Select the desired end of message character. For data transmission to a screen on a dumb terminal the CrLf (carriage return/line feed) is the most common option. If the data output is to be transmitted into a database or spreadsheet program the end of message character must be selected in accordance with the requirements of the application software.

Using the number keys enter the decimal code for the selected end of message character. A list of the decimal codes for the available ASCII characters can be found in Appendix B.

Step 15   With the desired decimal representation for the ASCII character entered and displayed press the enter key.

ENT

The HHC will return to pressure measurement and will transmit data to the terminal, acquisition device, computer or recorder as programmed.

While communicating, engineering units may be changed or the HHC may be changed between basic pressure measurement and flow measurement.

Important Note: Invoking set up functions or dedicated keypad functions will temporarily suspend the transmis-

sion of data during the setup process. For most functions data transmission will resume when the set up is complete. However, the RS232 interface must be re-enabled in the RS232 set up process to re-initiate data transmission after either automatic data logging or leak detection functions are activated.

Section 20.0   Status

The status selection provides a means to query the HHC as to the revision of firmware, hardware and the last calibration date of the sensor(s) installed. The hardware and firmware revision numbers are for factory use in determining the level of firmware and hardware in the HHC . In addition, the ability to check calibration dates for installed Quick Select pressure modules simplifies the tracking of recertification requirements for the Quick Select pressure modules.

Section 20.1   Reviewing Instrument Status

To invoke the status selection follow the steps below.

Step 1   With the HHC on and reading pressure press the set up key.

SET
UP

Step 2   Using the left/right and up/down arrow keys select the "Status" function from the setup menu. When selected the word Status will flash on the display.

```
EvntTimr Dampen
LeakRate Status
```

Step 3   With the word Status flashing press the enter key.

ENT

Step 4   After pressing ENT the display will read:

```
snXXXXXXdd/dd/dd
fw=XX.XXhw=XX.XX
```

where:

snXXXXXX: serial number of the base unit.
dd/dd/dd: provides the date of calibration of the base unit.
fw: revision level of the firmware
hw: revision level of the hardware

After reviewing this display and recording any desired information press the enter key to call up the second status screen.

ENT

Step 5   After pressing the enter key a second time, the HHC will respond by displaying the following:

```
LeftMod dd/dd/dd
Type X
```

where:

dd/dd/dd: the date of the last calibration of the left module.
Type: provides information on the type of Quick Select pressure module.

Step 6   After reviewing this display and recording any desired information press the enter key to call up the third status screen. After pressing the enter key the HHC will respond by displaying the following:

```
RightMod dd/dd/dd
Type X
```

where:

dd/dd/dd: date of the last calibration of the left module.
Type: provides information on the type of Quick Select pressure module.

Review the displayed information and record any desired information.

Step 7   Press the enter key to return to the basic pressure measurement mode.

ENT

Section 20.2   Battery Power Status Check

The battery check key, designated BAT CK, allows for easy tracking of the power level remaining in the 9 Volt dc batteries that power the HHC.

To check the battery power level press the BAT CK key. The HHC will respond by displaying the following

```
+X.XXV +XX%

‒ ‒ ‒ ‒ ‒ ‒ ‒ ‒ ‒ ‒ ‒ ‒ ‒ ‒
```

where:

+x.xx V: battery voltage level.

+xx %:   estimated battery life remaining as a percent of the 30 hours standard battery life provided by 2 fresh 9 Vdc batteries.

Note: Only a battery voltage reading will be displayed if the % battery life function is not enabled as detailed in section 3.4.2.

Two 9 Volt alkaline batteries will power the HHC for approximately 30 hours. The HHC display of percentage of battery life remaining is the % of 30 hours remaining. Use of non-alkaline batteries will render this percent value inaccurate. The bottom line of the display is a bar graph of the remaining battery life.

Important Notes:

1 – The bar graph must be reset when new batteries are installed. To reset the bar graph follow the steps outlined in section 3.4.2 of this manual.

2 – The percent life remaining is based on the character-istics of standard 9 Vdc alkaline batteries. Use of other batteries types, such as; zinc, lithium or rechargeable NiCad batteries, will result in inaccurate estimation of remaining battery life in both percent indication and bar graph indication.

Step 1 Install new batteries as outlined in the base unit start up section of this manual (Section 3.1).

Step 2 Turn the HHC on.

Step 3 With the HHC operating and displaying pres-sure press the battery check key, designated BAT CK:

**BAT
CK**

The HHC will respond by displaying:

+X.XXV   +XX%

Note: Installation of two new 9 Vdc alkaline batteries will produce an initial voltage measurement of 9.0-9.5 Volts on the calibrator. If the value measured is signifi-cantly below this level it is likely that the batteries have degraded in storage and that they will provide less than the 30 hours of operation expected from a set of fresh, fully charged batteries.

Step 4 Use the right arrow key to restore the bar graph to the full scale. The percentage value displayed will reflect the adjustments made to the bar graph.

The number of highlighted segments in the bar graph will automatically reduce as the remaining battery life is reduced through the use of the HHC.

Important Note: It is recommended that batteries be re-placed when the low voltage icon appears on the instru-the low battery icon appears is approximately 1 hour.

****WARNING****
Batteries must be changed in a non-hazardous environ-ment for all HHC units.

Section 21.0   Dual Sensor Functions

The calibrator is equipped with firmware that can auto-matically add the measured pressure values from two installed Quick Select pressure modules or to subtract the value measured by the Quick Select module installed in the right module bay from the measured value of the Quick Select value in the left module bay. This optional firmware allows for the following:

The ability to subtract the measured value from the left module of the measured value derived from the right module allows for simplified measurement of what are commonly referred to as high-line" or elevated static differential pressures. A complete description of this

capability is provided in Section 21.2 entitled Dual Sensor Differential Pressure Measurement.

2 – The ability to add the measured values of the two installed Quick Select pressure module allows for the addition of a measured barometric pressure from an absolute pressure module to the measured pressure from a gauge or differential pressure. This capability can come in handy and save money by allowing the use of gauge measurement Quick Select pressure modules for absolute pressure measurement activities.

Section 21.1   Accuracy of Dual Module Measurements

The accuracy of measurements made using the differ-ence or sum of 2 modules is a function of the full scale range of the Quick Select pressure modules used and, in the case of differential pressure measurements, the magnitude of the dp range.

For dual sensor summation measurements:
The worst case inaccuracy would be the sum of the inaccuracies of the two Quick Select modules used for the measurement. For example, if the measurement is made with two $\pm0.1\%$ full scale modules the maximum inaccuracy would be $\pm0.2\%$. In actual use, it is gen-erally acceptable to use the Root Sum of the Square (RSS) method of determining the accuracy of a multiple component measurement system. Using the RSS method the accuracy of the dual module summation is approxi-mately $\pm0.14\%$ of span.

For dual module differential pressure measurement:
The accuracy of the dual module differential pressure measurement is a function of the full scale range of the Quick Select pressure modules used in the measurement process and the magnitude of the dp range. In general, the accuracy for the dp measurement for dp ranges less than 10% of the rated range of the Quick select modules used is $\pm0.37\%$ of dp range ±1 count. For dp ranges greater than 10% of the range of the Quick Select pressure module installed, the accuracy of the dp measurement is $\pm0.37\%$ of the dp range x 0.1(R1) where R1 equals the ratio of the module full scale to the dp full scale (Sensor full scale/dp full scale).

Section 21.2   Setting Up Dual Module Differential Pressure Measurement

Step 1 With the calibrator off, install the two Quick Select pressure modules in the calibrator. Be certain to install the module so that the modules are in the desired module bays. The subtraction process is always defined as the subtraction of the measured value of the right module from that of the measured value of the left module (d/p = Left measurement value – right measure-ment value)

Step 2   With the modules installed, turn the calibrator on by pressing the on/off key.

ON
OFF

Step 3   With the calibrator on and displaying pressure measurement data from the two installed Quick Select modules press the Set Up key.

SET
UP

Step 4   Using the up/down and left/right arrow keys locate the section of the set up menu that includes dp measurement set up. This menu will appear on the calibrator screen as follows:

```
Calib    RtModule
dP Meas
```

Step 5   Use the arrow keys to highlight the text "dp Meas". When highlighted the text will flash on the display.

```
Calib    RtModule
dP Meas
```

Step 6   With the text "dp Meas" flashing press the enter key.

ENT

The calibrator will respond with the following display.

```
dP Meas Mode:
NONE   L-R      L+R
```

Step 7   To perform dual module differential pressure measurement select "L-R"; to exit this dp set up and return to basic pressure measurement select "NONE". To proceed, use the arrow keys to select the text "L-R"

```
dP Meas Mode:
NONE   L-R      L+R
```

Step 8   With the text "L-R" flashing press the enter key.

ENT

After pressing the enter key the calibrator will return to basic pressure measurement.

Step 9   To activate the dual sensor dp mode of operation press the port select key one time after the set up has been complete. The calibrator will display the following text

```
L-R PSI      PSI
XXX    XXX
```

for a calibrator displaying measurement values in the psi engineering unit.

When the dual sensor differential firmware is active the following measurement sequence will result from pressing the PORT SELECT (PORT SEL) key.

First press of the port select key:

```
L-R PSI    PSI
XXX        XXX
```

Second press of the port select key:
```
PSI     L-R      PSI
XXX              XXX
```

Third press of the port select key:
```
PSI                MA
XXX              XXX
```

Fourth press of the port select key:
```
MA               PSI
XXX              XXX
```

Fifth press of the port select key:
```
PSI                PSI
XXX              XXX
```

The sixth press of the port select key will return to the first dp screen as shown below and allow repeating the choice of available port select configurations:

```
L-R PSI        PSI
XXX            XXX
```

****IMPORTANT****
When static pressure is being applied to both modules at zero differential pressure press the TARE Key to eliminate any offset caused by the elevated static to optimize measurement accuracy. Notes on interpreting the displayed measurement values:

1 – On a display set up with an L-R indication on one side of the display and a straight engineering unit designation on the other side of the display the value under the L-R designation is the resulting valuefrom the subtraction of the right Quick Select measurement from that of the left Quick Select measurement. The value on the opposite side of the display, under the engineering unit without the L-R prefix represents the pressure measurement from the Quick Select pressure module installed in the corre-sponding side of the calibrator. By using the port select function it is possible to read the differential pressure measurement value as well as either of the inputs independently.

2 – Due to the length of the engineering unit designation when the d/p is expressed in a user engineering unit the L-R indication will be not be present on the display. The display is limited to 16 characters/line and cannot display both the L-R and a _XXXXXX engineering unit label.

Section 21.3   Setting Up Dual Module Summation Pressure Measurement

Step 1 With the calibrator off, install the two Quick Select pressure modules in the calibrator. As this is a summation process the modules may be in either sensor bay.

Step 2 With the modules installed, turn the calibrator on by pressing the on/off key.

ON
OFF

Step 3 With the calibrator on and displaying pressure measurement data from the two installed Quick Select modules press the Set Up key.

SET
UP

Step 4 Using the up/down and left/right arrow keys locate the section of the set up menu that includes dp measurement set up. This menu will appear on the calibrator screen as follows:

```
Calib      RtModule
dP Meas
```

Step 5 Use the arrow keys to highlight the text "dp Meas". When highlighted the text will flash on the display.

```
Calib      RtModule
dP Meas
```

Step 6 With the text "dp Meas" flashing press the enter key.

ENT

The calibrator will respond with the following:

```
dP Meas Mode:
NONE    L-R L+R
```

Step 7 To perform pressure measurement using the dual sensor summation mode select "L+R"; to exit this dp set up and return to basic pressure measurement select "NONE". To proceed, with use the arrow keys to select the text "L+R"

```
dP Meas Mode:
NONE L-R L+R
```

Step 8 With the text "L+R" flashing press the enter key.

ENT

After pressing the enter key the calibrator will return to basic pressure measurement.

Step 9 To activate the dual sensor dp mode of opera-

tion press the port select key one time after the set up has been complete. The calibrator will display the following text

```
L+R PSI PSI
XXX   XXX
```

for a calibrator displaying measurement values in the psi engineering unit.

When the dual module summation firmware is active the following measurement sequence will result from pressing the PORT SELECT key

First press of the port select key:

```
L+R PSI    PSI
XXX   XXX
```

Second press of the port select key:

```
PSI L+R PSI
XXX          XXX
```

Third press of the port select key:

```
PSI   MA
XXX XXX
```

Fourth press of the port select key:

```
MA        PSI
XXX       XXX
```

Fifth press of the port select key:

```
PSI   PSI
XXX XXX
```

The Sixth press of the port select key will return to the first dp screen as shown below and allow repeating the choice of available port select configurations

```
L+R PSI     PSI
XXX    XXX
```

Notes on interpreting the displayed measurement values:

1 – On a display set up with an L+R indication on one side of the display and a straight engineering unit designation on the other side of the display the value under the L+R designation is the resulting measurement for the summation product of the left Quick Select measurement added to the measurement value of the right Quick Select module. The value on the opposite side of the display, under the engineering unit without the L+R prefix, represents the pressure measurement from the Quick Select pressure module installed in the corresponding side of the calibrator. By using the port select function it is possible to read the summation pressure measurement value as well as either of the inputs independently.

