Operation Manual – PN 0040032001CS

Mensor Model 9424
Special Application Pressure Controller

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Version 2.04.00 To 2.04.02

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Mensor Model 9424
Special Application Pressure Controller

General Description:

The Mensor Model 9424 Special Application Pressure Controller is a single-channel pneumatic pressure monitor/controller/calibrator. The range of the instrument is preset by the customer and can be up to 1500 psi gauge or absolute pressure. The unit is optimized for high-speed pressure tests into volumes from near zero to 11 liters or more. The instrument utilizes the Mensor Series 6100 Digital Pressure Transducer for measurements. The transducer can be mounted in a special design allowing rapid exchange of the transducer from the front panel to facilitate external calibration. The standard Series 6100 transducers have an accuracy of 0.010 % of span and a precision of 0.003 % of span with a 180-day recommended calibration interval. (The Series 6180 can be offered in certain ranges with higher accuracy and a 365-day recommended calibration interval.) The 9424 is housed in an aluminum chassis having dimensions of 14.02” (35.61 cm) wide, 7.55” (19.2 cm) high, and 12.42” (35.61 cm) deep. All porting extends from the rear of the chassis and adds additional depth depending on fittings and connections to the unit. An optional rack mount configuration is available for a standard 19” instrumentation rack, 4U height.

The front panel contains a color LCD monitor with a touch screen. Manual operation of the 9424 is through the front panel. External pressure porting and electrical signal connections are provided on the rear of the unit. Pressure ports include a supply input port for clean dry inert media (air or nitrogen preferred), a vacuum or exhaust port, and either a single measure/control port or separate measure input and control output ports. If separate measure and control ports are installed, a pneumatic connection manifold is provided (designated as the Remote Pressure Sense Manifold, PN: 0017905001) to connect the measuring port to the pressure output port near the test volume. The advantage of this configuration is to improve control speed with long hoses and large volumes. Electrical connections consist of an RS-232 Serial Port for connection to a user computer and four individual driver outputs to control external devices using 12 volt DC, 1 Amp drive.

The instrument accepts universal AC power (90 to 260 Volts AC, 50 or 60 Hz, 100 Watts). Power is brought into the 9424 on a standard IEC 320 power entry module on the rear panel. A power switch is contained on the module along with fuses and line filters. Power is fused on both the hot and neutral AC lines entering the unit. No switching or adjustments are required.

Internally all components are powered by 5 Volt and 12 Volt DC supplies.

The Mensor 9424 communicates with a user-provided computer over a 3-wire RS-232 serial connection at a Baud of 57600, 8 data bits, 1 stop bit, and no parity.

Precautions:

1. The 9424 has a maximum supply pressure rating of 165 psi gauge for low-pressure instruments and 1500 psi gauge for high-pressure instruments and a recommended supply input of 110 % of the maximum installed transducer range. The internal transducer has a burst rating of approximately 1.5x the full-scale pressure.

2. The 9424 can operate in system configurations containing large pressure storage tanks. Large vessels even at fairly low pressures can hold large amounts of kinetic energy. Users should safely bleed all pressure stored in the tanks before servicing, removing pressure hoses, or removing instruments. For units configured below 400 psi, powering down the instrument should start the venting process to relieve pressure from both internally and externally connected vessels, but due to the size of the tanks and the desire to maintain a safe discharge rate; this operation can take an extended period of time to achieve. Units configured above 400 psi may require manual venting prior to powering down to discharge pressure. If the exhaust port is connected to a vacuum device, a relief valve may be required to protect the vacuum device from overpressure. If the exhaust port is unconnected a muffler may be required to reduce noise on higher pressure systems.

3. In control mode pressure is discharged through the exhaust port on the rear panel. In vent mode pressure is discharged through an internal port. On units configured above 400 psi, the internal vent port will be fitted with a muffler.

4. The system uses normal power line AC voltages. The user should remove the AC power cord from the mains when servicing inside the 9424 chassis.

5. Any maintenance or troubleshooting should be performed by users knowledgeable in pneumatic pressure instrumentation and electronic equipment.

Unpacking and Initial Setup:

The initial installation should include removing any packing material used in shipment and inspecting that fittings and screws are snug, and that hoses and electrical cords are not chaffed or cut. The Model 9424 should be installed on a level surface with adequate airflow to keep the system within its 15 to 45 C optimum operating temperature range. The system operates on line voltages between 90 and 260 VAC, 47 to 63 Hz. A source of dry inert gas media is required for operation. This supply for full operation should be approximately 110 percent of the range of the instrument, but should not exceed 165 psi for low-pressure instruments (or 1500 psi gauge for high-pressure instruments.) Mensor recommends that the gas supplied should be instrument quality. 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.

