Operating instructions

Pressure verification system Model 9476

EN

Pressure verification system Model 9476

Part of your business

EN Operating instructions model 9476

© 05/2019, Mensor, LP. All rights reserved.
Mensor is a registered trademark of Mensor, LP.
All other brand and product names are trademarks or registered trademarks of their respective companies.

Prior to starting any work, read the operating instructions!
Keep for later use!

0020507001A 09/2018 EN

Contents

EN

Contents

EN

1. General Information

The Mensor Model 9476 Pressure Verification System is a multi-channel pneumatic measuring and controlling instrument for wind tunnel pressure verification. It contains 5 measurement transducers arranged with a high precision barometric transducer, a single pressure control channel, and 3 dual transducer high line pressure differential transducers. The barometric transducer can be monitored independently and used as a precision reference to automatically null the readings of the four absolute transducers. The instrument can be operated from the front panel, over a RS-232 serial port or a 10/100/1000 Mbps Ethernet port. The barometric transducer has a range of 8 to 17 psiA with an accuracy of 0.008% of reading. The pressure control transducer has a range of 0 to 33 psiA with an accuracy of 0.010% of full scale. The 3 dual transducers are +/-15 psiD with up to 33 psi line pressure and +/-5 psiD with up to 33 psi line pressure. The dual transducers have accuracies of 0.009% IS-50 on the absolute side and 0.010% of full scale on the differential side. All transducers have a recommended calibration interval of 1 year. All transducers are protected with overpressure relief valves set to approximately 110% of range. Each transducer is removable from the front panel of the instrument. The instrument software provides multi-speed reading rates and optional reading synchronization for the 3 dual transducers. The system also includes a temperature probe secured near the transducers to allow the transducer temperature to be monitored.

The 9476 is housed in an aluminum chassis having dimensions of 17.75” (45.085 cm) wide, 7” (17.78 cm) high and 17.5” (44.45 cm) deep. Standard rack ears add 1.25 (3.175 cm) to the width and 1.75” (4.445 cm) to the depth. All porting extends from the rear of the chassis and adds additional depth depending on fittings and connections to the unit. The unit is configured for desktop or rack mounting in a standard 19” instrumentation rack and has a 4U height when the chassis feet are removed. The unit operates from universal power (100 to 240 volt 50/60 Hz) at 2 amps maximum. Two thumb screws on the front panel allow access to the removable transducers and the system memory card. The overall system can include as options, a calibration sled for external calibration of the measurement transducers and a transit case for secure shipping.

The major design goal was to provide synchronized and high speed transducer pressure readings while in the measurement or monitoring mode of operation. This was achieved with customized serial communication between the dual transducers and instrument firmware. These modifications allow one of four reading rates (nominally 14, 17, 20 or 29 readings per second with synchronization, 51, 64, 133 or 156 readings per second without synchronization).

1.1 Further information:

Mensor Corporation

- Address	201 Barnes Dr., San Marcos, TX 68666
- Internet address:	www.mensor.com
- Relevant data sheet:	CT 25.12
- Application consultant:	Tel.: (+1) 512-396-4200 (+1) 800-984-4200 (USA only) Fax: (+1) 512-396-1820 E-Mail: sales@mensor.com techservices@mensor.com

Importer for Europe

WIKA Alexander Wiengand SE & Co. KG

- Address	Alexander Wiegand-Straße 63911 Klingenberg, Germany
- Internet address:	www.wika.de / www.wika.com
- Relevant data sheet:	CT 25.12
- Application consultant:	Tel.: (+49) 9372/132-5015 Fax: (+49) 9372/132-8767 E-Mail: CTsales@wika.com

1.2 Warranty

All products manufactured by Mensor are warranted to be free of defects in workmanship and materials for a period of two year

EN

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 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, this warranty does not apply. The judgment of Mensor 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.
MENSOR MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THIS MANUAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Mensor shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

1.2.1 FCC Emission Notice

This equipment has been tested and found to comply with the limits for a Class B 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 residential 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.

1.2.2 CE Emission Notice

This equipment is of the emission class B, intended for operation in industrial, residential or commercial environments.

1.3 Software License Agreement

This product contains intellectual property, i.e. software programs, that are licensed for use by the end user/customer (hereinafter “end user”).
This is not a sale of such intellectual property.
The end user shall not copy, disassemble or reverse compile the software program.

The software programs are provided to the end user “as is” without warranty of any kind, either express or implied, including, but not limited to, warranties of merchantability and fitness for a particular purpose. The entire risk of the quality and performance of the software program is with the end user.

Mensor and its suppliers shall not be held to any liability for any damages suffered or incurred by the end user (including, but not limited to, general, special, consequential or incidental damages including damages for loss of business profits, business interruption, loss of business information and the like), arising from or in connection with the delivery, use or performance of the software program.

1.4 Mensor Service Plus

1.4.1 After the Warranty

Mensor’s concern with the performance 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.

1.4.2 Calibration Services

In addition to servicing our own products Mensor can perform a complete pressure calibration service, up to 30,000 psi, for all of your pressure instruments. This service includes an accredited calibration.

1.4.3 Certifications and Accreditations

Mensor 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.

2. Safety

2.1 Explanation of Symbols

DANGER!
... indicates a directly dangerous situation resulting in serious injury or death, if not avoided.

WARNING!
... indicates a potentially dangerous situation that can result in serious injury or death, if not avoided.

CAUTION!
... indicates a potentially dangerous situation that can result in light injuries or damage to property or the environment, if not avoided.

DANGER!
... identifies hazards caused by electrical power. Should the safety instructions not be observed, there is a risk of serious or fatal injury.

WARNING!
... indicates a potentially dangerous situation that can result in burns, caused by hot surfaces or liquids, if not avoided.

Information
... points out useful tips, recommendations and information for efficient and trouble-free operation.

2.2 Responsibility of the Operator

The instrument is used in the industrial sector. The operator is therefore responsible for legal obligations regarding safety at work.

The safety instructions within these operating instructions, as well as the safety, accident prevention and environmental protection regulations for the application area must be maintained.
The operator is obliged to maintain the product label in a legible condition.
The operator must ensure that:

- Mechanical vibration, mechanical shock are minimized
- The instrument is installed in areas without soot, vapor, dust and corrosive gases
- The instrument is not used in hazardous environments, flammable atmospheres
- The operating personnel are regularly instructed in all topics regarding work safety, first aid and environmental protection and know the operating instructions and in particular, the safety instructions contained therein
- The instrument is suitable for the particular application in accordance with its intended use
- Personal protective equipment is available

2.3 Personnel Qualification

WARNING!
Risk of injury should qualification be insufficient
Improper handling can result in considerable injury and damage to equipment.
► The activities described in these operating instructions may only be carried out by skilled personnel who have the qualifications described below.

EN

Skilled personnel
Skilled personnel, authorized by the operator, are understood to be personnel who, based on their technical training, knowledge of measurement and control technology and on their experience and knowledge of country-specific regulations, current standards and directives, are capable of carrying out the work described and independently recognizing potential hazards.

Operating personnel
The personnel trained by the operator are understood to be personnel who, based on their education, knowledge and experience, are capable of carrying out the work described and independently recognizing potential hazards.

Special knowledge for working with instruments for hazardous areas:
The skilled (electrical) personnel must have knowledge of ignition protection types, regulations and provisions for equipment in hazardous areas.
Special operating conditions require further appropriate knowledge, e.g. of aggressive media.

2.4 Personal Protective Equipment

The personal protective equipment is designed to protect the skilled personnel from hazards that could impair their safety or health during work. When carrying out the various tasks on and with the instrument, the skilled personnel must wear personal protective equipment.

Follow the instructions displayed in the work area regarding personal protective equipment!

The requisite personal protective equipment must be provided by the operating company.

Wear safety goggles!
Protect eyes from flying particles and liquid splashes.

Wear a protective helmet!
Protects the head from falling objects.

Wear safety shoes!
Protect feet from falling objects or objects lying around, as well as against toxic or hazardous liquids and aggressive media.

2.4.1 Symbols

Before mounting and commissioning the instrument, ensure you read the operating instructions!

CE, Communauté Européenne
Instruments bearing this mark comply with the relevant European directives.

This marking on the instruments indicates that they must not be disposed of in domestic waste. The disposal is carried out by return to the manufacturer or by the corresponding municipal authorities (see EU directive 2012/19/EU).

2.5 Warnings and Cautions

The Model 9476 has a maximum supply pressure rating of 30 psig (45 psia). The internal transducers have a burst rating of approxmiately 1.5x the full scale of pressure. Each transducer range in the unit is equipped with relief valves to protect from overpressure.