2 – Due to the length of the engineering unit designation when the d/p is expressed in a user engineering unit

the L+R indication will be not be present on the display. The display is limited to 16 characters/line and cannot display both the L+R and a U_XXXXXX engineering unit label.

Section 22.0   Data Logging Function (Optional)

There are two basic ways to perform data logging with the HHC system. These are

- sequentially ungrouped storage
- grouped for certification generation of an instrument under test.

Sequential data logging is detailed in this section (Section 22.1) of this manual.

Data logging with the enhanced certification generation data logging is detailed in Section 23 of this manual.

Note: Base units equipped with optional data logging include a lithium battery to back up the Random Access Memory (RAM) used to store data logged values. If the battery voltage is low the following message will appear on the DATA LOG key pressed.

```
Data Log Backup
Battery is Low
```

When this message appears on the display the battery should be replaced as soon as possible. Consult Section 24.2 for details on battery replacement. Acceptable batteries are listed in section 24.2.

Section 22.1   Sequential Data Logging Function (Optional)

The sequential data logging function provides three means of capturing and storing measurement data. These are:

- automatically at a defined time interval
- automatically with delayed start
- manually at the push of the data store key

In the automatic data logging mode, data logging can be programmed to occur at a time interval of from 0.1 to 65,000 seconds. The manual mode of data logging allows storage of the displayed measurement data at the push of a key.

In the sequential data logging mode the HHC has the capacity to store a maximum of 714 data sets with the time/date stamp function disabled. If the time date stamp is enabled the HHC system data logging memory can store a maximum of 387 data sets. Each data set includes the following; the record number, the measured value and the engineering units of the measurement value. If the time/date stamp is enabled the time (hours/minutes/seconds) and date (Year/Month/Day) are included with the logged measurement data.

When used in conjunction with the Event Timer function (see Section 24) the HHC system can be set up to take data during a selected future time period at an operator programmed time interval. For example, the combination of data logging and event timer provides the ability to set up the HHC system to take pressure measurements from 9:00 PM to 11:00 PM at a timed interval of one data set every 10 seconds, without operator intervention.

Section 22.2   Setting up the Data Logging Function (Optional)

The setup menu for the data logging function is accessed through a dedicated key on the keypad of the HHC system. This key has the designation DATA LOG. Pressing the data log key provides access to the complete data logging set up menu.

DATA
LOG

When the data log key is pressed the HHC system will respond with one of two prompt screens. If the unit is not equipped with the certification generation enhancement the calibrator will display:

Line 1   Auto   Manual
Line 2   Review   Off
Line 3   Label   Erase

If the HHC system is equipped with the certification generation data logging enhancement the response will be:

```
Select  Mode
Std     CertGen
```

To perform "standard" sequential manual or time based data logging highlight the text "Std" and with it flashing on the display press the enter key.

ENT

To access the certification generation capability of the HHC, using the right pointing arrow key highlight the text CertGen and with it flashing press the enter key.

ENT

The up/down and left/right arrows can be used to choose the desired selection from the data log set up menu. Information on the function of each of the above menu options follows.

Proceed to Section 23 of this manual for details on the certification generation mode of data logging.

Proceed through the balance of Section 22 for details on the use of the capabilities provided by the standard sequential data logging operation mode.

Section 22.3 Labeling Function – Standard Data Logging Mode

The label option allows the input of an alphanumeric label of up to 16 characters in length. Multiple labels can be used. For example, a label can be entered and data taken to be stored under the label. After completion of the measurement activities to be included under the first label another label may be entered and the next data set will follow that label in the data storage and transmission sequence. Label information can be viewed on the HHC system display and is transmitted when stored values are reviewed via the computer upload program detailed in Section 24.

To enter a label follow the steps below.

Step 1 With the HHC system on and reading pressure/temperature, press the data log key on the HHC system keypad.

DATA
LOG

In response the HHC system display will respond:

THE LAST DATA LOG MENU SCREEN USED

Step 2 Using the up/down and right/left arrows browse through the data log menu and locate the word "label". The menu line that contains the label function appears as:

Label   Erase

Step 3 Using the left/right arrow keys select the word Label. When selected the word label will flash.

Label   Erase

Step 4 With the word Label flashing press the enter key.

ENT

The HHC system will respond by displaying:

Enter Label
_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Step 5 Use the Up/down arrows to enter letters, numbers or a blank and the right/left arrows to move the cursor to the position in which the character is to be entered. When the label information is displayed press the enter key.

ENT

The label is now stored and will appear in sequence with the corresponding data logged values when the stored information is viewed on the display or uploaded to a computer.

Section 22.4 Automatic Data Logging – Standard Data Logging Mode

The automatic data logging function allows for the automatic, unattended logging of measurement data. The data logging process commences immediately after the completion of the set up of the automatic data function to be performed. Automatic data logging can be accomplished by the following procedure.

Step 1 With the HHC system on and reading pressure press the data log key on the keypad.

DATA
LOG

The HHC system will respond by displaying:

THE LAST DATA LOG MENU SCREEN USED.

Step 2 Using the up/down and right/left arrows browse through the data log menu and locate the word "Auto" The menu line with the word "Auto" appears as:

Auto   Manual

To initiate automatic, time interval, data logging select the word "Auto" by using the arrow keys. When selected the word "Auto" will flash on the display. For manual, operator controlled, data entry proceed to Section 22.5.

Auto   Manual

Step 3 With the word "Auto" flashing press the enter key.

ENT

The HHC system will respond by displaying:

Enter Interval
sec. XXXXX

Step 4 Using the number keys enter the desired time interval in seconds. The interval may be from 0.1 seconds to 65,000 seconds.

Enter Interval
sec. 12345

Step 5 After the desired time interval is shown on the display press the enter key.

ENT

Step 6 The HHC system will respond by displaying the following:

Readings to Log
None Left Rght Both

Step 7 Using the arrow key select the desired Quick

Select pressure modules to be monitored and logged.

```
Readings to Log
None Left Rght Both
```

In this example we have opted to log the output from both Quick Select pressure modules.

Step 8 With the Quick Select module(s) to be monitored selected and flashing press the enter key.

ENT

The HHC system will respond by displaying:

```
Date/Time Stamp
Disable   Enable
```

Note: If data storage is done with the time/date stamp option activated, the HHC system can store 387 sets of pressure measurements. If data storage is done without the time/date stamp option activated the HHC system can store 714 sets of pressure measurements. A data set is the full package of information defining the logged output from one module.

Using the arrow keys select the desired storage format. The desired format will flash when selected.

```
Date/Time Stamp
Disable   Enable
```

In this example we have opted to forego the date/time stamp of the stored data values.

Step 9 With the desired format displayed press the enter key.

ENT

The HHC system will immediately begin storing the pressure data requested at the desired interval until instructed to stop the data logging process.

Step 10 To stop the data logging process press the Data Log key. The HHC system will respond by displaying:

```
Auto    Manual
Review  Off
```

Step 11 Using the arrow keys select the word off. When selected the word "Off" will flash.

```
Auto    Manual
Review  Off
```

Step 12 With the word "Off" flashing press the enter key to disable the data log function.

ENT

Automatic, time interval based, data logging has now been terminated.

Section 22.5   Manual Data Logging – Standard Data Logging Mode

Follow the procedure below to conduct manual, operator controlled, data logging.

Step 1 With the HHC system on and reading pressure press the data log key.

DATA
LOG

The HHC system will respond by displaying:

THE LAST DATA LOG MENU SCREEN USED

Step 2 Using the up/down and right/left arrows browse through the data log menu and locate the word "Manual." The menu line with the word "Manual" appears as:

```
Auto Manual
```

To initiate manual data logging select the word "Manual" using the arrow keys. When selected the word "Manual" will flash on the display.

```
Auto Manual
```

Step 3 With the word "Manual" flashing press the enter key.

ENT

The HHC system will respond by displaying:

```
Readings to Log
None Left Rght Both
```

Step 4 Using the arrow key select the desired Quick Select modules to be monitored.

```
Readings to Log
None Left Rght Both
```

In this example we have opted to log the output from both Quick Select pressure modules.

Step 5 With the Quick Select module(s) to be monitored and logged selected and flashing press the enter key.

ENT

The HHC system will respond by displaying:

```
Date/Time Stamp
Disable   Enable
```

Note: If data storage is done with the time/date stamp option activated the HHC system can store 387 sets of pressure measurements. If data storage is done without the time/date stamp option the HHC system can store 714 sets of pressure measurements. Sets of pressure measurement data include all the data stored to define the output of one module.Using the arrow keys select the

desired storage format. The desired format will flash on the display when selected.

```
Date/Time Stamp
Disable   Enable
```

In this example we have opted to forego the date/time stamp of the stored data values.

Step 6 With the desired format selected and flashing press the enter key.

ENT

Step 7 The HHC system is now ready to log data on command. To store a measured pressure, flow, leak test, switch test, min/max data set, current or voltage value press the data store key.

DATA
STORE

Step 8 To disable the manual data logging capability press the Data Log key.

DATA
LOG

The HHC system will respond by displaying:

```
Auto    Manual
Review Off
```

Step 9 Using the arrow keys select the word "Off". When selected the word "Off" will flash.

```
Auto      Manual
Review   Off
```

Step 10 With the word "Off" flashing press the enter key to disable the data log function.

ENT

Manual, operator initiated, data logging has now been terminated.

Section 22.6	Review of Stored Data – On Instrument Display Standard Data Logging Mode

Data stored in either the manual or automatic data logging functions can be reviewed on the display of the HHC system or up loaded to an IBM compatible PC. For information regarding uploading of stored data to a personal computer skip to Section 24.0.

The HHC system provides the ability to review, on the display, the data logged measurement values. To review stored values follow the procedure below.

Step 1 With the HHC system on and reading pressure

press the data log key on the keypad.

DATA
LOG

The HHC system will respond by displaying the following:

THE LAST DATA LOG MENU SCREEN USED

Step 2 Using the up/down and right/left arrows browse through the data log menu and locate the word "Review". The menu line with the word "Review" appears as:

```
Review   Off
```

To initiate the review process select the word "Review" using the arrow keys. When selected the word "Review" will flash.

```
Review   Off
```

Step 3 With the word "Review" flashing press the enter key.

ENT

Step 4 The HHC system will respond by displaying the last data logged value stored in memory. The display of the data logged value will appear as follows:

```
+XXX      time
+123456   eng
```

where:

+xxx =   the 1-3 digit number representing the record number for the data point in the sequence of logged data.

+12345 = stored measurement value.

eng =   is the engineering unit of the stored value.

time =   time pressure measurement taken, when date/time stamp was enabled.

Important Note: If both the left and right pressure/flow or electrical measurements are logged the HHC system will store the data from the left module or side of the display in the odd numbered records and the data from the right module or right side of the display in the even numbered records. There is no stored indication of right or left module for the stored data values.

Step 5 To review data logged values use the arrow keys to browse through the stored values. Pressing the corresponding arrow key will result in the following action in the data log review process.

Key	Result
<	brings the next lowest stored address value to the display.

>	brings the next highest stored address value to the display.
^	skips 10 stored values in increasing address direction.
v	skips 10 stored values in decreasing address direction.
%	brings first data point to display.
mA/V	brings last data point to display.

Step 6 When the review process is complete press the data log key to return to normal pressure measurement.

**DATA
LOG**

Section 22.7   Erasing of Selected Stored Data – Standard Data Logging Mode

In some instances the ability to delete specific stored data points can be useful. In particular, this can be the case when data of questionable integrity has been stored in the data log memory. The HHC system allows for the deletion of specific operator selected stored data points. There are limitations to this capability.

These limitations are as follows:

1) The remaining data will stay in the original sequence with blank data fields left where the stored data points have been deleted.
2) The HHC system will not compress the data to the new, smaller data set.
3) The newly erased fields cannot be used for the storage of new data values until a complete data erase has been done.

The process to delete selected data points is as follows:

Step 1 With the HHC system on and reading pressure press the datalog key on the HHC system keypad.

**DATA
LOG**

In response the HHC system will display:

THE LAST DATA LOG MENU SCREEN USED

Step 2 Using the up/down and right/left arrows browse through the data log menu and locate the word "Review" The menu line with the word Review appears as:

Review Off

Using the arrow keys select the word Review. When selected the word Review will flash.

