



Installation and Operating Manual



EPR Series Electronic Pressure Regulator

MANUAL FOR NON-ATEX, NON-CSA, NON-HAZARDOUS AREA MODELS

READ THIS FIRST

THIS OPERATING MANUAL IS STRICTLY FOR USE WITH EPR NON-ATEX, NON-CSA, NON-HAZARDOUS AREA MODELS

CONTACT EQUILIBAR FOR INFORMATION ABOUT HAZARDOUS AREA OPTIONS

WARNING:

Make sure that you have read and understand these directions before using, installing, or maintaining an *EPR Series Electronic Pressure Regulator for non-ATEX Use*. Take steps to ensure this instruction manual reaches the operator of this regulator and stays with the regulator throughout its lifetime. Use, installation, operation, and maintenance of all pressurized products including this regulator must be performed by personnel who are properly trained and qualified through experience or specific training.

Failure to properly observe the instructions contained in this document may result in but is not limited to:

- Serious personal injury or death
- Unconstrained release of the pressurized media
- Permanent damage to the pressure regulator and/or permanent damage to connected equipment



NOTICE:

The manufacturer reserves the right to make any changes and improvements to the products described in this manual at any time and without notice.

Although we provide assistance on our products both personally and through our literature, it is the complete responsibility of the user to determine the suitability of any product to their application.

The manufacturer does not warrant or assume responsibility for the use of its products in life support applications or systems.

WARRANTY:

This product is warranted to the original purchaser for a period of one year from the date of purchase to be free of defects in material or workmanship. Under this warranty the product will be repaired or replaced at manufacturer's option, without charge for parts or labor when the product is carried or shipped prepaid to the factory together with proof of purchase. This warranty does not apply to cosmetic items, nor to products that are damaged, defaced or otherwise misused or subjected to abnormal use. See "Application" under the Installation section. Where consistent with state law, the manufacturer shall not be liable for consequential economic, property, or personal injury damages.

CONFORMITY / SUPPLEMENTAL INFORMATION:

The product complies with the requirements of the Low Voltage Directive 2006/95/EC and the EMC Directive 2004/108/EC and carries the CE Marking accordingly. Contact the manufacturer for more information.



Both normal operation as well as possible failure modes and foreseeable misuse must be accounted for in the design of the system which interacts with and connects to the *EPR Series Electronic Pressure Regulator for non-ATEX Use*. It is the responsibility of the end user to account for these hazards.

- Inspect the EPR for any damage. If you find any damage, consult Equilibar before proceeding.
- Verify that the part number on the EPR product label matches what you had requested.
- Verify that the Command, Monitor and Range listed on the product label match what you ordered.
- Contact Equilibar if you have any questions, concerns, or need a new copy of these instructions. Be sure to include the full part number and serial number of the EPR you are inquiring about. (01-828-650-6590, info@equilibar.com)
- Take precautions to prevent injury to personnel in the event of an internal or external leak. Sensitive fluid controls can experience internal or external leaks. See standard terms and conditions for important limitations of liability notes.
- Exceeding the maximum specified line pressure may cause permanent damage to the solid-state differential pressure transducer.
- The EPR is not orientation sensitive and may be mounted in any plane and maintain good pressure control.
- The EPR Series controllers are intended for use with clean, dry, non-corrosive gases only.
- EPR Series controllers have National Pipe Thread (NPT) female inlet and outlet port connections. Use anaerobic thread sealant such as Loctite 545 to prevent leakage around port threads.
- It is recommended that a 20 micron filter be installed upstream of EPR Series instruments.
- System media will be vented out the EPR exhaust port. Be sure that the media is vented to a safe environment, away from employees and in accordance with applicable laws in your jurisdiction. Take care that the outlet port cannot become blocked during operation.
- Even inert gases can cause suffocation through oxygen displacement. Take care to ensure that adequate ventilation and oxygen levels will be maintained.
- Provide adequate exhaust line or exhaust muffler capacity. Short or oversized exhaust lines are recommended. Inadequately sized mufflers can build to high pressures and explode.
- The Equilibar EPR is not a “Safety Accessory” as defined by the Pressure Equipment Directive 2014/68/EU. Be sure to install appropriate over pressure protection devices such as safety relief valves or rupture discs to protect the system and the EPR from exceeding the maximum allowable working pressures. These safety devices must meet applicable law, codes, regulations, and standards for your jurisdiction.
- Enriched oxygen media (>21%) should not be used in the EPR unless Equilibar has specifically worked with you to provide a product rated and labelled for enriched oxygen. Standard products are not oxygen cleaned. Particle impact, adiabatic compression, and solenoid motion can all cause ignition in an enriched oxygen media. This kindling chain can cause the entire EPR to oxidize extremely rapidly resulting in high temperatures, discharge of flames and molten metal, and unrestrained escape of process fluid.
- Never perform maintenance or inspections on a system when pressurized fluids are present. Depressurize the system before performing this work. After depressurizing, always de-energize all electrical power before attempting any service work.

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INTRODUCTION

The EPR is a high resolution electronic pressure regulator. The EPR provides a regulated output pressure that is proportional to an electrical command signal input.

The EPR is available in a wide range of calibrated pressure ranges covering vacuum through 3000 psig (200 Bar). The EPR is available with 4-20 mA or 0-5 VDC analog input signal types, and RS-232 or RS-485 (optionally) serial digital inputs.

The EPR is a complete closed loop control valve consisting of two solenoid valves, a manifold, an electronic control circuit board, and an internal pressure sensor. Pressure is controlled by the use of the two solenoid valves. One valve functions as inlet control and acts to allow supply media into the system to increase the controlled pressure. The other solenoid valve acts as the exhaust and will decrease the controlled pressure by venting the system to atmosphere. Both solenoid valves operate proportionally to the current supplied by the EPR's electronic control circuit.

This variable orifice effect allows precise control of pressure at low flow conditions and avoids the digital steps of traditional ON/OFF solenoids. The ability to vary the solenoid valve orifice opening in an analog fashion allows the EPR to control pressure with extremely high resolution.

The regulated pressure output is measured by a solid state pressure transducer internal to the EPR. This pressure transducer provides a feedback signal to the EPR's electronic control circuit. The control circuit compares the internal sensor feedback signal to the command signal input. Any difference between the two signals

causes the appropriate solenoid valve to open, allowing flow in or out of the system. Accurate pressure is maintained by controlling these two valves.

The EPR is a relatively low flow regulator. This makes the EPR a great choice any time low flow rates or small volumes require precise pressure control. The EPR is often used to provide the pilot pressure signal to the dome of either an Equilibar® back pressure regulator or an Equilibar® vacuum regulator. (See Fig. 1).

The EPR can then be used to electronically control back pressure or vacuum pressure in line sizes from 1/8 inch through 6 inch by pilot operating the appropriately sized regulator. An electronic monitor output signal from the internal pressure transducer is provided. All EPR valves come standard with an analog voltage monitor output in 4-20mA or 0-5Vdc matching the analog input.