WARNING!
The 9476 has a maximum supply pressure rating of 30 psi gauge (45 psi absolute). The internal transducers have a burst rating of approximately 1.5x the full scale pressure. Each transducer range in the unit is equipped with relief valves to protect from overpressure.

HIGH PRESSURE!
The 9476 can operate in system configurations containing large pressure storage tanks. Large vessels even at fairly low pressures can hold large amounts of kinetic energy. User should safely bleed all pressure stored in external volumes before servicing, removing pressure hoses, or removing transducers. Powering down the instrument isolates the instrument from external pressures, but does not vent or relieve pressure from internal or external vessels.

SHOCK!
The system uses normal power line AC voltages. User should remove the AC power cord from mains when servicing

inside the 9476 chassis.

WARNING!
Any maintenance or troubleshooting should be performed by technicians knowledgeable in pneumatic pressure instrumentation and AC powered electronic equipment.

WARNING!
The unit weighs approximately 40 lbs. and is intended as a 'two person lift.'

HOT!
Some moving mechanical devices contained within the chassis (specifically solenoid valves) can build up excessive heat during continuous operation. Care should be taken when servicing inside the instrument.

Additional Warning and Caution notices are found throughout this manual.

3. Initial setup

3.1 Unpacking and initial setup

The initial installation should include removing any packing material used in shipment and inspect that fittings and screws are snug, and that hoses and electrical cords are not chaffed or cut. The Model 9476 should be installed on a level surface (bench top or rack) with adequate airflow to keep the system within its 15 to 45 C optimum operating temperature range. The unit operates on line voltages between 100 and 240 VAC at 50 or 60 Hz.

A source of dry inert gas media is required for pressure control operations. Supply pressure is not required if only pressure monitoring operations are needed. The supply pressure for full range operation should be instrument quality at approximately 30 psi gauge (45 psi absolute). If compressed air is used it should be a quality class of 1.2.1 or better as defined by ISO Standard 8573.1. This limits dirt particles to less than 0.1 microns, a water pressure dew point of -40 C or lower at 100 psig, and oil vapor of less than 0.008 ppm. A vacuum pump or vacuum source is required if sub-atmospheric pressure control is required.

3.2 Pressure connections

- The supply pressure should be connected to the rear panel port labeled as “SUPPLY.” The pressure should be approximately 30 psi gauge as described in “Unpacking and Initial Setup.”
- For sub-atmospheric pressure control, a vacuum source is required and should be connected to the port labeled “EXHAUST.” If only control pressures above barometric pressure are required or only measuring is required, no vacuum source is needed and the exhaust port should be left open.
- If a pump is not used and exhaust noise is excessive, a pressure muffler can be installed on the exhaust port. Mensor can provide recommendations or a suitable muffler.
- Porting on the rear of the unit includes female 7/16-20 SAE straight thread manifold ports for all ports.
- Adapters are provided to convert to 1/4” tube fittings.

3.3 Electrical power connections

- Electrical AC power is connected to the IEC320 power entry module in the rear of the instrument using the power cord supplied. The entry module provides the main power switch, a power line filter, and fusing for the unit.

3.4 Electrical communication connections

- The communication ports on the rear of the instrument are provided for connections to a user’s computer or network. A DB9 M/F cable is provided to connect to a PC serial port. The length of this cable can be extended if desired by the user.
- Mensor recommends that a shielded cable be used and conform to local EMI standards.
- The Ethernet port utilizes a standard RJ45 cable. A straight cable should be used if connected through a hub or switch and a cross cable should be used if connected directly to a PC.
- A simple cross-over cable is provided for initial testing. This cable does not replace heavy duty certified Cat 5 or Cat 6 cable, but does provide something to get the unit up and running not knowing the actual required cable length for the final application.

EN

3.5 Operation

Generally, once configured, the system requires power, clean dry pressure media, and possibly a vacuum source for sub-atmospheric control and near-atmospheric control.

- Start up operation commences when power is applied using the rear panel power switch.
- If the front LED does not illuminate, verify power is applied to the rear panel and the fuses are operational. The unit may take about a minute to boot up.
- The unit powers up into measure mode of operation with all internal solenoid valves closed, and transducer null offsets turned off.
- All other start-up settings are dependent on the saved system configuration including pressure units, transducer synchronization and communication rate, head pressure correction, and remote communication settings.
- When the unit is powered down by turning off the unit with the rear port switch, the system will cease pressure operations and seal the system ports trapping incoming and outgoing pressures.
- On application of power, the processor and display should go through internal self tests and display the operating screen in approximately 1 minute. During this time the internal operating system will initialize, transducers will be identified and read, and serial and Ethernet connections will be verified using saved settings.
- The AUX transducer is treated as optional in the system, but boot times may be extended when it's not installed as the self-tests attempt to find it.
- When complete, the instrument will display a home screen similar to that shown here.

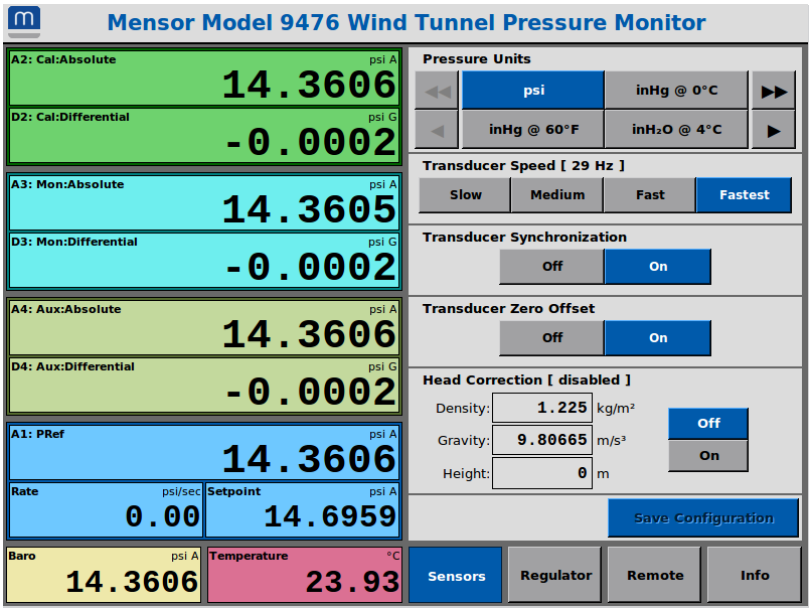


Figure 3.5 Initial Display

EN

4. Panel operation

4.1 Panel overview

4.1.1 Front panel

The front panel contains a color LCD monitor with touch screen along with a blue power LED indicator. Manual operation of the 9476 is through the front panel using the touch screen interface. The features provided on the touch screen are listed in the general operations section. Touch panel operation can be disabled using remote commands. Monitoring of operations, readings and pressure set point changes are still possible when the panel is locked. Disengaging the two thumb screws allows the front panel doors to open for access to the transducers and system memory card.

Figure 4.1.1 Front Panel

4.1.2 Rear panel

External pressure porting and communication connections are provided on the rear of the unit along with the main power entry module (switch, fuse & filter). Pressure ports include the supply port, exhaust port, vent port, barometric reference port, control reference port, and transducer channel measure ports. The supply port assumes the use of clean dry inert media (air or nitrogen preferred). The exhaust or vacuum port is provided if sub-atmospheric control is required. If not required, the exhaust port should be left unconnected. The test device should be connected to the measure ports. If external venting of the pressure is preferred or required for safety, the vent port will accept a 7/16-20 SAE fitting. The vent port includes a pre-installed muffler fitting that will need to be removed if external venting is used.

The instrument accepts universal AC power (100 to 240 volts AC, 50 or 60 Hz, 2 amps max). Power is brought into the unit on a standard IEC 320 power entry module (C13/C14) on the rear panel. A power switch is contained on the module along with fuses and a line filter. Power is fused on both the hot and neutral AC lines entering the unit. No switching or adjustments are required to go from 100 volt operation to 230 volt operation or back. Internally all components are powered by a 12 volt DC power supply.

Electrical signal connections consist of an RS-232 serial port and a 10/100/1000 Mbps TCP/IP (Ethernet) port for connection to a user computer. The RS-232 port supports a variety of settings. The TCP/IP connection support both IPv4 and IPv6 protocols. Settings for the serial and Ethernet ports can be configured using the front panel touch interface or through remote commands.

