Operation Manual

QUARTZ PRESSURE CALIBRATOR
Manual PN 0017108001 K

Model 8100

This Manual contains important information.
PLEASE READ PRIOR TO USE.

ISO 9001
428797

ACCREDITED
Calibration 2066.01

mensor®
WIKA Calibration Line

WARRANTY

All products manufactured by Mensor® Corporation are warranted to be free of defects in workmanship and materials for a period of one year from the date of shipment. No other express warranty is given, and no affirmation of Seller, by words or actions, shall constitute a warranty. SELLER DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSES WHATSOEVER. If any defect in workmanship or material should develop under conditions of normal use and service within the warranty period, repairs will be made at no charge to the original purchaser, upon delivery of the product(s) to the factory, shipping charges prepaid. If inspection by Mensor Corporation or its authorized representative reveals that the product was damaged by accident, alteration, misuse, abuse, faulty installation or other causes beyond the control of Mensor Corporation, this warranty does not apply. The judgment of Mensor Corporation will be final as to all matters concerning condition of the product, the cause and nature of a defect, and the necessity or manner of repair. Service, repairs or disassembly of the product in any manner, performed without specific factory permission, voids this warranty.

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WARNINGS AND CAUTION NOTES

WARNING: HIGH PRESSURE!
High pressure gases are potentially hazardous. Energy stored in these gases can be released suddenly and with extreme force. High pressure systems should be assembled and operated only by personnel who have been trained in proper safety practices.

WARNING: HIGH SOUND LEVELS!
Pressures from 600 psig and up can generate sound levels above 100 db for brief periods when they are exhausted directly to atmosphere. If no muffling devices are attached to the EXHAUST port, then ear protection is advised for personnel in the vicinity of instruments that will be operated under such conditions.

WARNING: NOT EXPLOSION PROOF!
Installation of this instrument in an area requiring devices rated as intrinsically safe is not recommended.

WARNING: POSSIBLE INJURY!
The tubing, valves and other apparatus attached to the gauge must be adequate for the maximum pressure which will be applied, otherwise physical injury to the operator or bystanders is possible.

CAUTION: USE THE PROPER PRESSURE MEDIUM. USE ONLY CLEAN, DRY NON-CORROSIVE GASES. THIS INSTRUMENT IS NOT DESIGNED FOR OXYGEN USE.

CAUTION: ESD PROTECTION REQUIRED. The proper use of grounded work surfaces and personal wrist straps are required when coming into contact with exposed circuits (printed circuit boards) to prevent static discharge to sensitive electronic components.

CAUTION: RISK OF ELECTRICAL SHOCK.

Additional Warnings and Caution notes are included throughout this manual.

PLEASE NOTICE...

The product specifications and other information contained in this manual are subject to change without notice.

Mensor Corporation has made a concerted effort to provide complete and current information for the proper use of the equipment. If there are questions regarding this manual or the proper use of the equipment, contact Mensor Corporation at:

TEL	1.512.396.4200
TEL	1.800.984.4200 (USA only)
FAX	1.512.396.1820
WEB SITE	http://www.mensor.com
E-MAIL	sales@mensor.com
	tech.support@mensor.com
	quality@mensor.com

PACKAGING FOR SHIPMENT

If the product must be shipped to a different location or returned to Mensor for any reason through a common carrier it must be packaged properly to minimize the risk of damage.

The recommended method of packing is to place the instrument in a container, surrounded on all sides with at least four inches of shock attenuation material such as styrofoam peanuts.

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This product contains intellectual property, i.e., software programs, that are licensed for use by the end user/customer (hereinafter “end user”).

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FCC RADIO FREQUENCY EMISSION NOTICE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his or her own expense.

USE SHIELDED CABLES TO CONNECT EXTERNAL DEVICES TO THIS INSTRUMENT TO MINIMIZE RF RADIATION.

TRADEMARKS

Mensor is a registered trademark of Mensor Corporation. All other brand and product names are trademarks or registered trademarks of their respective companies. This instrument contains software licensed from Microsoft Corporation.

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INTRODUCTION

DID YOU GET EVERYTHING?

In addition to this manual you should have:

- Model 8100 Quartz Pressure Calibrator
- Power cord
- 1/8 inch NPT fitting adapters
- Any accessories ordered
- Envelope containing a Calibration Certificate

INITIAL INSPECTION

Your new instrument was subjected to many hours of functional testing before it left the factory. In addition to testing, the unit was inspected for appearance prior to being packaged for shipment. Upon removal from its carton please examine the instrument for shipping damage. Report any apparent damage to the carrier immediately.

MEET YOUR 8100

The Model 8100 Quartz Pressure Calibrator is a multi-range pressure system designed to test and calibrate a variety of pressure devices in either absolute or gauge pressure modes from this single instrument. Using an optional second transducer the 8100 can have up to eight pressure ranges. By combining the output from the internal Barometric Reference Transducer with the two transducers the 8100's capability is extended by eight additional pressure ranges. Thus, a fully configured 8100 provides up to sixteen internal ranges (eight absolute and eight gauge ranges) to use as standards for calibrating external devices. The Mensor Model 8100 is truly "a calibration lab in a box".

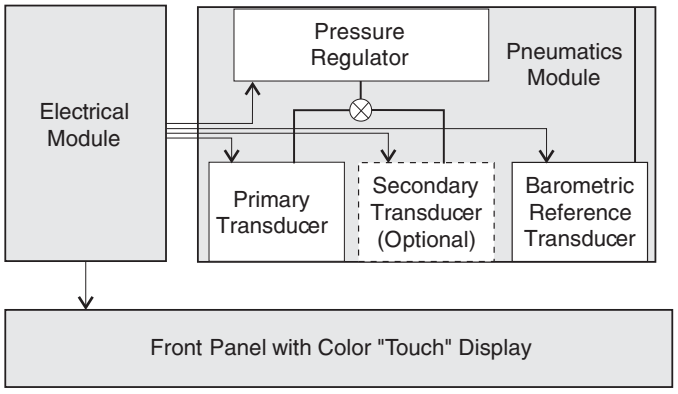


Figure 1.1 - System Block Diagram

Features

Here is a short list of significant features designed into the Mensor Model 8100:

1. Either one or two highly stable, temperature compensated, pressure transducers using resonant quartz sensors. Each transducer is capable of up to four ranges (turndowns);
2. An internal high accuracy Barometric Reference Transducer is standard and provides gauge pressure emulation for all of the absolute ranges and absolute pressure emulation for gauge ranges;
3. Both pressure transducers and the Barometric Reference Transducer are individually removable from the front of the 8100 without the use of tools. This feature greatly facilitates "out of instrument" recalibration of individual transducers;
4. A single pressure regulator for controlled output pressure. This regulator has a history of proven accuracy and stability;
5. A Pneumatic Module optimized for one of four pressure ranges;
6. A separate electrical module using a high speed microprocessor. The operating program is loaded from a non-volatile flash disk;
7. A large color VGA LCD display with a touch screen for intuitive operator interface. There are no other buttons, switches or keypads on the front panel to confuse or distract the operator;
8. Multiple languages; change the language for on-screen text and number/date formats instantly by simply touching one of the "national flag" cues available on the display (see figure 3.2). The current language selections available are:

Language	Country
English	USA
French	France
German	Germany
Italian	Italy
English	Canada
French	Canada
Spanish	Mexico
English	Great Britain
Spanish	Spain
Korean	Korea
Chinese	China
Japanese	Japan

Operate the 8100 while it is either sitting on a bench or mounted in a standard equipment rack. Leveling the instrument is not a consideration since the pressure sensors are not affected by orientation. Use either front panel input (Local Operation), or send commands and queries over a bus from a separate “host” controller (Remote Operation).

Front Panel

The 8100 front panel (figure 1.2) includes an 8.4 inch color VGA display featuring touch screen technology. Operator input is accomplished by finger pressure applied to the words or symbols presented on the resistive display. There are no discrete keypads or switches on the front panel.

On the right hand side of the front panel, under the Mensor logo and model number, there is a clear window which shows the calibrated pressure ranges of the internal transducers, and the instrument serial number.

To gain access to the internal modules simply loosen the two thumb screws on the right hand edge of the front panel and swing it open. With the panel open, various connectors and cables are revealed on the front on the electrical module. To the right of the electrical module are slots to accommodate two pressure transducer modules and a Barometric Reference Transducer. Each transducer can be removed and reinstalled through the front panel opening. See Section 5, *Maintenance,* for additional information on module removal and replacement.

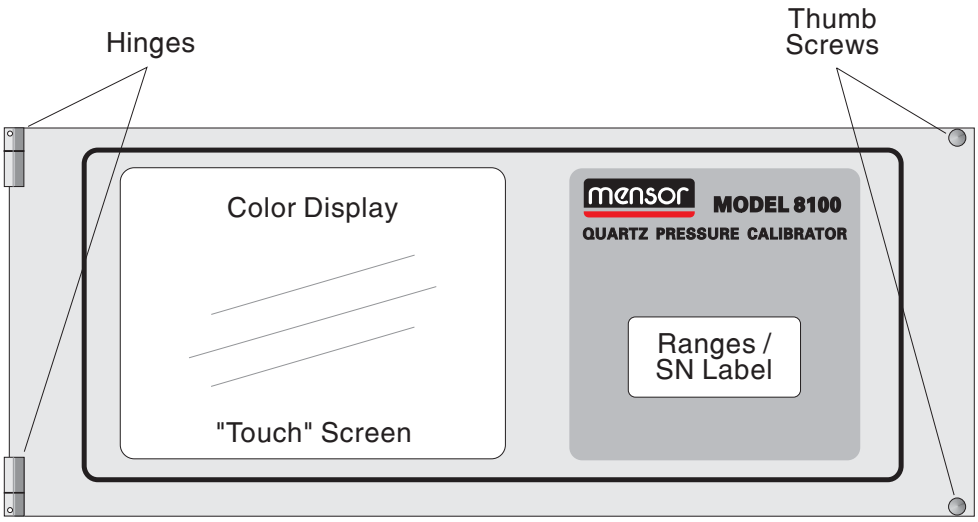


Figure 1.2 - Front Panel

Display

When the 8100 is powered up it takes about one minute for initialization, then displays a screen similar to figure 1.3. The display is made up of rectangles which display text or symbols.

Keys, Tabs, Labels and Windows: In this manual a **Key** is a small rectangle which acts as a switch when pressed. Keys have borders with a three dimensional, shadowed effect. **Tabs** are a group of touch points, each of which will overlay most of the screen with one page related to its title subject. Small rectangles with solid borders that display information, but do not respond to being touched, are called **Labels** or **Windows.**

Keys: Keys cause something to change when they are touched. Throughout this manual keys are represented with the displayed characters enclosed in brackets such as [PSI A]. Each key has a characteristic response when actuated; either an instant, single step response when the key is pressed, or continuously repeating steps while the key is held down, or a delayed response when released. Operators will quickly become accustomed to the particular characteristics of the frequently used keys. Some keys become labels under certain conditions, then resume their key function in other circumstances.

Header Bar: The bar across the top of the screen which displays the Mensor Logo, a title frame, and a national flag is stationary and remains displayed at all times. All of the number formats and text displayed on the 8100 screens will be in the language appropriate to the national flag displayed here; American English for the USA flag, etc. Touch the flag to access a drop-down window showing all of the flags programmed into the 8100. Touch any flag to change the display to the corresponding language.

Optional Display: The Optional Display is a large window centered near the bottom. This window can be set up to be blank, or to display any one of the following:

1. Peak Pressure; minimum and maximum
2. Rate of change of a measured pressure
3. Barometer reading

Footer Tabs: Like the top bar, the four tabs across the bottom of the display remain permanently on-screen. Use these tabs to select the desired operating subject according to the tab titles, Operate, Setup, Status, or Calibrate. The active tab will be a lighter shade than the others. Touch any one of the darker tabs to cause that subject page to appear in the display.

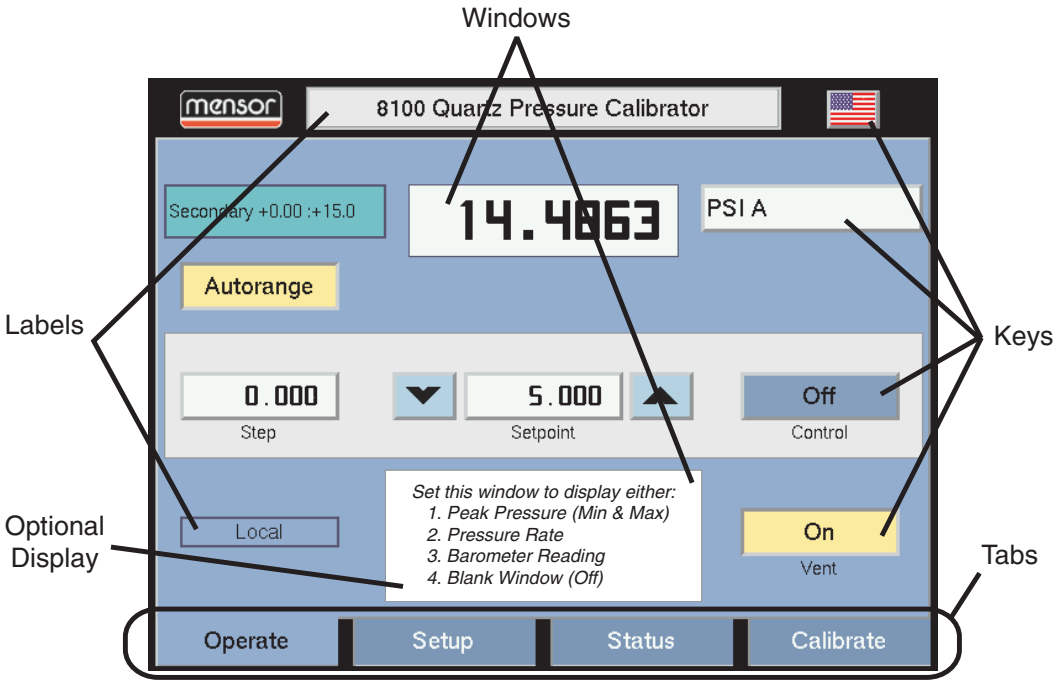


Figure 1.3 - Terminology of Screen Elements

Electrical Module

The electrical module is illustrated below with the module lid removed (figure 1.4). The module consists of the input power module which includes a fan, a power supply, and a computer. All program information to run the system resides on a solid state disk (flash disk) located inside this module. The power switch and line fuses are situated on the rear of the electrical module such that they are accessible on the rear of the fully assembled 8100.

Pneumatic Module

The pneumatic module (figure 1.5) includes platforms for up to two high performance, low-drift, pressure transducers which are traceable to NIST standards. Both of these transducers can be used in conjunction with the highly stable pressure regulator to produce a precise pressure output. Each transducer includes its own on-board compensation and calibration data so that any transducer can be replaced in the instrument without requiring a recalibration.

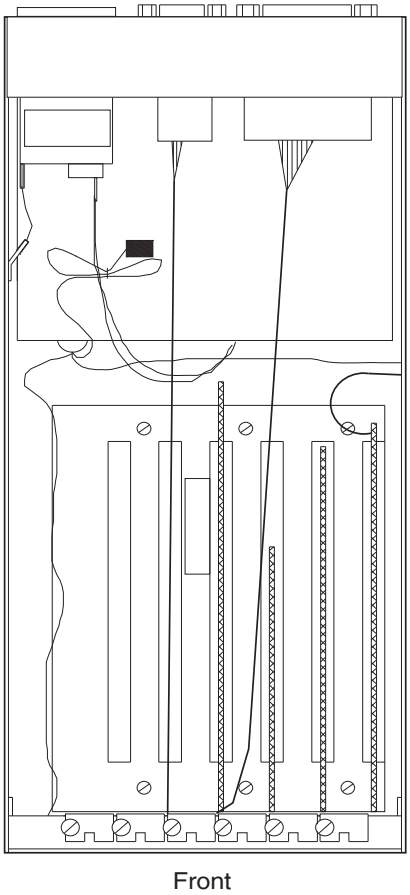


Figure 1.4 - Electrical Module-Top View

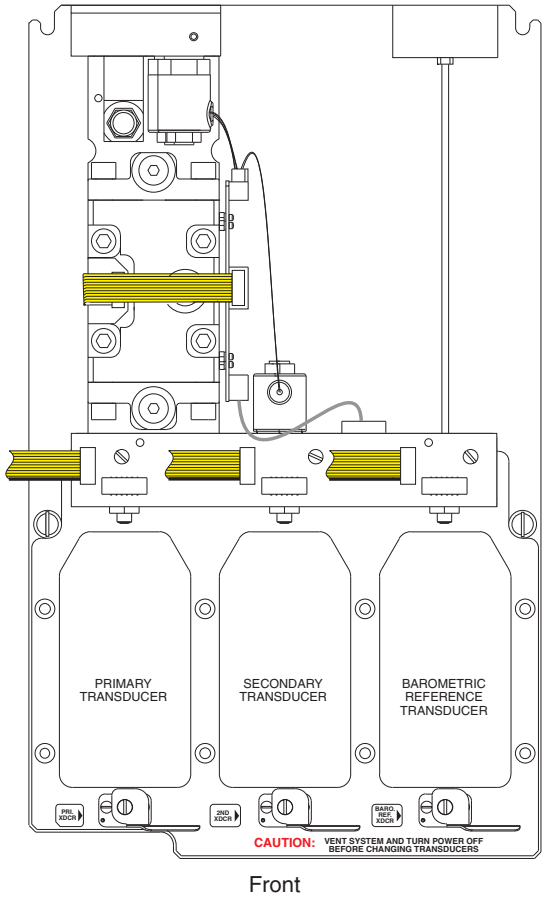


Figure 1.5 - Pneumatic Module-Top View

Rear Panel

Five pneumatic pressure ports are located down the center, and one near the lower left corner of the rear panel (figure 1.6). Positioned to the right of the pressure ports are the two remote bus input/output connectors, the system off/on switch, the line fuses, and a protective grill covering the ventilating fan.

Chassis Assembly

The chassis assembly acts as the housing for the system. The electrical and pneumatic modules are each self-contained inside the chassis, and either can be replaced using basic hand tools. In addition, each pressure transducer is individually removable without tools. Instructions for transducer and module removal are given in the *Maintenance* section (section 5).

The only moving parts in the 8100 are the fan, the pneumatic flow controller diaphragms and valves, and the solenoid valve plungers. There are no internal user adjustments or setup switches.