Fig. 1 EPR pilot operating an Equilibar H3P back pressure regulator

PLUMBING

It is most common to have a .050 inch diameter orifice in the inlet valve, and a .050 inch diameter exhaust valve. The response time of the system will depend on the size of the volume being controlled and the feed pressure.

The controllers are intended for use with clean, non-corrosive gases only. These instruments are **extremely sensitive to dirt and debris**, so the gas line should have a filter to ensure no dirt enters the controller.

The EPR controllers are designed with an Inlet port, a Process (outlet) port, and an Exhaust port. This allows the controllers to raise and lower the pressure of a closed system within the operating range of the controller without wasting gas under constant pressure conditions.

Your instrument is shipped with plastic plugs fitted in the exhaust and process port openings. To reduce the chance of contaminating the flow stream, do not remove these plugs until you are ready to install the device. The inlet port has a factory-installed filter as a final filter (after the gas line filter) to further reduce the chance of dirt and debris contamination. **Do not remove** this filter.

Connect the EPR into your process via the 1/8" NPT port on the front of the unit (see Fig. 2) This is the "Process" port.

Note that the process volume must be at least one cubic inch (16cc) to prevent the EPR from oscillating and blowing out the exhaust.

Connect a supply pressure to the 1/8" NPT port on the left side device. This is the "Inlet" port.

Note that the supply pressure connected to the inlet port must exceed the maximum calibrated range of the EPR by 15% to allow the inlet solenoid valve adequate differential pressure to operate correctly. For example, an EPR-3000 should have 3400 to 3500psi applied to the supply port.

The 1/8" NPT "Exhaust" port, located on the right side of the device can vent to atmosphere if the application is suitable, or to a collection network if necessary.

Note that the pressure at the exhaust port should be at atmospheric pressure or below to allow the controller to be used over its full scale range.

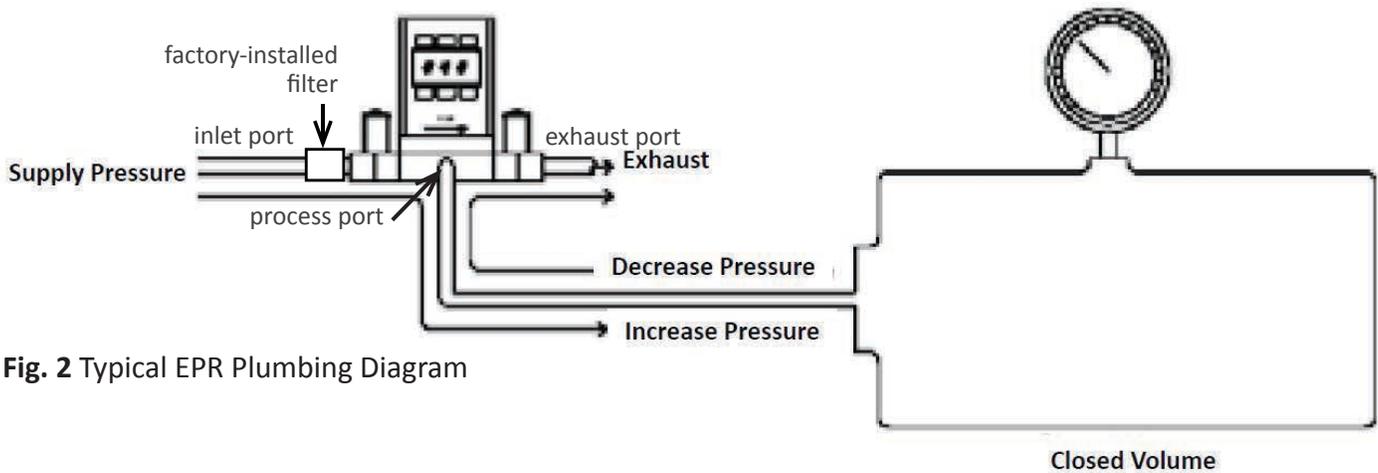


Fig. 2 Typical EPR Plumbing Diagram

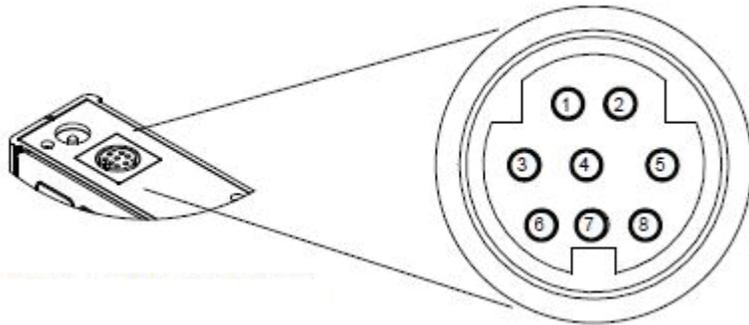
POWER AND SIGNAL CONNECTIONS

Power can be supplied to your controller through either the power jack or the 8 pin Mini-DIN connector.

An AC to DC adapter which converts line AC power to DC voltage and current as specified below is required to use the power jack.

A 2.1mm, positive center, 12-30 Vdc AC/DC adapter rated for at least 250 mA is required to use the adapter jack in a EPR Series controller.

NOTE: 4-20mA analog output requires at least 15 Vdc.



STANDARD 8 PIN MINI-DIN PIN-OUT

Pin	Function	Mini-DIN cable color
1	Primary 4-20mA Current Output Signal	Black
2	Static 5.12 Vdc Output	Brown
3	Serial RS-232 Input Signal (receive)	Red
4	Setpoint Input and Remote TARE (Ground to Tare)	Orange
5	RS-232 Serial Output Signal (transmit)	Yellow
6	Primary 0-5 Vdc Voltage Output Signal	Green
7	DC Power In	Blue
8	DC common for power, communications and analog signals	Purple

Note: The above pin-out is applicable to all the controllers with the Mini-DIN connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.



CAUTION! Do not connect power to pins 1 through 6 as permanent damage can occur!

It is common to mistake Pin 2 (labeled 5.12 Vdc Output) as the standard 0-5 Vdc analog output signal. In fact, Pin 2 is normally a constant 5.12 Vdc that reflects the system bus voltage and can be used as a source for the setpoint signal.

INPUT SIGNALS

ANALOG INPUT SIGNAL

Apply analog input to Pin 4 as shown on previous page.

4-20mA or 0-5Vdc input signal configuration is specified at the time of order. Depending on what was specified in the order:

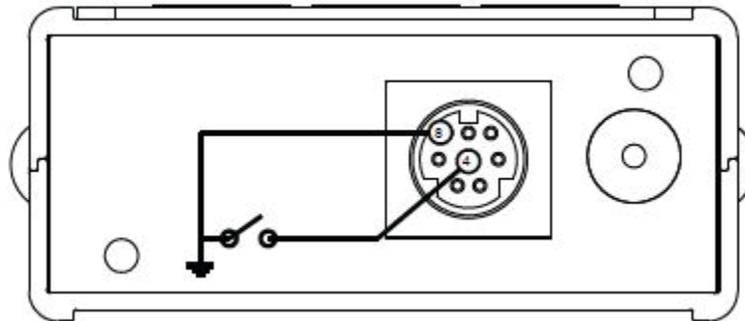
- A 4-20 mA input signal can be applied to pin 4, with common ground on pin 8; or
- A 0-5 V dc input signal can be applied to pin 4, with common ground on pin 8.

