

Rotork Fairchild PAX1 Motor Set Pressure Regulator User's Manual

Product Overview

The PAX1 Motor Set Pressure Regulator is a flexible low voltage DC powered linear actuator coupled to one of five Fairchild precision pressure regulators capable of controlling pressure ranges of 0-0.5 psig to 0-3000 psig and housed in a flameproof enclosure. The unit is inherently lock in last place as the actuator will maintain its position upon loss of electrical power.

The PAX1 can be actuated open loop using two optically isolated switch closure inputs (Up and Down) to change the pressure regulator's setpoint. The PAX1 will continue to change the pressure regulator setpoint in response to the input until either of the adjustable range limits are reached.

The PAX1 has an isolated 4-20 mA control input to proportionally control the pressure regulator setpoint. There is a 1-5 vdc non isolated control input as well. In analog control mode, the unit is fail freeze upon loss of either control signals.

The actuator features UP and DOWN push buttons under the cover to facilitate commissioning and to permit local control of the pressure regulator's setpoint. There is an 8mm (5/16") female hex motor drive interface under the cover to allow manual setpoint control in the case of loss of electrical power.

The actuator includes two fully adjustable 1A, 250VAC SPDT alarm relays (one High and one Low) providing alarm function when the pressure regulator output pressure reaches critical values. The relays are magnetically latched so the alarm switch states are maintained when the power is disconnected. This allows accurate alarm function on systems that remove power from the actuator between adjustments to conserve power as is typically done in solar powered installations.

The PAX1 offers an optional optically isolated electronic 4-20mA feedback output. This feedback feature is functional for both the pulse control and analog control configurations. The unit must be powered to facilitate the feedback output function.



General Information

The PAX1 Motor Set Pressure Regulator described in this document has been designed and manufactured with state of the art technology. All components are subject to stringent quality and environmental requirements during manufacture. Our quality systems are certified ISO 9001.

This user's manual contains important information that enables a competent user to install, operate and maintain this Motor Set Pressure Regulator. The installation, operation and maintenance of this unit in a hazardous area must be carried out by an appropriately trained and qualified person and in accordance with all relevant codes of practice for the particular Hazardous Area Classification.

Warning

- Installation must be carried out by qualified personnel in accordance with all national and local codes and ordinances.
- Shock Hazard. Multiple power sources possible. Disconnect all power sources before servicing. Serious injury or death could result.
- Read and understand all instructions carefully before starting installation. Save this document for future use. Failure to read and understand these instructions could result in improper operation of the device leading to equipment damage, serious injury, or death.

Hazardous Area Ratings (Flameproof)

Factory Mutual

Class I Division 1 Groups ABCD T6...T5
Class II, III Division 1, Groups EFG T6...T5
Class 1, Zone 1, AEx db IIC, T6...T5 Gb
Zone 21, AEx tb IIIC T85°C...100°C Db
T6[T85°C]: Ta = -40°C to +65°C
T5[T100°C]: Ta = -40°C to +70°C
Type 4X/6P, IP66/68

CSA

Class I, Division 1, Groups B,C,D T6...T5
Class II, III Division 1, Groups E,F,G T6...T5
Ex db IIC T6-...T5 Gb
Ex tb IIIC T85°C...T100°C Db
T6[T85°C]: Ta = -40°C to +65°C
T5[100°C]: Ta = -40°C to +70°C
IP66/68

Hazardous Area Conditions of use

- Hazardous locations wiring must comply with:
 - FM: ANSI/NFPA 70 (NEC[®]).
 - CSA: CEC Part 1.
- Wiring must be rated 110°C or higher.
- Explosion proof certified seals are required:
 - FM: Within 18" for Groups A, B, C and D installations or within 2" for Group IIC installations.
 - CSA: Within 18" for both Zones and Divisions installations.
- Under certain extreme circumstances, the non-metallic parts incorporated in the enclosure of this equipment may generate an ignition-capable level of electrostatic charge. Therefore the equipment shall not be installed in a location where the external conditions are conducive to the build-up of electrostatic charge on such surfaces. In addition, the equipment shall only be cleaned with a damp cloth.
- The PAX1 Actuator includes flame path joints. Consult the factory if repair of the flame path joints are necessary. (CONTINUED)