Auto   Manual
Review Off

Step 3 With the word review flashing press the enter key.

ENT

Step 4 Data points may be browsed through by using the keys as indicated below:

Key	Result
>	brings the next lowest stored address value to the display.
<	brings the next highest stored address value to the display.
^	skips 10 stored values in increasing address direction.
v	skips 10 stored values in decreasing address direction.
%	brings first data point to display.
mA/V	brings last data point to display.

To erase a stored data value press the clear entry key, designated CE, while the data to be deleted is displayed.

CE

The HHC system will respond by displaying:

Erase This Entry
Ent if OK

Step 5 To delete the displayed stored data point press the enter key.

ENT

The HHC system will respond by displaying:

+   XXX
Erased Entry

Step 6 Using the arrow keys additional data points can be reviewed and kept or deleted as desired.

Step 7 To exit this function press the data log key.

**DATA
LOG**

The HHC system will now resume normal pressure measurement activities.

Section 22.8   Erasing All Stored Data – Standard Data Logging Mode

Step 1 With the HHC system on and reading pressure press the data log key.

**DATA
LOG**

In response the HHC system will display:

THE LAST DATA LOG MENU SCREEN USED

Step 2 Using the up/down and right/left arrows browse through the data log menu and locate the word "Erase". The menu line with the word Erase appears as:

```
Label   Erase
```

Step 3 Using the left/right arrow keys select the word Erase. When selected the word Erase will flash.

```
Label   Erase
```

Step 4 With the word Erase flashing press the enter key.

ENT

The HHC system will respond by displaying:

```
Erase ALL Entrys
Cancel   Erase
```

The word cancel will be flashing. Select the word erase using the arrow keys to erase stored data.

Step 5 Using the right arrow select the word Erase and press the enter key.

ENT

WARNING

Pressing the enter key with the erase command flashing will irrevocably erase all stored data. If it is required that any of the stored data be retained select the word "cancel" and press the enter key on the keypad.

```
Erase ALL Entrys
Cancel   Erase
```

Step 6 To erase all stored data press the enter key.

ENT

The HHC system will now resume standard pressure measurement activities.

Section 23.0	Certification Generation Enhanced Data Logging Mode

The certification generation operating mode is designed to simplify the capture of measurement data taken during the calibration for easy generation of calibration certification sheets. The certification generation mode of data logging will simplify calibration activities. Performance of calibrations will be facilitated through operator prompts provided by the HHC when used in the enhanced certification generation mode. Further, the manipulation and use of calibration data is facilitated by the enhanced data labeling capability provided by this mode of operation.

Section 23.1	Set Up and Use of Certification Generation Data Logging Mode

Step 1 With the HHC on and displaying measurement data press the data log key.

**DATA
LOG**

The HHC will respond to the data log entry by displaying the following.

```
Select   Mode
Std      Certgen
```

"Std" represents standard sequential data logging without the benefit of formatting to aid in the calibration process. Standard data logging is most commonly used for time based data logging of processes or system controls or sampling of such things as HVAC ducts.

"CertGen" represents the Certification Generation mode of data logging. This is the mode that is detailed here. To review or use standard data logging refer to Section 22 of the users manual.

To access the "CertGen" capabilities use the arrow keys to highlight the text "CertGen" .

```
Select   Mode
Std      Certgen
```

Step 2 With the text "CertGen" flashing press the enter key.

ENT

The HHC will respond by displaying:

```
Certgen    Exit
Erase
```

The text "CertGen" will be flashing, indicating that pressing the enter key will activate the "CertGen" data logging process.

Selecting and entering the "Exit" option will return the calibrator to standard measurement activities.

Selecting the text "Erase" will allow deletion of any previous data logged information. The "Erase" selection deletes all data logged information, including any information stored from either "Std" or "CertGen" operating modes. If "Erase" is selected the HHC will respond by displaying:

```
Erase All Entrys
Cancel Erase
```

Selecting "Cancel" will result in the HHC reverting to basic measurement activities. Selecting "Erase" will result in the deletion of **ALL** stored data logging information.

Step 3 Using the arrow keys, highlight the text "CertGen to proceed with the certification generation process ".

```
CertGen
EXitErase
```

Step 4 With the text "CertGen" flashing on the display press the enter key.

ENT

The HHC will respond by displaying the following:

```
XXX  Rec Used XXXX
XX Points left
```

This display provides an indication of the approximate data logging memory available for storage of additional measurement and calibration data. The number of actual points that may be stored will vary based on the length of tag names assigned and whether or not the ambient temperature logging option has been exercised.

The percent indication is the percent of data logging memory used. As data is added to the data log memory during the data acquisition process the percent level will increase. This will be seen on the display as each data set is added to the data log memory. In addition the complete memory available summary as shown above will be displayed each time the "CertGen" process is initiated.

The HHC can store a minimum of 10 complete calibrations including: 10 "as received" data points, 10 "as left" data points, tag name, ambient temperature at time of "as found" tests, ambient temperature at time of "as left" tests"and the indication of the action taken.

Step 5 Pressing any key will clear the memory available summary from the display and allow continuation of the "CertGen" process.

After pressing any key the HHC will respond by displaying the following.

```
New Tag
Previous Tag
```

The text "New Tag" will automatically be selected and be flashing on the display when the "CertGen" process is initiated.

Step 6 To initiate the data logging of measurement information for the generation of a certification sheet press the Enter key with the text "New Tag" flashing.

ENT

The HHC will respond by displaying the following.

```
Enter   Tag Name
— — — — — — — — — — — — — — — — 
```

Use the up and down arrow keys to enter letters and or numbers to define an instrument tag name. The entry/ selection sequence is as follows:

Up/down arrows provide access as follows:

> 0, 1, 2, 3, 4, 5,
> 6, 7, 8, 9, _, A,
> B, C, D, E, F, G,
> H, I, J, K, L, M,
> N, O, P, Q, R, S,
> T, U, V, W, X, Y, Z

By maintaining pressure on the up/down arrow the displayed number or letter will continue to change until the last character has been reached.

By pressing and releasing the up/down arrow a single step from letter or number can be accomplished.

The left/right arrow keys allow for entry of alpha numeric data in any of the 16 available positions.

The tag name can be any combination of alphabetical or numeric entries. The maximum entries per tag name is 16 characters.

The tag name is the key designation under which all subsequent calibration for this calibration data set will be organized. Tag names or tag numbers are routinely identifiers assigned to measurement instruments when put into service within a facility. If no tag identifier is assigned to the device to be tested it is recommended that one be created by combining some abbreviation for the manufacturer's name and the instrument serial number for the device to be tested. The use of the "Cert-Gen" firmware requires the entry of a tag name for each device to be calibrated.

Use the up/down and left/right arrows to enter a tag name, as shown here.

```
Enter Tag Name
AB12345 — — — — — —
```

Step 7 With the desired tag name displayed press the enter key

ENT

The HHC will respond by displaying:

```
Collect Readings
ASFound ASLeft
```

The text "AsFound" will be flashing when this screen appears. Select "AsFound" to store the initial (uncorrected/unadjusted) calibration data. To collect "as found" data press the enter key with the text "AsFound" flashing on the display.

ENT

The HHC will respond by prompting the operator to enter the number of "as found" data points to be taken. A data point consists of the pressure measurement as read on the calibrator and the current or voltage output from the device under test as measured on the calibrator. Therefore, each data point is actually two (2) measurement values. The prompt appears as follows.

```
Enter#of TestPts
      .000000
```

The number of test points can be any value from 1 to 21.

Important Note: The HHC can store sufficient measurement data to calibrate 10 devices each with 10 "as found" and 10 "as left" data points (corresponding to 200 test points. Each test point includes both pressure/temperature and electrical measurement data). In addition to storing the measurement test data the heading or label information for each calibration is also stored in memory. This information includes: tag name, ambient temperature, "as found" label, "as left" label and action taken.

Prior to initiating the calibration process the base unit will prompt the operator with a screen providing the remaining storage capacity for data in terms of number of data points. If the operator enters a number of test points that exceeds the available memory the following message will be displayed:

```
Value exceeds #
remaining Points
```

Pressing any key will return the prompt requesting entry of the number of test points to be run. The number of test points entered must be less than or equal to the remaining test points available. Memory requirement for the calibration heading information are already factored into the information provided regarding the number of test points remaining. The number displayed may be completely allocated to measurement data without worry about leaving space for needed labelling.

Step 8 Using the numeral keys enter the desired number of "as found" data points to be logged. In this example 10 data sets will be stored in the calibrator's data logging memory.

```
Enter#of TestPts

             10
```

Step 9 With the desired number of test points entered and displayed press the enter key.

ENT

The HHC will respond by returning basic measurement operation.

Step 10 Prior to beginning the collection of data the HHC should be set up to display the information to be logged in the HHC's memory. For example, in standard transmitter calibration the calibrator display will routinely display the measured value from the Quick Select pressure module being used as the pressure standard and the measured current (mA) value output from the transmitter (input to the mA and COMM jacks on the calibrator front panel) as a result of the pressure input applied to the transmitter.

Therefore the HHC will typically be displaying either of the two following sets of information when performing the calibration process.

```
mA              PSI
XXXX     yyyy
```

or

```
PSI              mA
yyyy     XXXX
```

where: yyyy= the pressure measurement value
        xxxx= the current measurement value
               (output from the device under test)

Step 11 With the data to be logged shown on the display, introduce the first pressure/temperature measurement to be logged. After the system has stabilized press the data store key.

DATA
STORE

The HHC will briefly show the following information on the display each time a measurement set is logged to memory.

```
XXyy%
12341234
```

where:

xx =   the number of data points (records) and data fields used for calibration labelling information stored in **this** calibration data set.
yy =   the percent of data logging memory allocated to stored data.
1234 = the measured values in the engineering units chosen.

Step 12 Repeat the process, subjecting the HHC and the device under test to the controlled pressure/temperature input for each test point to be taken and store the measured values by pressing the data store key for each measurement set to be logged.

DATA
STORE

After the last set of data to be logged has been stored the HHC will prompt the operator with the following display.

```
ASFOUNd readings
View Done Redo
```

The options available are as follows:

View: Allows operator to scan through the stored values using the arrow keys. Use the leftpointing arrow to move in decreasing order from data point to data point. Use the down-ward pointing arrow to move in decreasing order 10 data points at a time. Use the right pointing arrow to move in increasing order from data point to data point. Use the upward pointing arrow to move in increasing order 10 data points at a time.

Done: Completes the collection of "AsFound" measurement data. See step 13 for continuation of the "CertGen" process.

Redo: Provides the ability to discard all the "As Found" data taken under the tag name being tested. Prior to deleting the data the operator will be prompted by the query.

```
ERASE all data
    Yes        NO
```

Selecting yes will result in the deletion of the just taken "as found data".

Step 13 After selecting "Done" the HHC will offer the opportunity to enter the ambient (environmental) temperature at the time the calibration is being done. This is accomplished by the display of the following.

```
Ambient Temperature
SkipEnter
```

To skip the act of logging the ambient temperature value select the text "Skip" and press the enter key.

ENT

To "capture" the ambient temperature and make it part of the calibration record use the arrow keys to select the text "Enter".

```
Ambient Temperature
Skip  Enter
```

Step 14 To proceed with the entry/recording of the ambient temperature value with the text "Entry" flashing press the enter key.

ENT

Step 15

Note: If the HHC has an GQS-RT or TC temperature module and the probe is installed it will automatically offer the opportunity to store the measured temperature value.

If a different value is to be entered or if the HHC is not equipped with a temperature module the temperature can be entered via the numeral keys on the keypad. With manual temperature entry completed the display will look as follows

```
Enter Amb Temp °F
              73.4
```

for an ambient temperature of 73.4 degrees Fahrenheit.

Step 16 With the desired temperature value displayed press the enter key.

ENT

The HHC will respond by displaying:

```
Action Taken
NoneRecal  Repl
```

Using the arrow keys select the desired course of action. Select:

None: if no action is required and the device under test is performing satisfactorily.
Recal: If adjustments are to be made to the device under test.
Repl: If it has been determined that the tested device must be taken off line and replaced.
The selected entry will become part of the stored data for the calibration being done against the previously entered tag name.

Step 17 With the desired selection highlighted press the enter key.

ENT

The HHC will respond by displaying:

```
Collect As Left
Yes  NO   ASFnd
```

Use the arrow keys to highlight the desired selection. The <u>typical</u> selections are:

Yes: If recalibration is selected as the action taken. Proceed to Step 18 for details on taking "As Left" data
No: If replace is selected as the action taken.
AsFnd: If no action is taken because the device under test was found to be within specification.