Note: This is a current sinking device. The receiving circuit is essentially a 250 ohm resistor to ground.

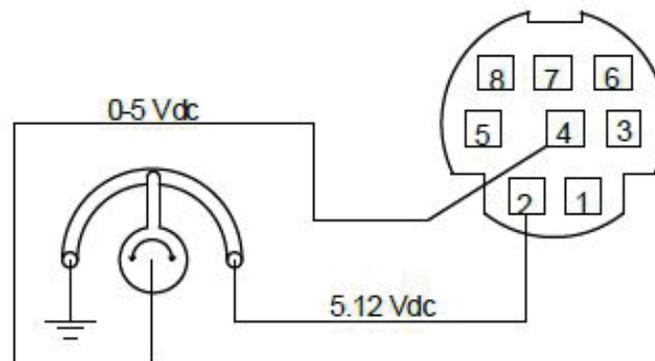
Note: 4-20mA output requires at least 15 Vdc power input.



CAUTION! Do not connect this device to "loop powered" systems, as this will destroy portions of the circuitry and void the warranty. If you must interface with existing loop powered systems, always use a signal isolator and a separate power supply.



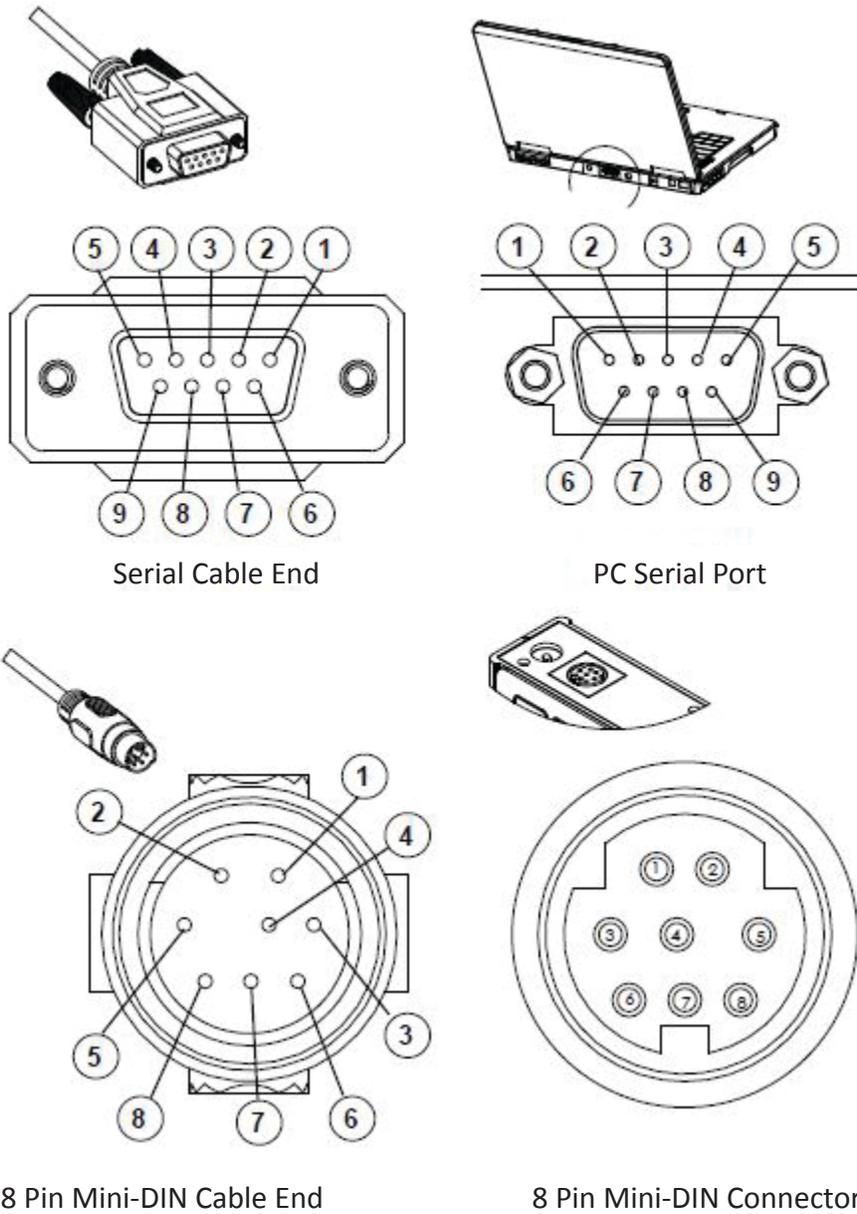
A remote tare can be achieved by momentarily grounding pin 4 to tare.



Controllers: A simple method for providing setpoint to controllers

RS-232 / RS-485 DIGITAL INPUT SIGNAL

To use the RS-232 or RS-485 input signal, connect the RS-232 / RS-485 Output Signal (Pin 5), the RS-232 / RS-485 Input Signal (Pin 3), and Ground (Pin 8) to your computer serial port as shown below. (See page 17 for more details on RS-232 / RS-485.)

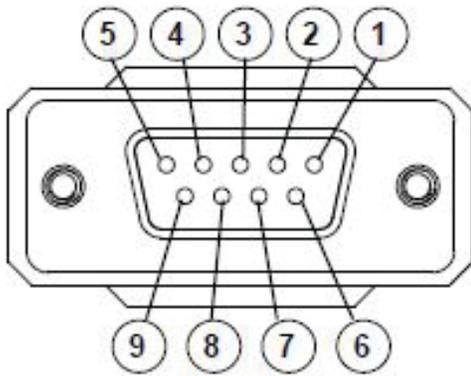


9 PIN SERIAL CONNECTION		8 PIN MINI-DIN CONNECTION	
Pin	Function	Function	Pin
5	DC Common (Ground)	DC Common (Ground)	8
3	Transmit	Receive	3
2	Receive	Transmit	5

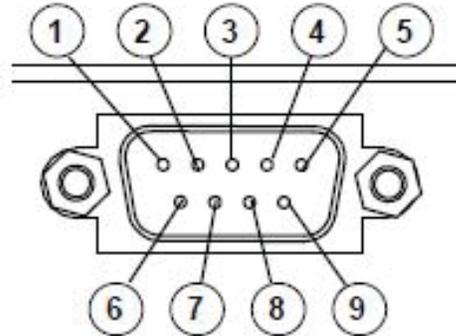
DB9 to Mini-DIN Connection for RS-232 / RS-485 Signals

STANDARD DB9 INPUT SIGNAL

If your instrument was ordered with a **DB9 connection** (check the Calibration Record accompanying the device), then the following chart describes the pin connection arrangement.