- Suitably rated conduit seals must be used for the conditions of use such as dust tight seals for Class II & III, Groups E, F, G or water proof seals to prevent water ingress.
- To maintain Type 4X and IP66 rating when installing threaded conduit, use PTFE thread sealant tape according to instructions.
- CSA Specific Conditions of use:
 - **“CAUTION – USE SUPPLY WIRES SUITABLE FOR AT LEAST 90°C”** and **“ATTENTION – EMPLOYER DES FILS D’ALIMENTATION QUI CONVENNENT POUR AU MOINS 90°C”**.
 - **“TO BE CONNECTED TO A CLASS 2 CIRCUIT ONLY”** and **“RACCORDER UNIQUEMENT À UN CIRCUIT DE CLASSE 2”**.
 - **“CAUTION – KEEP COVER TIGHT WHILE CIRCUITS ARE ALIVE”** and **“ATTENTION – GARDER LE COUVERCLE BIEN FERMÉ TANT QUE LE CIRCUITS SONT SOUS TENSION”**.
 - **“WARNING – POTENTIAL ELECTROSTATIC CHARGING HAZARD – SEE INSTRUCTIONS”** and **“AVERTISSEMENT – DANGER POTENTIEL DE CHARGE ELECTROSTATIQUE – VOIR LES INSTRUCTIONS”**.
 - **“A SEAL SHALL BE INSTALLED WITHIN 18 in (45 cm) OF THE ENCLOSURE”** and **“UN SCCELLEMENT DOIT ÊTRE INSTALLÉ À MOINS DE 45 cm (18 in) DU BOÎTER”**.

Installation

The PAX1 can be mounted in any position without affecting its operation. It can be mounted to a flat surface using the mounting holes on the actuator. An optional mounting bracket is also available. For details, see “PAX1 Exterior Dimensions”.

Clean all pipelines to remove dirt and scale before installation. Apply a minimum amount of pipe compound to the male threads of the fitting only. Do not use Teflon tape as a sealant. Start with the third thread back and work away from the end of the fitting to avoid the possibility of contaminating the regulator. Install the regulator in the air line. The inlet and outlet connections are labeled on the regulator body under the ports. Tighten connections securely.

NOTES: Oil free air must be applied to the regulator. Use a filter to remove dirt and entrained liquid in the air line ahead of the pressure regulator. If an airline lubricator is used, it **MUST** be located downstream of the pressure regulator or performance will be affected.

Installation below ground level

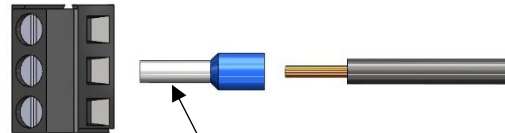
Pressure Regulator Vent: For units that are installed below ground and in areas where the unit may be under water due to flooding, the pressure regulator vent should be piped to an area where the outlet of the pipe is located at an elevation above any possible flooding. Water entering the bonnet vent will cause an increase in the outlet pressure in direct relation to the depth of the water above the vent. This can cause a significant increase in outlet pressure especially in low pressure systems and may cause dangerous system overpressure conditions.

Conduit Seal: The PAX1 is rated for limited submerged operation but the user is responsible for ensuring water cannot enter the PAX1 enclosure through the conduit connection and conduit port. Ensure the conduit installation is water tight at elevations that may be submerged below water. Where conduit is prone to collect internal condensation, appropriate conduit traps, drains and seals must be employed to prevent condensation from collecting inside the PAX1 enclosure.

Wiring

The PAX1 can be controlled with three different control interfaces. The wiring diagrams below show the connections required to operate the unit based on the control type as well as connections to other features such as position feedback and alarm switches.

The terminal blocks can accommodate wire size up to 1.5 mm (14 ga.). Due to safety requirements, wire entering TB2 and TB3 terminal blocks (alarm relays) require ferrules (supplied) to provide proper insulation for the high voltage AC connections.