Figure 4.1.2 Back Panel

EN

4.2 Front Panel Operation

The unit powers up into the default operating screen in the default mode of measure and with the control set point equal to the first barometric reading measured. The screen is divided into 2 primary sections, each with various sub-sections and a fixed model header across the top of the screen. The left half of the screen is the complete set of measurement and control values throughout the system, including the DPCAL transducer, DPMON transducer, AUX transducer, PREF transducer, barometric transducer, and internal temperature probe. The right half of the screen is for system configuration further divided into selectable categories: Sensors, Regulator, Remote, and Info.

Many settings are configured using simple, single tap push-buttons, often in mutually exclusive sets of values. An active setting button will be highlighted in blue with white text, inactive settings will be gray with black text.

Some settings require numeric input. To modify numeric values, tap the existing displayed value. A numeric input window will pop up aligned to the selected setting. The input pop up will typically have a header panel that may include some combination of minimum, maximum, default, and current values associated with the activated setting. This pop up window can be closed (canceled) by clicking the red “X” button on right right side. As numeric values are entered, the associated setting display field will highlight in red for invalid values and green for acceptable values. The value is submitted by tapping the green enter button on the bottom right. There is also a yellow clear (CLR) button to erase all current input and a yellow backspace button to clear a single character. Depending on the activated setting there may also be a +/- button to toggle negative and positive values, and decimal point button. The IPv6 address input pop up window has additional hex value digits and a colon separator. Any time a setting input pop up is displayed the rest of the interface is disabled until the pop up is closed. Canceling an input pop up entry will leave the associated setting unchanged.

4.3 System Measurement

- The first three measurement panels are the dual high precision transducers: DPCAL, DPMON, and AUX.
- Each of these three panels is further divided into two sub-panels, the absolute measurement on top and the differential measurement on bottom.
- Each sub-panel includes the transducer id and unit of measure with an absolute or gauge designation. Each sub-panel header will also include an A# or D# designator for the transducer’s associated output port on the rear panel.
- Beneath the three dual transducer panels is the PREF transducer panel. The PREF panel is divided into three sub-panels including the PREF pressure reading, the PREF reading rate of change, and the control set point.
- The rate sub-panel can be tapped to toggle between seconds and minutes scales.
- The set point sub-panel can be tapped to activate the input panel (discussed in detail later).
- Beneath the PREF panel is the barometric measurement panel and the internal temperature panel. The internal temperature panel can be tapped to cycle the temperature units.

4.4 System Configuration

The configuration categories are activated by tapping one of the four category buttons across the bottom right section of the screen:

Sensors	■ active by default boot-up ■ includes button to save configuration changes - only active if there are unsaved changes to the system configuration ■ provides configuration of system pressure units, transducer speed, tranducer synchronization, transducer zero offset, head pressure correction
Regulator	■ Provides interface to confrol system pressure routing, regulator operational mode and set point jogging ■ Includes button to save configuration changes - only active if there are unsaved changes to the system configuration
Remote	■ provides settings for remote communication with unit ■ Includes button to save configuration changes - only active if there are unsaved changes to the system configuration
Info	■ provides information about the unit itself and installed transducers

4.4.1 Sensor Configuration

The first sub-section of the sensor configuration category is system pressure units.

- Pressure units are set by tapping the button of the desired unit. Use the buttons with left and right pointing arrows to scroll through the list of available pressure units. The buttons with single arrows scroll a single page at a time. The buttons with double arrows jump to the first or last page of units. The active system pressure unit is saved to the system configuration and restored at boot up. The default system pressure unit is psi. System pressure units are applied globally, all pressure readings use the same pressure unit when set.
- The pressure transducer speed (reading rate) is set by tapping one of the 4 transducer speed options: Slow, Medium, Fast, or Fastest. The transducer speed header also includes a label displaying the calculated reading rate in hertz. Transducer reading synchronization can also be turned on or off using the synchronization buttons. Transducer speed and synchronization settings only affect the DPCAL, DPMON, and AUX transducers. When synchronization is turned off the transducers are each read as fast as possible without synchronization messages sent to the transducers. Turning transducer synchronization on introduces extra delay between sets of readings, but ensures sets of readings are aligned within 100 microsecond frames. Transducer speed and synchronization settings are saved to the system configuration and restored at boot up. The default transducer speed is medium and transducer synchronization is on by default.
- Transducer zero offset is used to toggle the calculated reference offset. This feature has no effect unless the regulator zero process is performed at least once (discussed in detail in regulator configuration). The zero offset applies an offset determined from the barometric pressure reading for absolute transducers in the system and a zero adjustment for gauge transducers in the system. The barometric transducer is not affected by the zero offset setting. The zero offset setting is not saved to the system configuration and is off by default.
- Head pressure correction is used to compensate for height differences between the internal transducers and the external DUT or point of measurement. Head correction assumes a single point configuration applied to all transducers in the unit equally (head correction settings cannot differ among transducers). The head correction calculation uses density, gravity and a height differential to calculate a pressure offset. Use positive height values when the DUT or point of measurement is above the 9476, negative values when the DUT or point of measurement is below the 9476. The head correction offset is disabled when off and applied to all absolute transducers except the baro when on. When the height value is zero no offset is applied. Head correction settings are saved to the system configuration and restored at boot up. Head correction is disabled by default.

4.4.2 Regulator Configuration and Control

- The first sub-section of the regulator configuration category is an interactive plumbing schematic to control measurement routing in the system.

Across the top are output indicators labeled A# and D# which correspond to each associated [A]bsolute and [D]ifferential transducer output port on the rear panel. Directly beneath each output indicator are output isolation solenoid indicators. These indicators can be tapped to manually toggle their open/close state. When closed they are dark gray in color and change to green when open. The vertical column of solenoid indicators on the left side are control isolation solenoids. The control isolation solenoids are used to route individual transducer channels to the PREF pressure control channel. When solenoids are open the channel route lines will also change to green to indicate the exposed route. The output isolation solenoids can be toggled at any time without limitation. The control isolation solenoids have several limitations imposed by the instrument software which make them appear unresponsive under certain conditions. The system will prevent control routing to transducers if it could cause overpressure to the routed transducer. The system also prevents simultaneous routing of both the absolute and differential sides of a dual transducer. Where over pressure is possible the solenoids will not open. Where abs/diff routing is mutually exclusive, the opposite side of a dual transducer may automatically close if already open.

- The second sub-section of the regulator configuration category is the regulator mode selection which includes Measure, Control, Vent, and Zero modes.

Measure mode will internally isolate the regulator from all transducer routes. While in measure mode solenoid routing can be manually toggled, but the current set point may prevent some solenoids from opening depending on the range of the routed transducer channel(s). Measure mode is the default operational mode at boot up. Measure mode is also used for leak checking (discussed in detail later). Normal operation of measure mode does not require a pressure or vacuum supply.
Control mode is used to drive the PREF channel (and any manually routed measurement channels) to a desired pressure set point. Control mode operation requires a pressure supply source and optional vacuum source as described in the Initial Setup section. In control mode the regulator output is automatically routed to the PREF channel, but PREF output (A1) on the rear panel must be manually toggled. PREF control uses absolute pressure readings. When routing to gauge (differential) channels care must be taken to determine the appropriate absolute set point needed to drive to a desired gauge pressure. To change the control set point tap the “Setpoint” sub-panel of the PREF display panel on the left side of the screen. A numeric input window will pop up aligned to the set point display. To cancel/close the input pop up tap the red “X” button at the top right. The top header of the input pop up will display the minimum and maximum acceptable values for the set point. The min/max range is based on several factors: ranges of

transducers installed, current solenoid routing, and current barometric pressure. The min/max values will be based on the smallest range transducer channel currently installed and routed to the PREF channel. The ranges of the absolute transducer channels are also limited by the corresponding differential range.
Vent mode is used to release the control channel pressure to atmosphere through the vent port on the rear panel. Any transducer channels routed to the PREF channel will also be vented.
Zero mode is used to calculate transducer offset values (null readings). Zero mode differs from the other three modes in that it's an automated temporary mode. Zero mode first vents the system completely then gathers transducer readings to calculate the new zero offset values. When the zero process completes, the system automatically switches to vent mode. Zero mode can be canceled at any time by changing to a different operating mode. Completion of zero mode does not automatically turn on and apply the calculated zero offsets. The offsets are only applied when manually turned on using the Transducer Zero Offset setting in the Sensors configuration category. Existing zero offset values (if any) are cleared every time Zero mode is activated.
Zero mode also overrides the solenoid activation restrictions during the venting process to open all transducer channels to the vent simultaneously. Upon completion of zero mode, the transducer channel isolation solenoids will remain open until manually closed or manually changing to control mode. Zero mode will take anywhere between 10 seconds up to several minutes depending on how long it takes the system to vent. Venting duration will depend on controlled pressure and volume at the time of vent. Proper zero mode functionality will result in all absolute transducer readings being as close to the barometric reading as possible and all gauge (differential) readings being as close to zero as possible (while still vented). The transducer zero offset values are applied at the instrument software level, no changes are made to the transducers themselves. Zero mode is not part of, or a substitute for, transducer calibration procedures. Calculated zero offset values are not saved to the system configuration.