Pressure Connections:

The supply pressure should be connected to the rear panel lower left port labeled as SUPPLY. The pressure should be approximately 110 % of range. For sub-atmospheric pressure control, a vacuum pump is required and should be connected to the pressure port labeled EXHAUST. If only pressures above barometric pressure are required, no vacuum pump 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 on a suitable muffler. Porting on the rear of the 9424 are female 7/16-20 SAE straight thread. Adapters are provided to convert to ¼" tube fittings or optionally 6 mm metric fittings on the exhaust or supply ports.

For units with individual measure and control ports, connection to the user's device under test (DUT) should be made with the Remote Pressure Sense Manifold provided and shown to the right. This manifold connects the MEASURE INPUT port and the CONTROL OUT port of the 9424 closer to the actual test device. Mensor provides two 2-meter hoses to connect the two ports on the 9424 to the two ports on the Remote Pressure Sense Manifold. The DUT output port on the manifold should connect to the DUT or near the DUT. The Remote Pressure Sense Manifold ports are 7/16-20 SAE straight thread. An adapter is provided to convert to ¼" tube fitting or optionally 6 mm metric fitting on the "To DUT" output.

On units with a single measure/control port, connection to the user's device under test should be made directly. Long hose lengths or small hose diameters serving large volume loads may require a 9424 with separate measure and control ports and the use of a Remote Pressure Sense Manifold. (Consult the factory if the unit has difficulty controlling large volumes.)

Electrical Connections:

The communication port on the rear of the instrument is provided for connection to a user's computer. A short 9-pin male to 9-pin female D-Sub 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.

On the rear panel, four Control Signals are available to drive external loads/devices. Each of the four drives is capable of driving 1 Amp loads at 12 volt DC. Wiring is done through a removable terminal block labeled from left to right as OUT1, OUT2, OUT3, and OUT4. Front panel touchscreen buttons and remote commands allow user control of these drive lines.

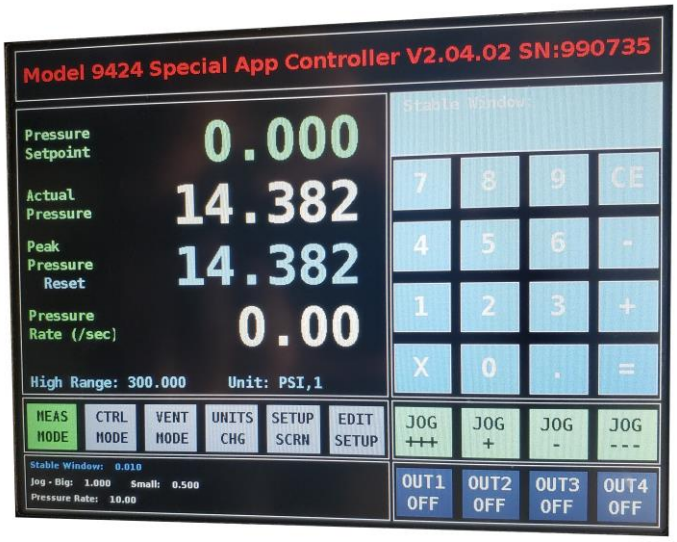
Operation:

Generally, the system once configured 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. The internal normally open vent valve(s) should immediately energize to seal the system to prepare for operation. The processor and display should go through internal self-tests and display the operating screen within approximately 45 seconds.

Front Panel Operation:

The 9424 powers up into the default operating screen in the default mode of measure and with the control set point equal to the first pressure measured. The screen is subdivided into functional sections. The top row identifies the instrument type. On the far right is the numeric keypad, below the keypad are the control jog functions, and below the jog functions are the toggle buttons for the external control signals. On the far left of the screen is a large window displaying the control set point value near the top and the current measured pressure reading below the set point value. The measured pressure reading also acts as the pressure stable indicator. The reading is green if the pressure is stable and yellow if the pressure is driving to a new control point. Below this window are 6 buttons labeled Meas Mode, Ctrl Mode, Vent Mode, Unit Chg, Setup Scrn, and Edit Setup. The first three buttons change the mode of operation from measure to control to vent. The Unit change button brings up 4 menus of pressure units that can be selected. Pressing one of the unit buttons immediately changes the set point value and the reading value to the new units of measure. On initial power-up, the setup/status window is normally displayed below the 6 buttons. The window can be called up if the SETUP SCRN, or EDIT SETUP button is pressed. This window displays the model, serial number, pressure range, stable window(stable tolerance), jog values, and transducer zero and span.