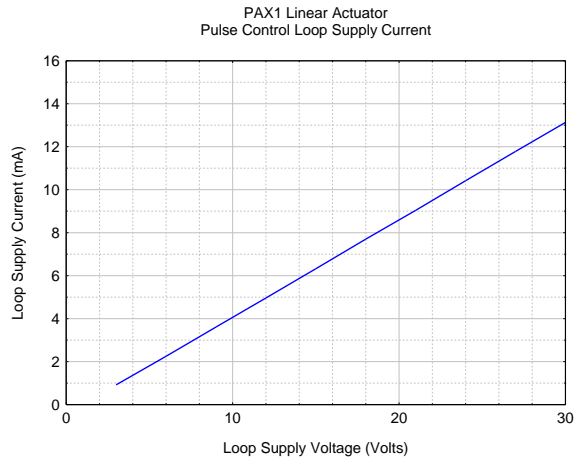
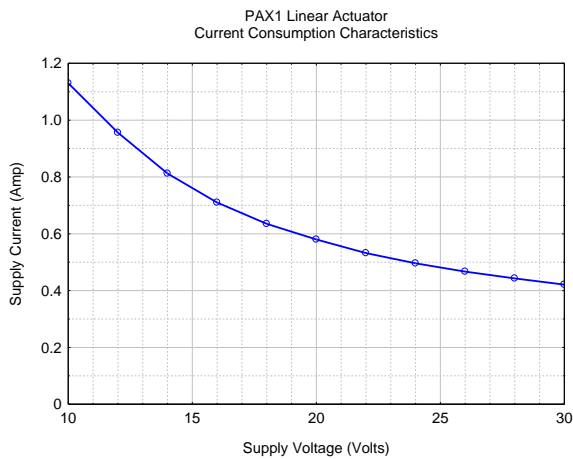


Crimp ferrule onto wire, then clamp it in the terminal block.

Power Supply Sizing

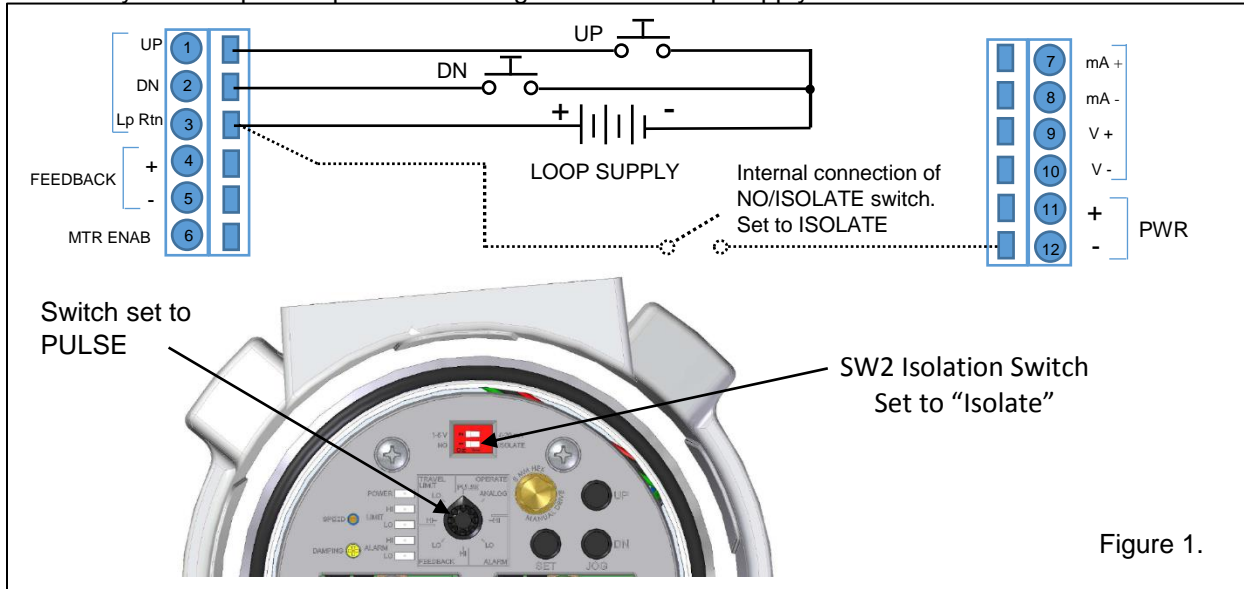
For 12 vdc operation, the recommended power supply should have 2 amp capacity.

For 24 vdc operation, the recommended power supply should have 1 amp capacity.