Male Connector: Front View



Female Connector: Front View

Pin	Function
1	Not Connected (4-20mA analog output signal optional)
2	5.12 Vdc or (secondary analog output (4-20mA, 5Vdc, 10Vdc or alarm optional)
3	Serial RS-232RX or RS-485(-)
4	Analog Input Signal [4-20mA, 5Vdc, or 10Vdc] (short to ground for remote tare function on non controllers)
5	Serial RS-232TX or RS-485(+)
6	0-5 Vdc Output Signal (or 0-10 Vdc optional)
7	Power In (+Vdc)
8	Ground (common for power, digital communications, analog signals and alarms)
9	Ground (common for power, digital communications, analog signals and alarms)
<p>Note: The above pin-out is applicable to all controllers with the DB9 connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's Calibration Record.</p>	



Do not connect RS-485 to RS-232 units or cables. Damage will occur!
Check part number or contact factory to verify RS-485 functionality.



Due to variance in cable manufacturing, please identify proper wiring/ pins via continuity check & color when using blunt cut multi-strand cables.

OUTPUT SIGNALS

See the Calibration Data Sheet that shipped with your device to determine which output signals were ordered.

CURRENT (4-20 MA) OUTPUT SIGNAL

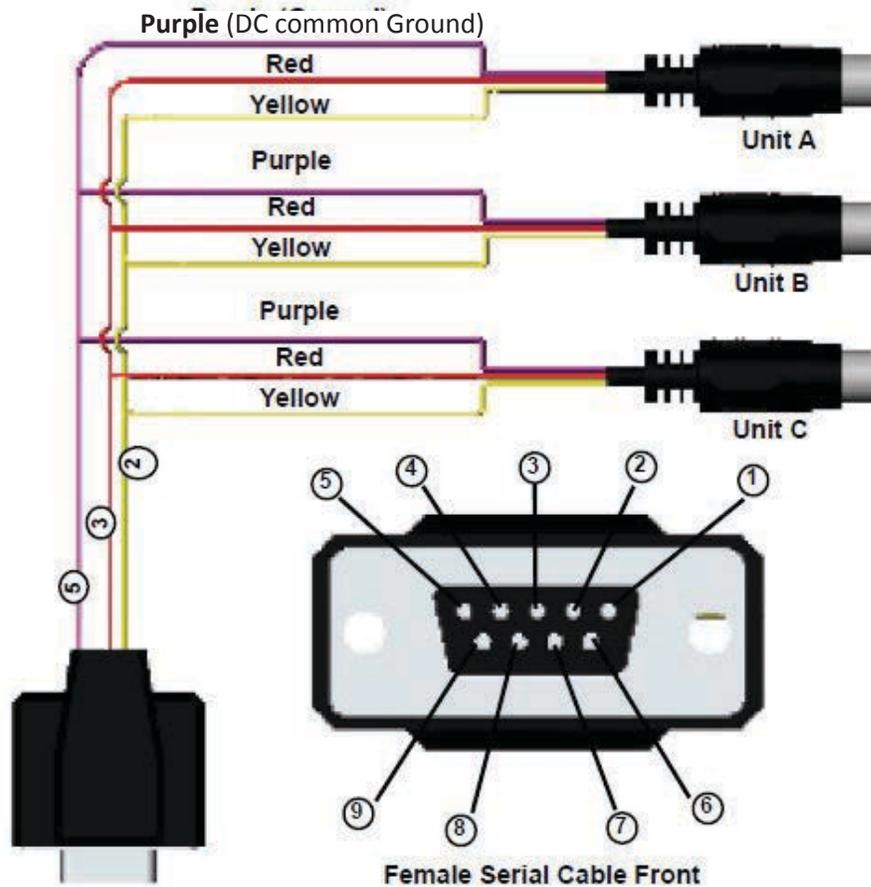
If your EPR controller was ordered with a 4-20 mA current output signal, it will be available on Pin 1 (see p.7 for details). The current signal is 4 mA at 0 pressure and 20 mA at the device's full scale pressure. The output current is linear over the entire range. DC common ground for this signal is on Pin 8. Current output units require 15-30Vdc power.

VOLTAGE (0-5 VDC) OUTPUT SIGNAL

EPR controllers equipped with with a 0-5 Vdc Output Signal will have this output signal available on Pin 6. This voltage is usually in the range of 0.010 Vdc for zero pressure and 5.0 Vdc for full-scale pressure. The output voltage is linear over the entire range. DC common ground for this signal is on Pin 8.

RS-232 / RS-485 DIGITAL OUTPUT SIGNAL

To use the RS-232 or RS-485 output signal, it is necessary to connect the RS-232 / RS-485 Output Signal (Pin 5), the RS-232 / RS-485 Input Signal (Pin 3), and Ground (Pin 8) to your computer serial port as shown on page 9. (See page 17 for details on accessing RS-232 / RS-485 output.)



Optional Multiple Device (Addressable) Wiring Configuration for RS-485

GETTING STARTED - DISPLAY SCREEN & MENUS

The following pages describe the controller screens that can be set with user preferences. Upon powering up, the MAIN screen will appear and navigation will begin there.

The MAIN screen shows the setpoint and actual pressure at the process port.

NAVIGATING EPR MENU OPTIONS AND FUNCTIONS

Press the button under MENU on the MAIN screen to access the following functions. Press the button above or below the function name to access the sub menu(s) of that item. Press <BACK> button to return to the previous screen. Press <MAIN> to return to main screen.

CONTROL

- SETPT RAMP
 - DELTA - Pressure change per unit of time
 - TIME UNITS - msec, sec, min, hr, day
 - TIME - Time per selected unit for ramp up or down
- ADV CONTROL
 - SETPT SOURCE – Selects Serial/Front Panel or Analog control of pressure setpoint
 - LOOP SETUP
 - LOOP VAR - Guage pressure is only option
 - LOOP TYPE - Select PD/PDF or PD2I control
 - LOOP GAINS - Proportional, Integral and Derivative gain settings
 - CONTROL OPTS
 - RAMP ENABLE - Enable or disable ramp up or ramp down function
 - DEAD BAND - Range (+ or -) within which the controller will not attempt control
 - SETPT LIMITS - Set minimum or maximum setpoint limits or remove limits
- SETPT - manually establish setpoint

ABOUT

- DEVICE INFO – Displays model, serial #, mfg date, calibration info, and firmware revision
- DEVICE STATE – Diagnostic information
- MFG INFO – No function. Manufacturer's information

TARES

- TARE PRESS – TARE function (establishes ZERO pressure point)
- AUTO TARE – Select or de-select the power-on TARE function