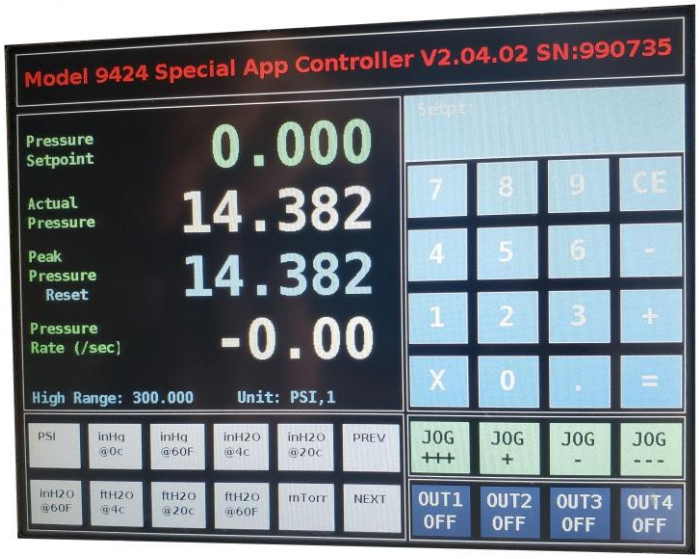
Keypad Entry Function:



The keypad (light blue in color) normally found on the right side of the screen is used for multiple numeric data entries. Normally at power up and whenever the set point window is pressed, the keypad is used for entering a control set point value. This is designated at the top of the keypad with the word “SETPT:”. As numeric values are entered they are displayed in the window next to “SETPT:”. The ‘CE’ key can be used to clear the last keystroke and the ‘X’ key deletes the entire entry. Once the correct value is entered, the ‘=’ key is used to accept the value and display it in the actual

Pressure Setting window. If the '=' key is pressed with no new value entered, no changes will be made to the value and the last value will be retained.

The EDIT SETUP function also uses the keypad to change instrument values such as Jog values and Stable window values. The top bar of the keypad window will indicate the function and allow the user to enter the value. Pressing the EDIT SETUP button will sequence through all editable values. Values are saved on exit.



The last keypad function (SETPT or SETUP) remains in effect until changed. This allows new set points to be entered one after another without pressing inside the set point window every time.

Jog Functions:
Below the keypad box are the control pressure jog buttons. These 4 buttons are labeled "+++" for large positive pressure change, "+" for small positive pressure change, "-" for small negative pressure change, and "---" for large negative pressure change. If the current set point was 100 mbar and the large jog value was10 and the small jog value was 1, pressing the "+++" button would change the control set point to 110 mbar, and the "-" would change the 100 mbar to 99 mbar. If the units were changed to psi, the 10 mbar jog value would be converted to psi and the large jog would change the set point to .145 psi (10 mbar equivalent). If a new jog value exceeds the range of the unit, it is ignored. Both the large jog and the small jog can be changed using the EDIT SETUP button.

Control Output Drivers:

Below the keypad and Jog function buttons, the control output (OUT1, OUT2, OUT3, and OUT4) buttons can be found. Each of the buttons controls the state of an output line on the rear of the instrument. The buttons function as on and off signal toggles. The 9424 powers up with all outputs in the OFF state. Pressing the appropriate button will energize the output and toggle the state to ON. When ON, the output provides 12 volts DC between the + and – pins on the rear panel. The maximum

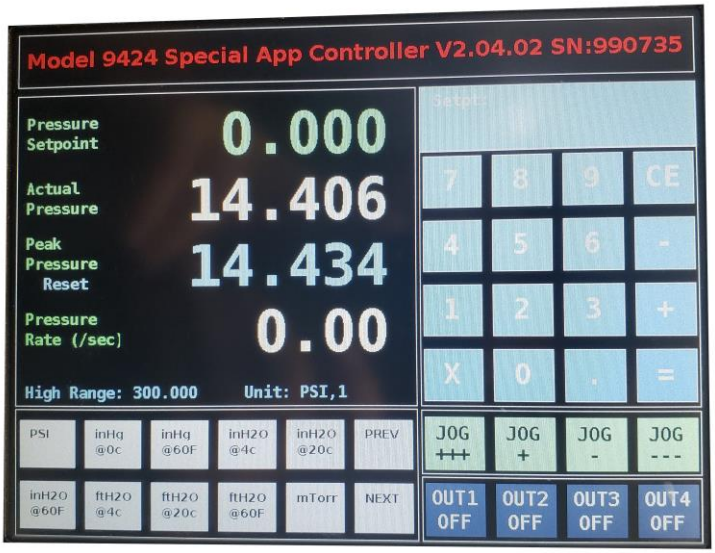
load is 1 Amp current (sink or source). Mensor can provide attachments that allow the 12-volt dc drive signals to switch larger AC power loads such as vacuum pumps, compressors, and AC enunciators up to 20 amps.

Mode Selection and Display:

In the center of the screen near the left side are the mode selection buttons. Three modes consisting of measure (MEAS), control (CTRL), and vent (VENT) are available. The mode that is currently active is displayed in green letters just above and to the right of the buttons. The MEAS mode shuts off all control functions and reads the pressure applied at the measuring port on the rear of the instrument, displaying the reading in the current units of measurement in the reading window. The CTRL mode controls the pressure on the CONTROL OUT port based on the pressure measured on the MEASURE INPUT port. Both ports need to be connected together using the remote sensor manifold provided. The VENT mode shuts off all control functions, opens the vent valve, and vents internal and external pressure to atmosphere. The pressure is continuously monitored and displayed in the pressure reading window area.