Selecting "AsFnd " will result in the following com-

ment being added to the calibration record for the device under test:

"Use AF for AL"

Step 18 To take "As Left" data and store the measured values in the HHC's memory use the arrow key to highlight the text "yes" under the "As Left" data prompt screen.

```
Collect As Left
Yes  No    ASFnd
```

Step 19 With the text "yes" flashing press the enter key

ENT

The HHC will respond by displaying:

```
Enter # Of Test Pts
        .000000
```

Step 20 Use the numeral keys to enter the number of "as left" data records to be stored. The number selected can be any value between 1 and 21. In this example 5 "As Left" data records will be taken and stored in the HHC's memory.

```
Enter # Of Test Pts
            5
```

Step 21 Be certain that the desired data to be logged is shown on the HHC's display. With the data to be logged shown on the display, apply the first pressure/temperature measurement to be logged. After the system has stabilized, press the data store key.

DATA
STORE

The HHC will briefly show the following display.

```
XX    YY%
1234    1234
```

where:

xx =   the number of data sets (records) stored in **this** calibration data set.

yy =   the percent of data logging memory allocated to stored data.

1234 =   the measured values in the engineering units chosen.

Step 22 Repeat the process, subjecting the HHC and the device under test to the controlled pressure/temperature input for each test point to be taken and store the measured values by pressing the data store key for each measurement set to be logged.

DATA

STORE

After the last set of data to be logged has been stored the HHC will prompt the operator with the following display.

```
ASLeft  readings
View Done Redo
```

The options available are as follows:

View: Allows operator to scan through the stored values using the arrow keys. Use the left pointing arrow to move in decreasing order from data point to data point. Use the downward pointing arrow to move in decreasing order 10 data points at a time. Use the right pointing arrow to move in increasing order from data point to data point. Use the upward pointing arrow to move in increasing order 10 data points at a time.

Done: Completes the collection of "As Found" measurement data. See step 13 for continuation of the "CertGen" process.

Redo: Provides the ability to discard all the "As Found" data taken under the tag name being tested. Prior to deleting the data the operator will be prompted by the query.

```
ERASE all data
    Yes    No
```

Selecting yes will result in the deletion of the just taken "as left" data.

Step 23 After selecting "Done" the HHC will offer the opportunity to enter the ambient temperature at the time the "as Left" calibration is done. This is accomplished by the display of the following prompt screen.

```
Ambient Temp
Skip    Enter
```

To skip the logging of the temperature information select the text "Skip" and press the enter key.

ENT

To "capture" the ambient temperature and make it part of the calibration record use the arrow keys to select the text "Enter".

```
Ambient Temp
Skip  Enter
```

Step 24 To proceed with the entry/recording of the ambient temperature value with the text "Enter" flashing press the enter key.

ENT

Step 25

Note: If the HHC has a GQS-RT or GQS-TC1 temperature module installed, it will automatically offer the opportunity to store the measured value the base unit is receiving from the RTD or thermocouple.

If a different value is to be entered or if the HHC is not equipped with a temperature module the temperature can be entered via the numeral keys on the keypad. With manual temperature entry completed the display will look as follows:

```
Enter Amb Temp °F
73.4
```

for an ambient temperature of 73.4 degrees Fahrenheit.

Step 26 With the desired temperature value displayed press the enter key.

ENT

The HHC will respond by displaying the following:

```
    Action Taken
NoneRecal   Repl
```

Using the arrow keys select the desired course of action. Select:

None: if no action is required and the device under test
      is performing satisfactorily.
Recal: If adjustments are to be made to the device
      under test.
Repl: If it has been determined that the tested device
      must be taken off-line and replaced.

The selected entry will become part of the stored data for the calibration being done against the previously entered tag name.

Step 27 With the desired selection highlighted press the enter key

ENT

After completion the HHC will once again display the memory available summarization screen as follows:

```
XXX   Rec Used
XXX% Points left
```

This display provides an indication of the approximate data logging memory available for storage of additional measurement and calibration data.

Step 28 Press any key to return to the first "CertGen" Screen as follows:

New Tag
Previous Tag

Highlighting and selecting:

New Tag: will result in initiating a new calibration
      certification process.
Previous Tag: will allow the review of data previ-
      ously taken for specific tag names.

Press the clear entry key to return to standard HHC measurement and test activities.

CE

Section 24.0   HHC System Set Up for Uploading Stored Data Into an IBM Compatible PC

The following steps will allow you to upload stored data to an IBM compatible PC.

Step 1 Turn the power off on the base unit.

Step 2 Connect a 9 pin RS232 cable to the HHC system and to a serial port on the PC.

Step 3 Turn the power to the base unit on and with the HHC system on and reading pressure press the setup key.

SET   UP

Step 4 Using the arrow keys locate and select the text RS232. When selected the text RS232 will flash.

```
Owner Alarm
DateTime RS232
```

Step 5 With the text RS232 flashing, press the enter key.

ENT

The HHC system will respond by displaying:

```
RS232 interface
Disable Enable
```

Step 6 Using the arrow keys select the word Enable. When selected the word Enable will flash.

```
RS232 interface
Disable  Enable
```

Step 7 With the word Enable flashing press the enter key.

ENT

The HHC system will respond by displaying:

```
Baud Rate
9600 2400 1200 300
```

Step 8 Using the left/right arrow keys select the desired baud rate. When selected the baud rate will flash.

```
Baud Rate
9600 2400 1200 300
```

In the above example 9600 baud has been selected.

Step 9   With the desired baud rate flashing press the enter key.

ENT

The HHC system will respond by displaying:

```
Disable ISO1745
Journal Inquiry
```

Step 10   In order to use the upload software provided with the HHC system use the arrow keys to select the text ISO1745. When selected the text ISO1745 will flash.

```
Disable ISO1745
Journal Inquiry
```

Step 11   With the text ISO1745 flashing press the enter key.

ENT

The HHC system is now set up for data logging. Next, the computer to be used for uploading must be prepared.

Section 24.1   Installing and Operating Upload Software

Important Note: Information regarding the installation and use of the upload utility software is provided in the supplemental software manual provided with the product. Please consult the User's Manual for the Upload Utility shipped with the HHC system.

Section 24.2   Battery Back Up Replacement

When the display indicates that the battery back up is low the lithium battery should be replaced as soon as possible. The battery is a standard 3 volt lithium battery. Replacement should be made with a Panasonic BR1225 or CR1220 battery.

WARNING

Replace battery with recommended batteries only. Use of another battery may present a risk of fire or explosion. Replacement batteries are available through most industrial supply and electronic supply distributors. Caution, battery may explode if mistreated. Do not recharge, disassemble or dispose of in fire.

Note: 1 – Installation category 1
          2 – Pollution degree 2

CAUTION

This procedure should only be performed by a trained electronic technician. The HHC incorporates CMOS components that can be damaged by electrostatic discharge. Technicians performing battery replacement must be properly grounded to avoid damaging sensitive electronic components.

Follow the procedures below to change the battery back up unit.

Note: The HHC system should be turned off prior to initiating battery replacement procedure.

Step 1   Turn the HHC indicator bottom side up and locate the four (4) phillips head screws that secure the upper and lower case halves together.

Step 2   Remove and place aside the four Phillips head screws

Step 3   Holding the two case halves together, turn the instrument over (right side up) and slip off the top of the case.

Step 4   Note the orientation of the cables and the connector used for each cable. Then, carefully disconnect the two ribbon cables. One cable connects the keypad to the main board and the second connects the display to the main board.

Step 5   Locate battery to be replaced. The battery unit is near connection P6, immediately to the right of pin 10.

Step 6   Remove depleted battery and install replacement unit. Be certain to install appropriate 3 volt lithium battery as outlined in introduction to this section.

Step 7   Remove jumper on connection P6 between pin 7 and pin 8. Wait 2-3 seconds and reinstall jumper in original location.

Step 8   Carefully reconnect cable between printed circuit board and keypad.

Step 9   Carefully reconnect cable between printed circuit board and display.

Step 10 Replace top half of case.

Step 11 Holding the two case halves together, turn the unit over (bottom side up).

Step 12 Reinstall four (4) screws used to connect the top and bottom sections of case.

Step 13 Follow steps in Section 3.5 to reinstall the desired Quick Select pressure modules.

Step 14 Power unit up and down three (3) times to enable the battery backup logic.

Battery replacement is now complete.

Section 25.0   Event Timer Function

The Event Timer allows for unattended data logging during a desired time period. For example, if it is necessary to monitor the pressure levels of a flue or HVAC duct during a specific time period the Event Timer, used in combination with the data logging function, can sat-

isfy this requirement.

Delayed initiation of unattended measurement activities requires the set up of BOTH the Event Timer and data logging function.

<div style="background:black;color:white">**Section 25.1   Event Timer Set-Up**</div>

To program the HHC system for delayed monitoring and data logging follow the steps below.

The event timer sets the starting and ending times for unattended monitoring to be performed during a future time period. The Event Timer function is programmed as follows.

Step 1   With the HHC system on and measuring pressure press the set up key.

SET
UP

Step 2   Using the arrow keys select the event timer, designated EvntTimr, option on the set up menu. When selected the text "EvntTimr" will flash on the display.

```
EvntTimr Dampen
LeakRate Status
```

Step 3   With the text EvntTimr selected and flashing on the display press the enter key.

ENT

The HHC system will respond by displaying:

```
HHMMSS    Start
XXXXXX
```

where:

HH =   hours in military time
MM =   minutes (0-60)
SS =   seconds (0-60)

Use the number keys to enter the hours, minutes and seconds in the corresponding entry fields to establish the start time.

Step 4   When entered the start time will look as follows for a time of 9:30 PM.

```
213000    Start
XXXXXX
```

Step 5   When the desired start time has been input and appears on the display press the enter key.

ENT

The HHC system will respond by displaying:

```
HHMMSS    StOP
XXXXXX
```

Step 6   Enter the desired stop time using the number keys. When properly entered a stop time of 11:30 PM will look as follows:

```
HHMMSS    StOP
233000
```

Step 7   When the desired stop time has been input and appears on the display of the HHC system press the enter key.

ENT

The HHC system will respond by displaying:

```
Event Timer
Disable  Enable
```

Step 8   Use the right arrow key to select the word Enable. When selected the word Enable will flash on the display.

```
Event Timer
Disable  Enable
```

Step 9   With the word Enable flashing press the enter key.

ENT

<div style="background:black;color:white">**Section 25.2   Data Log Set Up for Operation with the Event Timer**</div>

Automatic data logging must be set up to control the data logging parameters to be followed in time delayed data logging. For delayed data logging the logging function must be set up as follows.

Step 1   With the HHC system on and reading pressure press the data log key.

DATA
LOG

The HHC system will respond by displaying the following:

THE LAST DATA LOG MENU SCREEN USED

Step 2   To program the HHC system for time delayed data logging use the arrow keys to locate and select the word "Auto" in the data log menu. When selected the word Auto will flash on the display.

```
Auto  Manual
Review  Off
```

Step 3   With the word Auto flashing press the enter key.

ENT

The HHC system will respond by displaying:

```
Enter Interval
Sec. XXXXX
```

Step 4 Using the number keys enter the desired time interval in seconds. The interval may be from 0.1 seconds to 65,000 seconds.

```
Enter Interval
Sec. 600
```

The above example shows an interval of 600 seconds or 10 minutes.

Step 5 After the desired time interval is entered and shown on the display press the enter key.

ENT

The HHC system will respond by displaying the following:

```
Readings to Log
None Left Rght Both
```

Step 6 Using the arrow key select the desired Quick Select Modules to be monitored.

```
Readings to Log
None Left Rght Both
```

In the above example the left module has been designated as the Quick Select Module to be monitored for data logging.

Step 7 With the Quick Select module(s) to be monitored selected and flashing press the ENT key.

ENT

After the Quick Select pressure module(s) to be monitored has been entered the HHC system will respond by displaying:

```
Date/Time Stamp
Disable   Enable
```

Note: If data storage is done with the time/date stamp option the HHC system can store 387 sets of pressure measurements. Sets of pressure measurement data include pressure measurement from the left, right or both modules.

If data storage is done without the time/date stamp option the HHC system can store 714 sets of pressure measurements. Sets of pressure measurement data include pressure measurement from the left, right or both modules.

Step 8 Using the arrow keys select the desired stor-

age format. The desired format will flash on the display when selected.

```
Date/Time Stamp
Disable   Enable
```

In the above example the date time stamp function has been enabled and the stored data will be labeled with time date information in the database.

Step 9 With the desired format displayed press the enter key.

ENT

After pressing the enter key immediately turn the HHC system off.

When the event timer and data log functions are set up as outlined in Section 25, the HHC system will automatically turn itself on and make the programmed measurements over the desired time interval. At the conclusion of the programmed monitoring period the HHC system will automatically turn itself off.

To review logged data or perform any other data logging functions such as data labeling or uploading to a personal computer see the main data logging section (Section 22) of this manual.