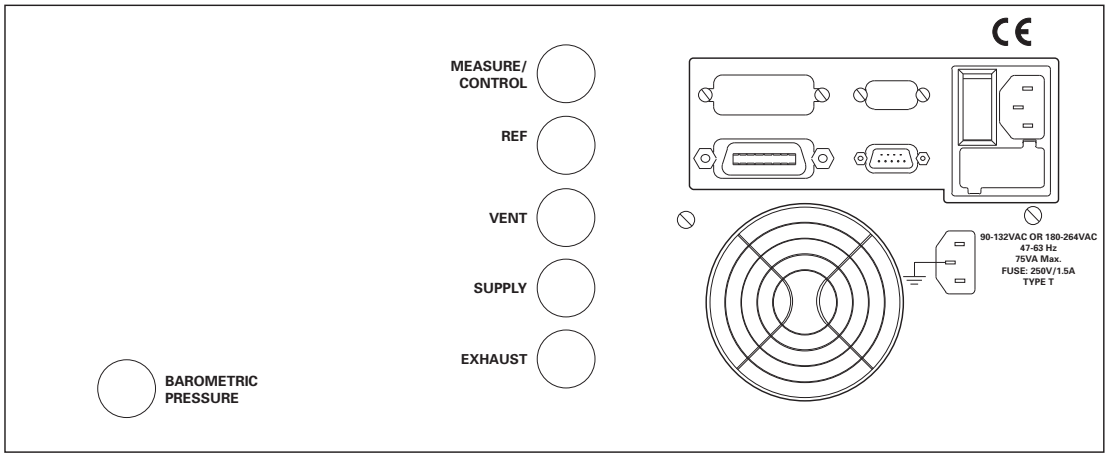


Figure 1.6 - Rear Panel

POWER UP!

You can confirm that your 8100 is operational right now. Simply apply power to the power connector on the rear of the instrument, remove any plastic plugs from the rear panel pressure ports and switch the power switch ON. The system will go through a brief initialization process and then a display will appear similar to the operating screen shown in figure 1.7.

Touch the Mensor Logo on the header bar and a drop-down window will appear as in figure 1.8, listing the Mensor corporate address and other contact addresses. Simply touch [Close] at the bottom of the window to close this window.

MENSOR SERVICE PLUS

If you have problems using your 8100 and you don't find the answer in this manual, contact Mensor at 1.800.984.4200 (U.S.A. only), or 1.512.396.4200 for personal assistance, or at any of the on-line addresses listed by touching the Mensor logo on the screen. We are ready to help.

After the Warranty

Mensor's concern with the welfare of this instrument is not limited to the warranty period. We provide complete repair, calibration and certification services after the warranty for a nominal fee as explained in Section 5, *Maintenance*.

Calibration Services

In addition to servicing our own products Mensor can perform a complete pressure calibration service, up to 20,000 psi, for all of your pressure instruments. This service includes a Certificate of Compliance and Calibration and a record of traceability to the pressure standards of the United States National Institute of Standards and Technology (NIST).

Accreditations

Mensor Corp. is registered to ISO 9001:2008. The calibration program at Mensor is accredited by A2LA, as complying with both the ISO/IEC 17025:2005 and the ANSI/NCSL Z540-1-1994 standards.

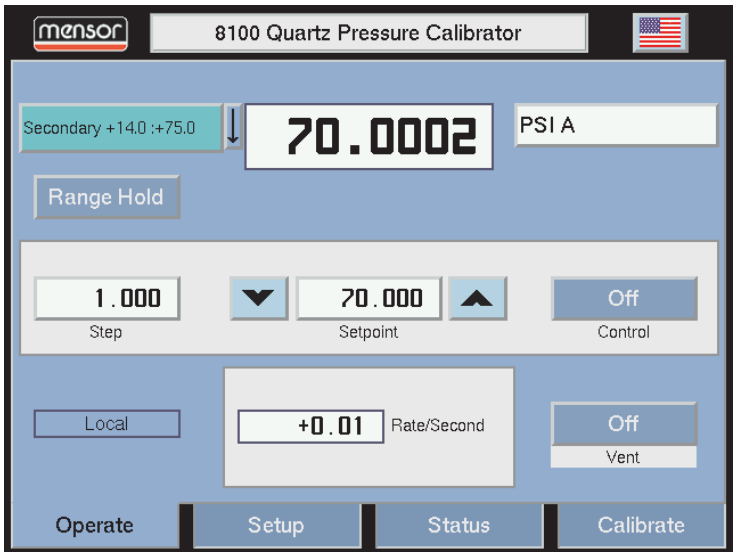


Figure 1.7 - Typical Operating Screen

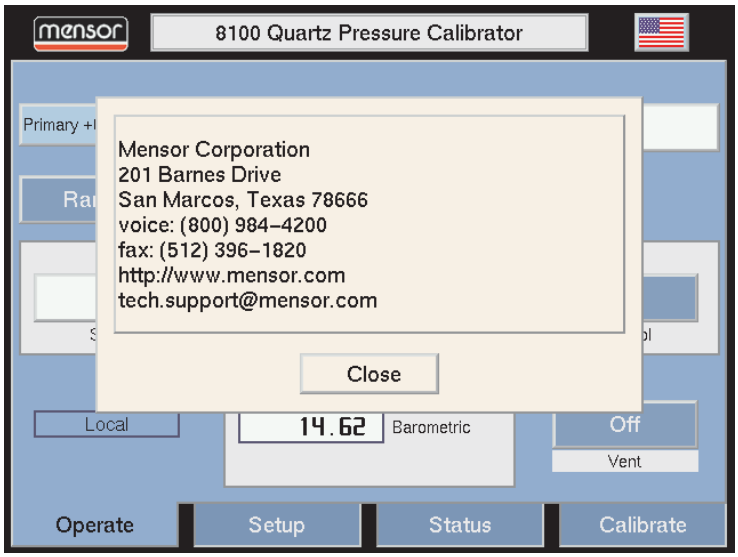


Figure 1.8 - Basic Display Information

INSTALLATION

MOUNTING

The instrument can be set up on a table-top or it can be rack-mounted. Rack mount adaptors are preassembled to the 8100 as a standard feature.

The special sensors used in the 8100 are relatively insensitive to tilt and vibration. However to further assure stability and accuracy, avoid mounting the instrument on surfaces subject to excessive motor or machinery vibration.

PRESSURE CONNECTIONS

NOTE: *When making up a connection to an o-ring adapter port use a back-up wrench to prevent over-stressing the threads in the manifold block.*

All of the pressure ports on the rear are female 7/16 - 20 SAE/MS straight threads per MS16142 and SAE J514 table 14. They require a tube fitting boss seal with an o-ring per MS33656. Mensor provides female 1/8" NPT adapter fittings with the instrument. The pressure connections can be made to these adapters with the proper mating hardware. We recommend the use of either Loctite Hydraulic Sealant or fresh teflon tape on the threads of any male pipe fitting. Do not use sealants on fittings sealed with an o-ring. The integrity of each seal is particularly important since even microscopic leaks can cause errors in pressure measurements. Figure 2.1 shows the rear panel connections and figure 2.2 is a complete pneumatic schematic, including the optional Secondary and Barometric Reference Transducers. Requirements for connecting to the ports on the 8100 manifold are as follows:

BAROMETRIC PRESSURE Port

The BAROMETRIC PRESSURE port, normally left open to atmosphere, ties directly to the barometric reference transducer.

MEASURE/CONTROL Port

Connect a device to be tested to the MEASURE/CONTROL port. In MEASURE mode the 8100 will precisely measure the pressure at this port up to the full scale range of the primary sensor.

A static pressure value, or a step value, can be programmed using an on-screen keypad. That pressure will then be output to the MEASURE/CONTROL port by switching to the CONTROL mode of operation.

WARNING: HIGH NOISE LEVELS!
As pressure decreases compressed gas will escape out the EXHAUST port. For ranges above 600 psi high noise levels may result during such pressure releases. To overcome objectionable exhaust noise either install a muffler or route the port to a remote location.

CAUTION: Improper use of this equipment may impair protection provided by this instrument.

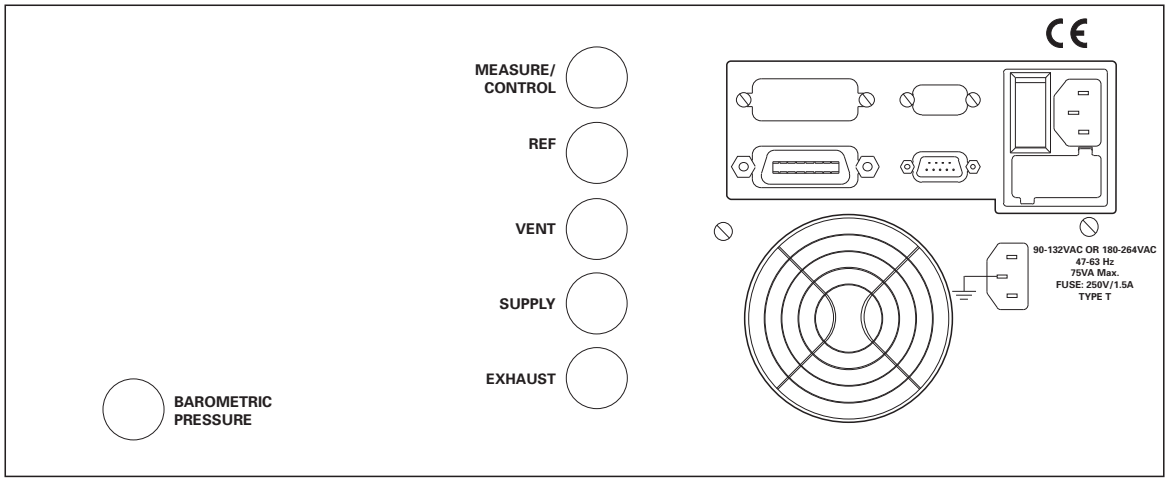


Figure 2.1 - Rear Panel

VENT Port
This port is normally left open to atmosphere.

SUPPLY Port
Connect a source pressure to the SUPPLY port which is greater than the highest control pressure which will be commanded. See "Source Pressure" in the *Specifications* section for supply pressure requirements for various pressure ranges.

EXHAUST Port
If sub-atmospheric control pressure is required a vacuum pump must be connected to the EXHAUST port. Otherwise, this port may be left open to atmosphere.

Remote Bus Connections
See Section 4, *Remote Operation* for connections and commands for operation over either the IEEE-488 or RS-232 remote bus.

POWER ON

After the pressure connections are secure apply power to the power connector on the rear of the instrument and switch the power switch ON. The instrument will go through an initialization process and system check. As soon as the system check is completed the system will default to an operating screen similar to figure 3.1. Allow at least 15 minutes of warm up before performing critical pressure measurements.

WARNING: EARTH GROUND!
Any power adaptors or surge protection devices that negate the protective earth ground should not be used.

The power cord is the disconnection device and its outlet should be accessible and contain a protective earth ground.

WARNING: VENTILATION!
Do not block airflow to ventilating fan located on rear of instrument.

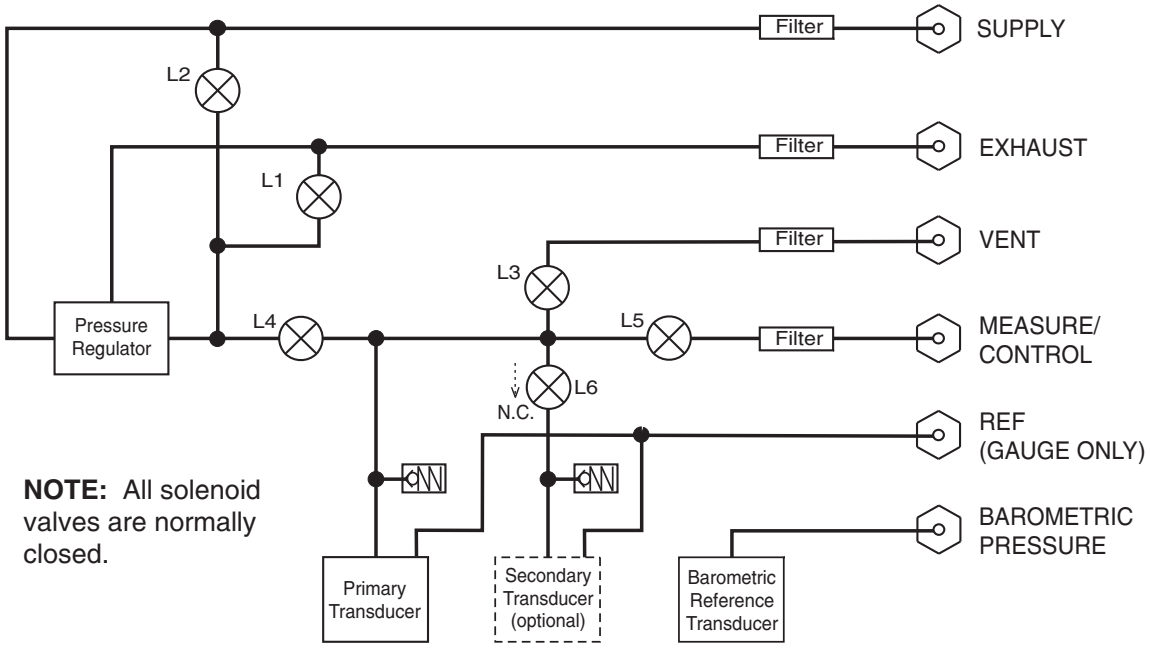


Figure 2.2 - System Pneumatic Schematic

LOCAL OPERATION

This section describes the procedures for operating the 8100 from the front panel. Instructions for operating the device remotely from an external computer are covered in the next section. By following the procedures provided in these two sections and section 6, *Calibration*, you can expect your 8100 to deliver maximum accuracy and dependability for years of useful service.

KEYS and TABS

Local operation is accomplished by observing the data presented in the display, then pressing the on-screen [key] or [tab] for the desired function. Throughout this manual characters enclosed inside square brackets [ ] represent the associated on-screen touch point.

OPERATION AREAS

The three areas most used during normal, local mode operation are, Operate, Setup, and Status. Illustrations (figures 3.1 through 3.17) and brief discussions of the local mode operating features are included in this section of the manual. Section 6, *Calibration*, presents the information and graphics relating to calibration of the 8100.

OPERATE TAB

Figure 3.1 is an example of a typical display after initialization, or whenever the [Operate] tab is active. A description of the features seen here follows.

[Mensor] Logo

The logo is also a key. Touch it to display a pop-up window listing various Mensor contact addresses (figure 1.9 in the *Introduction* section). Touch [Close] to close the window.

Center Label

The text in the light colored rectangle centered on the header will change according to which of the tabs on the bottom of the screen is active. This label, as with all labels, is not an active "touch" point.

[Flag] Symbol

The [USA Flag] on the header is a key that establishes the national language used in all of the text and number formats in all displays. Press the [Flag] for a pop-up window displaying several national flags (figure 3.2). Touch any one of these [Flags] to effect the language change. (See page 1-1 for a list of languages available.)

NOTE: *The language selection acts on the screen displays only, and does NOT affect remote commands and responses. All remote dialogs listed in the* Remote *section are literal as described.*

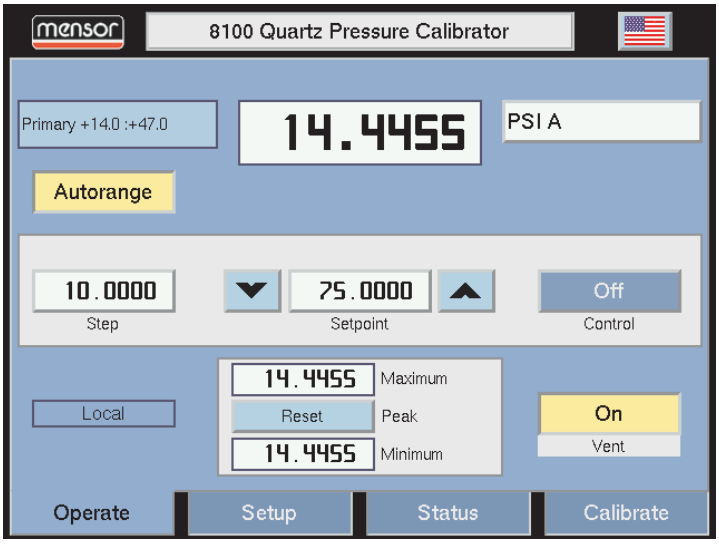


Figure 3.1 - Typical Operation Screen

Figure 3.2 - Language Selection Window

Turndown Label and [Range Selector] Key

The turndown label in the upper left portion of figure 3.1 describes the current active turndown as "Primary +14.0:+47.0". This is the full scale range for one of several turndowns assigned to the primary transducer. The turndown label becomes the [Range Selector] key, like figure 3.3, when [Range Hold] is enabled. This is explained further under the [Range Hold] description, below.

[Autorange / Range Hold] Key

The key directly under the turndown label is a toggle key which switches between autorange and Range Hold modes. In figure 3.1 the key is shown in autorange mode. As the pressure rises or falls autorange will automatically switch to the lowest viable turndown range in the system. Each change is immediately reflected in the turndown label.

Press [Autorange] and the key redefines itself as [Range Hold] as seen in figure 3.3. Simultaneously, the turndown label is transformed into a [Range Selector] key which continues to show the currently active range. However, the current turndown is locked in when using the Range Hold mode.

To select a different turndown, touch the [Range Selector] key directly above [Range Hold] and a drop-down menu appears similar to the one seen in figure 3.4. This menu shows all of the available turndowns. Different colors are used to distinguish Primary and Secondary Transducer ranges. The currently active range is highlighted with a yellow background. Touch any range other than the yellow one to select a different active turndown.

An important feature of the 8100 is that transducers can easily be changed. A transducer can be replaced in the 8100 in less than 30 seconds, with no tools required. Each installed transducer identifies itself to the system using its on-board stored data. Among the items stored in this data are the transducer serial number, curve characterizations and calibrations for each turndown, the dates of calibration, and the transducer's software version.

> **NOTE:** *There is no alarm or signal that a transducer has been removed or exchanged. If security is an issue, a visible seal or calibration sticker might be placed on the front panel in such a manner that it must be broken to gain access to the transducers.*

Pressure Label

To the right of the [Turndown] key in figure 3.3 is a larger label showing the measured pressure value, "14.4455". This large label always displays the current pressure reading.