Unit Selection and Display:

Just to the right of the three mode selection buttons is the UNITS CHG button. This button brings up the unit selection screen just below the button. There are four screens each showing 10 different units of measurement. To change the current unit, find and press the desired unit button. If the selection is not available, press either the PREVious or NEXT button to display the next 10 selections. Once a unit is selected, it will be displayed in the green pressure setting/pressure reading window at the bottom. Both the unit name and the unit number will be listed.



Control Stable Display:

The color of the pressure reading is used to indicate the pressure's stable status. It will turn green if the pressure difference between the measured pressure and the set point value is less than the tolerance specified by the STABLE WINDOW value. Outside this + and – tolerance, the pressure reading value will be yellow. The default tolerance is 0.01% of full scale. This tolerance may be changed over the serial communications port using the “STABLEWINDOW=” command or read back with the

"STABLEWINDOW?" query. The stable window value can be modified from the front panel by pressing the EDIT SETUP button until STABLE WINDOW is highlighted in blue and the keypad shows STABLE WINDOW above the numeric keys.

Setup Button:

The SETUP button displays the user's changeable values and other instrument-specific information. These values can only be changed when the EDIT SETUP button is pressed and the value is highlighted in blue. At this point, changes can be made using the numeric keypad. Once the enter key is pressed, the setup screen will re-appear. Changes are stored in the instrument or transducer and are retained through power-down cycles.

Setup - Jog (Big)

This function allows the large positive and negative jog values to be set. Acceptable values must be positive and within the range of the instrument in the current displayed units of measurement. The same absolute value is used for both the '+++' button (added to the current set point value) and the '---' button (subtracted from the current set point value). No check is made to determine if the large jog is bigger than the small jog. The user can use the buttons as desired.

Setup - Jog (Small)

This function allows the small positive and negative jog values to be set. Acceptable values must be positive and within the range of the instrument in the current displayed units of measurement. The same absolute value is used for both the '+' button (added to the current set point value) and the '-' button (subtracted from the current set point value). No check is made to determine if the large jog is bigger than the small jog. The user can use the buttons as desired.

Setup – Transducer Offset (Cal Zero)

This entry allows the calibration offset (in the transducer units only) to be monitored and changed. The zero offset is a fixed value that is added to each pressure reading. It is normally zero to start with and can be changed to adjust the pressure reading. This field is a display-only field and must be adjusted on the transducer by qualified calibration technicians. (See CPT6100 manual for more information.)

Setup – Transducer Multiplier (Cal Span)

This entry displays the transducer calibration span factor. The span is a multiplier (normally a non-dimensional value of 1.0000) that adjusts each reading. This field must

be adjusted by a qualified calibration technician using proper equipment. (See CPT6100 manual for more information.)
Pressure Setting Display:

The pressure setting window displays the current control set point in the current units of measurement. Pressing anywhere within the window sets the keypad function to accept new set point values.

Pressure Reading Display:

The reading display window shows the current pressure value in the current units of measurement. It is always active.

Info Display:

The info window is used for displaying user information. The displays vary based on modes and conditions encountered.

Remote Computer Controlled Operation

Functions available from the front panel are also available remotely using the command set found below. Communications between the user's external computer and the Model 9424 use standard RS-232 serial communications. The protocol is 19200 baud, 8 data bits, 1 stop bit, and no parity. The 9424 will accept upper, lower, and mixed-case ASCII commands. All commands should be terminated with a linefeed character or a carriage return character.
Responses to queries will terminate with a carriage return and a line feed.
A complete command set can be found below.

Command Set:

The following command set applies to software version V1.00. All commands should terminate with a line feed or a carriage return. Responses are terminated with a carriage return followed by a line feed. Commands are accepted in uppercase, lowercase, or mixed-case characters. Commands should not be concatenated together and must be separated with a linefeed or carriage return. The user should accept query responses prior to sending additional commands.

Command	Description	Example
rdg?	Returns the pressure reading of the internal measurement transducer in the current units of measurement. Returns 8	Send: "RDG?" Return: "123.456"