Section 26.0   Alarm Function – Overview (Optional Feature)

Important Note: This feature is not functional in FM Approved Units. In order for the base unit to meet the requirements of Class 1, Division 1, Groups A, B, C & D hazardous areas it was necessary to disable this function.

The HHC can be equipped with a set of single pole single throw (SPST) relays for use in triggering annunciator lights, fans, sirens, etc. The relays have the following specifications:

Relay Specifications

Parameter	Specification
Switch Arrangement:	Form C
Resistance (max):	50 micro ohms
Switching Power (max):	30 W, 62.5 VA (resistive load)
Switching Voltage (max):	110 V dc, 125 Vac
Switching Current (max):	1 Amp
Switching Capability (min):	10 micro amp, 10 mVdc

The relay contact closures are accessed through the 9 Pin female D connector on the right side of the HHC. Pin out information for set point contacts is as follows

Pin 1 Relay 1 common
Pin 7 Relay 1 (normally open or normally closed)

Pins   5   4   3   2   1

Pins   9   8   7   6
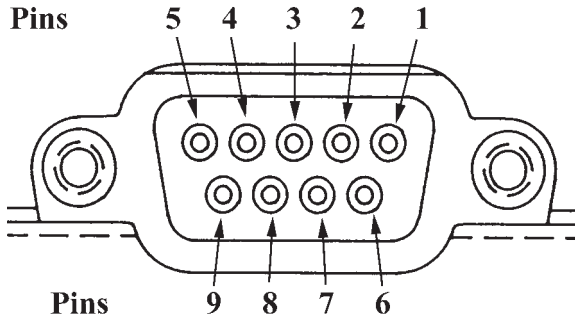
Pin 8 Relay 2 common
Pin 9 Relay 2 (normally opened or normally closed)

Section 26.1   Alarm Set Up

The alarm level trip points can be programmed from the keypad as follows.

Step 1 With the HHC on and reading pressure press the SET UP key.

SET
UP

Step 2 Using arrow keys select the alarm function from the setup menu. When selected the word "Alarm" will flash on the display.

```
Owner    Alarm
DateTimeRS232
```

Step 3 With the word Alarm flashing press the enter key.

ENT

This is an optional feature, if the option is not installed the HHC system will respond with:

```
Option not
installed
```

If this message appears press any key to resume normal operation.

Step 4 After pressing the enter key the display will read:

```
Alarm Relay
Enable  Disable
```

To set alarm levels, using the arrow keys, select the word Enable.

```
Alarm Relay
Enable  Disable
```

Step 5 With the word "Enable" flashing press the enter key.

ENT

Step 6 After pressing the enter key the HHC will respond:

```
High Setpoint
????????
```

Important Note: Set points must be entered for the specific engineering unit to be monitored. For example if a setpoint of 10 is entered the alarm relay will trip when measured and displayed pressure exceeds the numerical value of 10. The HHC will not automatically convert the entered trip point to a new value to reflect a change in engineering units.

```
Open Close
```

If Open is selected, the low limit contact will be open when the measured pressure exceeds the setpoint value. If Close is selected, the contact will close if the setpoint is exceeded.

Step 7 Using the arrow keys select the desired mechanical configuration. In this example we have configured the system to close the relay contact when the alarm value is exceeded.

```
Low Contact
Open   Close
```

Step 8 When the desired configuration has been selected and the text is flashing on the display, press the enter key.

ENT

Step 9 After the enter key has been pressed the HHC will respond by displaying:

```
Monitor Function
Left    Right
```

This will determine whether the HHC is monitoring the left or right Quick Select pressure or temperature module. Using the arrow keys select the desired pressure module to be monitored.

Step 10 Use the left/right arrow keys to select the desired module to be monitored. In this example the left module has been identified for monitoring.

```
Monitor Function
Left    Right
```

Step 11 With the desired module selected and flashing, press the enter key.

ENT

The alarm function is now armed and operating. This function is automatically disabled when the HHC is turned off and must be re-initiated by enabling the alarms via the set up menu.

Section 27.0   Recertification of the Calibrator

Both the base unit and the pressure modules can be recalibrated and recertified in the field. The base unit includes a firmware based, menu driven procedure that provides operator prompts to facilitate the recalibration process. The procedure encompasses both the acquisition of "as found" data and performing adjustment and recalibration of the base unit and modules. The recertification program is accessed via the set up menu key.

Access Code

The calibration data is password protected with an access code. The recalibration access code is different than the owner access code. Both of the access codes are provided with the calibrator at time of shipment and are located on the base unit calibration certificate. If the access code has been lost contact the factory and be prepared to provide the serial number of the base unit. The serial number is located on the product label in the module bay of the base unit. To locate the product label remove any installed pressure modules, hold the base unit keypad side down and look into the module bays. The label is located on the underside of the keypad/front panel section of the base unit.

Section 27.1   Calibration/Recertification Overview

The base unit calibration firmware provides a means of linearization and recertification of pressure modules and the base unit's electrical input (Vdc/mA) calibration reference. In addition, the base unit employs a precision 1 VDC reference for interfacing with the modules which can be calibrated. The calibration of this reference is critical to ensure the combined output of pressure module and base unit is within rated accuracy.

Section 27.2 Required Equipment

The following equipment is required to perform recalibration or recertification of the calibrator.

1. A precision voltage supply capable of providing 1 Vdc ± 50 microvolts (±0.00005 Vdc)

2. Primary pressure standard with an accuracy rating of 4:1 compared to the rating of the pressure module to be tested.

3. Test leads with banana jacks and mini clips.

4. Recommended – Model CQS calibration quick select module. Although recalibration and recertification work can be performed with out it, this module will greatly simplify the process and reduce risk of damage to the base unit.

Section 27.3   As Received Readings of the Base Unit Electronics

Please note. The following convention is used when referring to modules or module bays in this procedure.

Module Bay #1   Module Bay #2
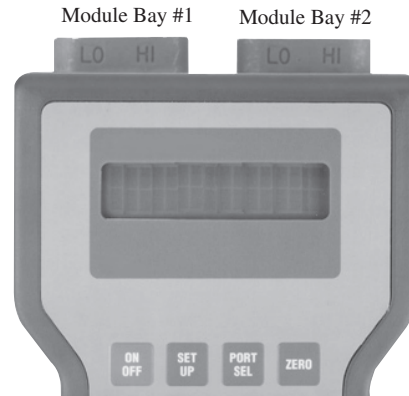
Step 1   Remove any installed measurement modules. If the CQS calibration module is to be used, install it in module bay #1 at this time.

Step 2   Turn power on and allow for at least 15 minutes warm up time.

Step 3   With the calibrator powered up and displaying a dashed line across the display, press the set up key.

SET
UP

Step 4   Using the arrow keys locate the text "Calib" in the set up menu.

```
Calib RTModule
```

Using the arrow keys select the text "Calib" from the set up menu. When the calibration function has been selected it will flash on the display.

Step 5   With the text "Calib" displayed and flashing press the enter key.

ENT

Step 6   The calibrator will respond by displaying:

```
Access Code ?
     .00000
```

Step 7   Enter the 5 digit calibration access code provided with the base unit.

```
Access Code ?
      12345
```

Note: The access code is specific for the base unit being used. The code is provided on the certification sheet that

accompanied the product shipment from the factory. See section 27.0 "Access Code" for information on lost passwords.

Step 8 With the correct access code displayed press the enter key.

ENT

The calibrator will respond by displaying:

```
Electrical
Pressure
```

The electrical calibration process allows for the calibration of the current and voltage input measurement capability of the base unit and calibration of the 0/1 vdc analog component of the interface between the base unit and the Quick Select module in use.

Step 9 When this screen appears, the word "Electrical" for electrical recertification is already flashing. Therefore, press the enter key to commence the electrical calibration.

ENT

The calibrator will respond by displaying:

```
        Calibration
Reference Check
```

Step 10 To perform "as received" readings use the down arrow key to select Reference Check. When selected the text "Reference Check" will flash on the display.

```
Calibration
Reference Check
```

Step 11 With text Reference Check Flashing press the Enter Key.

ENT

The calibrator will respond by displaying:

```
    ———
1.0V
    -.XXXXX    RefCheck
        *****WARNING*****
```

If the voltage standard is set to a level in excess of the recommended calibration input or is connected to incorrect pins or in contact with pins adjacent to the specified input pins during the calibration process the base unit electronics may be damaged. Use extreme caution when connecting test leads and applying test voltage inputs.

The Model CQS Calibration Quick Select module is available to simplify connection of the voltage standard to the base unit. The module provides banana jack

connections for the input of the voltage standard to the calibrator base unit.

Step 12 To check the measured voltage using a precision voltage source apply 1.00000 volt ±50 microvolts. **Do not use a voltage less than or greater than 1 volt ± 50 microvolts.** When the calibrator is ready to measure the reference voltage it will display:

```
APPlY 1.00000V
to J3 Pin 7
```

These pins are located in the connector in module bay #1 as shown below.
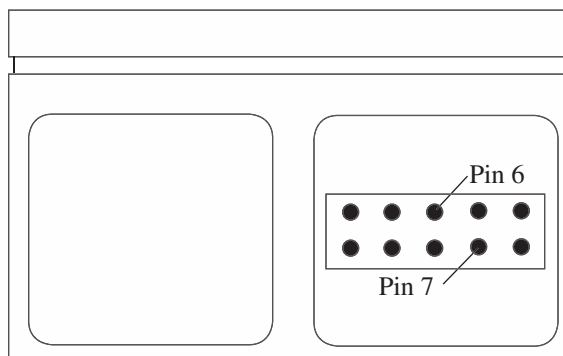
To apply the 1 Vdc signal to the calibrator connect the precision voltage generator so that the positive line is connected to Pin 7 and the ground is connected to Pin 6.

Step 13 The value displayed under the dashed line represents the as received reading for the 1 Vdc measurement. The reading will look as follows:

```
    ————            1.0V
    +.99998   RefCheck
```

(Reading must be between 0.99995 and 1.00005 for base unit to be within specification.)

After taking note of the reading press the enter key to proceed to the next as received reading. The calibrator will respond by displaying the following:

```
    ————            0.1V
    -.XXXXX   RefCheck
```

This is used for calibration of the 20mA measurement capability. The measured value must be within 0.03% of the applied voltage for the current measurement to be within the 0.03% of full scale specification.

Step 14 To check the measured voltage using a precision voltage source:

```
APPlY 0.100000V
to J3 Pin 7
```

To apply the 0.1 Vdc signal use the same procedure as outlined in steps 10 and 11 of this section.

Step 15 The value displayed under the dashed line represents the as received reading for the .1 Vdc measurement. The reading will look something like follows:

```
   ——————      0.1V
+.099998  RefCheck
```

Take note of the measured value.

Step 16 To repeat taking the as received readings press the enter key to return to the 1.0 Vdc as received reading screen. To exit the as received readings mode press the CE key.

CE

As received readings for the mA and voltage measurements performed through the miniature banana jacks on the instrument keypad can be done by simply setting the base unit up to measure the electrical parameter (current or voltage) to be tested and inputting a series of known values to the correct jacks. Refer to Section 7.0 to determine the set up procedure for the measurement of current and/or voltage inputs. As received readings are now completed.

Section 27.4   Adjustment/Calibration Base Unit Electronics

Step 1 With the calibrator on and displaying pressure measurement data press the set up key.

SET
UP

Step 2 Using the arrow keys locate the text "Calib" in the set up menu:

```
Calib   RTModule
```

Using the appropriate arrow keys select the text "Calib" from the set up menu.

Step 3 When the calibration function has been selected it will flash on the display:

```
Calib   RTModule
```

Step 4 With the text "Calib" displayed and flashing press the enter key.

ENT

Step 5 The calibrator will respond by displaying:

```
Access Code?
.000000
```

Step 6 Enter the 5 digit calibration access code pro-

vided with the calibrator base unit:

```
Access Code?
12345
```

Step 7 With the correct access code displayed press the enter key.

ENT

The calibrator will respond by displaying:

```
Electrical
Pressure
```

The electrical calibration process allows for the calibration of the current and voltage input measurement capability of the base unit as well as the calibration of the 0/1 Vdc analog component of the interface between the base unit and the Quick Select module in use.

Step 8 Use the arrow keys to select the word "electrical." When selected the word will flash on the instrument display:

```
Electrical
Pressure
```

Step 9 When this screen appears, the word "Electrical" for electrical recertification is already flashing. Therefore, press the enter key to commence the electrical calibration.

ENT

The calibrator will respond by displaying:

```
Calibration
Reference Check
```

Step 10 Select the text "Calibration." When selected the word calibrate will flash on the display of the calibrator:

```
Calibrate
Reference Check
```

Step 11 With the text "Calibrate" flashing press the enter key.