- The final sub-section of the regulator configuration category is the set point jogging interface. Small or large increments can be applied to the control set point by tapping the up and down arrows on either side of the panel. The actual increments can be set by tapping the big and small input boxes then entering the new values on the input pop up window. Big and small jog step values used are saved to the system configuration.

4.4.3 Remote Configuration and Control

- The first sub-section of the remote configuration category is the RS-232 serial port settings panel.

Here the user can select the serial baud, data bits, parity, and stop bits settings. The default serial communication configuration is 57600 baud, 8 data bits, no parity, and 1 stop bit. The serial configuration settings are applied immediately upon changing any of the settings so any active serial connections will need to re-connect with the new settings. The serial settings are saved to the system configuration.

- The second sub-section of the remote configuration category is the IPv4 Ethernet settings panel.

Here the user can select the IP address, gateway, net mask, and port for IPv4 connections. The IPv4 settings are applied immediately upon changing any of the settings so any active IPv4 connection will need to re-connect with the new settings. The IPv4 settings are saved to the system configuration.

- The third sub-section of the remote configuration category is the IPv6 Ethernet settings panel.

Here the user can select the IP address, net mask, and port for IPv6 connections. The IPv6 settings are applied immediately upon changing any of the settings so any active IPv6 connection will need to re-connect with the new settings. The IPv6 settings are saved to the system configuration.

- Both of the ethernet settings panels include a connection status icon in the top right corner.

The icons will have two device indicators using colors to indicate status. A gray/gray icon with a red "x" indicates a disconnected cable or an error with the connection, possibly due to a problem with the Ethernet settings. The disconnection icon may also briefly appear when connection settings are changed. A green/gray icon indicates a ready (listening) state. A green/green icon indicates an active connection with the associated protocol. In addition to these indicator icons, the underlying operating system may occasionally display brief pop up bubbles describing changes in Ethernet connection states.

- Even though changes to settings for all communication methods are applied immediately, the system configuration needs to be saved manually after changes for the new settings to persist after rebooting the unit.

All three communication methods can be utilized simultaneously, but for optimal performance, only a single method should be used at a time.

4.4.4 System Info

The Info category displays system details including model number, instrument software version, serial number and details about each transducer installed in the unit. Each transducer info panel displays the model, firmware version, serial number, date of calibration, pressure range, and native pressure units. The dual transducer panels will display two ranges for absolute and gauge designated by an “A” or “G” suffix. The transducer info panel colors match the corresponding measurement display panels on the left half of the screen. These panels will be blank if a transducer is not installed in the system or if the system failed to detect the transducer at start up.

4.5 Typical Operating Processes

4.5.1 Pressure Measuring and Monitoring

- Typical operation consists of connecting the pressure hoses to the appropriate rear panel pressure ports for measurement and monitoring. The unit should be powered up and allowed to complete the boot process. Once measurement readings are displayed on the front panel, the system is fully booted.
- An additional 15 minute warm-up period is required for full transducer accuracy (depending on the environment).
- Measure mode is active by default at boot up.
- After the warm-up period, zero mode should be used as described in the Regulator Configuration and Control section. After a zero process is performed, the unit will need to be returned to measure mode manually (from vent mode) by using the front panel interface or remote commands.
- Output isolation solenoids are closed by default at boot up. Each transducer channel requiring external measurement must have its output isolation solenoid manually opened by using the solenoid control panel on the display or by using the appropriate remote commands.
- In measure/monitor only conditions, the control isolation solenoids that route transducer channels to the PREF control channel should be closed, otherwise the transducer channels are no longer isolated from each other. Note that the control isolation solenoids will be opened during the zeroing process.
- Measurement values can be observed as needed on the front panel interface or read from the unit using remote queries. Measured values are not logged or saved within the instrument itself, all data must be collected by a remotely connected system.

4.5.2 Pressure Control

- ► Pressure control will require external pressure and optional vacuum sources as described in the Unpacking and Initial Setup section. Control mode is intended for system leak checking. Control stability is rated at 0.1% of full scale and is not intended for high precision pressure control.
- Set control mode and the desired set point as described in the Regulator Configuration and Control section.
- Use the solenoid interface panel or remote commands to route pressure to the desired channels.
- ► Note: the system will prevent solenoid activation, or set point values that would over-pressure a transducer channel.
- Once controlling to a target pressure there will be immediate changes in transducer readings and the PREF rate reading.
- When the control has settled at the target pressure the PREF pressure reading display will change from black to green text. Control stability can also be queried using remote commands.
- After completion of control mode operations the system, including all transducer channels, should be vented to release any trapped pressure.

4.5.3 Leak Testing

- ► Begin leak testing by following the procedures in the Pressure Control section.
- Control a single transducer channel to its max pressure range. If the channel fails to achieve stable control, there may be a large leak present.
- Once stable, wait approximately 5 minutes to achieve stable channel temperature.
- Switch the operational mode to measure, then wait an additional 10 seconds.
- Note the initial PREF channel pressure reading. Wait exactly one minute.
- Note the final PREF channel pressure reading. With all output isolation solenoid valves closed, there should be less than 0.005 psi difference between the initial and final PREF pressure readings. If one or more output isolation solenoid vales are open during the leak test, the acceptable pressure drop during the test will vary with the amount of volume in the system.
- Repeat the leak test procedure for each transducer channel in the system.

4.5.4 Remote Operation

- ► All functions available from the front touch panel interface are also available remotely using the remote command set.
- ► Communication with the 9476 is established with RS-232 serial communication or ethernet communication. Ethernet communication is available using both IPv4 and IPv6 protocols.
- ► Communication using multiple methods simultaneously is possible, but not recommended.

- Remote communication uses case-insensitive ASCII commands and queries.
- Communication is identical regardless of connection method used (e.g.: serial or ethernet).
- All commands and queries sent to the 9476 should be terminated with a carriage return (0x0D) and line feed (0x0A) pair. All responses are terminated with a carriage return and line feed pair. Serial and ethernet settings are end-user configurable.

EN

4.6 Serial Communication Configuration

- The RS-232 port is located on the rear panel as a DB9F configured as a DTE port.
- A cross-over cable or null modem adapter should not be required for connection to a PC or similar DCE equipment.
- Baud is user configurable to 9600, 19200, 38400, 57600 (default), or 115200 bps.
- Data bits are user configurable to 7 or 8 (default) bits.
- Stop bits are user configurable to 0, 1 (default), or 2.
- Parity is user configurable to none (default), odd, or even.
- All serial settings can be configured using the touch panel interface on the “Remote” panel.
- Serial settings can also be configured remotely. However, every serial setting change will immediately reinitialize the serial communications port requiring a reconnect with the new settings.
- Changes to the serial configuration will not persist unless the system configuration is saved. Erasing the system configuration will reset the serial configuration to default values.

4.7 Ethernet Communication Configuration

- The ethernet port is located on the rear panel as an RJ45 jack with GbE. Both IPv4 and IPv6 are supported with user configurable IP addresses, net masks, gateway, and ports.
- Both IPv4 and IPv6 protocol connections can be established simultaneously, but is not recommended.
- All ethernet settings can be configured using the touch panel interface on the “Remote” panel. The “Remote” panel also has ethernet connection indicator icons to show the status of each protocol.
- A green/gray icon is shown for a “listening” connection.
- A green/green icon is shown for an active connection.
- A gray/gray icon with a red “x” is shown when there is no cable connection detected.
- Ethernet settings can also be configured remotely. However, every ethernet setting change will immediately reinitialize the ethernet communications requiring a reconnect with the new settings.
- Changes to the ethernet configurations will not persist unless the system configuration is saved. Erasing the system configuration will reset the ethernet configurations to their default values.

4.8 Remote Command Set

The remote command set is comprised of messages categorized as commands, queries, and meta-queries. All messages should be terminated with a carriage return and line feed pair (CRLF: 0x0D 0x0A). All responses are terminated with a CRLF pair, however, not all commands result in a response from the unit. Messages categorized as “commands” will not generate a response. Messages categorized as queries and meta-queries will always respond in a manner detailed in the command set table. Queries and meta-queries are composed of the message name followed by one of the query characters. The standard query character is a question mark (?) and is used to request a value from the unit. Meta-queries are used to request additional information about a command or query in the remote command set.

■ The following list describes the general functionality of each query and meta-query character:

= : Used to assign a new value to a system setting. Must be followed by an appropriate value as described in the command set table.