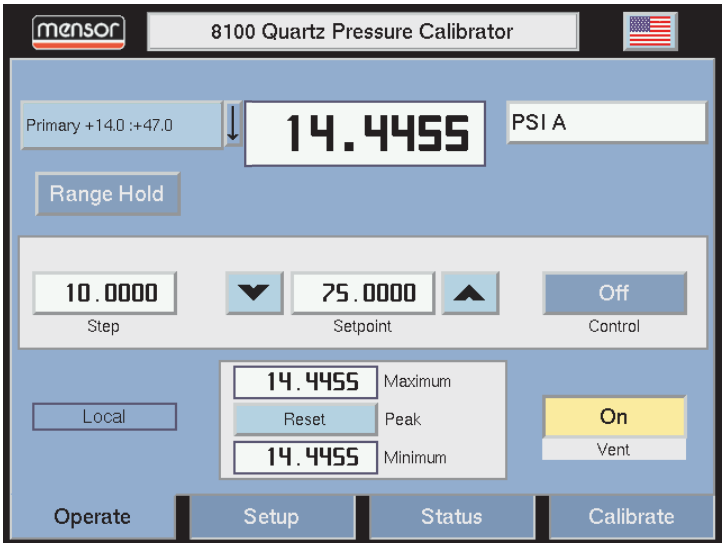


Figure 3.3 - Display with [Range Hold]

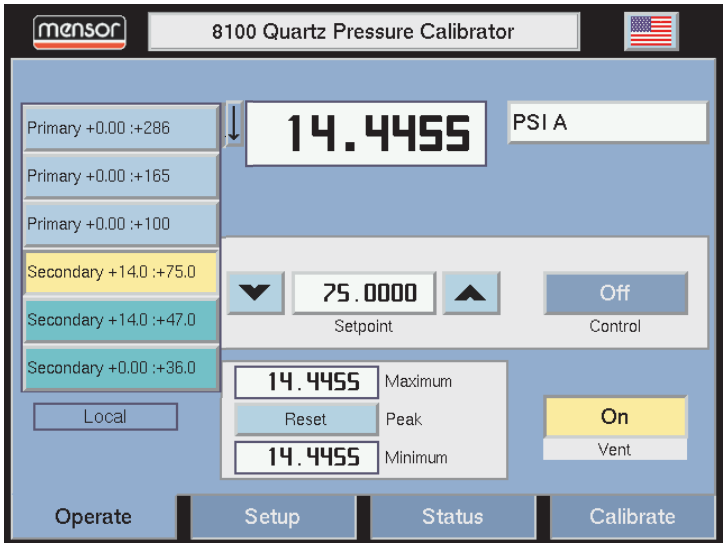


Figure 3.4 - [Range Selector] Drop-down Menu

Pressure [Units] Key

Next to the pressure label is the [Units] key, shown here as [PSI A]. Touch [PSI A] and after a slight pause a pop-up menu of pressure units will appear as in figure 3.5. This menu includes [User 1] and [User 2] keys, which can be custom values defined by the user. See "Sensor Setup" for details on assigning user values to these two keys.

The current units are highlighted by a yellow background. Touch any other [Pressure Units] key, then press [OK] to enable a change and return to the previous operation screen. All of the displayed pressure values will have changed to correspond to the newly selected units at the correct conversion ratio.

> **NOTE:** *Some pressure units can cause a number to be too long for the value window. In those cases the value will be abbreviated with an "m" (milli), "k" (kilo), or "M" (mega) multiplier appended to the range in the range drop list.*

Barometric Reference Transducer

The Barometric Reference Transducer is a very stable, measure only, absolute pressure device used to accurately measure local atmospheric pressure. The owner of an 8100 can purchase a Barometric Reference Transducer as an add-on. Simply insert the Barometric Reference Transducer into the appropriate berth in the pneumatic module to immediately enable the gauge pressure emulation on natively absolute instruments or absolute pressure emulation on natively gauge instruments.

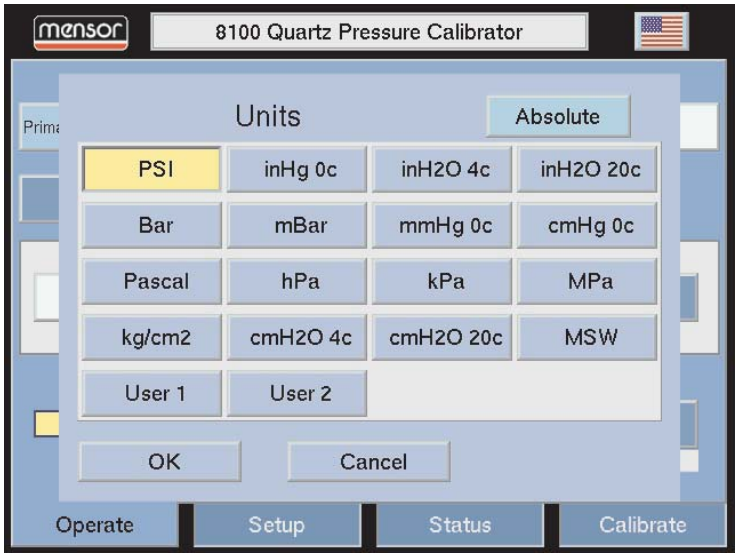


Figure 3.5 - Units Selection Window

> **IMPORTANT! On absolute units, in order to achieve maximum accuracy in gauge emulation mode, the barometric reference transducer should be calibrated against the internal pressure transducers. The 8100 will perform this calibration automatically, after pressure has stabilized, when the instrument is placed in the Vent mode. To demonstrate this feature, open the engineering units dialog and select gauge. Close the dialog and press the Vent button. After several seconds the pressure reading should autozero. You can try this in the absolute mode by electing to display the barometric reading on the main screen (Setup->Instrument->Optional Display->Barometer) and watch the barometric reading match the pressure reading.**

Gauge Pressure Emulation Key

On absolute units with the barometric reference transducer in place, set the 8100 for gauge pressure measurement and control by touching [Pressure Units] which will display the Units pop-up window shown in figure 3.5. In the upper right corner of this window is an [Absolute/Gauge] toggle key. Press [Absolute] to change to [Gauge], then press [OK]. The operation screen now shows Units [GE] in place of Units [A]. The "GE" indicates that the measurement and control values are in Gauge Emulation pressure units.

In the Gauge Emulation mode the atmospheric pressure reading from the barometric reference transducer is subtracted from the absolute pressure reading of the active channel to emulate a gauge pressure.

> **NOTE:** *Gauge emulation mode only adds the additional uncertainty of the resolution of the barometric reference transducer and its drift between zeroing, or approximately 0.00011 PSI to the uncertainty of the 8100. The absolute accuracy of the barometric reference sensor is <u>not</u> added because in vent mode, its output is matched to the high accuracy quartz sensor.*

Absolute Pressure Emulation Key

On gauge units, with the barometric reference transducer in place, set the 8100 for absolute pressure measurement and control by touching [Pressure Unit] which will display the Units pop-up window. In the upper right corner of this window

is an [Absolute/gauge] toggle key. Press [Gauge] to change to [Absolute], then press [OK]. The operation screen now shows Units [AE] in place of Units [G]. The "AE" indicates that the measurement and control values are in absolute emulation pressure units.

In Absolute Emulation mode the atmospheric pressure reading from the barometric reference transducer is added to the gauge pressure reading of the active channel to emulate an absolute pressure.

> **NOTE:** *Absolute emulation mode adds the total additional uncertainty of the barometric reference transducer to the uncertainty of the 8100 or approximately 0.0015 PSI.*

[Step Value] Key

The horizontal band through the center of the display is reserved for pressure control functions. The left end item in this band is the [Step Value] key. The step value displayed in figure 3.3 is [10.0000]. This is the incremental pressure subtracted from or added to the Setpoint value each time a [Step Down] or [Step Up] key is used. To change the step value touch the [Step Value] key and the step entry pad of figure 3.6 will appear.

This number pad shows the maximum and minimum values applicable to the active turndown. There is also a Current Value and a New Value window. Enter a new step number and then press [OK], or else touch [Cancel] to return to the operate screen without changing the step value.

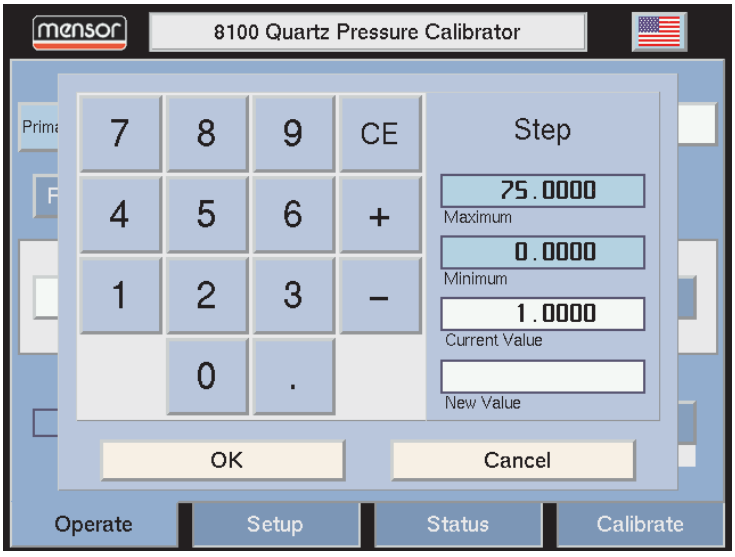


Figure 3.6 - Window to Change Step Value

[Step Down] and [Step Up] Keys

An arrow key is located on either side of the [Setpoint Value] key; one for [Step Down], and another for [Step Up]. An arrow key will change the setpoint by the step value with each key press.

Control Pressure [Setpoint Value]

The number displayed inside the [Setpoint Value] key is the setting for a controlled pressure output. When the Control [Off] key at the left end of the center band is switched to [On] the regulator will attempt to present that precise pressure to the Measure/Control port on the rear panel. The setpoint number is changed either by using the [Step Down] and [Step Up] keys, or by touching the [Setpoint Value] key to input a new number.

If the displayed number is beyond the range of a newly selected turndown, the number will change to a control value within the limits of the new turndown. The setpoint will change in value automatically, but it will not restore automatically if the previous turndown is reselected.

Local Label

Below the Control Band is a 'Local' label (figure 3.3) to indicate that an IEEE-488 host is not trying to control the instrument at this time. A 'Remote' flag will appear automatically with the first IEEE-488 command received by the 8100.

Optional Display

In figure 3.3 the optional display shows both the maximum and minimum Peak pressure measurements. Use the [Reset] key to begin a new measurement cycle of peak values.

Other features can be selected for display in this window as described later under "SETUP TAB".

Vent [On / Off] Key

As seen in figure 3.3 the Vent is [On], which means the manifold is open to atmosphere. Touch the [On] key to toggle the Vent [Off], thereby sealing the pressure system. With both Vent [Off] and Control [Off] the 8100 is in Measure mode.

Bottom Tabs

Each of the three remaining bottom tabs, [Setup], [Status], and [Calibrate] are discussed next under separate headings.

SETUP TAB

Touch the [Setup] tab on the bottom of the screen and a new display appears with another set of tabs across the top. These tabs are labeled [Instrument], [Sensor], [Controller], [IEEE-488] and [Serial]. The tab and screen that was last accessed is active by default. The top tabs are used to set up conditions for the related feature/ function as explained below.

Instrument Setup

Press the [Instrument] tab to access the Instrument Setup page like figure 3.7. From there the user can select the Optional Display to be [Off], or have it show either [Peak], [Rate], or [Barometer] readings. The content of the three active displays are:

[Peak] displays the highest and lowest pressure points since the last [Reset], or power up. Figure 3.1 shows an example of the Peak feature displayed in this window.

[Rate] reports the rate at which the measurand is changing in units/second. See figure 1.8 for an example of the Rate display.

Press [Barometer] to keep the current atmospheric pressure reading in the display window (figure 3.7).

Below the Optional Display bar is a [Default] key. Touch this key to immediately reset the instrument to the following conditions:

- Control Off
- Vent Off
- Autorange On
- Step value: Ignore if valid; Set to 1 if out of range
- Setpoint: Ignore if valid; Set to 0 if out of range
- Restart Peak Maximum and Peak Minimum
- Set Sensor Filter to Normal
- Set Control Rate to Maximum
- Set Maximum allowable Control point to match the highest maximum turndown in the instrument
- Set Minimum allowable Control point equal to the lowest minimum turndown in the instrument
- Set the Stable Window to 0.003% FS
- Set the Stable Delay to 2 seconds.
- Any existing conditions not covered above will be unaffected.

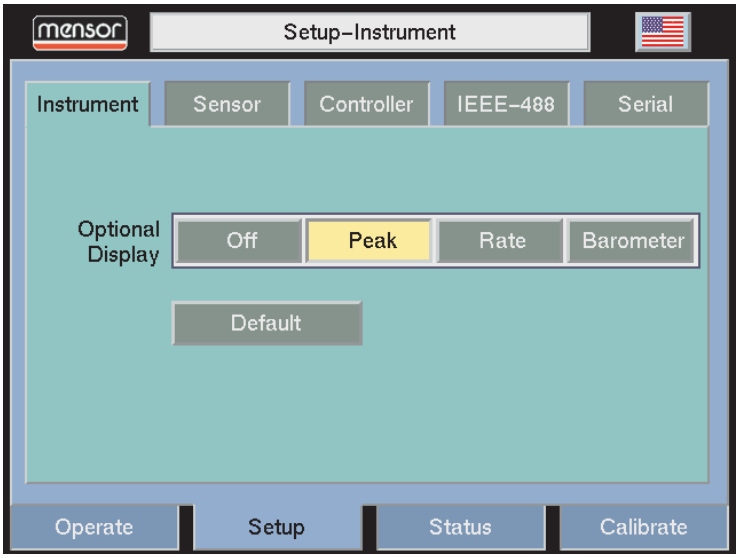


Figure 3.7 - Setup-Instrument Screen

Sensor Setup

Touch the [Sensor] tab and figure 3.8 will appear. The Filter is an electronic filter to smooth out the pressure readings. Because of the differences in resolution, more filtering may display a more stable reading for some pressure units. Select the best filter for the current units.

User Units (1 and 2) allow the user to enter customized pressure units. Touch [PSI] and it will toggle to Pascal. Press a [Value] key to enter a custom multiplier to equal either one PSI, or one Pascal, whichever is showing in the units key.

Controller Setup

Figure 3.9 shows the Controller Setup screen. This screen is used to set the control parameters for the entire instrument, regardless of which turndown is selected.

A Rate (slewing speed) which best suits the user's test requirements is selected here. The trade-off is that the faster the rate, the greater the overshoot.

In setting the limits, the maximum cannot exceed the upper limit of the primary transducer, nor can the minimum limit be less than the least low end of all the turndowns. To change a limit touch either of the [Limit Value] keys and enter the new value.

To change the Stable Window or Stable Delay press the appropriate key. The pop-up number pad will show the upper and lower limits for the item being edited.

The stablewindow is the % of full span that the instrument can deviate below or above the setpoint and still display a stable flag.

The stabledelay is the number of seconds that the instrument must remain stable before the stable flag is displayed.

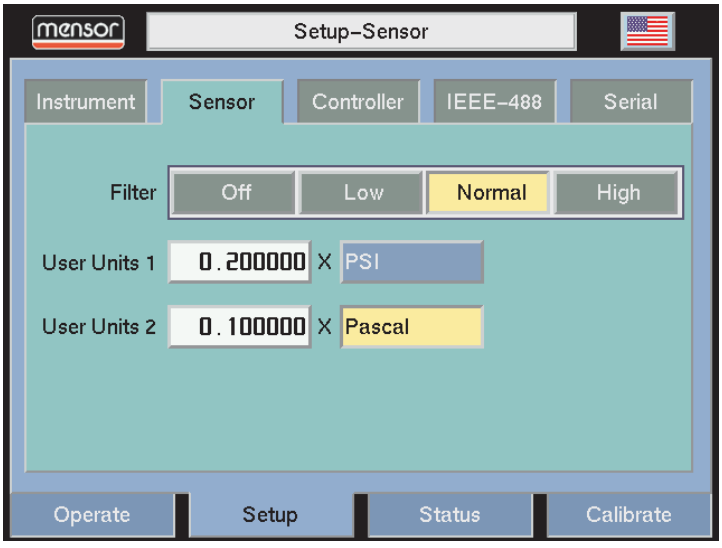


Figure 3.8 - Setup-Sensor Screen

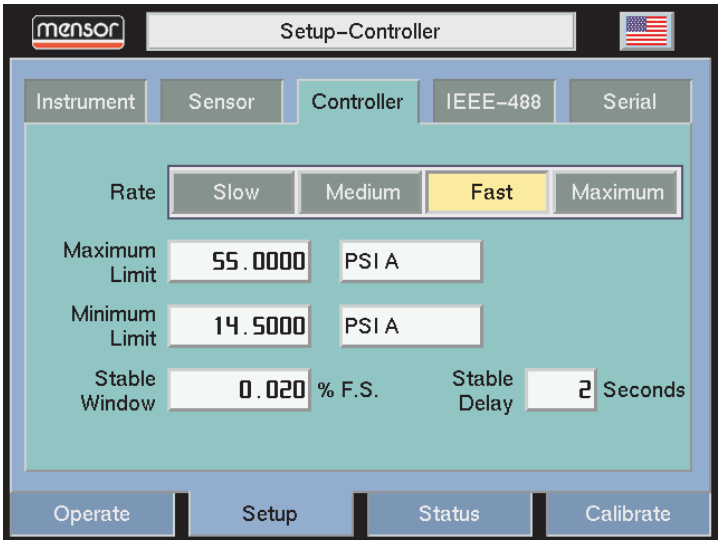


Figure 3.9 - Controller Setup Screen

IEEE-488 Setup

A [Number] key showing the IEEE-488 address is the only item displayed on the Setup screen. Touch the number and the keypad and information seen in figure 3.10 will appear. This screen shows the available address range, the current address, and an entry window for entering a new IEEE-488 address. Press [OK] after making a change, or [Cancel] to preserve the current address.

Serial Setup

Use this screen (figure 3.11) to set the operating parameters for the RS-232 serial port. On the horizontal line of keys for each parameter, press the key that displays the desired data value. Each line will have one highlighted key to indicate the selected value.

When the correct values have been selected for all four parameters simply touch any of the tabs across the top or the bottom of the screen to move on to another function.

STATUS TAB

The status screens are a set of five informational pages used to review current data or settings for the various subjects. Status tabs function in the same manner as the Setup tabs. Touch the [Status] tab at the bottom of the screen and a full set of tabs appear across the top of the display. The Status page that was last accessed is displayed by default. These top tabs are labeled [Instrument], [Sensor], [Controller], [Solenoid] and [Remote].

Instrument Status

Press the [Instrument] tab to see a display similar to figure 3.12. This screen shows the Model (8100), the instrument Serial Number, the Date of Manufacture, and the current system software version number. Notice that system software and transducer software are different from each other. Each transducer reports its own serial number and software version numbers in the sensor status screen.