ENT

Step 12 Using the precision voltage source apply 1.00000 volt ±50 microvolts to Module Bay #1.

To apply the 1 Vdc signal to the calibrator connect the precision voltage generator so that the positive line is connected to Pin 7 and the ground is connected to Pin 6.

These pins are located in the connector in Module Bay #1 as shown below.

Pin 6

Pin 7

*****WARNING*****

If the voltage standard is set to a level in excess of the recommended calibration input or is connected to incorrect pins or in contact with pins adjacent to the specified input pins during the calibration process the base unit electronics may be damaged. Use extreme caution when connecting test leads and applying test voltage inputs.
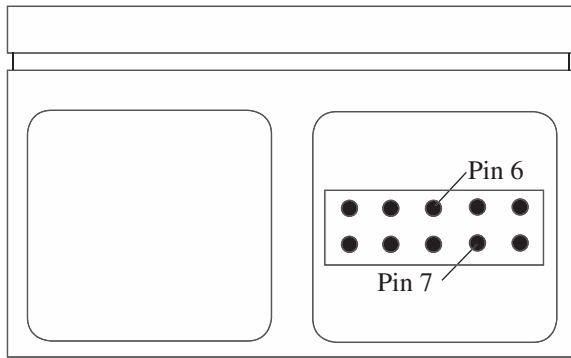
The Model CQS Calibration Quick Select module is available to simplify connection of the voltage standard to the base unit. This module provides banana jack connections for the input of the voltage standard to the calibrator base unit.

Step 13 The calibrator will display the following:

```
APPly 1.00000V
to J3 Pin 7
```

With 1.00000 volt (±50 microvolts) applied press the enter key.

ENT

The calibrator will respond by displaying:

```
XXXX working
```

The word "working" flashes as the calibrator makes the necessary internal adjustment to calibrate the voltage measurement electronics to 1.0000 volts. The reading must be between 0.99995 and 1.00005 for base unit to be within specification. The reference check mode can be used to verify calibration accuracy.

After completion of the adjustments for the 1.00000 volt input the calibrator will display:

```
APPly 0.100000V
to J3 Pin 7
```

With .100000 volt (±50 microvolts) applied press the enter key.

ENT

The calibrator will respond by displaying:

```
XXXX working
```

After the calibrator completes auto-adjusting the measured value it will display:

```
APPly 10.0000V
to Volts Jack
```

Step 14 Using a precision voltage generator apply a 10.0000 volt (±500 microvolts) input to the miniature recessed banana jacks. Use the COM and V jacks on the calibrator keypad.

Step 15 When the proper voltage is being applied press the enter key.

ENT

The calibrator will respond by displaying:

```
XXXX working
```

After completion of the adjustments for the 10.0000 volt input the calibrator will display:

```
APPly 30.0000V
to Volts Jack
```

Step 16 Using a precision voltage generator apply a 30.0000 volt (±3 millivolts) input to the voltage jacks. Use the COM and V jacks on the calibrator.

Step 17 When the proper voltage is being applied press the enter key.

ENT

When the proper voltage is being applied press the enter key.

The calibrator will respond by displaying:

```
XXXX working
```

After completion of the adjustments for the 30.0000 volt input the calibrator will display:

```
APPly 20.0000 mA
to mA Jack
```

Step 18 Using a precision current generator apply a 20.0000 mA (±5 microamps) input to the mA jacks.

Use the COM and mA jacks on the calibrator keypad.

Step 19 When the proper current is being applied press the enter key.

ENT

The calibrator will respond by displaying:

```
XXXX working
```

After completion of the 20 mA recertification the calibrator will display:

```
Calibration done
save   Cancel
```

Step 20 Using the left/right arrow keys select "Save" to write the new data to the EEPROM calibration storage. To discard the electrical readings select Cancel.

<center>***WARNING***</center>

Selecting and entering the word "Save" will overwrite the calibration data previously stored in EEPROM memory. Previously stored calibration data will be permanently   destroyed.

Step 21 With the desired selection flashing (Save or Cancel) press the enter key.

<center>**ENT**</center>

Step 22 If "cancel is selected the calibrator will exit the calibration mode. If "save" is selected the calibrator will prompt you to enter the date of the new calibration as follows:

```
MMddYY
 _ _ _ _ _ _
```

Step 23 Using the number keys enter the current date such as:

```
MMddYY
031196
```

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Step 24 With the desired date entered and displayed, press the enter key.

<center>**ENT**</center>

Step 25 Turn off the calibrator and install the desired Quick Select module.

Step 26 Turn on the calibrator to resume general pressure measurement activities.

Note: During electrical recertification any of the calibration ranges may be skipped by pressing the clear entry (CE) key. When the clear entry key is pressed during the electrical calibration process the calibrator will advance to the next electrical input in the calibration sequence.

<div style="background:black;color:white;padding:4px">

Section 27.5   Recertification of Quick Select Pressure Modules

</div>

The calibrator is available in a selection of accuracies from ±0.1% of span through ±0.025% of span, covering ranges from 0.25 inches of water to 10,000 psi. Whereas, the calibrator can be calibrated in the field, appropriate pressure standards must be used to assure the accuracy

of the calibrator system is not degraded by the calibration process. As recommended by standards organizations such as A.S.M.E., N.I.S.T and various U.S. and world government agencies calibration standards should be at least 4 times more accurate than the device to be calibrated.

Therefore, if you will be calibrating a ±0.1% of span Quick Select pressure module, a standard of equivalent range would have to have an accuracy of at least ±0.025% of span. If the standard to be used is of a higher range than the Quick Select pressure module to be calibrated, even greater accuracy is required. For example, if a ±0.1% of span Quick Select pressure module with a range of 50 psi is to be calibrated with a 100 psi standard, the calibrating standard should have a minimum accuracy of ±0.0125% of span.

To recertify a Quick Select pressure module follow the procedure outlined below.

Step 1 With the power to the calibrator off install the Quick Select pressure module to be calibrated in the left module bay (looking down on the unit with the keypad up and the display at the top).

Step 2 Power up the calibrator system by pressing the on/off key.

<center>**ON**
OFF</center>

Step 3 Set the left side of the display for the engineering units to be used for the calibration process. Information on engineering unit selection is provided in Section 8, Engineering Unit Selection.

Step 4 With the calibrator on and displaying pressure measurement data press the set up key.

<center>**SET**
UP</center>

Step 5 Using the arrow keys locate the text "Calib" in the set up menu.

```
Calib RTModule
```

Select the text "Calib". When selected the text will flash on the display.

Step 6 With the text "Calib" displayed and flashing press the enter key.

<center>**ENT**</center>

Step 7 The calibrator will respond by displaying:

```
Access Code ?
.000000
```

Step 8 Enter the 5 digit calibration access code provided with the calibrator base unit.

```
Access Code ?
12345
```

Step 9 With the correct access code displayed press the enter key.

ENT

The calibrator will respond by displaying:

```
Electrical
Pressure
```

Step 10 Using the down arrow key select the word "Pressure". When selected, the word Pressure will flash on the display:

```
Electrical
Pressure
```

Step 11 With the word "Pressure" flashing press the enter key.

ENT

The calibrator will respond by displaying:

```
Zero Cal
Yes  NO
```

Step 12 To perform zero calibration (adjustment) select Yes and press the enter key.

ENT

To skip zero adjustment and proceed to full scale calibration (adjustment) select No and press the enter key.

Step 13 With the pressure module at zero pressure, press the enter key.

ENT

Note: The following should be done to zero each type of pressure module:

Pressure
Type   Zero Source
Absolute –   Apply absolute zero using vacuum pump.
Gauge –   Vent to atmosphere
Compound –   Vent to atmosphere
Differential – Vent both ports to atmosphere
Vacuum –   Vent to atmosphere

The calibrator will respond by displaying:

```
XXXXX  working
```

Where xxxxxx is the voltage being read from the Quick

Select pressure module and the flashing word "working" indicates that the calibrator is making the internal adjustments necessary for the recalibration.

After approximately 3 seconds the calibrator will display:

```
Full Scale Cal
Yes       NO
```

Step 14 To perform full scale calibration (adjustment) select Yes and press the enter key.

ENT

To skip full scale adjustment and proceed to re-linearization process select No and press the enter key.

Important Note: If full recalibration of the pressure module is desired the zero and span adjustment must be reset through these procedures prior to entering the linearization mode. The zero and span values established in these procedures will be used for the zero and span values of the new calibration data. If zero and span are not reset at this time the recalibration will use the values for zero and span stored in memory from the previous zero and span activities.

Step 15 Apply the full scale pressure for the Quick Select pressure module being calibrated.

(Coming as close as possible to the full scale measurement range of the pressure module being calibrated) with the pressure applied press the enter key.

ENT

The calibrator will respond by displaying:

```
Enter Pressure
applied  .00000
```

Step 16 Using the keypad enter the exact value of the pressure applied to the Quick Select pressure module. Be certain to use the engineering unit in use for the left Quick Select module when calibration activities commenced.

```
Enter Pressure applied
      100.01
```

In the above example a pressure of 100.01 is being applied to the left Quick Select pressure module.

Step 17 With the full scale (F.S.) pressure applied and the corresponding value shown on the display, press the enter key.

ENT

The calibrator will respond by displaying:

```
Linearity Cal
Yes      NO
```

Step 18 If calibration activity is to be limited to zero and span, using the arrow keys select the word No (when selected the word "No" will flash on the display). If linearity adjustment is to be performed proceed to Step 21.

```
Linearity Cal
Yes    NO
```

Step 19 With the word No flashing press the enter key.

ENT

The calibrator will respond by displaying:

```
Calibration done
save      cancel
```

Step 20 To save the new zero and span values to memory, thereby overwriting the previously stored values in the EEPROM, select the word "Save" and press the enter key. To discard information and retain the information currently in the EEPROM of the calibrator select "Cancel" and press the enter key . If the save option is selected proceed to Step 21. To re-linearize module proceed to Step 26.

Step 21 If "cancel" is selected the calibrator will exit the calibration mode. If "save" is selected the calibrator will prompt you to enter the date of the new calibration as follows:

```
MMddYY
 _ _ _ _ _ _
```

Step 22 Using the number keys enter the current date such as:

```
MMddYY
031196
```

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Step 23 With the desired date entered and displayed, press the enter key.

ENT

Step 24 Turn off the calibrator and install the desired Quick Select module.

Step 25 Turn on the calibrator to resume general pressure measurement activities.

Step 26 To re-linearize a Quick Select pressure module select the word "Yes" to the linearity query.

Important Note: If full recalibration of the pressure module is desired the zero and span adjustment must be reset through these procedures prior to entering the

linearization mode. The zero and span values established in these procedures will be used for the zero and span values of the new calibration data. If zero and span are not reset at this time the recalibration will use the values for zero and span stored in memory from the previous zero and span activities.

```
Linearity Cal
 Yes  NO
```

Step 27 With the word "Yes" flashing press the enter key.

ENT

The calibrator will respond by displaying:

```
Clr Old Lin Data
Cancel  Proceed
```

Step 28 Use the arrow keys to select "Proceed" to continue the linearization process. Select "Cancel" using the arrow keys to discontinue the re-linearization process.

<p align="center">***WARNING***</p>

Entering "Proceed" will erase linearization data in the EEPROM of the calibrator.

```
Clr Old Lin Data
Cancel   Proceed
```

Step 29 To continue the linearization process, with the word "Proceed" flashing press the enter key.

ENT

The calibrator will respond by displaying:

```
Apply and enter
value 1.00000
```

Step 30 Apply the pressure required for point one and enter the numerical value, using the number keys of the exact pressure level applied. (Use the engineering unit in use for the left pressure module at the time the calibration process was started). When point 1 has been applied and entered the display will look as follows for calibration point of 10.002.

```
Apply and enter
value    10.002
```

Step 31 With the applied pressure displayed press the enter key.

ENT

The calibrator will respond by displaying:

```
+XXXXX    working
```

After 3-5 seconds the calibrator will request the next calibration point by displaying.

```
Apply and enter
value   2.00000
```

Step 32 Apply the pressure required for the next calibration point and enter the applied pressure value with the number keys. For the second point a pressure of 20.003 has been applied.

```
Apply and enter
value     20.003
```

Step 33 With the required pressure level applied and shown on the display press the enter key.

ENT

Step 34 Repeat steps 23-26 as many times as required to produce the desired number of linearization points. Points must be in sequence (low to high).

A maximum of 18 linearization points plus the zero and span points may be programmed for Quick Select pressure modules. Factory calibration consists of a 10 point linearization combined with a 10 point upscale and 10 point down scale linearization and hysteresis check.