? : Standard query to request a value or status.

: Request the default value of a system setting, if supported. This is the value used for a system setting when the configuration is reset.

- : The minimum value the system will accept for a setting, if supported.

+ : The maximum value the system will accept for a setting, if supported.

$: A short description of the command/query, if supported.

■ Example commands:

SAVECFG
HCON
MODE=VENT
SCCA=1

■ Example Queries:

STATUS?
RDGS?

- Example Meta-Queries:

XSPD#
HCGRAVITY+
AUXCONN$

EN

A single asterisk (*) followed by CRLF can be sent to the unit to get a comma separated list of all valid remote commands. Each command name will have a suffix of all the query characters supported by that message. If the message refers to a saved configuration value there will also be a caret (^) symbol in the suffix list.
Many commands/queries in the command set use boolean values. When assigning boolean values 0, NO, OFF, and FALSE all equate to a false value, 1, YES, ON, and TRUE all equate to a true value. However, all boolean queries always respond with False or True.

Sensor Commands and Queries
All pressure commands and queries use values in the current system pressure units.
All temperature commands and queries use values in the current system temperature units.

Message	Function	Example Usage	Example Response	Features
BARO	pressure reading of BARO transducer	BARO?	14.3542	?$
A1	absolute pressure reading of PREF transducer	A1?	15.8121	?$
D2	differential pressure reading of DPCAL transducer	D2?	2.5297	?$
A2	absolute pressure reading of DPCAL transducer	A2?	25.5442	?$
D3	differential pressure reading of DPMON transducer	D3?	2.5297	?$
A3	absolute pressure reading of DPMON transducer	A3?	15.8121	?$
D4	differential pressure reading of AUX transducer	D4?	0.0001	?$
A4	absolute pressure reading of AUX transducer	A4?	29.9815	?$
CAL	both differential and absolute pressure readings of the DPCAL transducer	CAL?	(DIFF, ABS) 2.1019, 15.6441	?$
MON	both differential and absolute pressure readings of the DPMON transducer	MON?	(DIFF, ABS) 2.1019, 15.6441	?$
AUX	both differential and absolute pressure readings of the AUX transducer	AUX?	(DIFF, ABS) 2.1019, 15.6441	?$
RDGS	all transducer pressure readings in the following order separated by commas: BARO, PREF, CAL:DIFF, CAL:ABS, MON:DIFF, MON:ABS, AUX:DIFF, AUX:ABS	RDGS?	14.3582, 13.4630, 0.5618, 13.8754, 0.5403, 13.8433, 0.5319, 14.6485	?$
ALLRDGS	same as RDGS query with temperature reading and status word appended. This is also the default system query, sending only a question mark to the unit yields the same response.	ALLRDGS? ?	14.3584, 13.4640, -0.5615, 13.8766, -0.5400, 13.8446, -0.5320, 14.6496, 25.00, 12336	?$

HIDEAUX	get or set a boolean value to hide AUX readings from the RDGS and ALLRDGS queries. The AUX transducer is optional in the system. When not installed there will be NaN placeholders in the responses from the RDGS and ALLRDGS queries. Set HIDEAUX to true to omit the NaN placeholders from those queries. If the AUX transducer is installed, this setting is ignored.	HIDEAUX? HIDEAUX=0 HIDEAUX=1 HIDEAUX=True HIDEAUX=False	True or False (when queried)	?=#$
AUXCONN	returns True if the AUX transducer is present, False otherwise	AUXCONN?	True or False	?$
XSPD	get or set the pressure transducer reading speed, A, B, C, or D where A is the slowest and D is the fastest. Only affects DPCAL, DPMON, and AUX transducers.	XSPD=A XSPD=B XSPD=C XSPD=D XSPD?	A, B, C, or D	?=-+#$
XSYNC	get or set a boolean value to toggle transducer reading synchronization. Only affects DPCAL, DPMON, and AUX transducers.	XSYNC=True XSYNC=False XSYNC?	True or False	?=#$
XRDRATE	gets the calculated pressure transducer reading rate in Hz. This will be affected by the XSPD and XSYNC settings. This value will be unstable for a few seconds after changing XSPD and XSYNC settings.	XRDRATE?	17.3	?$
NULLRDGS	get or set a boolean value to apply calculated zero offsets to pressure readings. BARO transducer is not affected.	NULLRDGS=True NULLRDGS=False NULLRDGS?	True or False	?=$
NULLON	turns on zero offsets. Same as NULLRDGS=True	NULLON		$
NULLOFF	turns off zero offsets. Same as NULLRDGS=False	NULLOFF		$
NULLCALC	activates regulator “Zero” mode to calculate zero offsets. Regulator switches to “Vent” mode when complete. Use MODE=MEAS or MODE=VENT to cancel.	NULCALC		$
A1RPS	rate of change of the PREF transducer in units per second	A1RPS?	2.15	?$
A1RPM	rate of change of the PREF transducer in units per minute	A1RPM?	12.42	?$
PRESHIGH	True if any pressure transducer is reading outside its calibrated range, False otherwise.	PRESHIGH?	True or False	?$
TEMP	Temperature sensor reading.	TEMP?	25.93	?$
TEMPHIGH	True if temperature reading is below temperature minimum or above temperature maximum. False otherwise.	TEMPHIGH?	True or False	?$
TEMPMIN	Temperature minimum. Temperature readings below this value will trigger the temperature range status alert.	TEMP-MIN=20.0 TEMPMIN?	20.00	?=#$
TEMPMAX	Temperature maximum. Temperature readings above this value will trigger the temperature range status alert.	TEMP-MAX=70.0 TEMPMAX?	70.00	?=#$
HCSTATUS	get or set a boolean value to apply calculated head pressure offset to pressure readings.	HCSTATUS=True HCSTATUS=False HCSTATUS?	True or False	?=#$
HCON	turns head pressure offset on. Same as HCSTATUS=True	HCON		$
HCOFF	turns head pressure offset off. Same as HCSTATUS=False	HCOFF		$
HCDENSITY	get or set the head pressure correction density value in kg/m^2	HCDENSI-TY=1.25 HCDENSITY?	1.225	?=-+#$
HCGRAVITY	get or set the head pressure correction gravity value in m/s^3	HCGRAV-ITY=9.8 HCGRAVITY?	9.80665	?=-+#$

HCHEIGHT	get or set the head pressure correction height difference in meters. Use positive values when DUT is above the instrument, negative values when DUT is below the instrument.	HCHEIGHT=12.5 HCHEIGHT=-3.42 HCHEIGHT?	12.625	?=-+#$
HCVALUE	get the calculated head pressure correction offset. Always returns 0 if head correction not active.	HCVALUE?	0 -0.022	?$
UNITS	provides a list of all available pressure units in a comma separated list including each unit's id number and name.	UNITS?	1: UNIT1, …, N: UNITN	?$
UNIT	get or set the pressure unit code for the current system pressure units. Valid values are 1 through 39 excluding 31 and 34.	UNIT=1 UNIT?	1	?=-+#$
UNITNAME	name of the current system pressure unit.	UNITNAME?	psi	?#$
TEMPUNITS	provides a list of all available temperature units in a comma separated list including each unit's id number and name.	TEMPUNITS?	1: UNIT1, …, N: UNITN	?$
TEMPUNIT	get or set the temperature unit code for the current system temperature units. Values values are 1 through 3.	TEMPUNIT=2 TEMPUNIT?	2	?=-+#$
TEMPUNIT-NAME	name of the current system temperature unit.	TEMPUNIT-NAME?	Celsius	?#$

System Status Commands and Queries				
Message	Function	Example Usage	Example Response	Features
STATUS	16 bit integer value in decimal base with various system status flags. Same value included in the ALLRDGS query. Bits 0-2: Regulator mode 000: Measure 001: Control 010: Vent 011: Zero 100: Regulator Unavailable Bit 3: Regulator stable Bit 4: Transducer Synchronization active Bit 5: Touch panel enabled Bit 6: Temperature over-range indicator Bit 7: Pressure over-range indicator Bit 8: Head height correction active Bit 9: Zero offset active Bit 10: Aux transducer not present Bit 11: System error Bit 12: Unsaved configuration changes Bit 13: Expected internal transducer serial port(s) missing Bit 14: Expected internal transducer connection(s) missing Bit 15: Temperature probe missing	STATUS?	12592	?$
STATUS.B	Same as status query in base 2 with leading 0s.	STATUS.B?	11000100110000	?$
STATUS.X	Same as status query in base 16.	STATUS.X?	3b19	?$
ERRMSG	gets and removes the oldest error message from the system error queue. Returns [N/A] if the error queue is empty.	ERRMSG?	Command not found in the protocol [N/A]	?$
LOGMSG	gets and removes the oldest system log message from the log queue. Returns [N/A] if the log queue is empty. The system log messages are informational messages that may help in troubleshooting problems, but typically won't be meaningful to the end user.	LOGMSG?	[10:53:05.631] [HWM] Activating IPv4 server... [N/A]	?$
CLRERRBIT	Clears all messages from the error queue and clears the status word error bit.	CLRERRBIT		$