ADV SETUP

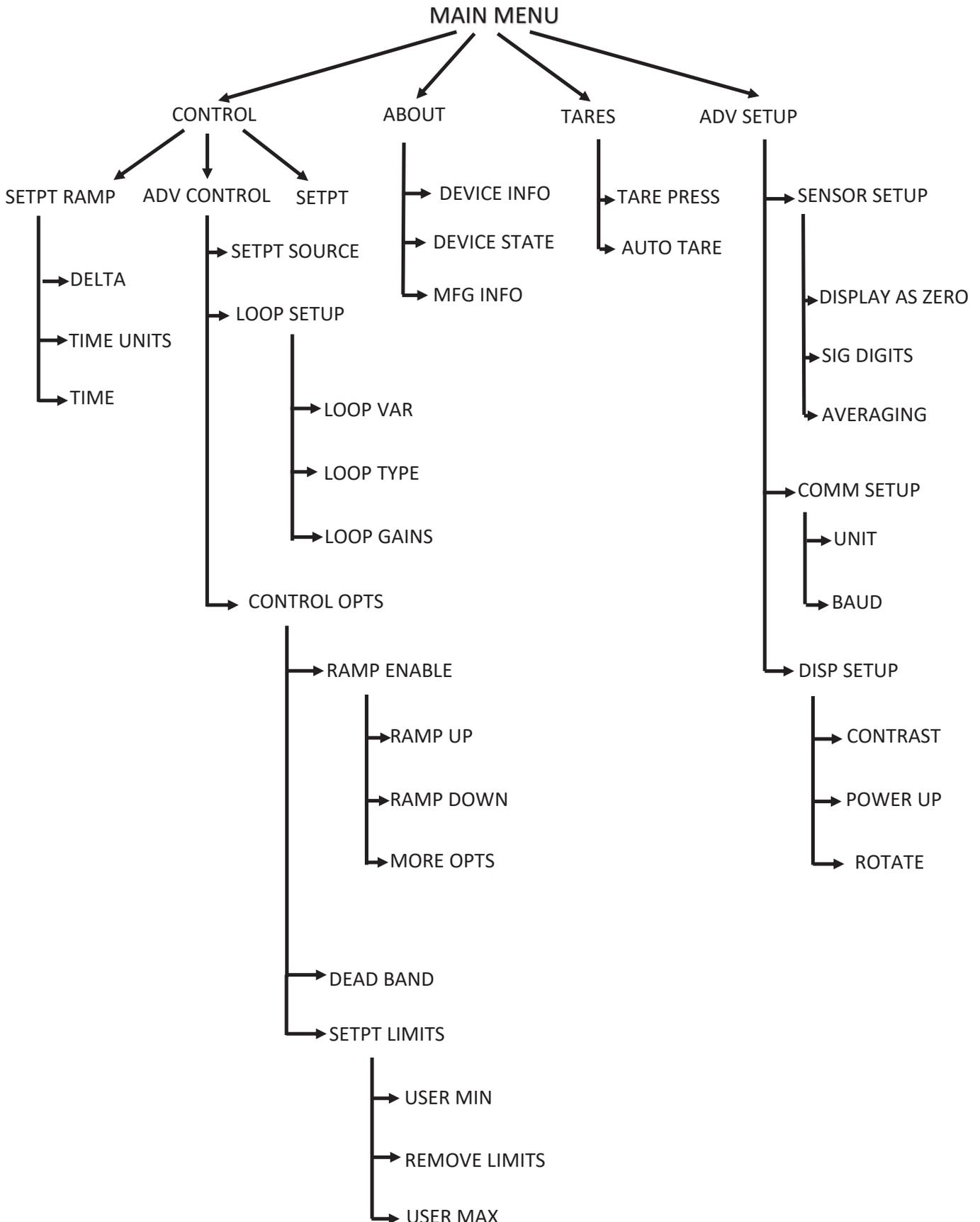
- SENSOR SETUP
 - DISPLAY AS ZERO – Percent of full scale to display as zero
 - SIG DIGITS - Select “Maximize significant digits” or “Match older devices”
 - AVERAGING – Set averaging time constant in milliseconds
- COMM SETUP
 - UNIT ID – Set unit ID
 - BAUD – Serial baud rate
- DISP SETUP
 - CONTRAST – Set the contrast of the LCD display
 - POWER UP - Select the power-up state of the display backlight
 - ROTATE - Rotate the display 0 to 180 degrees



Flashing Error Message: An error message (POV = pressure overrange) flashes when pressure exceeds the range of the sensor. When any item flashes, the pressure measurement is not accurate. Reducing the pressure to within specified limits will return the unit to normal operation and accuracy. If the unit does not return to normal operation, contact Equilibar.

MENU STRUCTURE

The tree diagram below outlines the menu structure for the EPR Series controllers. To access a specific menu, follow the appropriate tree, by pressing the button(s) listed until you reach the desired menu screen. Detailed menu operations can be found on pages 14-15.



MAIN MENU DETAILS

The MAIN screen displays the pressure setpoint and actual pressure in the units specified at the time of order. To change units, press the top left button then press “**Set Button Eng Units**” to change the displayed units. Or press “**Set Device Eng Units**” to change the displayed units *and* the units the device sends across the serial port to the computer. Pushing the TARE PRESS button tares the pressure gauge. See information under “TARES MENU” for more details. Pushing SETPT button allows you to set the pressure setpoint when “Front Panel” is selected as SETPT SOURCE.

CONTROL MENU AND SUBMENU DETAILS

ADVANCED CONTROL > SETPT SOURCE

Pressing the button above SETPT SOURCE will allow you to select how the setpoint will be conveyed to your controller.

The controller will ignore any setpoint except that of the selected setpoint source and it will remember which input is selected even if the power is disconnected. OPTIONS:

1. Serial/Front Panel

- Serial refers to a setpoint applied via a serial connection to a computer or PLC as described in the RS-232 / RS-485 Communications Setup pages of this manual.
- Front Panel refers to a setpoint applied directly at the controller. *Front Panel input must be selected prior to changing the setpoint at the device.

2. Analog

- Analog refers to a remote analog setpoint

applied to Pin 4 of the Mini-DIN connector as described in the installation section of this manual. To determine what type of analog setpoint your controller has, refer to the Calibration Data Sheet that was included with your controller.

- Caution: If nothing is connected to Pin 4, and the controller is set for analog control, the device will generate random setpoint values.

ADVANCED CONTROL > LOOP GAINS

PID Values determine the performance and operation of your EPR control valve. These terms dictate control speed, control stability, overshoot and oscillation. All units leave the factory with a generic tuning designed to handle most applications. If you encounter issues with valve stability, oscillation or speed, then fine tuning these parameters may resolve the problem. PID fine tuning steps are given on p. 16.

TARES MENU DETAILS

Do Not Attempt to Tare Absolute Pressure (psia) Instruments!



Taring (or zeroing) is an important step in obtaining accurate measurements. Taring (or zeroing) an EPR pressure controller provides it with a reference point for zero pressure.

Before performing the TARE function, It is very important to ascertain that the process ports are open to atmosphere and that there is **No Flow!**

TARE PRESS

If your pressure controller was ordered with the optional “TARE PRESS”, you may tare it by pressing the TARE PRESS button.

AUTO TARE ON/ OFF

The controller must be left in the default AUTO TARE OFF mode except when actually taring the controller as explained below.

To correctly tare a pressure controller:

1. Be sure the unit is in the AUTO TARE OFF default setting.
2. Disconnect all plumbing and make sure there is No Flow.
3. Push the button above AUTO TARE OFF once so that the display reads AUTO TARE ON.
4. Enter a Setpoint of ZERO. A zero setpoint results in the closing of the valve and a known “no flow” condition.
5. Wait at least 30 seconds.
6. Push the button above AUTO TARE ON once so that the display reads AUTO TARE OFF.
7. Reconnect the plumbing.