Important Note: The number of calibration points needed to assure adequate correction for non-linearity is as follows:

Sensor Accuracy	Number of Points
0.025% & 0.05% including temperature	20 (5% increments)
0.025-0.07%	11 (10% increments and zero)
0.1%	6 (20% increments and zero)
0.25%	5 (25% increments and zero)

Step 35 When the final linearization point to be performed has been completed press the clear entry key.

CE

The calibrator will respond by displaying:

```
Calibration done
save    cancel
```

Step 36 To save the new linearization data to memory, thereby overwriting the previously stored values in the EEPROM, select "Save" and press enter. To discard the newly generated calibration information select "Cancel" and press enter.

Step 37 If "cancel" is selected the calibrator will exit the calibration mode. If the enter key is pressed with the word "save" flashing the calibrator will prompt entry of the date of the new calibration as follows:

```
MMddYY
_ _ _ _ _ _
```

Step 38 Using the number keys enter the current date such as:

```
MMddYY
031196
```

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Step 39 With the desired date entered and displayed, press the enter key.

ENT

Step 40 Turn off the calibrator and install the desired Quick Select module.

Step 41 Turn on the calibrator to resume general pressure measurement activities.

APPENDIX A. – PRESSURE CONVERSION FACTORS
CONVERSION FACTORS FOR UNITS OF PRESSURE

TO CONVERT FROM ↓ TO →	psi	mbar	bar	atm	Pa	kPa	cmH$_2$O @20°C	in.H$_2$O @20°C	ftH$_2$O @20°C	mmHg @0°C	in.Hg @0°C	gm/cm²	kg/cm²	in. sea water	ft sea water	m sea water
psi	1	68.9476	0.0689476	0.0680460	6894.76	6.8947	70.433	27.730	2.3108	51.7149	2.03602	70.30686	0.07030686	26.9484	2.2457	.684482
mbar	0.0145038	1	0.001	9.86923×10^{-4}	100	0.100	1.0215	0.40218	0.03352	0.75006	0.0295300	1.01972	0.00101972	.39085	.032571	.0099276
bar	14.5038	1000	1	0.986923	100000	100	1021.5	402.18	33.52	750.06	29.5300	1019.716	1.019716	390.85	32.571	9.9276
atm	14.6959	1013.25	1.01325	1	101325	101.325	1035.08	407.511	33.959	760.0	29.9213	1033.227	1.033227	396.031	33.002	10.0591
Pa	1.45038×10^{-4}	0.01	0.00001	9.86923×10^{-6}	1	0.001	0.010215	0.0040218	3.352×10^{-4}	7.5006×10^{-3}	2.95300×10^{-4}	0.0101972	1.019716×10^{-5}	3.9085×10^{-3}	3.2571×10^{-4}	9.9276×10^{-5}
kPa	0.145038	10.0	0.010	0.0098692	1000	1	10.215	4.02118	0.33520	7.5006	0.295300	10.19716	0.0101972	3.9085	0.32571	.099276
cmH$_2$O @20°C	0.014198	0.97891	9.7891×10^{-4}	9.66105×10^{-4}	97.891	0.097891	1	0.3937	0.032808	0.73424	0.028907	.99821	9.9821×10^{-4}	.382613	0.031884	.0097182
in.H$_2$O @20°C	0.036063	2.4864	0.0024864	2.45392×10^{-3}	248.64	0.24864	2.5400	1	0.083333	1.8650	0.073424	2.5354	0.0025354	.971840	0.080986	.024684
ftH$_2$O @20°C	0.432756	29.8368	0.0298368	0.0294470	2983.68	2.98368	30.480	12	1	22.380	0.881089	30.425	0.030425	11.6621	0.97183	.29621
mmHg @0°C	0.0193368	1.33322	0.0013322	0.00131579	133.322	0.133322	1.3619	0.53620	0.04468	1	0.03937	1.35951	0.00135951	.521096	0.043424	.013236
in.Hg @0°C	0.491154	33.8639	0.0338639	0.0334211	3386.39	3.38639	34.593	13.619	1.13491	25.400	1	34.5316	0.0345316	13.23581	1.1030	.33619
gm/cm²	0.0142233	.980665	9.80665×10^{-4}	9.67842×10^{-4}	98.0665	.0980665	1.0018	.3941	.032868	.735559	.028959	1	.001	.383292	.0319410	.0097355
kg/cm²	14.2233	980.665	0.980665	0.967842	98060.5	98.0665	1001.8	394.41	32.868	735.559	28.959	1000	1	383.292	31.9410	9.7355
in. sea water	.037108	2.55851	2.55851×10^{-3}	2.52505×10^{-3}	255.851	.255851	2.6136	1.02900	.08575	1.91908	.07555	2.60896	2.60895×10^{-3}	1	.08333	.0254
ft sea water	0.4453	30.702	0.030702	0.030301	3070.2	3.0702	31.3638	12.3482	1.02900	23.029	0.90664	31.308	0.031308	12	1	.3048
m sea water	1.46096	100.731	.100730	.099409	10073.0	10.0730	102.90	40.512	3.3760	75.553	2.9745	102.716	.102716	39.37007	3.2606	1

APPENDIX B – ASCII CHARACTER CODE

This chart shows the ASCII character set and corresponding code numbers in decimal, hexadecimal and binary form.

Decimal	Binary	Hexa-decimal	ASCII Character	Decimal	Binary	Hexa-decimal	ASCII Character
0	00000000	00	(NUL)	56	00111000	38	8
1	00000001	01	(SOH)	57	00111001	39	9
2	00000010	02	(SRX)	58	00111010	3A	:
3	00000011	03	(ETX)	59	00111011	3B	;
4	00000100	04	(EOT)	60	00111100	3C	<
5	00000101	05	(ENQ)	61	00111101	3D	=
6	00000110	06	(ACK)	62	00111110	3E	>
7	00000111	07	(BEL)	63	00111111	3F	?
8	00001000	08	(BS)	64	01000000	40	@
9	00001001	09	CI)	65	01000001	41	A
10	00001010	0A	(LF)	66	01000010	42	B
11	00001011	0B	(VT)	67	01000011	43	C
12	00001100	0C	(FF)	68	01000100	44	D
13	00001101	0D	(CR)	69	01000101	45	E
14	00001110	0E	(SO)	70	01000110	46	F
15	00001111	0F	(SI)	71	01000111	47	G
16	00010000	10	(DLE)	72	01001000	48	H
17	00010001	11	(DCI)	73	01001001	49	I
18	00010010	12	(DC2)	74	01001010	4A	J
19	00010011	13	(DC3)	75	01001011	4B	K
20	00010100	14	(DC4)	76	01001100	4C	L
21	00010101	15	(NAK)	77	01001101	4D	M
22	00010110	16	(SYN)	78	01001110	4E	N
23	00010111	17	(SRX)	79	01001111	4F	O
24	00011000	18	(CAN)	80	01010000	50	P
25	00011001	19	(EM)	81	01010001	51	Q
26	00011010	1A	(SUB)	82	01010010	52	R
27	00011011	1B	(ESC)	83	01010011	53	S
28	00011100	1C	FS)	84	01010100	54	T
29	00011101	1D	(GS)	85	01010101	55	U
30	00011110	1E	(RS)	86	01010110	56	V
31	00011111	1F	(115)	87	01010111	57	W
32	00100000	20	(SP)	88	01011000	58	X
33	00100001	21	!	89	01011001	59	Y
34	00100010	22	”	90	01011010	5A	Z
35	00100011	23	#	91	01011011	5B	[
36	00100100	24	$	92	01011100	5C	/
37	00100101	25	%	93	01011101	5D	]
38	00100110	26	Et	94	01011110	5E	^
39	00100111	27	‘	95	01011111	5F	-
40	00101000	28	(	96	01100000	60	‘
41	00101001	29	)	97	01100001	61	a
42	00101010	2A	*	98	01100010	62	b
43	00101011	2B	+	99	01100011	63	c
44	00101100	2C	,	100	01100100	64	d
45	00101101	2D	-	101	01100101	65	e
46	00101110	2E	.	102	01100110	66	f
47	00101111	2F	/	103	01100111	67	g
48	00110000	30	0	104	01101000	68	h
49	00110001	31	1	105	01101001	69	1
50	00110010	32	2	106	01101010	6A	j
51	00110011	33	3	107	01101011	6B	k
52	00110100	34	4	108	01101100	6C	l
53	00110101	35	5	109	01101101	6D	m
54	00110110	36	6	110	01101110	6E	n
55	00110111	37	7	111	01101111	6F	o

Decimal	Binary	Hexa-decimal	ASCII Character
112	01110000	70	p
113	01110001	71	q
114	01110010	72	r
115	01110011	73	s
116	01110100	74	t
117	01110101	75	u
118	01110110	76	v
119	01110111	77	w
120	01111000	78	x
121	01111001	79	y
122	01111010	7A	z
123	01111011	7B	{
124	01111100	7C		
125	01111101	7D	}
126	01111110	7E	~
127	01111111	7F	(DEL)
128	10000000	80	
129	10000001	81	
130	10000010	82	
131	10000011	83	
132	10000100	84	
133	10000101	85	
134	10000110	86	
135	10000111	87	
136	10001000	88	
137	10001001	89	
138	10001010	8A	
139	10001011	8B	
140	10001100	8C	
141	10001101	8D	
142	10001110	8E	
143	10001111	8F	
144	10010000	90	
145	10010001	91	
146	10010010	92	
147	10010011	93	
148	10010100	94	
149	10010101	95	
150	10010110	96	
151	10010111	97	
152	10011000	98	
153	10011001	99	
154	10011010	9A	
155	10011011	9B	
156	10011100	9C	
157	10011101	9D	
158	10011110	9E	
159	10011111	9F	
160	10100000	AO	
161	10100001	A1	
162	10100010	A2	
163	10100011	A3	
164	10100100	A4	
165	10100101	A5	
166	10100110	A6	
167	10100111	A7	

Decimal	Binary	Hexa-decimal	ASCII Character
168	10101000	A8	
169	10101901	A9	
170	10101010	AA	
171	10101011	AB	
172	10101100	AC	
173	10101101	AD	
174	10101110	AE	
175	10101111	AF	

Decimal	Binary	Hexa-decimal	ASCII Character
176	10110000	B0	
177	10110001	B1	
178	10110010	B2	
179	10110011	B3	
180	10110100	B4	
181	10110101	B5	
182	10110110	B6	
183	10110111	B7	
184	10111000	B8	
185	10111001	B9	
186	10111010	BA	
187	10111011	BB	
188	10111100	BC	
189	10111101	BD	
190	10111110	BE	
191	10111111	BF	
192	11000000	C0	
193	11000001	C1	
194	11000010	C2	
195	11000011	C3	
196	11000100	C4	
197	11000101	C5	
198	11000110	C6	
199	11000111	C7	
200	11001000	C8	
201	11001001	C9	
202	11001010	CA	
203	11001011	CB	
204	11001100	CC	
205	11001101	CD	
206	11001110	CE	
207	11001111	CF	
208	11010000	D0	
209	11010001	D1	
210	11010010	D2	
211	11000011	D3	
212	11010100	D4	
213	11010101	D5	
214	11010110	D6	
215	11010111	D7	
216	11011000	D8	
217	11011001	D9	
218	11011010	DA	
219	11011011	DB	
220	11011100	DC	
221	11011101	DD	
222	11011110	DE	

Decimal	Binary	Hexa-decimal	ASCII Character
223	11011111	DF	
224	11100000	E0	
225	11100001	E1	
226	11100010	E2	
227	11100011	E3	
228	11100100	E4	
229	11100101	E5	
230	11100110	E6	
231	11100111	E7	
232	11101000	E8	
233	11101001	E9	
234	11101010	EA	
235	11101011	EB	
236	11101100	EC	
237	11101101	ED	
238	11101110	EE	
239	11101111	EF	
240	11110000	F0	
241	11110001	F1	
242	11110010	F2	
243	11110011	F3	
244	11110100	F4	
245	11110101	F5	
246	11110110	F6	
247	11110111	F7	
248	11111000	F8	
249	11111001	F9	
250	11111010	FA	
251	11111011	FB	
252	11111100	FC	
253	11111101	FD	
254	11111110	FE	
255	11111111	FF	

BASE UNIT PHYSICAL SPECIFICATIONS

Dimensions
7.88 in. (L) x 4.24 in. (W) x 3.25 in. (H)

Weight
Max. 2.2 lbs. w/2 pressure modules installed

Case Material
High impact ABS

Sensor Module Capacity
2 bays for GQS "Quick Select®" sensor modules

Display
2 line LCD, 0.037 in. height per line. Can display simultaneous readings from 2 modules

Electrical Connection
Miniature recessed banana jacks (one set of test leads provided with each base unit)

BASE UNIT OPERATING SPECIFICATIONS

Operating Temperature Range
Standard: 32° to 120°F
Optional: –4 to 120°F

Storage Temperature
–4° to 158°F

Update Rate
130 ms (nominal) with one sensor installed

Resolution
±0.002% of span, 60,000 count (max)