System Information Commands and Queries				
Message	Function	Example Usage	Example Response	Features
ID	get the unit's model and firmware info.	ID?	Mensor Model 9476 Wind Tunnel Pressure Monitor, Version 1.0	?$
SERIALNO	get the manufacturer assigned serial number of the unit.	SERIALNO?	999888	?$
BAROINFO	info about the baro transducer installed in the system in the following format: Name, Model, SN, version, native units, range min, range max, date of cal (MM/DD/YYYY).	BAROINFO?	BARO, 6000SNSR, 41000OJF, V6.00, psi, 8.0000, 17.0000, 12/10/2018	?$

A1INFO	info about the PREF transducer installed in the system in the following format: Name, Model, SN, version, native units, range min, range max, date of cal (MM/DD/YYYY).	A1INFO?	PREF, 6000SNSR, 41000OJX, V6.00, psi, 0.0000, 33.0000, 12/11/2018	?$
D2INFO	info about the DPCAL:DIFF transducer installed in the system in the following format: Name, Model, SN, version, native units, range min, range max, date of cal (MM/DD/YYYY).	D2INFO?	DPCAL:DIFF, ADTS_XDR, 41000RX7, V7.00, psi, -15.0000, 15.0000, 11/14/2018	?$
A2INFO	info about the DPCAL:ABS transducer installed in the system in the following format: Name, Model, SN, version, native units, range min, range max, date of cal (MM/DD/YYYY).	A2INFO?	DPCAL:ABS, ADTS_XDR, 41000RX7, V7.00, psi, 0.0000, 35.0000, 11/14/2018	?$
D3INFO	info about the DPMON:DIFF transducer installed in the system in the following format: Name, Model, SN, version, native units, range min, range max, date of cal (MM/DD/YYYY).	D3INFO?	DPMON:DIFF, ADTS_XDR, 41000RXA, V7.00, psi, -15.0000, 15.0000, 11/14/2018	?$
A3INFO	info about the DPMON:ABS transducer installed in the system in the following format: Name, Model, SN, version, native units, range min, range max, date of cal (MM/DD/YYYY).	A3INFO?	DPMON:ABS, ADTS_XDR, 41000RXA, V7.00, psi, 0.0000, 35.0000, 11/14/2018	?$
D4INFO	info about the AUX:DIFF transducer installed in the system in the following format: Name, Model, SN, version, native units, range min, range max, date of cal (MM/DD/YYYY).	D4INFO?	AUX:DIFF, ADTS_XDR, 41000RW1, V7.00, psi, -5.0000, 5.0000, 12/11/2018	?$
A4INFO	info about the AUX:ABS transducer installed in the system in the following format: Name, Model, SN, version, native units, range min, range max, date of cal (MM/DD/YYYY).	A4INFO?	AUX:ABS, ADTS_XDR, 41000RW1, V7.00, psi, 0.0000, 35.0000, 12/11/2018	?$

Pressure Regulator Commands and Queries				
Message	Function	Example Usage	Example Response	Features
MODE	get or set the operational mode of the system pressure regulator (Measure, Control, Vent, Zero). Accepted values for Measure: 0, M, MEAS, MEASURE Accepted values for Control: 1, C, CTRL, CONTROL Accepted values for Vent: 2, V, VENT Accepted values for Zero: 3, Z, ZERO Zero mode is an automated mode to calculate zero offsets for all pressure transducers. When Zero mode completes the system is placed in Vent mode. Zero mode can be canceled by changing to a different mode.	MODE=measure MODE=2 MODE=Z MODE?	Measure, Control, Vent, or Zero	?=#$
SETPT	get or set the regulator control set point.	SETPT=20.5 SETPT?	25.0000	?=$
STABLE	True if the regulator is in control mode and stable at the current set point, false otherwise.	STABLE?	True or False	?$
Solenoid Valve Control Commands and Queries **All solenoid queries return True when activated (open) and False when deactivated (closed).** **Some additional solenoids in the system can only be controlled indirectly by changing the regulator mode.** **Each dual transducer's DIFF/ABS control isolation valves are mutually exclusive (i.e.: activating SOMA will automatically deactivate SOMD). Command parameters will accept 0, NO, OFF, FALSE, 1, YES, ON, or TRUE.**				
Message	Function	Example Usage	Example Response	Features
SOR	PREF output isolator	SOR=0 SOR?	True or False	?=
SOCD	DPCAL:DIFF output isolator	SOCD=ON SOCD?	True or False	?=
SOCA	DPCAL:ABS output isolator	SOCA=YES SOCA?	True or False	?=
SOMD	DPMON:DIFF output isolator	SOMD=1 SOMD?	True or False	?=
SOMA	DPMON:ABS output isolator	SOMA=NO SOMA?	True or False	?=
SOAD	AUX:DIFF output isolator	SOAD=False SOAD?	True or False	?=
SOAA	AUX:ABS output isolator	SOAA=true SOAA?	True or False	?=
SCCD	DPCAL:DIFF control isolator	SCCD=FALSE SCCD?	True or False	?=
SCCA	DPCAL:ABS control isolator	SCCA=off SCCA?	True or False	?=
SCMD	DPMON:DIFF control isolator	SCMD=True SCMD?	True or False	?=
SCMA	DPMON:ABS control isolator	SCMA=on SCMA?	True or False	?=
SCAD	AUX:DIFF control isolator	SCAD=TRUE SCAD?	True or False	?=
SCAA	AUX:ABS control isolator	SCAA=Off SCAA?	True or False	?=

Front Panel Interface Commands and Queries				
Message	Function	Example Usage	Example Response	Features
PANELSTATUS	get or set the unit's front panel lock state. True to enable the touch interface, False to lock.	PANELSTA-TUS=0 PANELSTA-TUS?	True or False	?=#$
LOCKPANEL	lock the front panel touch interface. Same as PANELSTATUS=FALSE	LOCKPANEL		$
UNLOCKPANEL	unlock the front panel touch interface. Same as PANELSTATUS=TRUE	UNLOCK-PANEL		$
JOGSMALL	get or set the small jog step value	JOGS-MALL=0.1 JOGSMALL?	0.01	?=-+#$
JOGBIG	get or set the big jog step value	JOGBIG=2.0 JOGBIG?	2.5	?=-+#$
Device Management Commands and Queries				
Message	Function	Example Usage	Example Response	Features
CFGCHG	True if there are unsaved configuration changes, False otherwise. Unsaved changes are lost when the system is turned off.	CFGCHG?	True or False	?$
SAVECFG	Saves current system configuration.	SAVECFG		$
ERASE	Erases the saved configuration.	ERASE		$
USRTMP	Temporary data store for arbitrary user data. Not saved to configuration data.	USRTMP=anything USRTMP?		?=$
USRTAG	Data store for arbitrary user data. Saved to configuration data.	USRTAG=anything USRTAG?		?=$
APPRESTART	Restarts the system software. Not a full reboot. Unsaved configuration changes will be lost.	APPRESTART		$

Serial Communication Commands and Queries
Changes to serial port settings will immediately reinitialize the serial port (disconnection will occur).
Changes will not persist unless configuration is saved.