Figure 3.11 - Setup-Serial Screen

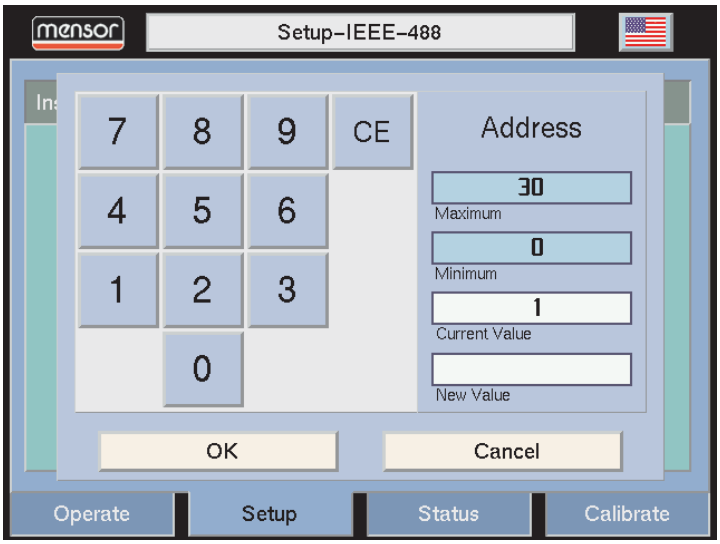


Figure 3.10 - IEEE-488 Address Setup Screen

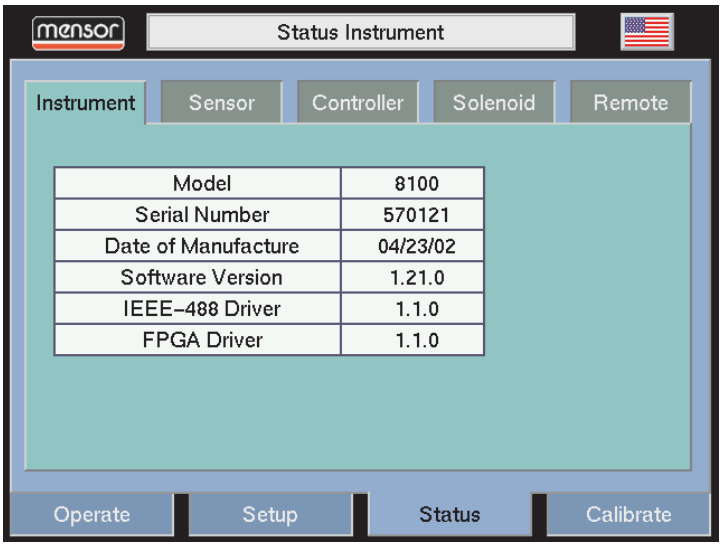


Figure 3.12 - Status-Instrument Screen

Sensor Status

Figure 3.13 shows a status screen that is seen when the [Sensor] tab is used. Each transducer in the system has a separate data window, and a separate line is used to record data for up to four turndowns within the transducer. The displayed data for each turndown includes the range Minimum and Maximum values (for the current measurement units), the date of calibration, and a status window that shows either "OK" for a valid turndown, or "N/A" for a non-existent turndown. The separated data line below the main table reports the serial number, version number for this transducer, and native mode of the sensor..

Under the data table are three transducer selection keys, [Primary], [Secondary], and [Barometer]. Press any of these to access the data window for the indicated sensor.

> **NOTE:** *The Barometric Reference Transducer is a precision Barometer, and is not capable of additional turndowns.*

Controller Status

The Controller Status screen illustrated in figure 3.14 is an interactive diagnostic display. The four modulating valves of the regulator can be operated from this screen to perform functional tests on the regulator. Flow through the regulator valves is controlled by the three [Flow Rate] keys, with windows to report the current pressure and the flow rate.

Information on the use of these features is presented in Section 5, *Maintenance*.

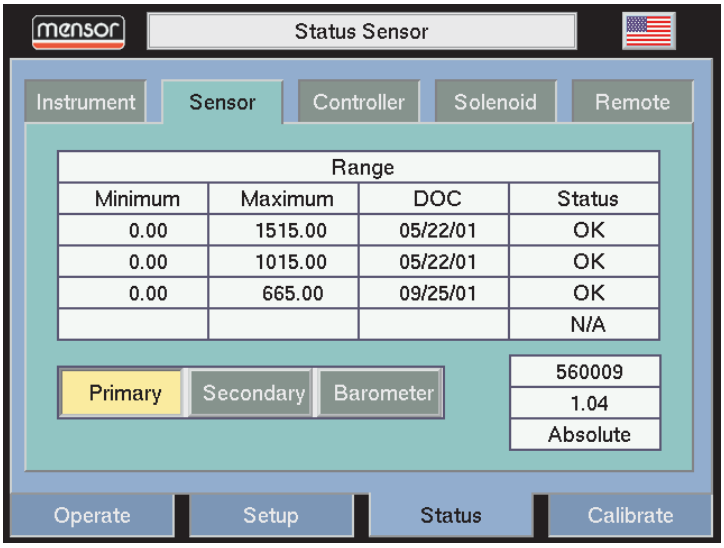


Figure 3.13 - Status-Sensor Screen

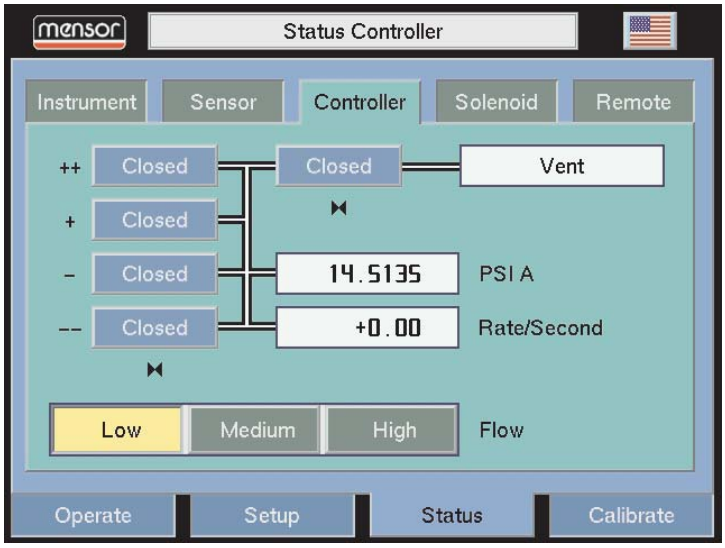


Figure 3.14 - Status-Controller Screen

Solenoid Status

The Solenoid Status screen is displayed in figure 3.15. This is also an interactive diagnostic display used for troubleshooting the overall pneumatic system of the 8100. While using this test procedure the Output shutoff valve L5, is closed to prevent damage to any devices connected to the Measure/Control port.

Proper use of these features are described in Section 5, *Maintenance*.

PROCEED WITH CAUTION!
This test feature is a powerful troubleshooting tool, but it incurs a dangerous potential for misdirecting high pressures which may be present in the system. Study the schematic of Figure 5.1 to understand the possible consequences of various pressure routings.

Remote Status

Figure 3.16 shows the Remote Status screen. This screen records the last ten remote commands received by the 8100.

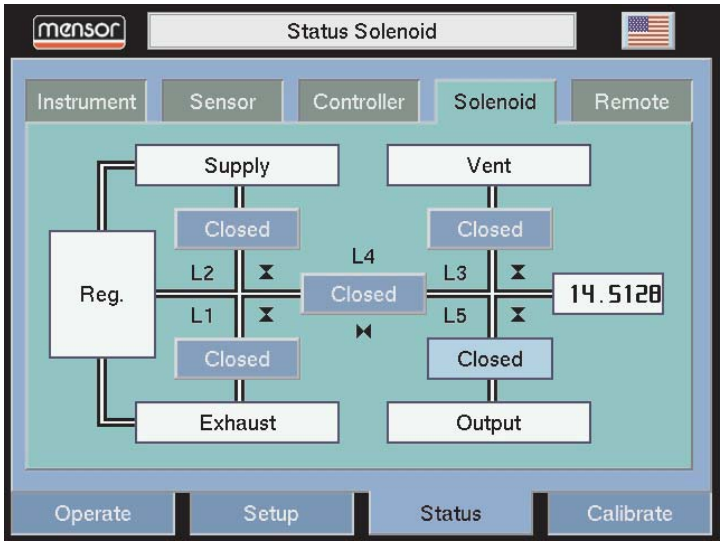


Figure 3.15 - Status-Solenoid Screen

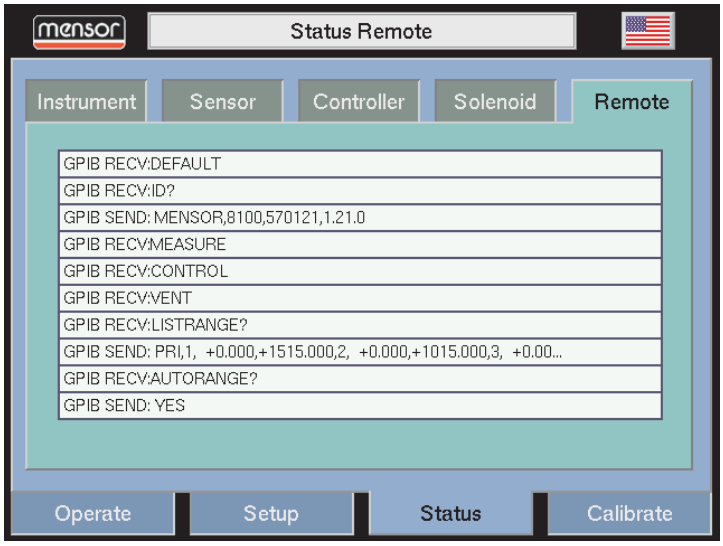


Figure 3.16 - Status-Remote Screen

CALIBRATE TAB

The Calibration screen shown in figure 3.17 is the first of several screens relating to the calibration functions. This screen allows the user to perform any of the following tasks:

1. Calibrate zero and span values on any turndown open of all installed sensors. Natively absolute 8100's do not allow calibration of the barometric reference transducer;

2. Establish a new Date of Calibration (DOC) for any turndown;

3. Change the system password;

4. Autozero all turndowns at one time.

Notice the padlock icon on the display. This signifies that the indicated values on the screen are not able to be modified until the password has been entered.

If the head correction option was ordered on your 8100 instrument, figure 3.17 will appear different. See figures 8.2 and 8.3 in the *Options* section.

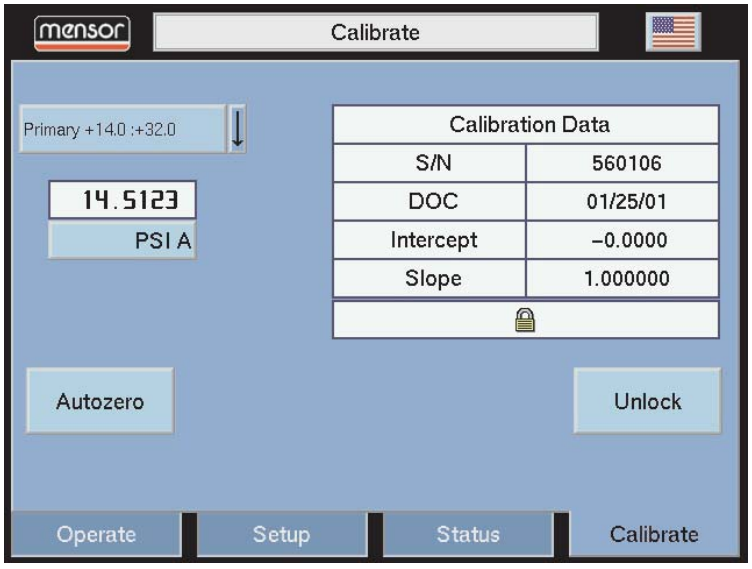


Figure 3.17 - Autozero Screen

[Unlock] Key

Touch [Unlock] to move on to the password screen. Details on this function are included in the *Calibration* section.

[Autozero] Key

The [Autozero] key in figure 3.17 is not "locked". Press this key to have the 8100 automatically re-zero all turndowns that can measure the vented pressure.

For a natively absolute (and absolute emulation) 8100, this automatic function will:

1. Vent the system;

2. Select the turndown with the smallest span that can measure the vented pressure.

3. Record that pressure as "current barometric pressure";

4. Adjust the zero offset of each turndown so the turndown's output equals the "current barometric pressure".

For a natively gauge (and gauge emulation) 8100, this automatic function will:

1. Vent the system;

2. Adjust the zero offset of each turndown that can measure the vented pressure so the turndown's output is equal to zero.

REMOTE OPERATION

This section provides information on two methods of remote communication with the 8100; parallel operation over the IEEE-488-STD bus, and serial operation over the RS-232 bus. The operator must choose which method of remote operation to use since simultaneous use of both methods is not practical. For IEEE-488 operation the host computer must contain an IEEE-488 Communications Board.

To prepare the 8100 for remote operation review the Remote Setup instructions in the *Local Operation* section. IEEE-488 operation requires first setting the instrument address, while RS-232 operation requires several parameters be defined before proceeding.

All of the commands in the following text are the bare commands seen by the 8100 stripped of all programming idioms. Depending on the specific program language used, these commands may have to be preceded by or enclosed in various symbols for transmission. The 8100 commands are not case-sensitive, i.e., upper and lower case commands are interpreted the same.

IEEE-488

The manufacturer of the host IEEE-488 interface board provides software to allow communication between the board and various programming languages. An interactive program for debugging is usually provided as well. Refer to the board manufacturer's documentation for more information.

IEEE-488 Capability Codes

SH1 . . . . . Full source handshake capability
AH1 . . . . . Full acceptor handshake capability
T6 . . . Talker with serial poll and unaddress if MLA
L4 . . . . . Listener with unaddress if MTA
SR1 . . . . . Full service request capability
RL1 . . . . Full remote/local capability including LLO
PP0 . . . . . No parallel poll capability
DC1 . . . . . Full device clear capability
DT1 . . . . . Full device trigger capability
C0 . . . . . No controller capability
E2 . . . . . Tri-state outputs

Interface Functions

The 8100 responds to the following IEEE-488 interface functions:

SRQ — Service Request
A service request is asserted whenever an error is encountered. When the bus controller issues a serial poll the error will be cleared. If the host IEEE board includes automatic serial polling capability, turn this feature off in order to view all errors (see ERROR? command).

LLO — Local Lockout
The front panel keyboard of the 8100 may be locked by sending LLO or the command LOCK ON.

GET — Group Execute Trigger
When this message is received, the 8100 will save the current readings until the next time it is addressed as a talker.

GTL — Go To Local
A GTL message will cause the 8100 return to local operation and unlock the keyboard.

DCL — Device Clear
When this message is received, the 8100 will clear all errors and buffers and remain in the REMOTE mode.

SDC — Selected Device Clear
The effect is the same as DCL.

EOI — End or Identify
May be used as a command or query terminator in the place of, or concurrent with, a terminating linefeed.

Command and Query Format

All commands (messages sent to the 8100) and queries (requests for information from the 8100) follow a common format. The 8100 accepts commands and queries in the form of ASCII strings. The strings are divided into two or three fields. All strings must terminate with a linefeed (<lf>, 0a hex or 10 dec). All fields must be separated with at least one white space character (20 hex or less except 0a hex). Normally an ASCII space (20 hex, 32 dec) is used for the field separator. Lower and upper case letters are optional. Either may be used and mixed to improve readability.

Command/Query Field: Unless otherwise specified, commands are converted to queries by appending a question mark to the command. Table 4.1 lists all of the 8100 command/query keywords.

Data Field: The data field is either in ASCII {*string*} or numeric {*value*} form. In the case of multiple data fields, commas are required to separate the fields. Queries do not have a data field. String (text) or value (numeric) data are acceptable in any of the following formats:

Examples of {*string*} data*:*
ON
OFF
mBar
inHg

Examples of {*value*} data*:*
1
1.0
-5.678
25.68324e-5

Command Set Definitions

In this manual a data entry made up of alpha characters is defined as a string, as opposed to data containing only numbers, such as "Enter 1 for ON or 0 for OFF" where 1 and 0 are defined as values.

The instrument is not case sensitive. Send any combination of upper or lower case text.

Command:
Any command or query listed in Table 4.1.

Separator:
Space (SP).
Exception: 0x0a, (LF), which is used to terminate each command.

Data:
ASCII representations of numbers, {*value*}, or alpha characters, {*string*}, data as defined above. When sending code a literal variable replaces the braces and the enclosed character(s) shown in the following examples.

Termination:
Linefeed (LF) is used to signal the end of a command statement. For IEEE-488 operation "EOI" is an acceptable alternative.

Always send commands in one of the following formats:

1. [Command] [Termination];

2. [Command] [Separator] [Data] [Termination];

3. Queries are special instructions in the form: [Command?] [Termination] where the question mark, "?", immediately precedes the terminator.

When a valid query is received, the 8100 will return {*data*} terminated by CR and LF.

Floating point data is returned in the current engineering units in exponential format.

Output Formats

Pressure readings are returned in exponential notation in a format according to the OUTFORM command as follows:

1. <sp> pressure value <cr><lf>

2. <sp> pressure, units number, mode <cr><lf>

3. <sp> pressure, pressure rate <cr><lf>

4. <sp> pressure, minimum peak, maximum peak<cr><lf>

5. <sp> pressure, active sensor (P or S), active turndown (1-4)<cr><lf>

6. <sp> pressure, control point, "stable" or "slewing"<cr><lf>

7. <sp> pressure, "no barometer" or baro reading<cr><lf>

Command/Query List

Table 4.1 lists all of the current 8100 specific commands and queries. The 8100 will also respond to many commands and queries designed for a Mensor PCS 400 controller. See the heading "PCS 400 Remote Emulation" near the end of this section for details and the relevant command set.

Table 4.1 - Command/Query List

Ref	Command	Data	Function/Response
1	?	See "Output Format" text	Returns data per the current Output Format.
2	Acquire?	<sp>{NAME}<cr><lf>	Acquires control of the 8100 where {name} is a ASCII string from 1 to 15 characters long that describes the computer desiring control. The successful response will be: 'YES,name' where name is the uppercase version of the name passed. If the 8100 is already being controlled by another computer, this query will respond with: 'NO,name' where name is the computer that has control.
3	Address	{0 to 31}	Sets the GPIB ADDRESS.
4	Address?	<sp>{value}<cr><lf>	Returns a GPIB address within 00 to 31.
5	Autorange	{ON or OFF}	Toggles Autorange function to its opposite state, either ON or OFF (enabled or disabled).
6	Autorange?	<SP>{ON or OFF}<cr><lf>	Returns current Autorange status as ON or OFF.
7	Autozero	none	Re-zero all ranges that can measure the vented pressure. These adjustments are not password protected and are not saved through power cycles. This command takes approximately 60 seconds.
8	Autozero?	S,T,X,X	Returns autozero data where S represents state (responses can be 0 = complete, 1 = local autozero, or 2 = remote autozero), T represents the estimated remaining time to complete in seconds, and X is a (0) character since this data location is not used at this time.
9	Autozeroabort	none	Aborts zero.
10	Barocaldisable	{YES or NO}	Disables the vent mode baro cal function (default = NO).
11	Barocaldisable?	<sp>{YES or NO}<cr><lf>	Returns YES or NO reflecting the state of the baro-cal-disable.
12	Caldisable	{ON or OFF}	Disables the zero and span commands (default = ON). When the cal-disable is ON, the ZERO and SPAN commands are disabled.
13	Caldisable?	<SP>{ON or OFF}<cr><lf>	Returns current caldisable status as ON or OFF.
14	Control	none	Places the 8100 in CONTROL mode.
15	Control?	<sp>{YES or NO}<cr><lf>	Returns YES if currently in CONTROL mode; NO if other mode.
16	CRate	{SLOW, MEDIUM, FAST or MAXIMUM}	Sets the control RATE to one of four choices.
17	CRate?	<sp>{string}<cr><lf>	Returns the current control RATE setting.
18	Default	none	Restores DEFAULT values.
19	DOC	{mm/dd/yyyy}	Sets this as the DATE OF CALIBRATION for the active range.
20	DOC?	<sp>{mm/dd/yyyy}<cr><lf>	Returns the DATE OF CALIBRATION for the active range.
21	DOM?	<sp>{mm/dd/yyyy}<cr><lf>	Returns the DATE OF MANUFACTURE.
22	Error?	<sp>{string}<cr><lf>	Returns a text description of the next error in the error queue.
23	Filter	{OFF, LOW, NORMAL or HIGH}	Sets the reading filter value to one of four choices.
24	Filter?	<sp>{string}<cr><lf>	Returns the current filter setting {string} of OFF, LOW, NORM or HIGH.
25	Gasdensity	n {numeric value}	Sets the gas density where n = gas density in lb/cu ft (optional).
26	Gasdensity?	<sp>{numeric value}<cr><lf>	Returns gas density (optional).
27	Gastemp	n {numeric value}	Sets temperature where n = temperature in °F (optional).
28	Gastemp?	<sp>{numeric value}<cr><lf>	Returns gas temperature (optional).
29	Height	n {numeric value}	Sets height where n = height in inches (optional).