	characters with decimal point.	
setpt=	Commands the instrument to a new set point in the current units of measurement. Command takes effect immediately if in the control mode or prepares the unit to control at this point when placed in the control mode. Command will be ignored if it is less than minimum range of instrument or greater than range of instrument.	Send: “SETPT=23.400” Returns:
setpt?	Returns the current set point in the current units of measurement. Returns 8 characters with decimal point.	Send: “Setpt?” Returns:“ 23.400”
mode=	Sets the mode of operation to measure (MEAS), control (CTRL), vent (VENT)	Send: “MODE=ctrl” Returns:
mode?	Returns the current mode of operation measure (MEAS), control (CTRL), vent (VENT)	Send: “Mode?” Returns: “MEAS”
unit=	Sets the displayed units to any of the built in units. (See UNITS? Query to obtain a list of those built in.) Instrument will accept either the unit number (1,2 3,4…) or the unit name (PSI, inHG, mBar, kPa, Bar, mmHG, ATM, inH2o)	Send: “UNIT=mbar” Returns: “mbar, 15” Send: “UNIT=15” Returns: “mbar, 15”
unit?	Returns the current units of measurement	Send: “Unit?” Returns: “mBar, 15 ”
units?	Returns a list of available units of measurement by both the unit number and the unit name. The actual multiplier from PSI to the units is also provided.	Send: “Units?” Returns: “1 psi 1.000000 2 inHg@0C 2.036020 …
id?	Returns the unit identification of the 9424.	Send: “ID?” Returns: “Mensor Model 9424 Spec App Controller”
sn?	Returns the serial number of the 9424.	Send: “SN?” Returns: “990354”
stable?	Returns the control stable flag, an indication of control value	Send: “Stable?” Returns: “HI”,

	being within the stablewindow setting. A returned value of HI indicates that the pressure reading is above the stable window setting, A returned value of LO indicates that the pressure reading is below the stable window setting , and a returned value of OK indicates that the pressure reading is within the window.	“LO”, Or “OK”
stablewindow=	Sets the allowed pressure difference (control set point and measured pressure reading) to indicate a stable setting. The setting is in the current units of measurement.	Send: “stablewindow=0.12” Returns:
stablewindow?	Returns the allowable stable error setting. This is the allowed pressure difference between the control set point and the measured reading in the current units of measure	Send: “Stablewindow?” Returns: “0.12”
zero=	With the proper password, allows the current zero offset value to be changed on the internal transducer. See CPW= command to enter the password. The value sent should be in the current units of displayed measurement.	To make a 760 mmHg read 770 mmHg, send “zero=10.000” To make a 300 psi unit read 295, send “zero=-5.0”
zero?	Returns the current zero offset value on the internal transducer. It is an offset in the current units of measurement and the base transducer unit of measurement. All changes should be made in the displayed units of measurement.	Send: "zero?" Returns: "5.0 mmHg"
span=	With the proper password, allows the current span multiplier value to be changed on the internal transducer. See CPW= command to enter the password.	Send: “span= 1.0” Returns:

span?	Returns the current span multiplier value on the internal transducer. The Span is typically a number around 1.00	Send: “span?” Returns: "1.000"
pass=	Allows commands and queries to be passed directly to the internal Mensor 6100 transducer. Commands can be found in the Mensor Model 6100 Operation Manual included in the appendix. Since the passed commands can change the calibration of the transducer, they are password protected like the zero and span commands. See CPW= command for details.	PASS=#1? To read the pressure reading directly from the internal transducer.
lockpanel	Disables the front panel touch screen to force only remote communications and ignore manual front panel operations. Turning the power off and back on resets the unit to allow touch screen events or the Unlockpanel command can be sent.	Send: “LOCKPANEL” Returns:
unlockpanel	Enables operation from the front panel or over the serial communication port.	Send: “UNLOCKPANEL” Return:
panelstate?	Returns the panel lock condition.	Send: "Panelstate?" Returns: "Panel Lock ON" Or "Panel Lock OFF"
version?	Returns the software version in the instrument.	Send: "version?" Returns: "V2.04.02"
echoon	Turns on command echo for the remote serial communications port. Can be turned off with the EchoOFF command. Unit defaults to EchoOn at power up.	Send:“ECHOON” Returns:
echooff	Turns off command echo for remote serial communications port. Can be turned on with the EchoOn command or by cycling the unit power.	Send: “ECHOOFF” Returns:

cpw=	Calibration password required to change the zero offset or span multiplier on the internal transducer. The calibration password if accepted (correct) will return “CPW”. A correct password will allow the zero, span and pass= commands to be used within the next four commands before it is disabled and the password must be entered again.	Send: “cpw=123456” Returns:"CPW"
out1on	Turn on output 1	
out1off	Turns off output 1	
out2on	Turn on output 2	
out2off	Turns off output 2	
out3on	Turn on output 3	
out3off	Turns off output 3	
out4on	Turn on output 4	
out4off	Turns off output 4	
outon	Turns all outputs on	
outoff	Turns all outputs off	
jogbig=	Sets the jog value from a typical value of 10 to a new value. After entry, the value is used any time the JOG+++ or JOG--- keys are pressed. This value is saved through power cycles.	Send: “jogbig=20” Returns:
jogsmall=	Sets the jog value from a typical value of 1 to the new value. After entry, the value is used any time the JOG+ or JOG- keys are pressed. This value is saved through power cycles.	Send: “jogsmall=2” Returns:
setrate?	Returns the control rate.	Send: “setrate?” Returns: "25.0000"
setrate=	Assigns the control rate.	Send: “setrate=25” Returns:
rate?	Returns the current rate of change in pressure in displayed units/second.	Send: “rate?” Returns: "12.3456"
rateon	Turns on rate control	Send: “rateon” Returns:
rateoff	Turns off rate control	Send: “rateoff”