Message	Function	Example Usage	Example Response	Features
BAUD	get or set the serial port baud (9600, 19200, 38400, 57600, 115200).	BAUD=115200 BAUD?	57600	?=#$
DATABITS	get or set the serial port data bits (7 or 8).	DATABITS=8 DATABITS?	8	?=#$
STOPBIT	get or set the serial port stop bits (One, Two).	STOPBIT=1 STOPBIT=TWO STOPBIT?	One or Two	?=#$
PARITY	get or set the serial port parity (0: None, 1: Odd, 2: Even).	PARITY=0 PARITY=1 PARITY=Even PARITY?	None, Odd, or Even	?=#$

Ethernet Communication Commands and Queries Changes to ethernet settings will immediately reinitialize the ethernet communications (disconnection will occur). Changes will not persist unless configuration is saved.				
Message	Function	Example Usage	Example Response	Features
MAC	get the MAC address for the unit's ethernet port.	MAC?	00:18:7D:BF:E9:37	?$
IPADDR	get or set the unit's IPv4 address	IPADDR=193.2.1.50 IPADDR?	193.2.1.4	?=#$
IPNETMASK	get or set the unit's IPv4 net mask	IPNETMASK=255.255.0.0 IPNETMASK?	255.255.255.0	?=#$
IPGATEWAY	get or set the unit's IPv4 gateway	IPGATEWAY=193.2.1.255 IPGATEWAY?	193.2.1.255	?=#$
IPPORT	get or set the unit's IPv4 port number	IPPORT=49990 IPPORT?	49999	?=-+#$
IPADDRV6	get or set the unit's IPv6 address	IPADDRV6=fe80::0218:7dff:fe9d:f6a0 IPADDRV6?	fe80::0218:7dff:fe9d:f6ff	?=#$
IPNETMASKV6	get or set the unit's IPv6 net mask	IPNETMASKV6=24 IPNETMASKV6?	64	?=#$
IPPORTV6	get or set the unit's IPv6 port number	IPPORTV6=49992 IPPORTV6?	49999	?=-+#$

4.9 System Memory

4.9.1 Stored Data

The folllowing information is saved to a configuration file on the system memory card with each setting's default value.

1. Active pressure unit (psi)
2. Active temperature unit (celsius)
3. Ethernet IPv4 address (193.2.1.4)
4. Ethernet IPv4 net mask (255.255.0.0)
5. Ethernet IPv4 gateway (193.2.1.255)
6. Ethernet IPv4 port number (49999)
7. Ethernet IPv6 address (fe80::0218:7dff:fe9d:f6ff)
8. Ethernet IPv6 net mask (64)
9. Ethernet IPv6 port number (49999)
10. Serial baud (57600)
11. Serial data bits (8)
12. Serial parity (none)
13. Serial stop bits (1)
14. Small jog (0.01)
15. Big jog (1.0)

16. Head correction density (1.2250)
17. Head correction gravity (9.80665)
18. Head correction height (0)
19. Head correction enabled (false)
20. Transducer speed (medium)
21. Transducer synchronization (true)
22. Hide Aux transducer placeholders (true)
23. Low temperature alarm (15)
24. High temperature alarm (45)
25. User defined tag data ([no data])

All stored data can be erased by sending the “ERASE” remote command. This will restore all settings to the factory default values. Transducer calibration data is stored on the transducers and is unaffected by erasing or changing the system configuration data.

4.9.2 Memory Card Access

The system memory card is a 16GB SDHC card suitable for system booting. The memory card contains the underlying operating system, the instrument software, and stored configuration data. The system memory card can be accessed for removal/ replacement through the front panel access door.

- The system should be powered off completely prior to removal of the memory card.
- The memory card is located in the card tray mounted to the inside left wall of the instrument.
- The card is not spring loaded and should easily slide in and out of the tray.

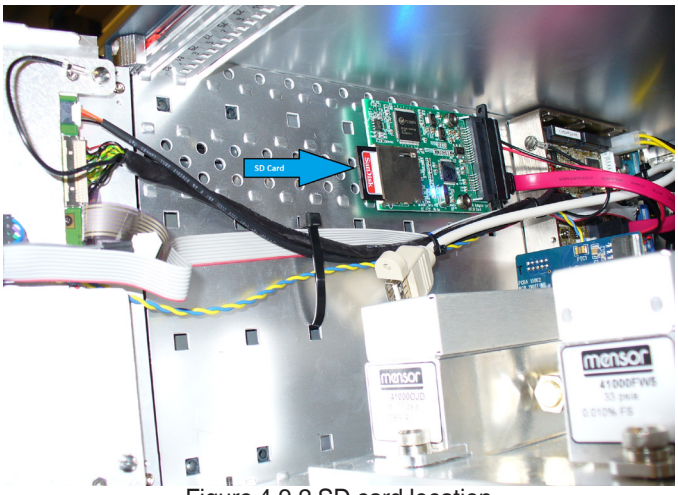


Figure 4.9.2 SD card location

5. Calibration and Maintenance

For contact details, please see Chapter 1 “General information” or the back page of the operating instructions.

EN

5.1 Calibration

Calibration of the pressure equipment should be done periodically. Mensor Digital Pressure Transducers used in the instrument have a recommended calibration interval of 365 days. This interval can be extended or shortened depending on the requirements of the intended application and historical data from previous calibrations.

- ► The transducers must be removed from the system for calibration.
- ► The instrument must be powered off prior removal of transducers.
- ■ Open the front panel access doors by unscrewing the two thumb screws on the right side of the left door.
- ■ With the left door open, the right door can open in the opposite direction. Each transducer is held in place with a single thumb screw that must be loosened.
- ► The first transducer on the left is the barometric transducer. The second transducer from the left is the PREF transducer.
- ► The remaining three dual transducers are, from left to right, DPCAL, DPMON, and AUX.
- ■ The transducers are mated to spring loaded fittings. To remove, push the transducers inward while lifting up.
- ■ The three dual transducers each have two DB9 connectors on top that must be disconnected by loosening the thumb screws.
- ■ Refer to the transducer manuals for calibration instructions.

5.2 Storage and Transportation

The 9476 can be stored for a reasonable amount of time without any adverse effects. Storage temperature should not exceed 70 C or drop below -20 C. The humidity should not be so high as to cause condensation in the system. The pressure ports should be covered, but not completely sealed to prevent contamination in the system. Extended storage should ensure that no water vapor is trapped within the unit and the storage temperature remains between -20 C and 70 C in a non-condensing relative humidity.

- ► When returning the unit to service after an extended storage period, the unit should be inspected similar to that of a new unit and also allowed to stabilize to normal room temperatures before operation.

The unit should be transported in a suitable container typical of a precision laboratory type instrument. Mensor recommends utilizing foam inserts and box similar to the type the unit was originally shipped in. If not possible, the unit should be placed in a container (or corrugated box) of a size that allows at least 4 inches of shock attenuation material on all sides and in a manner that keeps the unit from shifting within the box. Mensor also recommends shipment on a pallet.

5.3 Maintenance

Standard maintenance may include checking for loose fittings and screws and general housekeeping. The cooling fan in the back of the unit should be inspected for operation and cleaned to remove lint and dust. Maintenance of internal components can be minimized when clean dry pressure media is always used. See Calibration section and transducer manuals for additional information.

5.3.1 Beyond the Warranty

Take advantage of Mensor’s expert product care. Mensor provides complete maintenance and calibration services, available for a nominal fee. Our service staff is knowledgeable in the innermost details of all of our transmitters. 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. Returning your transmitter to Mensor for service benefits you in several ways:

- Our extensive knowledge of the transmitter assures you that it will receive expert care.
- All repairs should be performed by Mensor due to the complexity of performing these repairs.

5.4 Calibration Services by Mensor or WIKA worldwide

Mensor and WIKA worldwide have extensive experience and knowledge of Mensor products. Calibration of the transmitters can be performed at the addresses below or by competent internal or external labs using the procedures in this section.

Service Center USA	Service Center Europe
Mensor website: www.mensor.com tel: 1-512-396-4200 1-800-984-4200 fax: 1-512-396-1820 email: tech.support@mensor.com	WIKA Alexander Wiegand SE & Co. KG website: www.wika.de / www.wika.com tel: (+49) 9372 132-0 fax: (+49) 9372 132-406 email: CTServiceTeam@wika.com
Service Center China	
WIKA China website: www.wika.cn contact: Baggio Li tel: (+86) 512 6878 8000 fax: (+86) 512 6809 2321 email: baggio.li@wika.com	

EN

6. Specifications

6.1 Measurement Specifications -Pressure

Accuracy	
Baro:	0.008% of reading
PREF	0.010% full scale
Dual-absolutes	0.009% IS-50
Dual-guage	0.010% of full scale
Uncertainties include all pressure effects, temperature effects and calibration stability over 365 days after rezeroing.	
Precision	
0.003% of span	8.9" color LCD with resistive touchscreen
Ranges (at time of manufacture)	
Baro:	8..17 psi abs
PREF:	0...33 psi abs
DPCAL-Abs	0...35 psi abs
DPCAL-Diff	-15...15 psi guage
DPMON-Abs	0...35 psi abs
DPMON-Diff	015...15 psi gauge
AUX-Abs	0...35 psi abs
AUX-Diff	-5...5 psi guage
Measurement Units	
37 pressure units including	psi, inHg, InH20, mbar, bar mmHg, kPa, etc. at varoius temperatures. ► See UNITS? remote query for complete list

6.2 Measurement Specifications - Temperature

Digital Temperature Monitor:	
	± 0.5˚C accuracy from -10...85°C
	-55...125°C maximum range
	0.06° C Resolution updated approximatelyl every 600 milliseconds