Continued on next page ...

Table 4.1 - Continued

Ref	Command	Data	Function/Response
30	Height?	<sp>{numeric value}<cr><lf>	Returns height (optional).
31	ID?	<sp>MENSOR,8100, {ssssss},{v.vv}<cr><lf>	Returns the instrument identity where {ssssss} is the serial number, and {v.vv} is the software version number.
32	Keylock	{YES or NO}	YES to lock, or NO to unlock the on-screen keys.
33	Keylock?	<sp>{YES or NO}<cr><lf>	Returns current keylock status as YES or NO.
34	List?	<sp>Pri,{x,x,x};Sec,{x,x,x};Bar,1	Returns list of available turndowns on installed transducers. “x” will be zero (0) if there are no available turndowns.
35	Listrange?	<sp>Pri,1,x,x,2,x,x,3,x,x...	Returns list of ranges available by turndown.
36	Locale	xx_xx{locale code}	Sets language and country code: Locale Code / Language / Country en_us / english / us en_ca / english / canada en_gb / english / great brittain fr_fr / french / france fr_ca / french / canada es_es / spanish / spain es_mx / spanish / mexico de_de / german / germany it_it / italian / italy zh_ch / chinese / china ko_ko / korean / korea ja_jp / japanese / japan
37	Locale?	xx_xx	Returns current language and country locale.
38	Localgravity	n{numeric value}	Sets local acceleration of gravity where n = local acceleration of gravity in ft/sec^2 (optional).
39	Localgravity?	<sp>{numeric value}<cr><lf>	Returns local gravity (optional).
40	LowerLimit	Value inside primary xducer range on turndown #1 in current units	Sets the 8100 lower control limit.
41	LowerLimit?	<sp>{xxxxxxx}<cr><lf>	Returns the lower control limit in the current pressure units.
42	Measure	none	Places 8100 in MEASURE mode.
43	Measure?	<sp>{YES or NO}<cr><lf>	Returns YES if currently in MEASURE mode; NO if other mode.
44	Menu	{OPERATE,SETUP, STATUS, or CALIBRATE}	Sets the displayed menu to OPERATE, SETUP, STATUS, or CALIBRATE.
45	Menu?	<sp>{OPERATE,SETUP, STATUS, or CALIBRATE}<cr><lf>	Returns the current menu.
46	Mode	{STANDBY, MEASURE, CONTROL, or VENT}	Sets the operation mode of the 8100.
47	Mode?	<SP>{STANDBY,MEASURE, CONTROL, or VENT}<cr><lf>	Returns the current mode of the 8100.
48	Outform	{1 to 7}	Sets the output format (see table 4.2 in *Remote Operation* section.
49	Outform?	<sp>{x}<cr><lf>	Returns the current output format (see table 4.2).
50	PType	{A or G} or {ABSOLUTE or GAUGE}	Sets 8100 to Abs or Ga pressure; Ga pressure is derived by combining readings from a pressure transducer and the barometric ref transducer.
51	PType?	<sp>{ABSOLUTE or GAUGE}<cr><lf>	Returns A (abs) or G (ga) for current pressure type.
52	RangeMax?	<sp>{xxxxxxx}<cr><lf>	Returns 7 character value in current units for maximum range of the current transducer and turndown.

Continued on next page ...

Table 4.1 - Continued

Ref	Command	Data	Function/Response
53	RangeMin?	<sp>xxxxxxx<cr><lf>	Returns 7 character value in current units for minimum range of the current transducer and turndown.
54	Rate?	<sp>{xxxxxxx}<cr><lf>	Returns the RATE reading in the current units per second.
55	Release?	<sp>{NAME}<cr><lf>	Releases control of the 8100 and returns 'YES,AVAILABLE' if 'name' matches the current controlling computer name. Returns: 'NO,name' if 'name' does not match.
56	SBaud	{9600, 19200, 38400, 57600}	Sets the serial BAUD.
57	SBaud?	<sp>{xxxxx}<cr><lf>	Returns the current serial BAUD setting.
58	SData	{7 or 8}	Sets the serial DATA bits.
59	SData?	<sp>{x}<cr><lf>	Returns the serial DATA bits number; either 7 or 8.
60	Sensor	{T, X}	Sets the active TURNDOWN where T is either Primary or Secondary, and X is either 1, 2, 3, or 4 for the selected turndown within that transducer.
61	Sensor?	<sp>{T,X}<cr><lf>	Returns the active transducer and turndown as above.
62	SensorID?	<sp>{Mensor QRS,SNxxxxx xx,VER v.vv}<cr><lf>	Returns the active transducer's IDENTITY including the sensor style (QRS), serial number (xxxxxx) and software version number (v.vv).
63	Setpt	{A value inside the upper/lower limit settings, and inside the range of the active turndown}	Sets the control SETPOINT value in the current units.
64	Setpt?	<sp>{xxxxxxx}<cr><lf>	Returns the control SETPOINT value in the current units.
65	Span	{Desired pressure, or ?}	Sets span on active transducer (must be > 50% FS, and within 1% limit), or ? to clear previous value.
66	Span?	<sp>{xxxxxxx}<cr><lf>	Returns span scale factor for the active turndown.
67	SParity	{EVEN, ODD or NONE}	Sets serial PARITY.
68	SParity?	{<sp>{TTTT}<cr><lf>	Returns TEXT as above.
69	SStop	{1 or 2}	Sets the serial stop bit(s).
70	SStop?	<sp>{x}<cr><lf>	Returns the serial stop bit, 1 or 2.
71	Stable?	<sp>{YES or NO}<cr><lf>	Returns YES if stable, not stable returns NO.
72	StableDelay	{0 to 65535}	Sets the STABLE TIME to the number of seconds entered.
73	StableDelay?	<sp>{xxxxxxx}<cr><lf>	Returns the STABLE TIME in number of seconds.
74	StableWin	{0 to 100}	Enter STABLE WINDOW as a % FS for the active turndown.
75	StableWin?	<sp>{x}<cr><lf>	Returns the current STABLE WINDOW setting for the active turndown.
76	Standby	none	Sets instrument to STANDBY mode.
77	Standby?	<sp>{YES or NO}<cr><lf>	Returns YES if 8100 is in STANDBY, NO if otherwise.
78	Step	{A value between upper and lower limits, within the active turndown's range}	Sets the control pressure incremental STEP value.
79	Step?	<sp>{xxxxxxx}<cr><lf>	Returns the current control STEP setting.
80	Step+	<n>	Steps up by current step value if no <n> is used, or by the step value <n>.
81	Step-	<n>	Steps down by current step value if no <n> is used, or by the step value <n>.
82	Units	{Units Code, or Output Format text from Measurement Units table (Table 9.1 in *Appendix*)}	Sets the measurement units for the instrument.

Continued on next page ...

Table 4.1 - Continued

Ref	Command	Data	Function/Response
83	Units?	<sp>{xx}<cr><lf>	Returns the current UNITS setting.
84	Unlock	none	Forces release of control of 8100.
85	UpperLimit	{Value within primary xducer range on #1 turndown in current units}	Sets the UPPER CONTROL LIMIT for the active transducer.
86	UpperLimit?	<sp>{xxxxxxx}<cr><lf>	Returns the UPPER CONTROL LIMIT for the active transducer.
87	Vent	none	Places the instrument in VENT mode.
88	Vent?	<sp>{YES or NO}<cr><lf>	Returns YES if in Vent mode, otherwise returns NO.
89	Zero	{Desired pressure or ?}	Sets zero to the current pressure, or ? to clear previous value.
90	Zero?	<sp>{xxxxxxx}<cr><lf>	Returns the ZERO OFFSET value for the active transducer.

RS-232 SERIAL COMMUNICATION

The serial communication port allows the 8100 to communicate in RS-232 format with computers, terminals, PDAs, or similar hosts. Refer to the IEEE-488 text at the beginning of this section for additional information relating to commands and responses.

Cable Requirements

RS-232 communications are transmitted over a three conductor, shielded cable terminated in a standard DB9S connector on the instrument end, and usually the same connector on the host end. Figure 4.1 illustrates the proper pin-outs for the interconnect. Notice that each pin 2 is connected to pin 3 on the opposite end. This configuration is commonly referred to as a 9-pin null modem cable.

Setup

Prior to first time use of RS-232 the four serial parameters, Baud, Data Bits, Stop Bits, and Parity must be set to match the host setup. These are selected from the Setup-Serial screen of figure 3.11, or they can be set remotely from an IEEE-488 host.

RS-232 Command Format

The format for RS-232 commands is the same as those given for IEEE-488 operation except that the termination character may be either <cr> or <lf>.

Commands must be sent in ASCII format and terminated with either a line feed (<lf>) or a carriage return (<cr>). Commands are not case sensitive, and both upper and lower case characters are accepted. Each query returns a response. If an error is detected the response will include an error message.

One of the first commands issued when starting serial communications should be “Keylock Yes”. This will disable the on-screen keys and tabs, and place the “Keylock” label on the screen. Turning Keylock on prevents the potential conflicts that could occur if someone pressed an on-screen key, either intentionally or by accident.

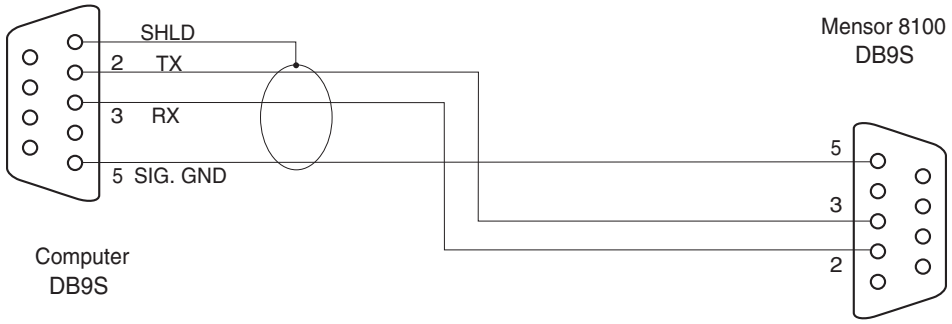


Figure 4.1 - Serial Cable

PCS 400 REMOTE EMULATION

The Mensor PCS 400 is the earlier generation equivalent to the 8100. There is some compatibility between the 8100 and a PCS 400 in that the 8100 will respond to many of the remote instructions as if it were the older instrument.

Table 4.2 is a list of the remote commands and queries which the 8100 will recognize and respond to.

A space between elements in a command indicate a required delimiter. Use either a space, comma or tab where such a delimiter is indicated. A full description of the syntax and use for each of these commands and queries are presented in the PCS 400 manual.

NOTE: *All pressure values will be in the currently active pressure units unless otherwise stated.*

Table 4.2 - PCS 400 Command/Query List

Ref	Command	Data	Function/Response
1	_pcs4 func meas		Instrument placed in measure mode.
2	_pcs4 func ctrl <value> <unitno>		Instrument placed in control mode at <value> pressure in <unitno> units.
3	_pcs4 func stby <unitno>		Instrument placed in standby mode in <unitno> units.
4	_pcs4 func vent <unitno>		Instrument placed in vent mode in <unitno> units.
5	_pcs4 unit <unitno>		Sets the instrument to specified engineering units.
6	_pcs4 cal zero <value>		Sets the zero of the active transducer to <value>.
7	_pcs4 cal span <value>		Sets the span of the active transducer to <value>.
8	_pcs4 cal_disable on		Prevents zero or span calibrations.
9	_pcs4 cal_disable off		Enables zero or span calibrations if previously disabled.
10	_pcs4 default		Sets default values into instrument.
11	_pcs4 ctrl <value>		Sets control value. Will take effect immediately if instrument is in control mode.
12	_pcs4 ctrlmax <value>		Sets maximum control value.
13	_pcs4 ctrlmin <value>		Sets minimum control value.
14	_pcs4 autorange <value>	0 or 1	1 turns autorange on, 0 turns autorange off.
15	_pcs4 outform <digit>		Sets output format.
16	_pcs4 stablewindow <value>		Sets the pressure window that is used to indicate pressure is stable.
17	_pcs4 stabledelay <value>	1 to 255	Sets the number of consecutive readings that the pressure must remain within the stable window for a pressure stable indication.
18	_pcs4 stat?		Returns Mode and stable flag status “mode, stable CR LF”.
19	_pcs4 id?		Returns instrument ID.
20	_pcs4 err?		Returns the error number and description.
21	_pcs4 ctrl?		Returns the current control point in current engineering units.
22	_pcs4 ctrlmax?		Returns current maximum control pressure.
23	_pcs4 ctrlmin?		Returns current minimum control pressure.
24	_pcs4 xducer?		Returns the number of the currently active transducer.
25	_pcs4 autorange?		Returns 1 if in autorange, 0 if in range hold.
26	_pcs4 rangemin?		Returns the minimum pressure of the active transducer.

Continued on next page ...

Table 4.2 - Continued

Ref	Command	Data	Function/Response
27	_pcs4 rangemax?		Returns the maximum pressure of the active transducer.
28	_pcs4 outform?		Returns the current output format.
29	_pcs4 stablewindow?		Returns the pressure tolerance allowed for a stable pressure indication as a % of span of the active transducer.
30	_pcs4 stabledelay?		Returns the number of readings that must be within the stable window before a stable pressure is indicated.
31	_pcs4 unit?		Returns the current engineering units and the type of transducer (A, G, D).
32	_pcs4 zero?		Returns the stored zero offset of the active transducer and turndown in the current pressure units.
33	_pcs4 span?		Returns the stored multiplication factor from the active transducer and turndown.

MAINTENANCE

The 8100 was designed for maintenance-free operation. User maintenance is not recommended beyond replacement of parts listed in table 5.1. If you have questions not covered by this manual, call 1.800.984.4200 (USA only), or 1.512.396.4200 for assistance, or send an E-MAIL to tech.support@mensor.com.

BEYOND THE WARRANTY

Take advantage of Mensor's expert product care. Mensor Corporation provides complete maintenance and calibration services, available for a nominal fee. Our service staff is knowledgeable in the innermost details of all of our instruments. We maintain units that are in operation in many different industries and in a variety of applications, and by users with a wide range of requirements. Many of these instruments have been in service for over twenty years, and continue to produce excellent results. Returning your instrument to Mensor for service benefits you in several ways:

1. Our intimate knowledge of the instrument assures you that it will receive expert care.
2. In many cases we can economically upgrade an older instrument to the latest refinements.
3. Servicing our own instruments which are used in "real world" applications keeps us informed as to the most frequent services required. We use this knowledge in our continuing effort to design better and more robust instruments.

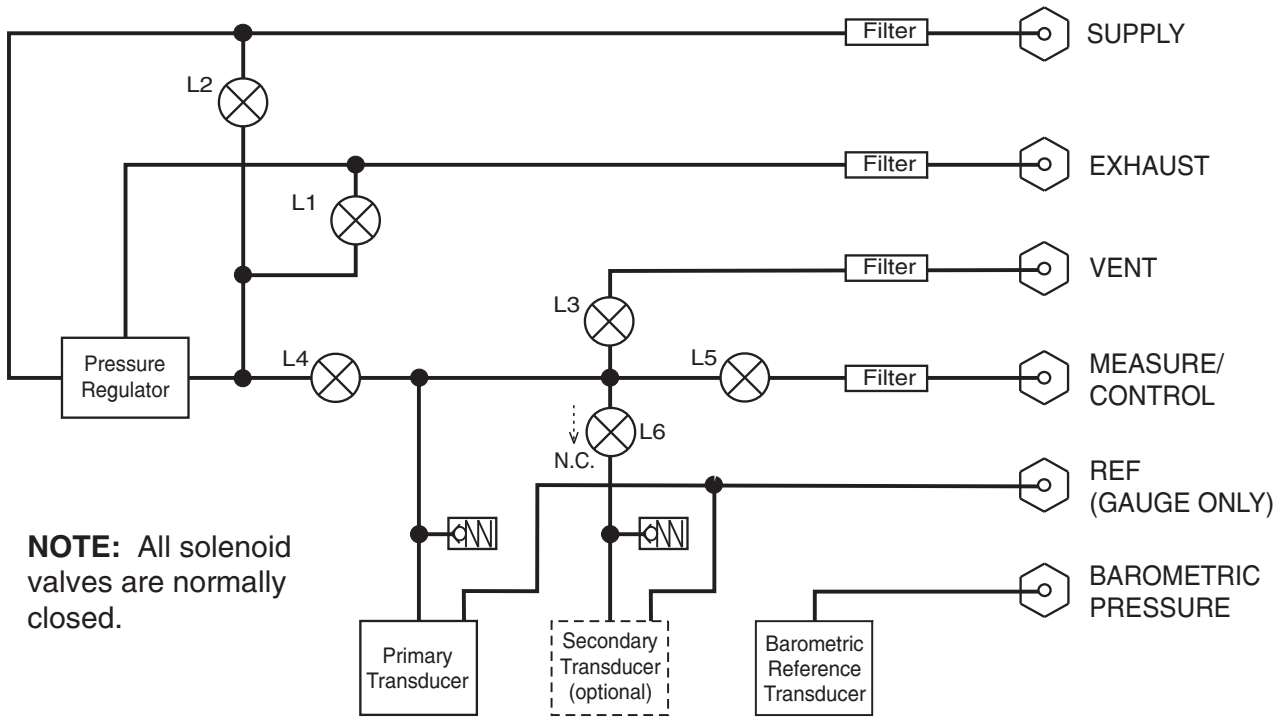


Figure 5.1 - System Pneumatic Schematic

TROUBLESHOOTING PNEUMATICS

Regulator Valves

Figure 5.2 shows [Open/Closed] keys for the four regulator modulating valves. These valves can be operated from this screen to perform diagnostic tests on the regulator. The relationship between the "+" and "–" symbols and the regulator valves is:

++ = Medium Supply Valve
+ = Fine Supply Valve
– = Fine Exhaust Valve
– – = Medium Exhaust Valve

When a key is pressed the regulator valve operates to let pressure into or out of the regulated pressure trunk. During this time the output shutoff valve (L5 in figure 5.3) is closed to prevent pressure damage to any devices connected to the Measure/Control port. The flow rate through the valves is displayed in the "Rate/Second" window, and the trunk pressure is reported in the "PSI A" window. Observe these values while operating the valves for trouble shooting purposes.

If the supply valves are left open until the pressure in the regulated pressure trunk exceeds the pressure range of the currently selected turndown in Range Hold mode, or the maximum range of the primary transducer in Autorange mode, the test will automatically terminate.

Pneumatic Module Solenoids

Solenoid valves L1 through L4 in the pneumatic schematic (figure 5.1) can be tested individually. To access this feature press the [Status] tab, then the [Solenoid] tab to display the Solenoid Status screen illustrated in figure 5.3.