		Returns:
ratestat?	Returns the current rate control setting.	Send: “ratestat?” Returns: "Rate control is ON" or "Rate control is OFF"
kp?	This is how much gain is given to the rate position error (Default value = .5). Too much and it will overshoot or oscillate around the setpoint. Too little and it will be sluggish at the rate setpoint.	Send: “kp?” Returns: ".5000"
kp=	Assigns the position gain value.	Send: “kp=1” Returns:
ki?	Integrator gain (default value = 80). This is how much gain is given to the integrator error.Globally applied without regard to how much postion error there is. The control algorithm mainly controls with the integrator term, hence the higher gain, the more rapid rate of correction.	Send: “ki?” Returns: "80"
ki=	Assigns the integrator gain value.	Send: “ki=100” Returns:
itime?	This is the integrator time constant (Default value = .01) The amount of error transferred to the integrator each cycle If you make this value too big, the unit will oscillate around the rate setpoint It can also cause oscillations at the pressure setpoint. if you make it too small, it wiil not track the control rate	Send: “itime?” Returns: ".0100"
itime=	Assigns the value for the Integrator time constant.	Send: “itime=.0050” Returns:
decaytime?	This is the number of seconds before reaching the setpoint that the control rate will start to decay (Default Value= 4). To speed up control make this number smaller. To reduce overshoot or	Send: “decaytime?” Returns: "4.0000"

	oscillations at the pressure setpoint, make this number larger.	
decaytime=	Assigns the value for the Decay Time.	Send: “decaytime=3” Returns:

Added in versions 1.10

JogBig=	Sets the jog value from a typical value of 10 to a new value. After entry, the value is used any time the JOG+++ or JOG--- keys are pressed. This value is saved through power cycles.	Jogbig=20.000
JogSmall=	Sets the jog value from a typical value of 1 to the new value. After entry, the value is used any time the JOG+ or JOG- keys are pressed. This value is saved through power cycles.	Jogsmall=.001

Typical Operating Processes:

A typical operation would consist of setting up the supply, measure, and control hoses to the appropriate ports. If power is not applied to the 9424, it should be powered up. The unit will initialize into the measure mode with the initial control set point equal to the first measured pressure reading. If pressure control is desired, the incoming supply pressure should be adjusted to the recommended pressure in the Unpacking and Initial Setup section, but not more than 165 psi gauge for low-pressure units or 1500 psi for high-pressure units.
To control pressure, verify the control setting is within an acceptable value with respect to any connected devices and then select the control mode button CTRL MODE. Once in the control mode, new control points can be entered from the numeric keypad and pressing the ‘=’ key. Also, the jog functions can be used to jump in uniform steps through the useable pressure range. At the end of the process, the VENT mode can be used to vent internal pressure. The unit should be left in the measure mode when not being utilized or can be powered off if the unit is not needed for an extended period of time to reduce energy consumption.

Calibration:

Calibration of the pressure equipment should be done periodically. Mensor CPT6100 Digital Pressure Transducers have a recommended calibration interval of 180 days. Units equipped with Mensor 6180 Digital Pressure Transducers 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 calibration data.

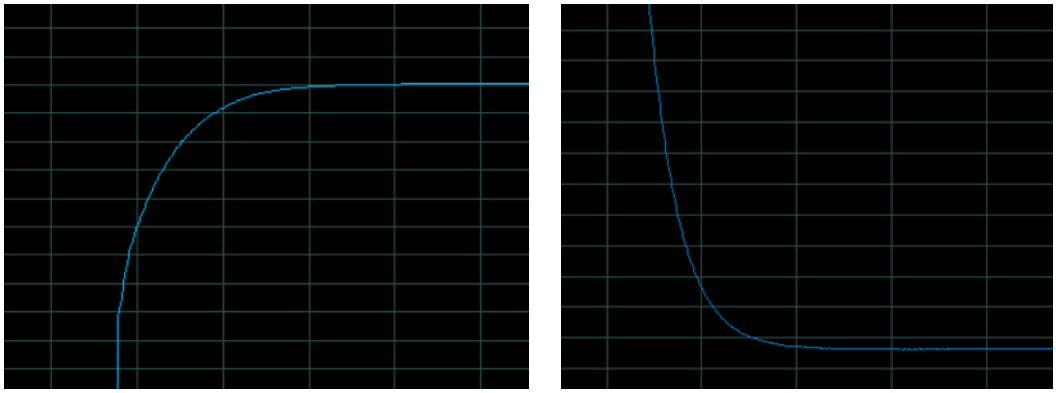
The transducer in the Model 9424 can be removed from the unit for calibration. If the transducer is removed from the unit, an optional power supply, cable, and software are required to perform the remote calibration. (Contact Mensor if this option is preferred.) To remove the transducer when removable options are chosen, turn the power off and allow time for the unit to vent any pressure externally and internally. Loosen the two screws on the right side of the front panel to open the panel door. The transducer should be in the front on the right side of the chassis. Two screws (highlighted in red in the photo to the right) near the bottom of the transducer toward the back should be removed. The transducer should be pulled out sufficiently to remove the 9-pin d-sub connector on the top. A CPT 6100 Operation Manual describing the calibration process is included in the appendix. The transducer is set for an address of 'A' and a protocol of 19200 baud, 8 data bits, 1 stop bit, and no parity. The transducer is set up for standard RS-232 communications. Utilize instructions and connection recommendations found in the CPT 6100 Manual section 4.