If the unit reads significantly different than zero when removed from the line and open, it is a good indication that it was given a false zero.

ABOUT MENU DETAILS

Press **DEVICE INFO** to view model #, serial #, manufacture date, calibration info, and firmware revision.

Press **DEVICE STATE** to view diagnostic information. **MFG INFO** menu button has no function.

ADV SETUP MENU AND SUBMENU DETAILS

SENSOR SETUP

AVERAGING > PRESS AVG

Pressure Averaging may be useful to make it easier to read and interpret rapidly fluctuating pressures. Pressure averaging can be adjusted between 0 msec (no averaging) and 999 msec (maximum averaging).

Pressure averaging can be effective at “smoothing” high frequency process oscillations such as those caused by diaphragm pumps. Use the SELECT DIGIT button and the UP and DOWN buttons to change the value. Press SET to save.

COMM SETUP

UNIT ID

This identifier allows you to assign a unique address to each EPR unit so that multiple units can be connected to a single RS-232 or RS-485 computer port. Valid unit identifiers are the letters A-Z and @.

Press UNIT ID, then use the UP and DOWN buttons to change the Unit ID. Press SET to record the ID.

Any Unit ID change will take effect upon exit of Communication Setup menu.

If the symbol @ is selected as the Unit ID, the device will enter streaming mode when Communication Select menu is exited.

See RS-232 Communications (page 17) for information about the streaming mode.

COMM SETUP (cont'd)

BAUD

Both the EPR and your computer must send/receive data at the same baud rate. The default baud rate for is 19200 baud.

Baud rate choices are 115200, 57600, 38400, 19200, 9600, or 2400 baud. Use the UP and DOWN buttons to select the baud rate that matches your computer. Press SET to save.

Any baud rate change will not take effect until power to the unit is cycled.

DISP SETUP

LCD CONTRAST

The display contrast can be adjusted between 0 and 31, with zero being the lightest and 31 being the darkest. Use the UP and DOWN buttons to adjust the contrast. Press SET when you are satisfied.

POWER UP

Toggle between “LIT” display or “DARK” display upon powering up.

ROTATE DISP

The EPR is not orientation sensitive and may be mounted in any plane and still maintain good pressure control. In order to read the display more easily if it is not mounted in an upright position, the display may be rotated 180°. The display and buttons will rotate together.



CAUTION! Never leave a Controller with a non-zero setpoint if no pressure is available to make flow. The controller will apply full power to the valve in an attempt to reach the set-point. When there is no flow, this can make the valve very HOT!

PID TUNING

EPR Series controllers allow you to adjust the Proportional, Integral and Differential terms of the PID control loop.

To change the PID loop parameters, push the button below PID.

Press LOOP TYPE. Then use the UP and DOWN buttons to select the appropriate PID control algorithm. Press SET.

Read below for descriptions of the PID Loop Types (PID Control Algorithms).

P refers to the Proportional term of the PID loop.
I refers to the Integral term of the PID loop.
D refers to the Differential term of the PID loop.

Press P, I or D. Then use SELECT to choose the decimal with the arrow and the UP and DOWN buttons to change the value. Press SET to record your value. Press CLEAR to return to zero.

Before changing the P, I or D parameter, please record the initial value so that it can be returned to the factory setting if necessary.

Valve tuning can be complex. If you would like assistance, please contact Equilibar for technical support. This video provides helpful instructions: https://www.youtube.com/watch?v=Hm3d0Vh_tgY

The PD algorithm is the most common PID algorithm used on EPR Series controllers.

It is divided into two segments:
The first compares the process value to the setpoint to generate a proportional error. The proportional error is multiplied by the **'P' gain**, with the result added to the output drive register.

The second operates on the present process value minus the process value during the immediately previous evaluation cycle. This 'velocity' term is multiplied by the **'D' gain**, with the result subtracted from the output drive register.

The additions to and subtractions from the output drive register are carried over from

process cycle to process cycle, thus performing the integration function automatically.

Increasing the **'P' gain** will promote the tendency of the system to overshoot, ring, or oscillate.

Increasing the **'D' gain** will reduce the tendency of the system to overshoot.

The PD2I algorithm is a PID algorithm used primarily for high performance pressure control applications.

It exhibits two basic differences from the PD algorithm that most controllers utilize.

1. Instead of applying a damping function based upon the rate of change of the process value, it applies a damping function based upon the square of the rate of change of the process value.
2. The damping function is applied directly to the proportional error term before that term is used in the proportional and integral functions of the algorithm. This provides a certain amount of 'look ahead' capability in the control loop.

Because of these differences, you will note the following:

1. Increasing 'P' gain can be used to damp out overshoot and slow oscillations in pressure controllers. You will know that 'P' gain is too high, when the controller breaks into fast oscillations on step changes in setpoint. A good starting value for 'P' gain is 200.
2. If the unit was originally shipped with the PD2I algorithm selected, the 'D' gain value should be left at or near the factory setting because it relates primarily to the system phase lags. If you are changing from the default algorithm to the PD2I algorithm, you should start with a 'D' gain value of 20.
3. The 'I' gain is used to control the rate at which the process converges to the setpoint, after the initial step change. Too low a value for 'I' gain shows up as a process value that jumps to near the setpoint and then takes a while to converge the rest of the way. Too high a value for 'I' gain results in oscillation. A good starting value for the 'I' gain is 200.

RS-232 / RS-485 COMMUNICATIONS SETUP

CONFIGURING HYPERTERMINAL®:

1. Open your HyperTerminal® RS-232 / RS-485 terminal program (installed under the “Accessories” menu on all Microsoft Windows® operating systems).
2. Select “Properties” from the file menu.
3. Click on the “Configure” button under the “Connect To” tab. Be sure the program is set for: 19,200 baud (or matches the baud rate selected in the RS-232 / RS-485 communications menu on the meter) and an 8-N-1-None (8 Data Bits, No Parity, 1 Stop Bit, and no Flow Control) protocol.
4. Under the “Settings” tab, make sure the Terminal Emulation is set to ANSI or Auto Detect.
5. Click on the “ASCII Setup” button and be sure the “Send Line Ends with Line Feeds” box is not checked and the “Echo Typed Characters Locally” box and the “Append Line Feeds to Incoming Lines” boxes are checked. Those settings not mentioned here are normally okay in the default position.
6. Save the settings, close HyperTerminal® and reopen it.

STREAMING MODE (RS-485 units do not have a streaming mode)

In the default Polling Mode, the screen should be blank except the blinking cursor. In order to get the data streaming to the screen, hit the “Enter” key several times to clear any extraneous information. Type “* @= @” followed by “Enter” (or using the RS-232 / RS-485 communication select menu, select @ as identifier and exit the screen). If data still does not appear, check all the connections and COM port assignments.

Streaming Mode – Advanced

The streaming data rate is controlled by register 91. The recommended default rate of data provision is once every 50 milliseconds and this is suitable for most purposes.

If a slower or faster streaming data rate is desired, register 91 can be changed to a value from 1 millisecond to 65535 milliseconds, or slightly over once every minute.