PROCEED WITH CAUTION!
This test feature is a powerful troubleshooting tool, but it incurs a dangerous potential for misdirecting high pressures which may be present in the system. Study the schematic of Figure 5.1 to understand the possible consequences of various pressure routings.

In figure 5.3 each key is an [Open/Closed] toggle. As each key is pressed the key will change text and color, and the target solenoid will make an audible "click". If a key changes color without the accompanying click it's an indication of a defective solenoid or a bad connection.

Supply solenoid L2 has a momentary response, staying open only as long as the [Open] key is held. Notice that the symbol for output solenoid L5 is a label rather than a key, and cannot be tested from here. Also note that the transducer routing solenoid, L6 in the pneumatic schematic of figure 5.1, is not represented on the screen in figure 5.3.

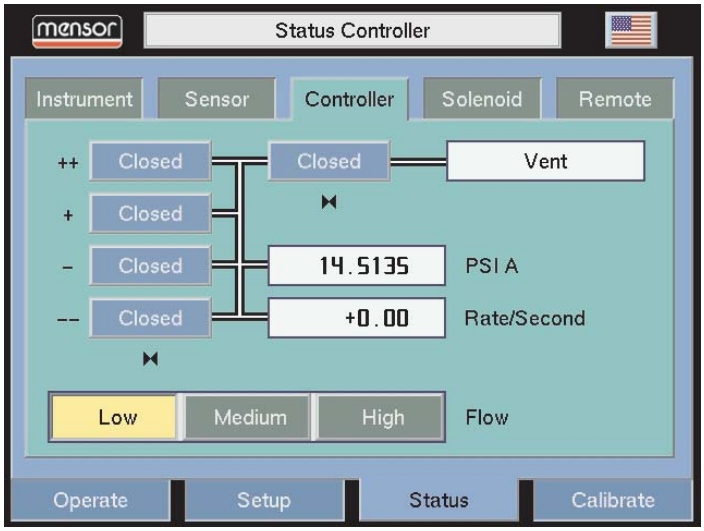


Figure 5.2 - Regulator Solenoids

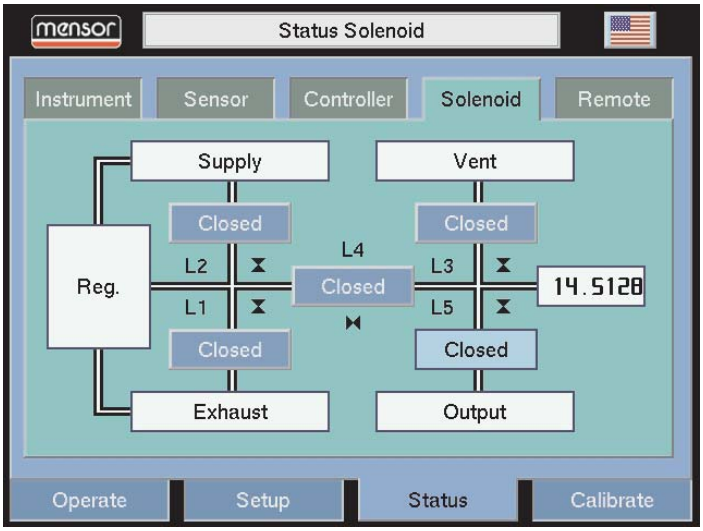


Figure 5.3 - Pneumatic Module Solenoids

REPLACING MODULES

CAUTION: ESD PROTECTION REQUIRED.
The proper use of grounded work surfaces and personal wrist straps are required when coming into contact with exposed circuits (printed circuit boards) to prevent static discharge damage to sensitive electronic components.

Always store loose transducers and PC boards in static protective bags or containers.

Transducer Removal

1. Vent the system, then turn off the power.
2. Loosen the two captive screws on the front panel (figure 1.2), and swing the panel open.
3. Gently swing the selected transducer clamp (figure 5.4) outward until it reaches its stop.
4. Apply a light inward pressure against the bottom of the transducer frame, just below the range label, while tilting the frame upward to clear the clamp plate and screw head.
5. Pull the transducer module outward, through the front opening.

Removing a transducer disengages the electrical and pneumatic connections and seals off the pressure on the pneumatic module. This permits the 8100 to be turned on with the supply pressure connected even with no transducers installed.

CAUTION! There must be a transducer installed in the "Primary Transducer" berth for the system to function properly. If the system is operated with the primary berth empty the results will be unpredictable.

Transducer Replacement

To replace a transducer first make sure that it is going into the proper transducer berth in the pneumatic module. Each berth is clearly marked on the pneumatic module baseplate. (See figure 5.5.) The "PRIMARY TRANSDUCER" must be the transducer with the highest pressure rating.

CAUTION! Do not install a high pressure transducer into a low pressure 8100. It is acceptable to install a low pressure transducer in a high pressure instrument, but control stability will suffer.

To install a transducer with the front panel already open:

1. Swing the transducer clamp (figure 5.4) outward to its open position.
2. Rest the transducer on the baseplate and the clamp. The transducer will be tilted down slightly.
3. Slide the transducer inward until resistance is felt. Then apply enough pressure against the transducer for it to clear the clamp so that it is fully seated and level on the baseplate.
4. Check and close ALL transducer clamps.
5. Swing the front panel closed and secure it by tightening the two captive screws.

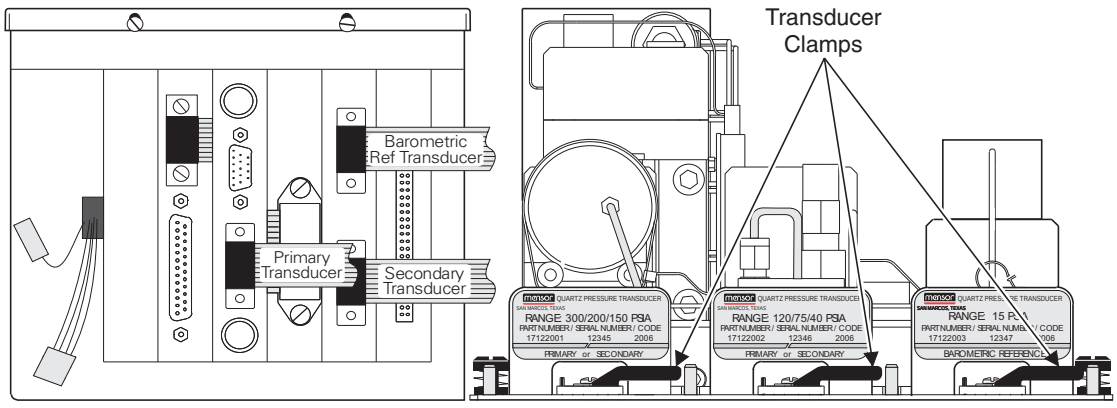


Figure 5.4 - Chassis Interior, Front View

Pneumatic Module Removal

1. Vent the system and turn off the power.
2. Loosen the two captive 3mm Allen hex screws at the rear corner of the top cover, then lift and slide the cover off.
3. Remove all external pressure connections.
4. Remove the slotted 6-32 screw that screws into the rear pressure manifold. This is the screw on the rear panel nearest the MEASURE/CONTROL port. This is the only loose screw that must be saved for the re-installation.
5. Inside the pneumatic module disconnect one ribbon cable connector at the regulator, and the two connectors on the power cable.
6. Use a screwdriver to loosen the two captive screws (figure 5.2) attached to the baseplate.
7. Loosen the two captive front panel screws and swing the panel open.
8. At the front of the electrical module, disconnect the three transducer ribbon cables identified in figure 5.1.
9. Slide the pneumatic module out through the front panel opening, and clear of the chassis.

Pneumatic Module Replacement

To replace the pneumatic module, simply reverse the steps taken for its removal.

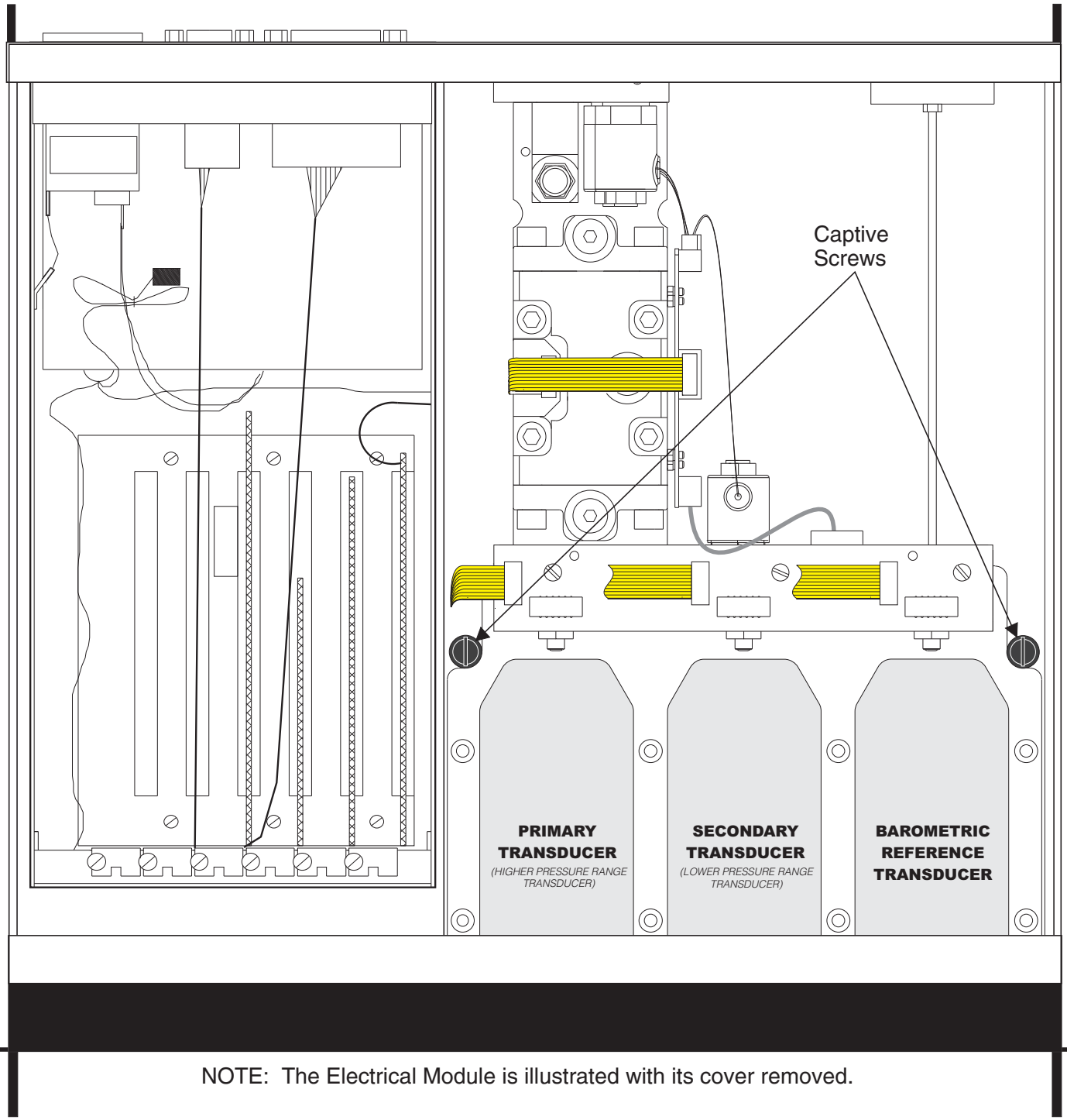
Electrical Module Circuit Boards

To gain access to the circuit boards (figure 5.5) inside the electrical module:

1. Loosen the two captive 3mm Allen hex screws at the rear corners of the instrument top cover, then lift and slide the cover off.
2. Loosen the two captive screws on the front panel and swing the panel open.
3. Loosen, but do NOT remove, the two slotted screws at the front of the electrical module.
4. Tilt the cover upward and pull forward, disengaging it from the electrical module.

CAUTION! There must be a transducer installed in the "Primary Transducer" berth for the system to function properly. If the system is operated with the primary berth empty the results will be unpredictable.

CAUTION! STATIC SENSITIVE DEVICES INSIDE. The proper use of grounded work surfaces and personnel are required when coming into contact with printed circuit boards in order to prevent static discharge damage to sensitive components.



NOTE: The Electrical Module is illustrated with its cover removed.

Figure 5.5 - Chassis Interior, Top View

SPARE PARTS LIST

Table 5.1 lists the spare parts for the 8100 that can be ordered from Mensor.

Table 5.1 – Spare Parts

Part Description	Part Number
Miscellaneous	
Manual	0017108001
Fuses	4100111150
Power Cord	4000400002
Front Panel Assy w/Color Screen	0017110001
Electrical Module	0017075001
PLA Board	0014293001
Serial Communication Board	4904000048
Power Supply	4901000024
Pneumatics Module - LP	0017096001
Pneumatics Module - HP	0017096002
Regulator Assy - <5 psi	0014265001
Regulator Assy - 5-100 psi	0014265002
Regulator Assy - 100-700 psi	0014265003
Regulator Assy - 700-1,500 psi	0014265004
Pressure Transducer - Primary or Secondary (Calibrated)	0017113XXX Consult factory
Barometric Reference Transducer	0017122001
Fitting Adapter - 7/16-20 to 1/8 NPT Female	4250010020
O-ring seals for 7/16-20 Fitting	4250010021

CALIBRATION

The 8100 automatically adjusts the pressure reading for the effects of temperature and non-linearity within the calibrated temperature range of 15-35°C. The process is referred to as dynamic compensation because each reading is so adjusted before it is output to the display or to a communication bus. Thus, a calibrated 8100 operated within its temperature band, and with proper zero and span adjustments, will provide accurate pressure measurements.

The 8100 should have the calibration verified periodically on all turndowns to insure stability. The recommended calibration cycle is twelve months.

ENVIRONMENT

For maximum accuracy, allow the 8100 to warm up for a minimum of 15 minutes in an ambient temperature within the compensated range prior to commencing a calibration. In addition the instrument should be at rest on a stable platform which is free of excessive vibration and shock.

PRESSURE STANDARDS

Mensor recommends the use of appropriately accurate primary pressure standards when calibrating this instrument. Such standards should be sufficient so that when the techniques of the ISO *Guide to the Expression of Uncertainty in Measurement* (GUM) are applied, the instrument meets its accuracy statements as required by ANSI/NCSL *Z540,* or other applicable standards.

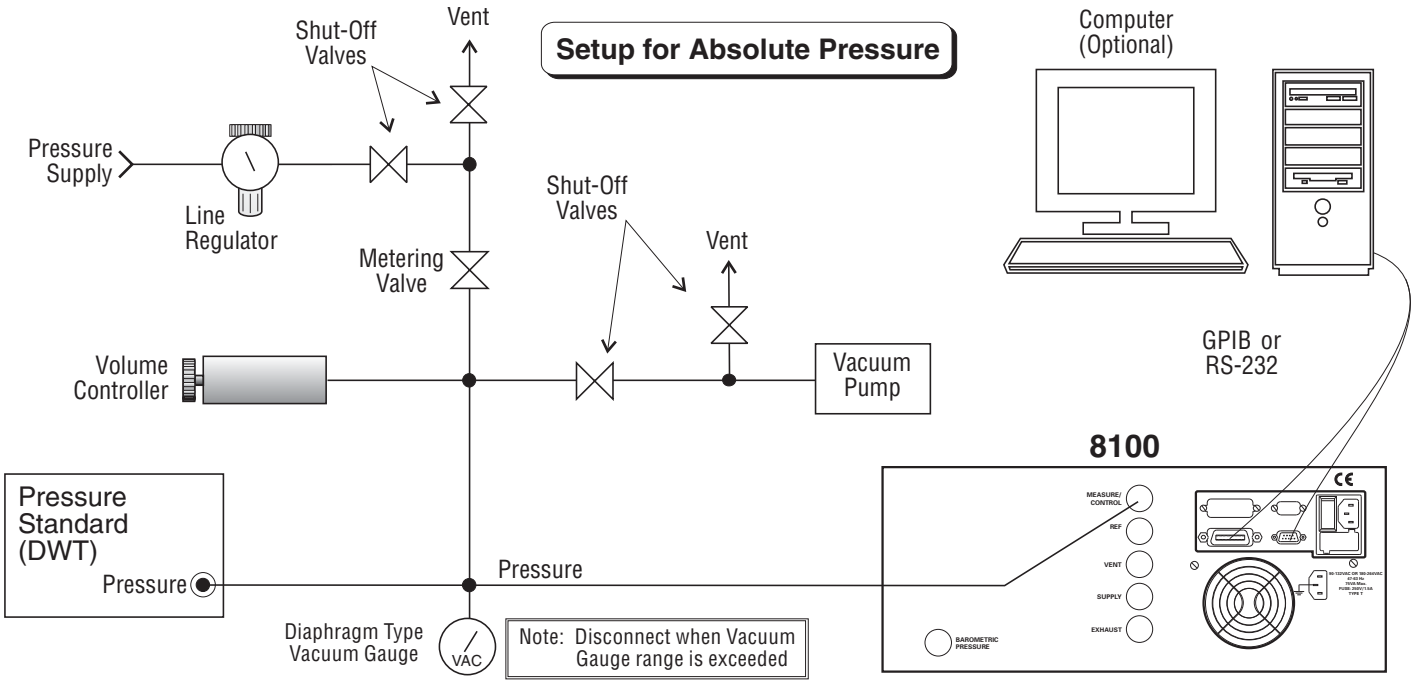
MEDIUM

The recommended calibration medium is dry nitrogen or clean dry instrument air. For pressures below 20 psia a height variation between the standard and the 8100 can cause significant errors. See 'Head Pressure Correction' in the *Appendix* for further information.

SETUP

Figure 6.1 (Calibration Setup) illustrates a typical setup for either local or remote calibration for an absolute or gauge pressure instrument. In the illustration the 'Optional Computer' is required only for performing a remote calibration.

The 'Pressure Standard' is normally a deadweight test instrument, and the 'Volume Controller' refers to a hand operated variable-volume pressure vernier device. A diaphragm type vacuum gauge is recommended over the gauge tube type of vacuum sensor for calibrating sub-atmospheric pressures (see figure 6.1, under '"Setup for Gauge Pressure"). A vacuum source with a minimum capacity of generating 300 millitorr is recommended.