6.4 Control Specifications

Control Specifications	
Pressure supply requirements	30 psi guage (45 psi absolute max, 25 psi guage nominal
Exhaust requirements	Optional for sub-atmospheric control
Stability of controlled pressure	0.1% full scale or better, depending on environment and controlled volume.
Maximum controlled pressure	33 psi abs
Control time	Dependent on controlled volume
Supply consumption	No gas used at a steady-state control point (positive shutoff)
Measurement to control offset	Typically less than 0.005% of span.
Control volume	Tune for 0.3 to 5 liters
Overshoot	<1% full scale into a 2 liter volume typical
Communication	
Interface	Standard: Ethernet, IEEE-488, USB, RS-232.
Command sets	Mensor, WIKA SCPI, others optional
Response time	approx. 100 ms
Internal program	up to 24 sequences with up to 99 steps each

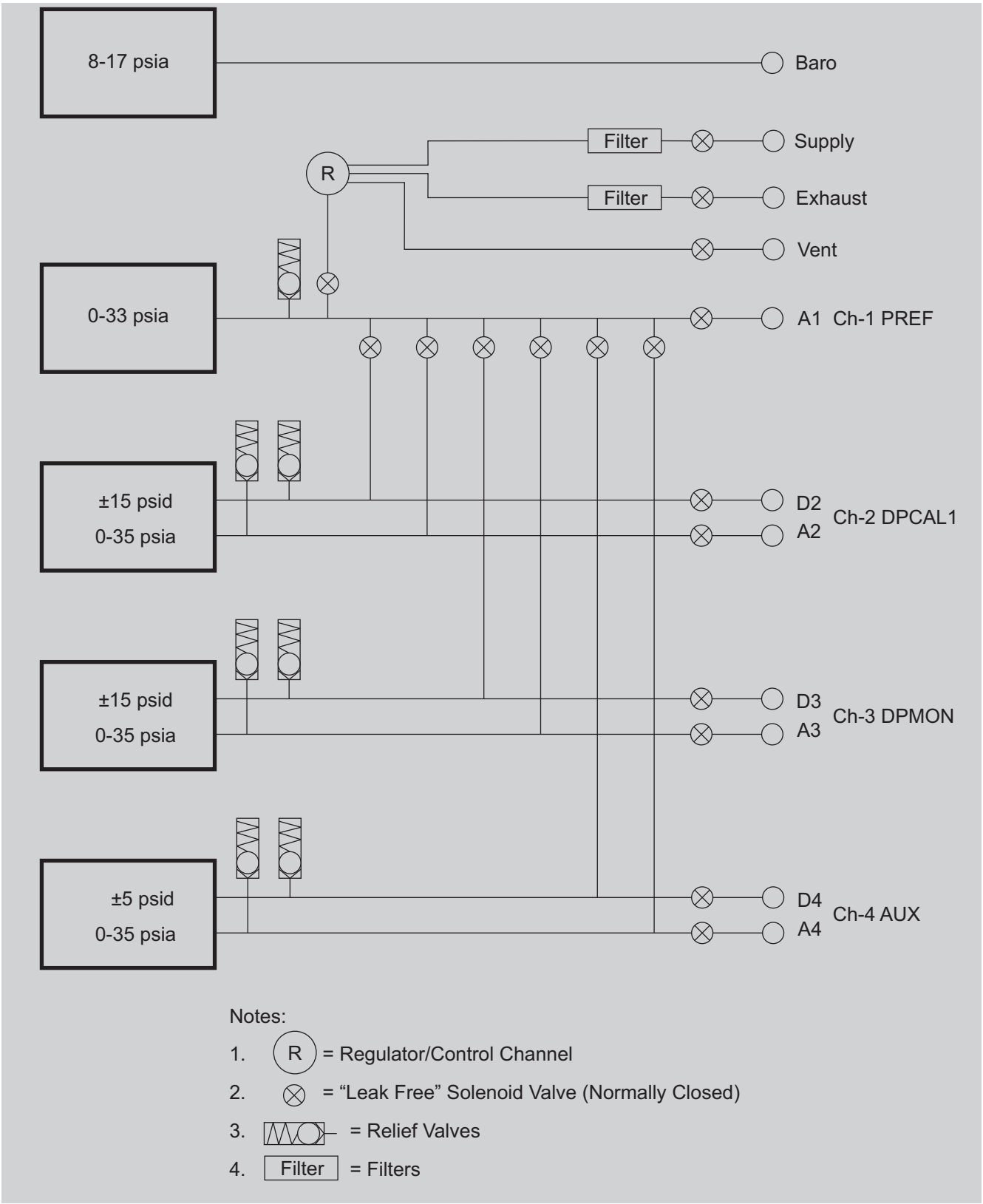
6.6 General Specifications

Rack Mount Size (includes rack mount panels with no rear fittings)		
WxHxD in	19 x 7 x 19.25 in	
WxHxD cm	48.26 x 17.78 x 48.9 cm	
Weight	Approximately 40 lbs	
Power input requirements	100 to 240 volt AC 50/60 Hz	
Fuses	(2) 2 Amp, 250 Volt type T	
	Approximately 30 to 60 watts while idle, 60 to 80 watts in non-measure mode (varies with solenoid valve states)	
Pneumatic Interfaces		
Supply	7/16”-20 female SAE with 1/4” tube adaptor provided	
Exhaust	7/16”-20 female SAE with muffler installed	
Barometric Reference Port	7/16”-20 female SAE with 1/4” tube adaptor provided	
Measure/Control Ports	7/16”-20 female SAE with 1/4” tube adaptor provided	
Pneumatic Overpressure Protection	Each transducer is protected by integrated mechanical relief valve Relief valves set at a guage pressure of approximately 110% of span (Standard barometric offset for absolute reading transducers.	
Compensated Temperature Range	15°C...45°C	
Operating Temperature Range	0°C...70°C	
Storage Temperature Range	0°C...70°C minimal vibrations, non-condensing humidity	
Front Panel User Interface	8.4 in color LCD display with 8-wire resistive touch screen	
Remote Interface	User configurable RS-232 serial communications with up to 115200 baud on DB9F connector ► Null modem not required when connecting to standard DCE equipment	
	10/100/1000, full duplex ethernet TCP/IP with IPv4 and IPv6 on RJ-45 connector.	
Warm-up	Approximately 15 minutes to achieve full accuracy depending on environment	
Tranducer Reading Rate	Dual transducers	User configurable speeds at noinal values of 14 (slow), 17 (medium), 20 (fast) or 29 (fastest) readings per second with sychronization, 51 (slow), 64 (medium), 133 (fast) or 156 (fastest) without sychronization
	Barometric transducer	Fixed rate of approximately 20 readings per second
	PREF transducer	Fixed rate of approximately 50 readings per second
Tranducer Reading Synchronization	Dual transducers querieed in sets falling within 100 microsecond frames per update cycle. Barometic and PREF transducers are not included in sychronization framess.	
Orientation Effects	Negligible, can be removed without re-zeroing	
Transducer Reading Rate	Dual transducers	User configurable speeds at nominal values of 14 (slow), 17 (medium), 20 (fast) or 29 (fastest) readings per second with synchronization, 51 (slow), 64 (medium), 133 (fast) or 156 (fastest) without synchronization.
	Barometric transducer	Fixed rate of approximately 20 readings per second.
	Remote interface	User configurable RS-232 Serial Communications with up to 115200 baud on DB9F connector. Null modem not required when connecting to standard DCE equipment. 10/100/1000, full duplex Ethernet TCP/IP with IPv4 and IPv6 on RJ-45 connector.
Warm-up	Approximately 15 minutes to achieve full accuracy depending on environment.	
Shock / Vibration:	2 gravities maximum per MIL-T-28800	
Operating Environment:	5 to 95% RH non-condensing	
Pressure Media:	Clean, dry, non-corrosive, non-combustible, non-oxidizing gases. Dry nitrogen recommended. Not suitable for oxygen use.	

7. Appendix

7.1 Pneumatic schematic

EN



WIKA subsidiaries worldwide can be found online at www.wika.com.

Mensor LP
201 Barnes Drive
San Marcos, TX 78666 • USA
Tel. (+1) 512 3964200-15
Fax (+1) 512 3961820
E-Mail sales@mensor.com
www.mensor.com

Imported to Europe by:
WIKA Alexander Wiegand SE & Co. KG
Alexander-Wiegand-Straße 30
63911 Klingenberg • Germany
Tel. +49 9372 132-0
Fax +49 9372 132-406
info@wika.de
www.wika.de

0020507001A 09/2018 EN