Below approximately 40 milliseconds, data provision will be dependent upon how many parameters are selected. Fewer data parameters can be streamed more quickly than more. It is left to the user to balance streaming speed with number of parameters streamed.

To read register 91, type “*r91” followed by “Enter”.

To modify register 91, type “*w91=X”, where X is a positive integer from 1 to 65535, followed by “Enter”.

To return to the recommended factory default streaming speed, type “*w91= 50”.

SENDING A SETPOINT VIA RS-232 / RS-485:

To send a setpoint via RS-232 / RS-485, “**Serial/Front Panel**” must be selected under SETPT SOURCE

Method 1: Setpoint may be set in floating point in serial communication using serial command (UnitID)SX.YZ

Example: AS4.54 results in Unit ID A changing setpoint to 4.54.

Method 2: Type in a number between 0 and 65535 (2% over range), where 64000 denotes full-scale pressure rate, and hit “Enter”.

The setpoint column and pressure rates should change accordingly. If they do not, try hitting “Enter” a couple of times and repeating your command. The formula for performing a linear interpolation is as follows: $\text{Value} = (\text{Desired Setpoint} \times 64000) / \text{Full Scale Pressure Range}$

For example, if your device is a 50 psig full-scale unit and you wish to apply a setpoint of 12.5 psig you would enter the following value: $16000 = (12.5 \text{ psig} \times 64000) / \text{Full Scale Pressure Range}$

If the controller is in polling mode as described in *Changing from Streaming Mode to Polling Mode*, the setpoint must be preceded by the address of the controller. For example, if your controller has been given an address of D, the setpoint would be sent by typing: D16000 followed by “Enter”

CHANGING FROM STREAMING TO POLLING MODE:

When the meter is in the Streaming Mode (RS-485 units do not have a streaming mode), the screen is updated approximately 10-60 times per second (depending on the amount of data on each line) so that the user sees the data essentially in real time. It is sometimes desirable, and necessary when using more than one unit on a single RS-232 line, to be able to poll the unit.

In Polling Mode the unit measures the pressure normally, but only sends a line of data when it is “polled”. Each unit can be given its own unique identifier or address. Unless otherwise specified each unit is shipped with a default address of capital A. Other valid addresses are B thru Z.

Once you have established communication with the unit and have a stream of information filling your screen:

1. Type *@=A followed by “Enter” (or using the RS-232 / RS-485 communication select menu, select A as identifier and exit the screen) to stop the streaming mode of information. Note that the flow of information will not stop while you are typing and you will not be able to read what you have typed. Also, the unit does not accept a backspace or delete in the line so it must be typed correctly. If in doubt, simply hit enter and start again. If the unit does not get exactly what it is expecting, it will ignore it. If the line has been typed correctly, the data will stop.
2. You may now poll the unit by typing A followed by “Enter”. This does an instantaneous poll of unit A and returns the values once. You may type A “Enter” as many times as you like. Alternately you could resume streaming mode by typing *@=@ followed by “Enter”. Repeat step 1 to remove the unit from the streaming mode.
3. To assign the unit a new address, type *@=New Address, e.g. *@=B. Care should be taken not to assign an address to a unit if more than one unit is on the RS-232 / RS-485 line as all of the addresses will be reassigned. Instead, each should be individually attached to the RS-232 / RS-485 line, given an address, and taken off. After each unit has been given a unique address, they can all be put back on the same line and polled individually.

COLLECTING DATA

The RS-232 / RS-485 output updates to the screen many times per second. Very short-term events can be captured simply by disconnecting (there are two telephone symbol icons at the top of the HyperTerminal® screen for disconnecting and connecting) immediately after the event in question. The scroll bar can be driven up to the event and all of the data associated with the event can be selected, copied, and pasted into Microsoft® Excel® or other spreadsheet program as described below.

For longer term data, it is useful to capture the data in a text file. With the desired data streaming to the screen, select “Capture Text” from the Transfer Menu. Type in the path and file name you wish to use. Push the start button. When the data collection period is complete, simply select “Capture Text” from the Transfer Menu and select “Stop” from the sub-menu that appears.

Data that is selected and copied, either directly from HyperTerminal® or from a text file can be pasted directly into Excel®. When the data is pasted it will all be in the selected column. Select “Text to Columns...” under the Data menu in Excel® and a Text to Columns Wizard (dialog box) will appear. Make sure that “Fixed Width” is selected under Original Data Type in the first dialog box and click “Next”. In the second dialog box, set the column widths as desired, but the default is usually acceptable. Click on “Next” again. In the third dialog box, make sure the column data format is set to “General”, and click

“Finish”. This separates the data into columns for manipulation and removes symbols such as the plus signs from the numbers. Once the data is in this format, it can be graphed or manipulated as desired.

For extended term data capture see: “Sending a Simple Script to HyperTerminal®” on the next page.

Data Format:

The data stream on the screen represents the pressure parameters of the main mode in the units shown on the display.

For EPR Series Controllers, there are 2 columns of data representing pressure and setpoint. The first column is pressure (normally in psig), the second column is the setpoint (in the units specified at time of order and shown on the display).

```
+014.70 014.70  
+014.70 014.70  
+014.70 014.70  
+014.70 014.70  
+014.70 014.70  
+014.70 014.70
```

EPR Series Pressure Controller Data Format

SENDING A SIMPLE SCRIPT FILE TO HYPERTERMINAL®

It is sometimes desirable to capture data for an extended period of time. Standard streaming mode information is useful for short term events, however, when capturing data for an extended period of time, the amount of data and thus the file size can become too large very quickly. Without any special programming skills, you can use HyperTerminal® and a text editing program such as Microsoft® Word® to capture text at defined intervals.

1. Open your text editing program, MS Word for example.
2. Set the cap lock on so that you are typing in capital letters.
3. Beginning at the top of the page, type A<Enter> repeatedly. If you're using MS Word, you can tell how many lines you have by the line count at the bottom of the screen. The number of lines will correspond to the total number of times the pressure device will be polled, and thus the total number of lines of data it will produce.

For example: A
 A
 A
 A
 A
 A

will get a total of six lines of data from the pressure meter, but you can enter as many as you like.

The time between each line will be set in HyperTerminal.

4. When you have as many lines as you wish, go to the File menu and select save. In the save dialog box, enter a path and file name as desired and in the "Save as Type" box, select the plain text (.txt) option. It is important that it be saved as a generic text file for HyperTerminal to work with it.
5. Click Save.
6. A file conversion box will appear. In the "End Lines With" drop down box, select CR Only. Everything else can be left as default.
7. Click O.K.
8. You have now created a "script" file to send to HyperTerminal. Close the file and exit the text

editing program.