To calibrate the Mensor 6100 transducer(s) when mounted inside the Model 9424 chassis, an external pressure standard needs to be connected to the MEASURE Port on the rear of the instrument and the 9424 needs to be powered up and left in the MEASURE mode of operation. Calibration checks can be performed with a precision pressure standard. See CPT 6100 Operation Manual in the appendix for typical calibration setup and instructions.

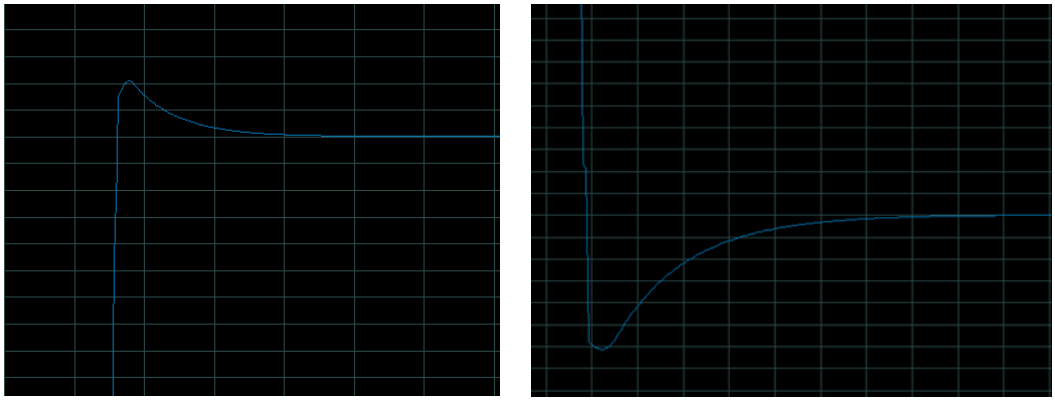
Adjustments to the calibration are done by changing the zero offsets and span multiplier on the transducer. This can be done over the communication bus or through the front panel.

Tuning the Model 9424 Pressure Controller

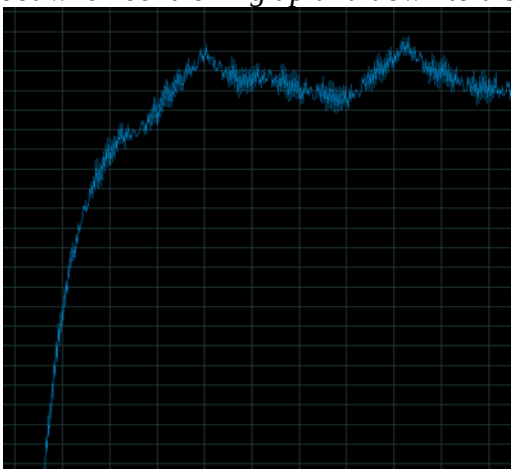
When tuning the Model 9424, there are several variables to consider such as the DUT volume, pressure range and control rate from one setpoint to the next. To operate the Model 9424 efficiently, users must tune the machine to match their performance requirements. Ideally, when the Model 9424 has been tuned correctly, there will be little or no overshoot when controlling to a given setpoint and the pressure will be stable once it reaches the desired setpoint.



No Overshoot when controlling and stable at setpoint



Overshoot when controlling up and down to a setpoint



Unstable at setpoint

The Model 9424 uses a simple PI control algorithm.
There are six parameters that can be set (=) and read (?) to change the control characteristics.

decaytime=
decaytime?
Default value= 4.0
This is the number of seconds before reaching the setpoint that the control rate will start to decay.
To speed up control make this number smaller.
If there is any overshoot or oscillations at the pressure setpoint, make this number larger

itime=
itime?
Default value= 0.01
This is the integrator time constant.
If you make this value too big, the unit will oscillate around the rate setpoint.
If you make it too small, it will not track the control rate.
For best control with no overshoot, make this value very small (.000001).

kp=
kp?
Default value= 0.5
Position gain.
How much gain is given to the rate position error.
Too much and it will overshoot or oscillate around the rate setpoint.
Too little and it will be sluggish at the rate setpoint.

ki=
ki?
Default value= 80.0
Integrator gain.
This is how much gain is applied to the integrator error.
Similar to itime but globally applied without regard to how much position error there is.

setrate=
setrate?
Default value= 10
Desired pressure control rate.
This is an easy way for a user to modify the speed of the pressure controller once the controller has been tuned properly. The user can edit this value via RS-232 or through the Edit Setup menu on the touch screen. Setting this value too high will exacerbate any overshoot or stability problems.
If the itime value is too low, it will not follow this rate control parameter.

stablewindow=

stablewindow?
Default value = .04

This is the window around the setpoint where the controller displays that it is near the desired setpoint. Normally, the smallest a user should make this is the rated uncertainty of the pressure indication. If the user has a 100 PSIA transducer that is rated for .01%FS accuracy, then the smallest setwindow value should be .01 PSIA.