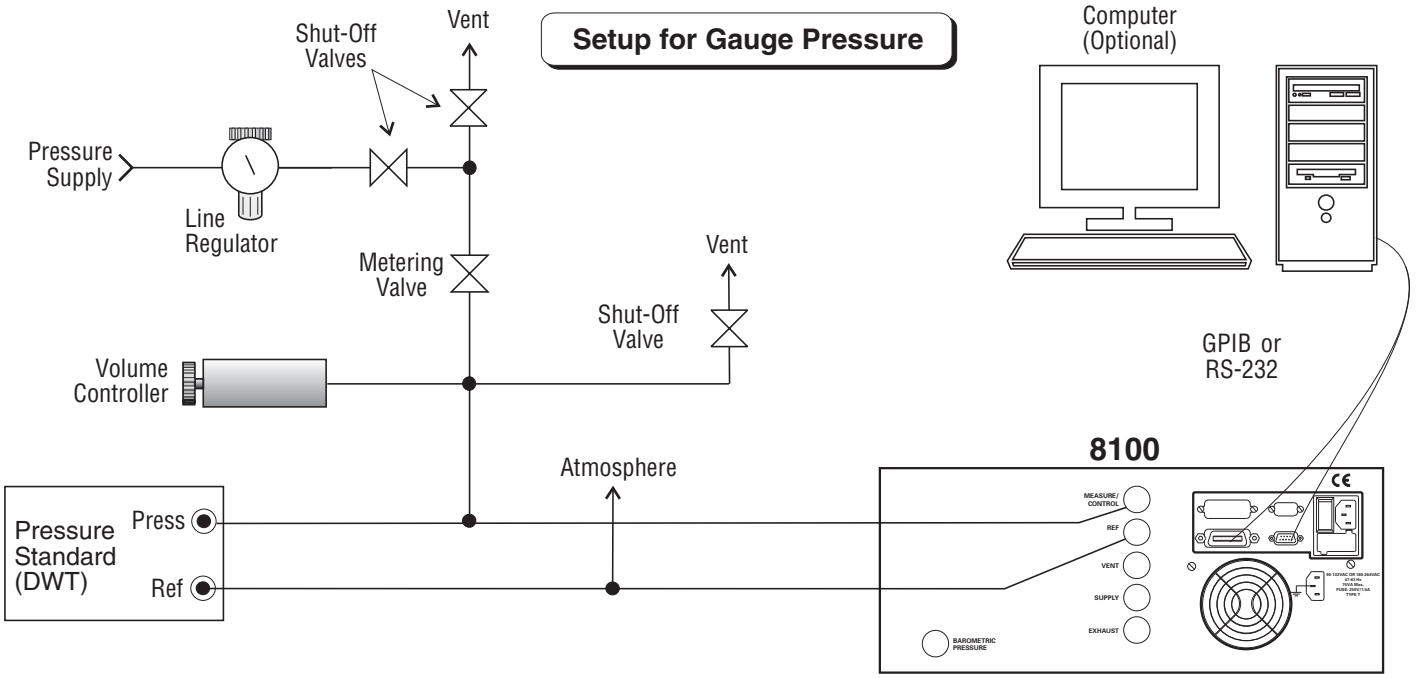


Figure 6.1 - Calibration Setup

PASSWORD

As explained in section 3, *Local Operation*, Autozero does not require a password, however one is needed to change any date of calibration, Zero, Span, or to change the system password. The password installed at the factory was 1 2 3 4 5 6, but the user can change this as described below.

Change Password

To change the current password:

1. Press the [Calibrate] tab to see the Calibration Data screen similar to figure 6.2. Notice the padlock;

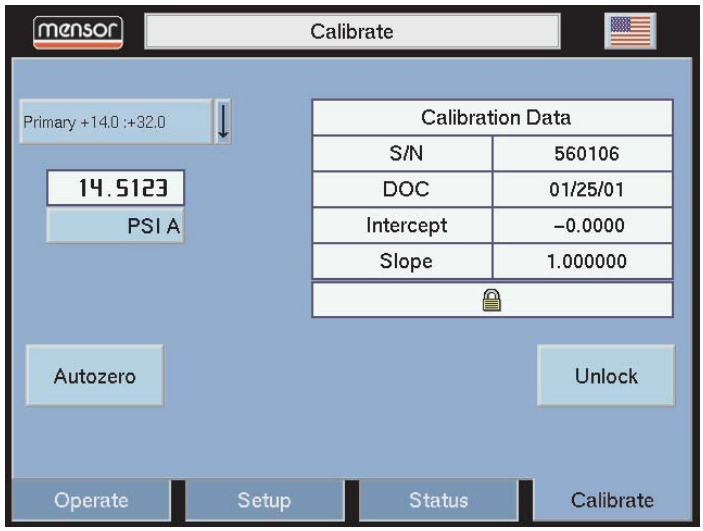


Figure 6.2 - Locked Calibration Data Screen

Figure 6.3 - 'Enter Password' Window

2. Touch the [Unlock] key to display the Enter Password screen as in figure 6.3.

3. Enter the current password. As each number is pressed an '*' appears in the 'Password' window. When completed touch [OK] to unlock the calibration data screen.

4. The Calibration Data screen of figure 6.4 is displayed. Use this screen to change DOC, Zero, Span, or the Password. Touch [Change Password] to see the Change Password window (figure 6.5).

   If the head correction option was ordered on your 8100 instrument, figures 6.2 and 6.4 will appear different. See figures 8.3 and 8.4 in the *Options* section;

5. At the Change Password window enter from one to six digits for a new password. As each number is pressed it appears in the Password window;

6. Before proceeding, review the displayed digits for accuracy. A mistake here could prevent future access to this screen. To make a correction use [CE] to backspace through the entries and immediately re-enter the correct numbers;

CAUTION! The password is seldom used and is easily forgotten. After a change write down and save the new number. If the password is lost contact Mensor.

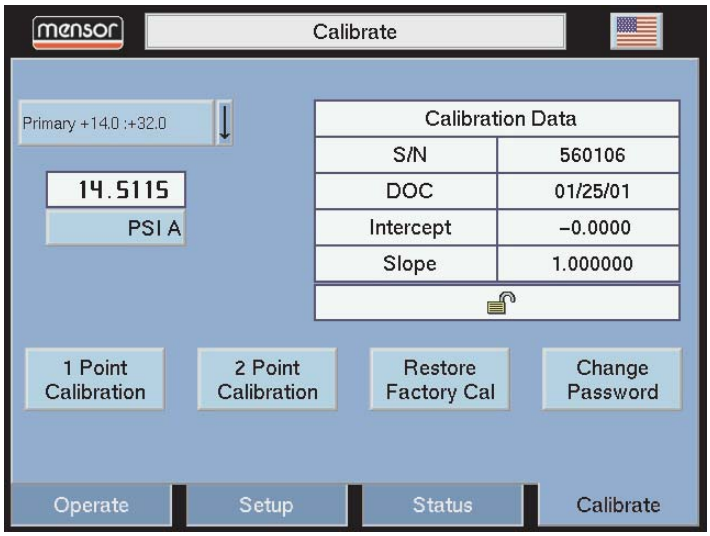


Figure 6.4 - Unlocked Calibration Data Screen

7. When satisfied that the new password is correct, ***and a written copy has been stored,*** press [OK] to complete the entry. The previous password is immediately replaced by the new one;

8. Confirm that the new password is valid by pressing [Operate], then repeat steps 1 through 3 to return to the Calibration Data screen (figure 6.4). If this screen can't be accessed using either the old or the new password contact Mensor.

RESTORING A MENSOR CALIBRATION

The offset and slope values established for each turndown at the final factory calibration are stored in permanent memory within each transducer. These factory values can be restored at any time regardless of the the number of subsequent calibrations. To restore the factory calibration to the active turndown simply press [Restore Factory Cal] on the unlocked Data Entry screen seen in figure 6.4. This will restore both the factory zero offset and slope calibration values to the active turndown. The [Restore Factory Cal] function can be repeated for each turndown as desired.

> **NOTE:** *This selection is not available on units with optional head pressure correction.*

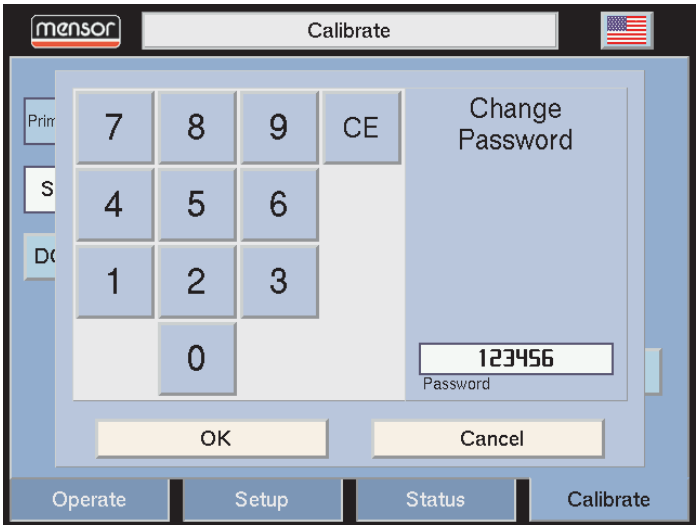


Figure 6.5 - 'Change Password' Window

ON-SITE CALIBRATION

The 8100 contains one primary transducer and may have an additional, secondary transducer. Each transducer (except the Barometric Reference Transducer) can have up to four separately calibrated ranges (four turndowns). Zero and span adjustments are available for each of these turndowns.

Linearity is preset at the factory and is not adjustable. One and two point calibrations are used to make a linear correction to the pressure readings using the formula: (uncorrected reading) X slope) + offset. The one point calibration adjusts the offset, the two point calibration adjusts both the offset and the slope.

Procedure For On-Site Calibration

The following is a step-by step instruction for calibrating a selected turndown.

8100 Preparation

Evacuate the pressure transducer(s) to a low pressure that will still maintain a viscous flow, typically 600 millitorr (0.0116 psi). At pressures lower than this the pressure at any particular point in the system is questionable. Allow from five to ten minutes for the target pressure to stabilize, then convert the millitorr reading to an equivalent instrument reading in the active measurement units. Table 9.3 in the Appendix lists millitorr conversion factors.

To begin a calibration, press the [Calibrate] tab and unlock the calibration screen as described in the previous section. Select the turndown to calibrate from the drop list and the units in which to perform the calibration on the unlocked calibration data screen.

One Point Calibration

A one point calibration adjusts only the offset of the active turndown. From the unlocked calibration data screen, press the [1 point calibration] button. The '1 Point Cal' window illustrated in figure 6.6 will appear. This window shows the maximum and minimum acceptable values and the current reading. The [?] button pops up a help dialog with instructions about how to use this screen. Enter the current known pressure in the 'Desired Reading' data window. Values entered that are outside of the displayed Maximum/Minimum limits will not be accepted. When the desired reading is displayed in the data window press the [OK] button and the offset will be stored. The [Cancel] button will exit this window and not make any adjustments to the calibration of the active turndown.

Figure 6.6 - '1 Point Cal' Window

Two Point Calibration

A two point calibration adjusts both the offset and the slope of the active turndown. The low point must be within 20% of the minimum range of the active turndown and the high point must be within 20% of the maximum range of the active turndown. From the unlocked calibration data screen, press the [2 point calibration] button. The 'Low Point Cal' window illustrated in figure 6.7 will appear. This window shows the maximum and minimum acceptable values and the current reading. The [?] button pops up a help dialog with instructions about how to use this window. Enter the current known pressure in the 'Desired Reading' data window and press the [OK] button.

The 'High Point Cal' window illustrated in figure 6.8 will appear. It's function is identical to the 'Low Point Cal' window. Enter the new known pressure and press the [OK] button.

The [Cancel] button will exit either window and not make any adjustments to the calibration of the active turndown.

The 'Date of Calibration' window illustrated in figure 6.9 will appear. Enter the date of calibration in a mm/dd/yyyy format exactly, including the '/' separation marks. Press the [OK] button and the new data of calibration will be saved to the turndown.

Figure 6.7 - 'Low Point Cal' Window

Figure 6.8 - 'High Point Cal' Window

Figure 6.9 - 'DOC' Window

SPECIFICATIONS

Accuracy specifications presented herein are obtained by comparison with primary standards traceable to the National Institute of Standards and Technology (NIST). These specifications are obtained in accordance with the ISO *Guide to the Expression of Uncertainty in Measurement* (GUM). Mensor also adheres to ANSI/NCSL-*Z540*. If there is an exception to the requirements and recommendations of *Z540* during a calibration the exception is noted on the individual calibration certificate.

Mensor reserves the right to change these specifications without notice.

MEASURE SPECIFICATIONS

Accuracy
0.007% FS + 0.003% R for each turndown range. Uncertainties include all pressure and temperature effects over the calibrated range.

Precision
0.003% of span

Calibration Stability
0.007% FS + 0.003% R for 360 days typical (after zeroing).

Pressure Ranges
15 to 1,500 psi. Exact ranges are selectable by the customer. Consult factory for other ranges.

Measurement Units
See “Measurement Units” Table in the *Appendix* Section.

Resolution
Up to 1 ppm, depending on pressure range and units selected.

CONTROL SPECIFICATIONS

External Pressure Requirements
Source Pressure: Instrument air or dry nitrogen at pressure equal to 110% of FS. Accurate external regulation is not required.

Exhaust Pressure: Atmospheric exhaust for gauge pressure control above 0.05 psig. Vacuum pump required for sub-atmospheric pressure control.

Stability of Controlled Pressure
±0.003% FS pressure.

Minimum Control Pressure
Exhaust pressure plus 0.05% FS or 0.025 psia, whichever is greater.

Control Time
When controlling: For the output pressure to be in the stable window, 55 seconds is typical between any two pressure points from 0.5% FS above the exhaust pressure to full scale with a 1/2 liter volume. A larger volume can lengthen this time. The time will also be longer for absolute pressures below 0.5 psia.

GENERAL SPECIFICATIONS

Size
17.75" wide x 7" high x 17.50" deep (45.085 cm x 17.78 cm x 44.45 cm). Standard rack ears add 1.25" width x 1.75" depth (3.175 cm x 4.445 cm). (See Figure 7.1.)

Weight
36 lbs. (16.33 kg).

Power Input Requirements
90-132 VAC or 180-264 VAC, 47-63 Hz, 75 VA max on power supply controlled by a rear panel switch.

Fuses: 250V, 1.5A, TypeT

Pneumatic Interfaces
7/16" - 20 SAE/MS (female),
(1/8" Female NPT Adapters provided.)

Particle Filters
Four internal replaceable 20 micron filters in line with rear panel ports.

Pneumatic Overpressure Protection
Protected by relief valves.

Compensated Temperature Range
15°C to 35°C.

Operating Temperature Range
0°C to 50°C. NOTE: This is not the compensated temperature range.

Storage Temperature Range
0°C to 70°C. Minimal vibration. Non-condensing humidity.

Local User Interfaces
Display: Graphic 8.4" (diagonal) backlit, color LCD display with a resistive touch screen.

Remote User Interfaces
IEEE-488.1 and RS-232.

Warm-up
Approximately 15 minutes to achieve full accuracy depending on environment.

Reading Rate
Typically 32 readings per second.

Response Time
0.33 seconds or <333 mS for FS step.

Orientation Effects
Negligible in any orientation. Any effects can be removed by re-zeroing.

Shock/Vibration
2 gravities maximum per MIL-T-28800.

Operating Environment
5 to 95% RH non-condensing.

Media Compatibility
Clean, dry, non-corrosive, non-combustible, non-oxidizing gases. Not suitable for oxygen use.

ADDITIONAL SPECIFICATIONS

Options
Transport Case.
Secondary Transducer.

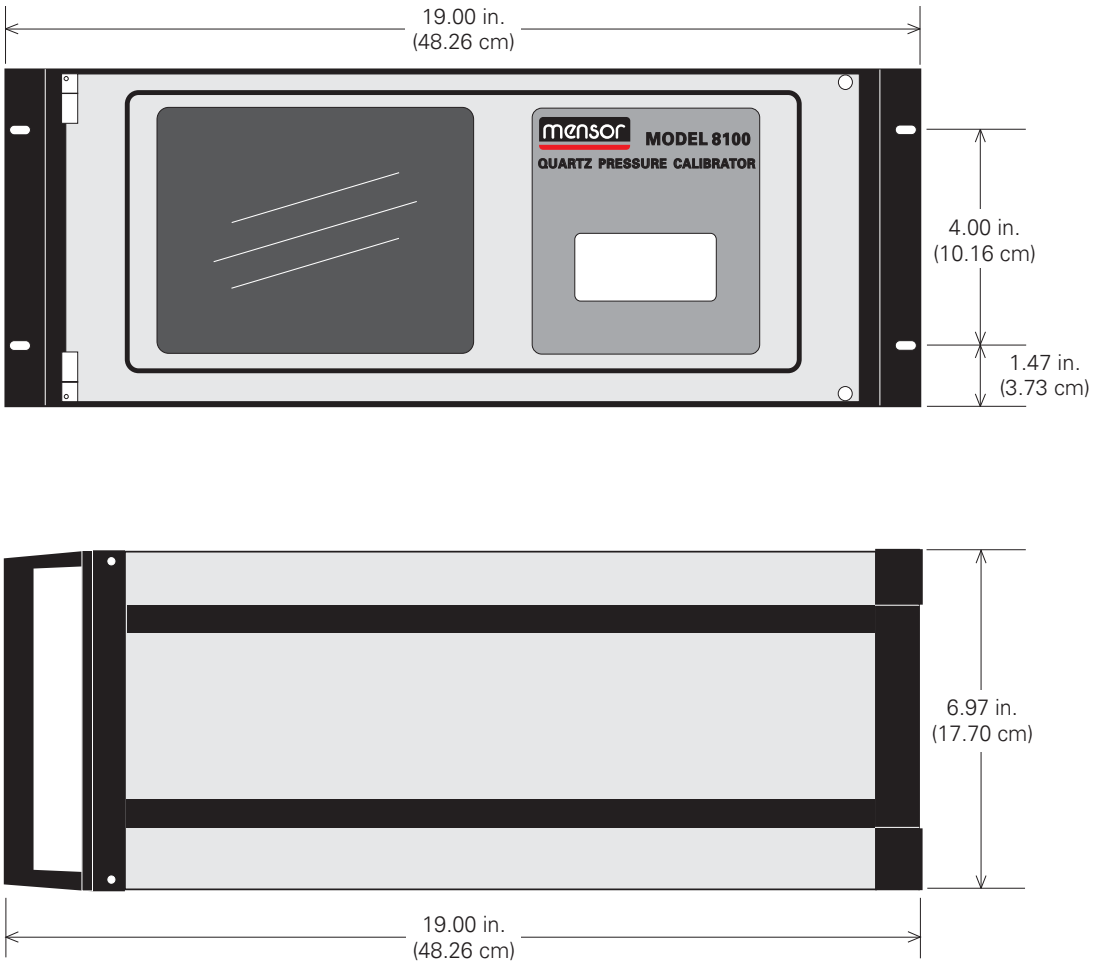


Figure 7.1 - 8100 Dimensions

OPTIONS

This section lists options available for the 8100. Users might consider letting the factory install a special feature not listed here. Mensor welcomes the opportunity to quote on such requests. The cost of adding an enhancement frequently will amortize itself in a very short time because of improved process efficiency.

TRANSPORT CASE (PN 0011159001)

A wheeled Transport Case is available suitable for moving the 8100 between sites, or as an air-freight (or other) shipping container. The case is constructed of a high impact plastic with a black exterior. It includes two keys, locks, a piano hinge, an anodized interlocking tongue and groove opening, various nickel-chrome and stainless steel fixtures, a vinyl satchel style handle and a retractable pull-out handle. The interior is filled with high density polyurethane foam with a die-cut cavity to cradle the instrument with fitting adapters in place, and an additional cavity to store related accessories. Rugged and weather resistant, the case makes an attractive, practical shipping and moving container. The case weighs approximately 29 pounds (13.15 kg) unloaded, and can support a load of up to 150 pounds (68.04 kg). Nominal dimensions are 15 inches by 24 inches by 26 inches (38.10 cm x 60.96 cm x 66.04).