9. Open HyperTerminal and establish communication with your pressure device as outlined in the manual.
10. Set the pressure device to Polling Mode as described in the manual. Each time you type A<Enter>, the meter should return one line of data to the screen.
11. Go to the File menu in HyperTerminal and select "Properties".
12. Select the "Settings" tab. 43
13. Click on the "ASCII Setup" button.
14. The "Line Delay" box is defaulted to 0 milliseconds. This is where you will tell the program how often to read a line from the script file you've created. 1000 milliseconds is one second, so if you want a line of data every 30 seconds, you would enter 30000 into the box. If you want a line every 5 minutes, you would enter 300000 into the box.
15. When you have entered the value you want, click on OK and OK in the Properties dialog box.
16. Go the Transfer menu and select "Send Text File..." (NOT Send File...).
17. Browse and select the text "script" file you created.
18. Click Open.
19. The program will begin "executing" your script file, reading one line at a time with the line delay you specified and the pressure device will respond by sending one line of data for each poll it receives, when it receives it.
You can also capture the data to another file as described in the manual under "Collecting Data". You will be simultaneously sending it a script file and capturing the output to a separate file for analysis.
20. You can also capture the data to another file as described in the manual under "Collecting Data". You will be simultaneously sending it a script file and capturing the output to a separate file for analysis.

SUPPORTED UNITS OF MEASURE

This device supports many different units of measure. You may select the desired units as described . Note that only units appropriate to this device are available for selection.

PRESSURE UNITS

Absolute	Gauge	Differential	Notes
PaA	PaG	PaD	pascal
hPaA	hPaG	hPaD	hectopascal
kPaA	kPaG	kPaD	kilopascal
MPaA	MPaG	MPaD	megapascal
mbarA	mbarG	mbarD	millibar
barA	barG	barD	bar
g/cm2A	g/cm2G	g/cm2D	gram force per square centimeter
kg/cmA	kg/cmG	kg/cmD	kilogram force per square centimeter
PSIA	PSIG	PSID	pound force per square inch
PSFA	PSFG	PSFD	pound force per square foot
mTorrA	mTorrG	mTorrD	millitorr
torrA	torrG	torrD	torr
mmHgA	mmHgG	mmHgD	millimeter of mercury at 0 C
inHgA	inHgG	inHgD	inch of mercury at 0 C
mmH2OA	mmH2OG	mmH2OD	millimeter of water at 4 C (NIST conventional)
mmH2OA	mmH2OG	mmH2OD	millimeter of water at 60 C
cmH2OA	cmH2OG	cmH2OD	centimeter of water at 4 C (NIST conventional)
cmH2OA	cmH2OG	cmH2OD	centimeter of water at 60 C
inH2OA	inH2OG	inH2OD	inch of water at 4 C (NIST conventional)
inH2OA	inH2OG	inH2OD	inch of water at 60 C
atm			atmosphere
m asl			meter above sea level (only in /ALT builds)
ft asl			foot above sea level (only in /ALT builds)
V	volt; no conversions are performed to or from other units		
count	count	count	setpoint count, 0 – 64000
%	%	%	percent of full scale

VALVE DRIVE UNITS

Label	Notes
count	+/- 65536 at full drive
%	Percent of full scale drive

TROUBLESHOOTING

Display does not come on or is weak.

Check power and ground connections and supply voltage.

Pressure reading is fixed either near zero or near full scale regardless of actual line pressure.

Differential pressure sensor may be damaged. A common cause of this problem is instantaneous application of high-pressure gas as from a snap acting solenoid valve upstream of the EPR. If you suspect that your pressure sensor is damaged, please discontinue use of the controller and contact Equilibar.

Displayed pressure is flashing and message POV is displayed.

The EPR controllers display an error message (POV = pressure overrange) when a the pressure exceeds the range of the sensors in the device. When any item flashes on the display, the pressure measurement is not accurate. Reducing the pressure to within specified limits will return the unit to normal operation and accuracy. If the unit does not return to normal contact Equilibar.

My controller does not respond to the setpoint.

Check that your setpoint signal is present and supplied to the correct pin and that the correct setpoint source is selected under the SETPT SOURCE list in the control set up display (page 14). Also check that the unit is properly grounded.

After installation, there is no pressure.

EPR Series Controllers incorporate normally closed valves and require a setpoint to operate. Check that your setpoint signal is present and supplied to the correct pin and that the correct input is selected under the SETPT SOURCE list in the control set up display (page 14). Also check that the unit is properly grounded.

The pressure lags below the setpoint.

Be sure there is enough pressure available. If either the setpoint signal line and/ or the output signal line is relatively long, it may be necessary to provide heavier wires (especially ground wiring) to negate voltage drops due to line wire length. An inappropriate PID tuning can also cause this symptom if the D term is too large relative to the P term. See page 16 for more information on PID tuning.

Controller is slow to react to a setpoint change or imparts an oscillation to the flow.

An inappropriate PID tuning can cause these symptoms. Use at conditions considerably different than those at which the device was originally set up can necessitate a re-tuning of the PID loop. See page 16 for more information on PID tuning. Note: The larger the volume pressured, the longer it takes to change the pressure in that volume.

The output signal is lower than the reading at the display.

This can occur if the output signal is measured some distance from the EPR controller as voltage drops in the wires increase with distance. Using heavier gauge wires, especially in the ground wire, can reduce this effect.

My controller oscillates wildly and/or exhibits very different reactions to the setpoint than I expect.

Conditions considerably different than those at which the device was originally set up can necessitate a re-tuning of the PID loop. See page 16 for more information on PID tuning. Ensure the volume on the output is at least one cubic inch (16cc).

RS-232 / RS-485 Serial Communications is not responding.

Check that your EPR controller is powered and connected properly. Be sure that the port on the computer to which the EPR controller is connected is active. Confirm that the port settings are correct per the RS-232 / RS-485 instructions in this manual (Check the RS-232 / RS-485 communications select screen for current EPR readings). Close HyperTerminal® and reopen it. Reboot your PC. See pages 9, 10 and 17 for more information on RS-232 / RS-485 signals and communications.

Slower response than specified.

EPR Series Controllers feature an RS-232 / RS-485 programmable Geometric Running Average (GRA). Depending on the full scale range of the controller, it may have the GRA set to enhance the stability/readability of the display, which would result in slower perceived response time. Please see “Pressure Averaging” on page 15.

Jumps to zero at low pressure.

EPR Controllers feature an RS-232 / RS-485 programmable zero deadband. The factory setting is usually 0.5% of full scale. This can be adjusted between NONE and 3.2% of full scale. See page 15 for ZERO BAND setup.

MAINTENANCE AND RECALIBRATION

GENERAL

EPR Series Pressure Controllers require minimal maintenance. The single most important thing that affects the life and accuracy of these devices is the quality of the gas being controlled. The instruments are designed to control CLEAN, DRY, NON-CORROSIVE gases. If your application requires an aggressive or corrosive gas, please contact Equilibar for more information.

RECALIBRATION

The recommended period for recalibration is once every year. A label located on the back of the controller lists the most recent calibration date. The controller should be returned to the factory for recalibration within one year from the listed date. Before calling to schedule a recalibration, please note the serial number on the back of the meter. The Serial Number, Model Number, and Date of Manufacture are also available on the DEVICE INFO display menu (see pages 12-14 for more information).

CLEANING

EPR Series Pressure Controllers require no periodic cleaning. If necessary, the outside of the controller can be cleaned with a soft dry cloth. Avoid excess moisture or solvents.

For repair, recalibration or recycling of this product, please contact Equilibar

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