Storage and Transportation:

The 9424 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. Once the system is brought back online, it should be allowed to stabilize within its normal operating temperature range before power is applied. 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 that 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 similarly 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 a 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.

Maintenance:

Standard maintenance may include checking for loose fittings and screws and general housekeeping. A small 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. The calibration of the Series 6100 Digital Pressure Transducer should be periodically checked with a high accuracy pressure standard per the included CPT6100 or CPT6180 manual.

Specifications:

Measurement Specifications:

Accuracy:

Using Series 6180 Digital Pressure Transducers - 0.010 % of reading 50 to 100 % of range, 0.005 % fs below 50 % of range. Uncertainties include all pressure effects, temperature effects and calibration stability over 365 days after re-zeroing.

Using Series 6100 Digital Pressure Transducers - 0.010% of span Uncertainties include all pressure effects, temperature effects and calibration stability over 180 days after re-zeroing.

Precision:

0.003 % of span

Pressure Range:

One or two transducers with a maximum range of 1500 psi, range selected by user.

Measurement Units:

35 units of measurement including the most common units of PSI, inHG, mmHG, Torr, kPa, MPa, Pa, Bar, mBar, inWater, etc.

Resolution:

6 significant digits plus decimal point

Control Specifications:

Source Requirements:

1500 psi maximum for higher range units, 165 psi for lower range units, 110 % of f.s. range recommended.

Exhaust Requirements:

A vacuum source is required for sub-atmospheric pressure control.

Stability of Controlled Pressure:

0.01% f.s. or better

Maximum Control Pressure:

(Determined by transducer range selected)

Control Time:

Dependent on Volume attached

Supply Consumption:

No gas used at a steady-state control point (positive shutoff)

Measurement to Control Offset:

Typically less that 0.001% of Span

Control Volume:

Tuned for volume up to 0.5 to 5 liters or per customer requirements

Overshoot:

< 1% f.s. into a 2 liter volume typical

General Specifications:

Desktop Size: (includes chassis feet with no rear fittings)
14.02” wide x 7.55” high x 12.42” deep
35.61 cm wide x 19.2 cm high x 31.55 cm deep

Rack Mount Size: (includes rack mount panels with no rear fittings)
19” wide x 7.0” high x 12.42” deep
48.26 cm wide x 17.78 cm high x 31.55 cm deep

Weight:
Approximately 25 lbs, 11.3 kg

Power Input Requirements:
90 to 250 Volt AC 47 to 63 Hz, 100 VA.
Fuses: (2) 1.0 Amp, 250 Volt type T

Digital Outputs:
Four digital outputs capable of driving loads up to 1 amp at 12 VDC.

+ 12 output	ground	Function / Description
Pin 1	Pin 2	OUT1
Pin 3	Pin 4	OUT2
Pin 5	Pin 6	OUT3
Pin 7	Pin 8	OUT4

Pneumatic Interfaces:
Supply
7/16”-20 female SAE, ¼” tube or 6 mm tube adapter provided
Exhaust
7/16”-20 female SAE, ¼” tube or 6 mm tube adapter provided
Measure In
7/16”-20 female SAE, ¼” tube or 6 mm tube adapter provided
Control Out
7/16”-20 female SAE, ¼” tube or 6 mm tube adapter provided
Remote Sense Pressure Manifold provided on Large Volume Applications

Pneumatic Overpressure Protection:
Mechanical Relief Valve set to approximately 110% of equivalent gauge pressure. (Absolute pressure – 14.7 psi)

Compensated Temperature Range:
15 C to 45 C

Operating Temperature Range:
0 C to 70 C

Storage Temperature Range:
0 C to 70 C Minimal vibrations, Non-condensing humidity

Front Panel User Interface:
8.4” color LCD display with 8 wire resistive touch screen.

Remote Interface:
RS-232 Serial Communications at 19200 baud, 8 data bits, 1 stop bit and no parity

Warm-up:

Approximately 15 minutes to achieve full accuracy depending on environment.

Reading Rate:

Internal reading rate 50 readings per second maximum,
20 to 30 readings per second typical

Reading Response Time:

< 333 ms for FS step, (actual pressure change depends on configuration)

Orientation Effects:

Negligible, can be removed with re-zeroing

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.

Appendix:

Mensor CPT6180 Digital Pressure Transducer Manual