SECONDARY TRANSDUCER

A secondary transducer of any standard range, and with up to four turndown ranges, can be purchased as an add-on. In all other regards, the add-on transducer will meet all of the specifications and operating parameters outlined throughout this manual.

Secondary Transducer Installation

If the add-on transducer is of a higher full scale range than the existing Primary Transducer, then this newer transducer becomes the Primary, and the existing transducer must be moved to the Secondary Transducer berth. For complete installation instructions see the text under “Transducer Replacement” in the *Maintenance* section.

CAUTION! The pressure regulator is configured for one of four pressure ranges. Do not install a high pressure transducer into a low pressure 8100. However, it is acceptable to install a low pressure transducer in a high pressure instrument.

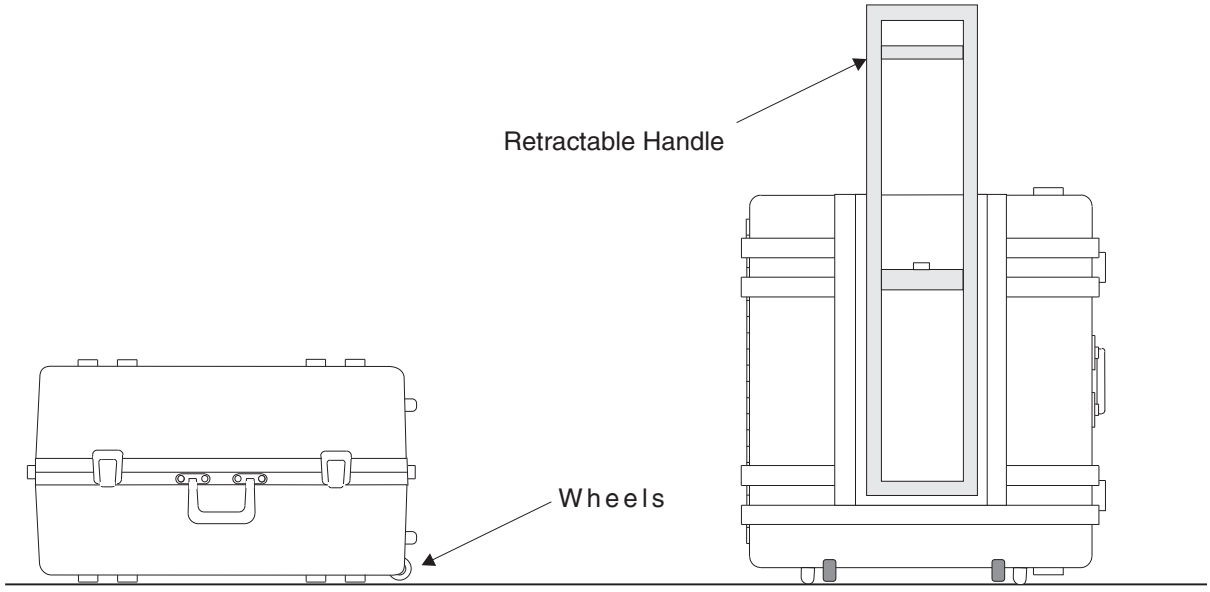


Figure 8.1 - Transport Case

HEAD PRESSURE CORRECTION

Software Version 1.16 and greater adds optional head pressure correction to the 8100. The correction is accessed from the calibration menu. Four parameters may be set to reflect conditions at the operator's site. Press either [English] or [Metric] units for entering head pressure correction information into the 8100.

1. **Height:** Enter the difference in height between the center of the measure/control port of the 8100 and the reference level of the Device Under Test (DUT). If the reference level of the DUT is lower than the center of the measure/control port of the 8100, enter a positive height. If it is higher, enter a negative height.

2. **Gas Density:** If nitrogen (N2) or Dry Air are being used as a pressure medium, press the appropriate selection. If another gas is being used, enter the density for the gas at standard pressure and temperature in either lb/cubic foot (english) or kg/liter (metric) units.

3. **Gas Temperature:** Enter the average gas temperature in degrees F or C. If unsure of the gas temperature use 68 F.

4. **Local Gravity:** Enter the local gravity acceleration value. If unsure, use the standard gravity radio button.

Limits

Height:	±1200 inches
Density:	0 to 1 lb/cu ft
Temperature:	0 to 120 °F
Gravity:	32 to 32.4 ft/sec²

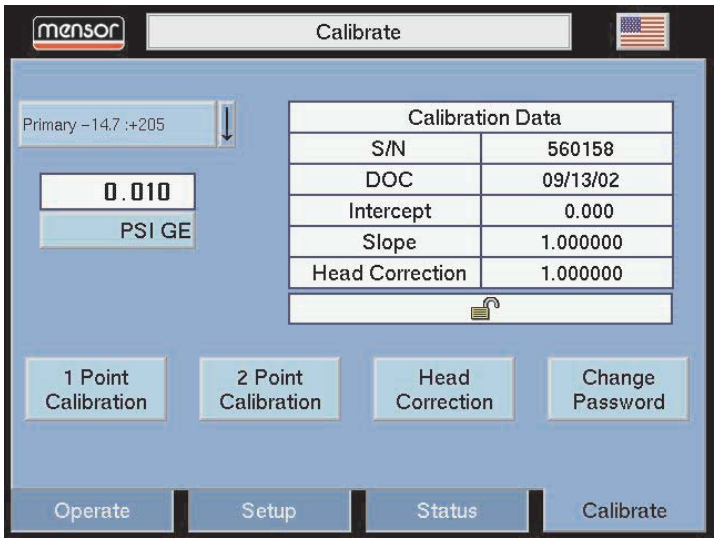


Figure 8.2 - Unlocked Calibration Data Screen

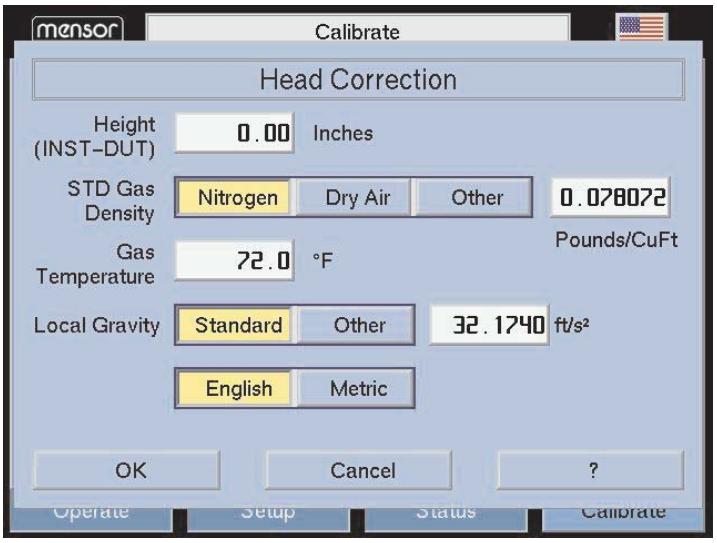


Figure 8.3 - Head Correction Window

APPENDIX

MEASUREMENT UNITS

The Units command selects the measurement units to be output on the bus and the display.

Table 9.1 – Measurement Units (unitno)

Code	Description	Output Format
1	pounds per square inch	PSI
2	inches of mercury @ 0°C	INHG 0C
3	inches of mercury @ 60°F	INHG 60F
4	inches of water @ 4°C	INH2O 4C
5	inches of water @ 20°C	INH2O 20C
6	inches of water @ 60°F	INH2O 60F
7	feet of water @ 4°C	FTH2O 4C
8	feet of water @ 20°C	FTH2O 20C
9	feet of water @ 60°F	FTH2O 60F
10	millitorr	MTORR
11	inches of seawater @ 0°C 3.5% salinity	INSW
12	feet of seawater @ 0°C 3.5% salinity	FTSW
13	atmospheres	ATM
14	bars	BAR
15	millibars	MBAR
16	millimeters of water @ 4°C	MMH2O 4C
17	centimeters of water @ 4°C	CMH2O 4C
18	meters of water @ 4°C	MH2O 4C
19	millimeters of mercury @ 0°C	MMHG 0C
20	centimeters of mercury @ 0°C	CMHG 0C
21	torr	TORR
22	kilopascals	KPA
23	pascals	PA
24	dyne per square centimeter	DYNE/SQ CM
25	grams per square centimeter	G/SQ CM
26	kilograms per square centimeter	KG/SQ CM
27	meters of seawater @ 0°C 3.5% salinity	MSW
28	ounce per square inch	OSI
29	pounds per square foot	PSF
30	tons per square foot	TSF
31	percent of full scale	%FS
32	micron HG @ 0°C	UHG 0C
33	ton per square inch	TSI
34	n/a	n/a
35	hectopascals	HPA
36	megapascals	MPA
37	millimeters of water @ 20°C	MMH2O 20C
38	centimeter of water @ 20°C	CMH2O 20C
39	meters of water @ 20°C	MH2O 20C
n/a	User Units 1 (Local only)	User defined
n/a	User Units 2 (Local only)	User defined

CONVERSION FACTORS, PSI

The values listed in the column **To convert from psi** are the values imbedded in the instrument program. The values listed under **To convert to psi** are internally calculated approximations based on the imbedded values.

Table 9.2 – Conversion Factors, PSI

Code	Pressure Unit	To convert from PSI	To convert to PSI
1	PSI	1	1
2	INHG @ 0C	2.036020	0.4911544
3	INHG @ 60F	2.041772	0.4897707
4	INH2O @ 4C	27.68067	0.03612629
5	INH2O @ 20C	27.72977	0.03606233
6	INH2O @ 60F	27.70759	0.03609119
7	FTH2O @ 4C	2.306726	0.4335149
8	FTH2O @ 20C	2.310814	0.4327480
9	FTH2O @ 60F	2.308966	0.4330943
10	MTORR	51715.08	0.00001933672
11	INSW @ 0C 3.5% salinity	26.92334	0.03714250
12	FTSW @ 0C 3.5% salinity	2.243611	0.445710
13	ATM	0.06804596	14.69595
14	BAR	0.06894757	14.50377
15	MBAR	68.94757	0.01450377
16	MMH2O @ 4C	703.0890	0.001422295
17	CMH2O @ 4C	70.30890	0.01422295
18	MH2O @ 4C	0.7030890	1.422295
19	MMHG @ 0C	51.71508	0.01933672
20	CMHG @ 0C	5.171508	0.1933672
21	TORR	51.71508	0.01933672
22	KPA	6.894757	0.1450377
23	PA	6894.757	0.0001450377
24	DYNE/SQ CM	68947.57	0.00001450377
25	G/SQ CM	70.30697	0.01422334
26	KG/SQ CM	0.07030697	14.22334
27	MSW @ 0C 3.5% salinity	0.6838528	1.462303
28	OSI	16	0.0625
29	PSF	144	0.006944444
30	TSF	0.072	13.88889
31	% FS	(PSI / RANGE) x 100	(% FS x RANGE) / 100
32	MICRON HG @ 0C	51715.08	0.00001933672
33	TSI	0.0005	2000
35	HPA	68.94757	0.01450377
36	MPA	0.006894757	145.0377
37	MMH2O @ 20C	704.336	0.001419777
38	CMH2O @ 20C	70.4336	0.01419777
39	MH2O @ 20C	0.704336	1.419777

CONVERSION FACTORS, MILLITORR

The following table lists factors which should be used as multipliers when converting other pressure units to or from millitorr.

Table 9.3 – Conversion Factors, millitorr

Code	Pressure Unit	To convert from millitorr	To convert to millitorr
1	PSI	0.00001933672	51715.08
2	INHG @ 0C	0.00003936995	25400.08909
3	INHG @ 60F	0.00003948117	25328.53093
4	INH2O @ 4C	0.0005352534	1868.273977
5	INH2O @ 20C	0.0005362028	1864.966281
6	INH2O @ 60F	0.0005357739	1866.458778
7	FTH2O @ 4C	0.00004460451	22419.25773
8	FTH2O @ 20C	0.00004468356	22379.59744
9	FTH2O @ 60F	0.00004464783	22397.50637
10	MTORR	1.0	1.000000022
11	INSW @ 0C 3.5% salinity	0.0005206091	1920.827359
12	FTSW @ 0C 3.5% salinity	0.00004338408	23049.92831
13	ATM	0.000001315786	760002.2299
14	BAR	0.000001333220	750063.6259
15	MBAR	0.001333220	750.0636259
16	MMH2O @ 4C	0.0135954	73.5540997
17	CMH2O @ 4C	0.001359544	735.5409971
18	MH2O @ 4C	0.00001359544	73554.09971
19	MMHG @ 0C	0.001	1000.000022
20	CMHG @ 0C	0.0001	10000.00022
21	TORR	0.001	1000.000022
22	KPA	0.0001333220	7500.636259
23	PA	0.1333220	7.500636259
24	DYNE/SQ CM	1.333220	0.750063626
25	G/SQ CM	0.001359506	735.561166
26	KG/SQ CM	0.000001359506	735561.166
27	MSW @ 0C 3.5% salinity	0.00001322347	75623.11663
28	OSI	0.0003093875	3232.1992
29	PSF	0.002784488	359.132477
30	TSF	0.000001392244	718265.0575
32	MICRON HG @ 0C	1.0	1.000000022
33	TSI	n/a	n/a
35	HPA	0.001333220	750.0636259
36	MPA	0.0000001333220	7500636.259
37	MMH2O @ 20C	0.01361955	73.42388114
38	CMH2O @ 20C	0.001361955	734.2388114
39	MH2O @ 20C	0.00001361955	73423.88114

TEMPERATURE CONVERSION

Table 9.4 – Temperature Conversion Chart

Find the known value in a center (shaded) column. If the known value is in °C, then the equivalent value is found in the °F column, or if the known value is in °F, then the conversion is found in the °C column.

°C		°F
-17.78	0	32.00
-17.22	1	33.80
-16.67	2	35.60
-16.11	3	37.40
-15.56	4	39.20
-15.00	5	41.00
-14.44	6	42.80
-13.89	7	44.60
-13.33	8	46.40
-12.78	9	48.20
-12.22	10	50.00
-11.67	11	51.80
-11.11	12	53.60
-10.56	13	55.40
-10.00	14	57.20
-9.44	15	59.00
-8.89	16	60.80
-8.33	17	62.60
-7.78	18	64.40
-7.22	19	66.20
-6.67	20	68.00
-6.11	21	69.80
-5.56	22	71.60
-5.00	23	73.40
-4.44	24	75.20
-3.89	25	77.00
-3.33	26	78.80
-2.78	27	80.60
-2.22	28	82.40
-1.67	29	84.20
-1.11	30	86.00
-0.56	31	87.80
0.00	32	89.60
0.56	33	91.40
1.11	34	93.20
1.67	35	95.00
2.22	36	96.80
2.78	37	98.60
3.33	38	100.40
3.89	39	102.20
4.44	40	104.00
5.00	41	105.80
5.56	42	107.60
6.11	43	109.40
6.67	44	111.20
7.22	45	113.00
7.78	46	114.80
8.33	47	116.60
8.89	48	118.40
9.44	49	120.20

°C		°F
10.00	50	122.00
10.56	51	123.80
11.11	52	125.60
11.67	53	127.40
12.22	54	129.20
12.78	55	131.00
13.33	56	132.80
13.89	57	134.60
14.44	58	136.40
15.00	59	138.20
15.56	60	140.00
16.11	61	141.80
16.67	62	143.60
17.22	63	145.40
17.78	64	147.20
18.33	65	149.00
18.89	66	150.80
19.44	67	152.60
20.00	68	154.40
20.56	69	156.20
21.11	70	158.00
21.67	71	159.80
22.22	72	161.60
22.78	73	163.40
23.33	74	165.20
23.89	75	167.00
24.44	76	168.80
25.00	77	170.60
25.56	78	172.40
26.11	79	174.20
26.67	80	176.00
27.22	81	177.80
27.78	82	179.60
28.33	83	181.40
28.89	84	183.20
29.44	85	185.00
30.00	86	186.80
30.56	87	188.60
31.11	88	190.40
31.67	89	192.20
32.22	90	194.00
32.78	91	295.80
33.33	92	197.60
33.89	93	199.40
34.44	94	201.20
35.00	95	203.00
35.56	96	204.80
36.11	97	206.60
36.67	98	208.40
37.22	99	210.20

°C		°F
37.78	100	212.00
38.33	101	213.80
38.89	102	215.60
39.44	103	217.40
40.00	104	219.20
40.56	105	221.00
41.11	106	222.80
41.67	107	224.60
42.22	108	226.40
42.78	109	228.20
43.33	110	230.00
43.89	111	231.80
44.44	112	233.60
45.00	113	235.40
45.56	114	237.20
46.11	115	239.00
46.67	116	240.80
47.22	117	242.60
47.78	118	244.40
48.33	119	246.20
48.89	120	248.00
49.44	121	249.80
50.00	122	251.60
50.56	123	253.40
51.11	124	255.20
51.67	125	257.00
52.22	126	258.80
52.78	127	260.60
53.33	128	262.40
53.89	129	264.20
54.44	130	266.00
55.00	131	267.80
55.56	132	269.60
56.11	133	271.40
56.67	134	273.20
57.22	135	275.00
57.78	136	276.80
58.33	137	278.60
58.89	138	280.40
59.44	139	282.20
60.00	140	284.00
60.56	141	285.80
61.11	142	287.60
61.67	143	289.40
62.22	144	291.20
62.78	145	293.00
63.33	146	294.80
63.89	147	296.60
64.44	148	298.40
65.00	149	300.20

°C		°F
65.56	150	302.00
66.11	151	303.80
66.67	152	305.60
67.22	153	307.40
67.78	154	309.20
68.33	155	311.00
68.89	156	312.80
69.44	157	314.60
70.00	158	316.40
70.56	159	318.20
71.11	160	320.00
71.67	161	321.80
72.22	162	323.60
72.78	163	325.40
73.33	164	327.20
73.89	165	329.00
74.44	166	330.80
75.00	167	332.60
75.56	168	334.40
76.11	169	336.20
76.67	170	338.00
77.22	171	339.80
77.78	172	341.60
78.33	173	343.40
78.99	174	345.20
79.44	175	347.00
80.00	176	348.80
80.56	177	350.60
81.11	178	352.40
81.67	179	354.20
82.22	180	356.00
82.78	181	357.80
83.33	182	359.60
83.89	183	361.40
84.44	184	363.20
85.00	185	365.00
85.56	186	366.80
86.11	187	368.60
86.67	188	370.40
87.22	189	372.20
87.78	190	374.00
88.33	191	375.80
88.89	192	377.60
89.44	193	379.40
90.00	194	381.20
90.56	195	383.00
91.11	196	384.80
91.67	197	386.60
92.22	198	388.40
92.78	199	390.20

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Operation Manual
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