Warm-Up
5 minutes for rated accuracy

Damping (Measurement Averaging)
Programmable averaging from zero through 16 consecutive readings

Electrical Measurements
0-50 mA or 0-30 Vdc

Input (volts)	Accuracy
0/10 Vdc	±0.025% FS
0/30 Vdc	±0.10% FS
0/20mA	±0.03% FS
0/50mA	±0.05% FS

Auto Ranging 10/30 Vdc and 20/50mA

Temperature Effect Electrical Measurement
±.001% of Span per °F over compensated range

Serial Interface
Type: RS-232
Baud Rate: 300, 1200, 2400 or 9600 selectable

Field Calibration
Both Quick Select pressure modules and base unit electronics can be calibrated in the field via prompted keypad commands

Options
Datalogging with Hi-Lo Relay Feature – Datalogging manually or automatically stores up to 715 measured values for upload to PC. Includes upload utility software. Hi-Lo relay feature allows programming of setpoints for activation of alarms or control valves. (Hi-Lo not available with FM approval.)
Enhanced LCD – For –4 to 120°F operating range
FM Approval – Class 1, Div. 1, Groups A,B,C & D (Not available with CE Mark)
CE Mark – EMI/RFI immunity rating (not available with FM approval)

Power Requirements
Standard: (2) 9Vdc Alkaline Batteries (provides up to 30 hours operation per set)
Optional: 110 or 220 Vac transformer to power calibrator from line power

Certification
N.I.S.T. Traceable certification document provided for base display unit and sensor modules

PRESSURE SENSOR MODULE SPECIFICATIONS

GQS-1

Pressure Types
Gauge, differential & compound

Available Ranges
(See Chart)

Available Accuracies
±0.06 (0/2-0/200 in. H_2O), ±0.07 (0/0.25-0/1 in. H_2O) or 0.1% of Span

Compensated Temperature Range
20°F to 120°F

Temperature Effect
±.004% of Span per °F over compensated range (from reference temperature range of 70° ±3°)

Repeatability
±0.01% of span (range 0/1 in. H_2O or higher)
±0.02% of span (ranges below 0/1 in. H_2O)

Sensitivity
±0.002% of span (typical)

Media Compatibility
Clean, dry, non-conductive, non-corrosive gas

Under/Overpressure Capability
–15 to 50 psi

Maximum Static (line) Pressure
100 psi

Process Connection
Standard: $1/8$ NPT female
Optional: G $1/8$ British standard

Other Options
FM Approved (for use with FM approved base unit)
CE Mark (for use with CE Mark rated base unit)

GQS-2

Pressure Types
Gauge, absolute, compound & vacuum

Available Ranges
(See Chart)

Available Accuracies
±0.025, 0.05 or 0.1 % of Span (±0.025 & 0.05% not available on 0/10,000 psi range)

Compensated Temperature Range
20°F to 120°F

Temperature Effect
Standard: ±.004% of Span per °F over the compensated range (from reference temperature of 70° ±3°)
Optional: No additional error due to temperature over the compensated range

Repeatability
±0.01% of span

Sensitivity
±0.002% of span (typical)

Media Compatibility
0/5 psi range only: Clean, dry, non-conductive, non-corrosive gas
0/10-0/10,000 psi ranges: Any medium compatible with 316 SS.

Optional: Cleaned for Oxygen Service
(0/10-0/10,000 psi ranges only)

Overpressure Capability
200% for ranges up to 1000 psi
150% for ranges over 1000 psi

Process Connection
Standard: $1/8$ NPT female
Optional: $1/8$ NPT female with flush port
(ranges 10 psi and over)

G $1/8$ British standard
G $1/8$ British standard with flush port
(ranges 10 psi and over)
Welded VCR fitting with standard finish

Other Options
FM Approved (for use with FM approved base unit)
CE Mark (for use with CE Mark rated base unit)

TEMPERATURE INTERFACE MODULES

GQS-RT Series (RTD)

GQS-RT1 and GQS-RT2 interface modules allow the PTE-1 to measure temperature with an RTD

GQS-RT1: Accommodates Pt100, Ni120, Cu10 and other common 2, 3 or 4 wire probes with resistance outputs of 400 ohms or less.
GQS-RT2: Accommodates Pt1000 and other common 2, 3 or 4 wire probes with resistance outputs of 4000 ohms or less.

Selectable Units of Measure
°C, °F, °K, °R and ohms

Input Receptacle
Accepts TA4F type RTD connector

RTD Probes
Pt-100 probes, 6˝ or 12˝ length, with or without handle. DIN Class A accuracy. Includes mating TA4F connector.

Options
FM approved (for use with FM approved base unit)
(CE) not available

GQS-TC1 (Thermocouple)

Compatibility
Programmed to provide direct temperature readout from types J, K, T, E, R, S, B & N thermocouples or direct millivolt readout from any thermocouple.

Reference Junction
Automatic internal or manual external

Resolution
Automatic or manually selectable, up to .01°

Units of Measure
Selectable; °C, °F, °K, °R and millivolts

Receptacle
Accepts "miniature thermocouple connector", Omega® type SMP

Options
FM approved (for use with FM approved base unit)
(CE) not available

ACCESSORIES

110Vac/60 Hz ac Adapter
220Vac/50 Hz ac Adapter
Contoured protective case
Soft carrying case
Hard carrying case
LPSIIa External 24vdc Loop Power Supply – to power transducers and pressure switch test circuit
SM-1 Voltage Adapter – provides ability to check "live" pressure switches

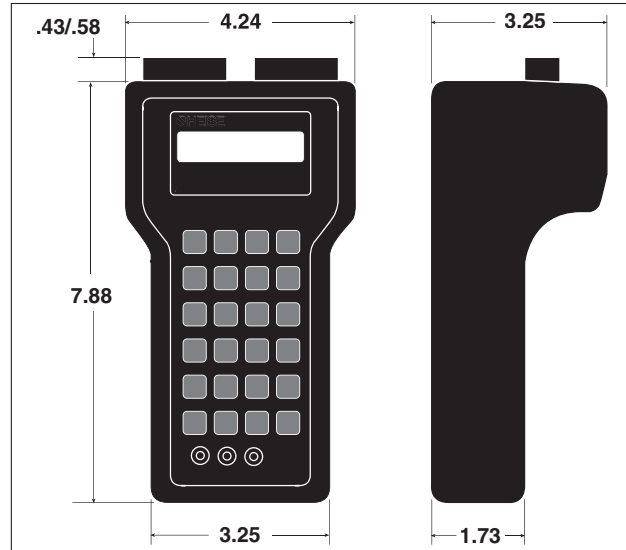***Specifications subject to change without notice**

STANDARD RANGES

GQS-2 psi (gauge and absolute pressure)	GQS-1 ˝H₂O (gauge/ differential pressure)	Other Engineering Units**
*5	0.25*	psi
10	0.5*	in. H₂O
15	1.0*	in. Hg
20	2.0*	ftSW
25	3.0*	Bar
30	5.0*	mBar
50	10*	kPa
60	15*	mPa
100	25*	mmHg
150	50*	cmH₂O
200	100*	mmH₂O
250	150*	kg/cm²
300	200*	User Selectable
500		
600		**Note: Engineering units identified above are
1000		accessible through the unit select feature.
1500		However, readout will default to the pri-
2000		mary unit of measure on start-up. Sensor
2500		modules scaled in primary units other
3000		than in. H₂O (GQS-1) or psi (GQS-2) are also
5000		available.²
6000		Consult factory.
7500		
10,000		
vacuum		
5		
10		
15		
compound		
±5	±0.125*	
±10	±0.25*	
±15	±0.5*	
−15/+30	±1.0*	
−15/+60	±1.5*	
	±2.5*	
	±5.0*	
	±7.5*	
	±12.5*	
	±25*	
	±50*	
	±75*	
	±100*	

* Non-isolated, for clean dry gas only

DIMENSIONS

.43/.58   4.24   3.25

7.88

3.25   1.73

SYSTEM ACCURACY WITH
GQS-TC1 THERMOCOUPLE INTERFACE
TABLE I

System Accuracy (reading in temperature units): Includes the HHC base unit and GQS-TC1 interface module. (Does not include inaccuracy of the thermocouple device. Consult thermocouple manufacturer or ISA MC96.1 for thermocouple accuracy specifications. Typical inaccuracies range from ±1 to ±2.2°C.)

Thermocouple Type	Measurement Range (°C)	Accuracy @ 25°C Ambient (Not Including Internal Reference Junction) Expressed as ±°C	Accuracy @ 25°C Ambient (Including Internal Reference Junction) Expressed as ±°C	Max. additional error due to ambient temperature deviation from 25°C. Expressed as additional C error per each C deviation from 25°C
J	−210 to −151	0.7	1.1	0.02
	−150 to 1200	0.3	0.4	0.01
K	−240 to −201	1.5	2.2	0.05
	−200 to −101	1.0	1.5	0.03
	−100 to 999	0.5	0.8	0.02
T	−250 to −201	1.5	2.2	0.05
	−200 to −101	0.8	1.2	0.03
	−100 to 400	0.5	0.8	0.02
E	−250 to −201	1.2	2.0	0.04
	−200 to −101	0.6	1.1	0.02
	−100 to 400	0.3	0.6	0.01
R&S	−50 to 299	3.4	3.6	0.10
	300 to 1768	1.2	1.3	0.04
B	100 to 199	14.0	14.0	0.44
	200 to 499	5.0	5.0	0.16
	500 to 999	3.0	3.0	0.08
	1000 to 1820	1.2	1.2	0.04
N	−250 to −226	4.3	5.7	0.14
	−225 to −101	2.1	2.8	0.07
	−100 to 1300	1.0	1.4	0.02

Conversion Factors (to convert °C specifications to other units of measure):
To convert from °C to °F: °F = (1.8 x °C) +32
To convert from °C to °K: °K = °C +273.15
To convert from °C to °R: °R = (1.8 x °C) +427.67

TABLE II

System Accuracy (based on direct millivolt reading from thermocouple – includes MDI base unit and GQS-TC1 interface module. (Does not include inaccuracy due to the thermocouple device. Reference junction not applicable to direct millivolt readings.)

Input Range of	Accuracy @ 25°C	Max. additional error due to ambient temperature deviation from 25°C. Expressed as additional millivolt error per each °C deviation from 25°C
−10 to 100 millivolt	± 0.0125 millivolts	.001

APPENDIX D

RTD PROBE CONNECTOR

SWITCHCRAFT TINI QG (TA4F)

PIN	FUNCTION
1	2W+
2	4W+
3	4W−
4	2W−

2 WIRE RTD

TA4F

1
2
3
4

3 WIRE RTD

TA4F

1
2
3
4

4 WIRE RTD

TA4F

1
2
3
4
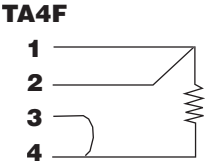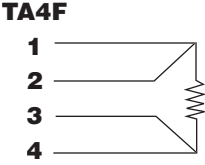
APPENDIX E

Certification of the TC1 Thermocouple Interface Module

THEORY

With the TC1 module installed in the base unit (set-up to display in mV), a precision millivolt calibrator/supply will apply a known mV signal to the module/base unit system (simulating the Seebeck voltage) in place of a thermocouple. The applied mV signal can then be read on the base unit display and compared to the nominal input provided by the precision millivolt calibrator/supply. The TC1 module cannot be adjusted. If the module will not meet the specified accuracy, contact the factory or instrument supplier.

CERTIFICATION PROCEDURE

1. Remove all existing modules from the base unit (handheld calibrator firmware rev. 3.01 or later, digital indicator firmware 2.00 or later) and install the TC1 in the either module bay.

2. Attach copper wire to the + and - terminal posts of a precision millivolt calibrator/source, rated at .0025% or better.

3. Wire the opposite end of the wires to a miniature "U" type (copper-copper) thermocouple connector, and plug the connector into the receptacle located in the top of the TC1 module.

4. Turn on the millivolt calibrator/source and adjust until it is supplying 0mV to the TC1 module.

5. Turn on the base unit by pressing the on-off switch. Allow the base unit to complete its startup routine.

6. Press the "Setup" button.

7. Using the arrow key, toggle once to the right and down 7 times until "TCmodule" is flashing.

8. Press enter.

9. Set engineering unit to "millivolt" by pushing the right arrow button until "mV" is flashing.

10. Press enter.

11. While the precision millivolt calibrator/source is providing 0mV to the module, read the mV display on the base unit.

12. If the reading is within ± .01 millivolts, the base unit/TC1 system is within specification and may be certified.

13. Repeat the certification procedure at 50 and 100 mV.

Revision 4.6 3/2004

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