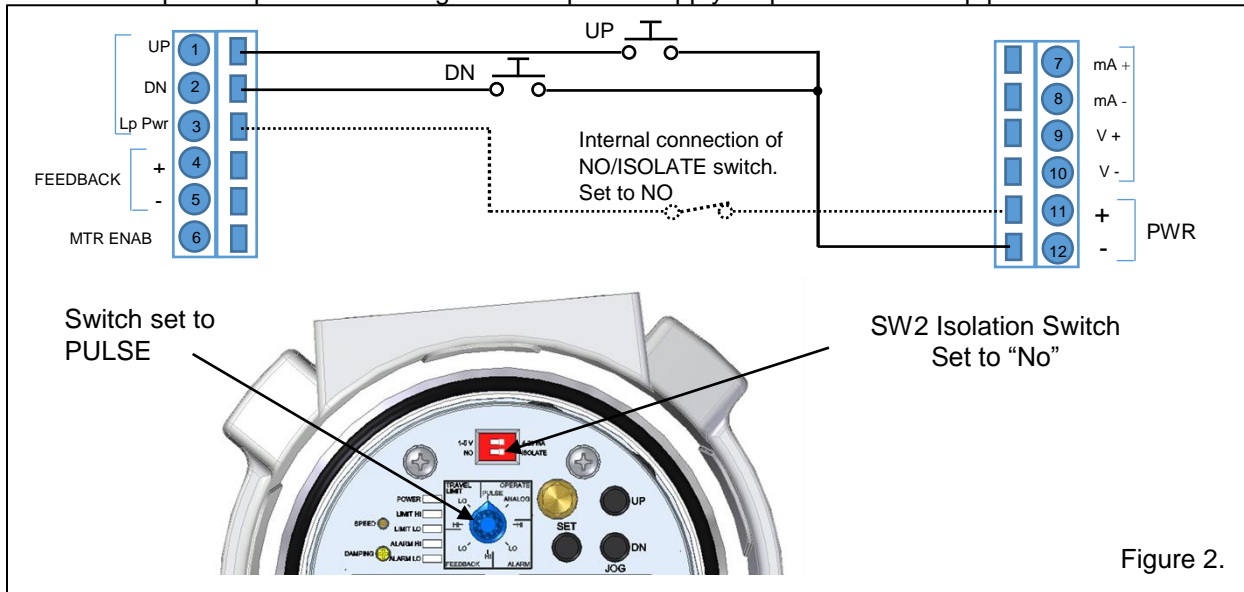


Electrical Connections

Electrically isolated pulse input control using an external loop supply



Non isolated pulse input control using common power supply for pulse control loop power



4-20 mA analog control

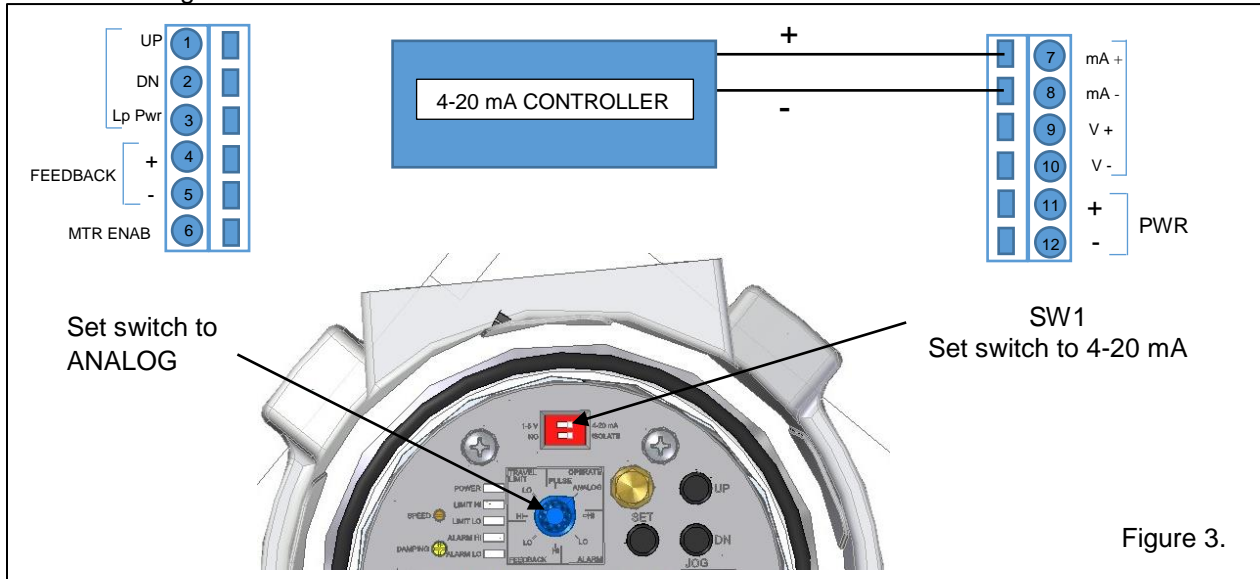


Figure 3.

1-5 vdc analog control

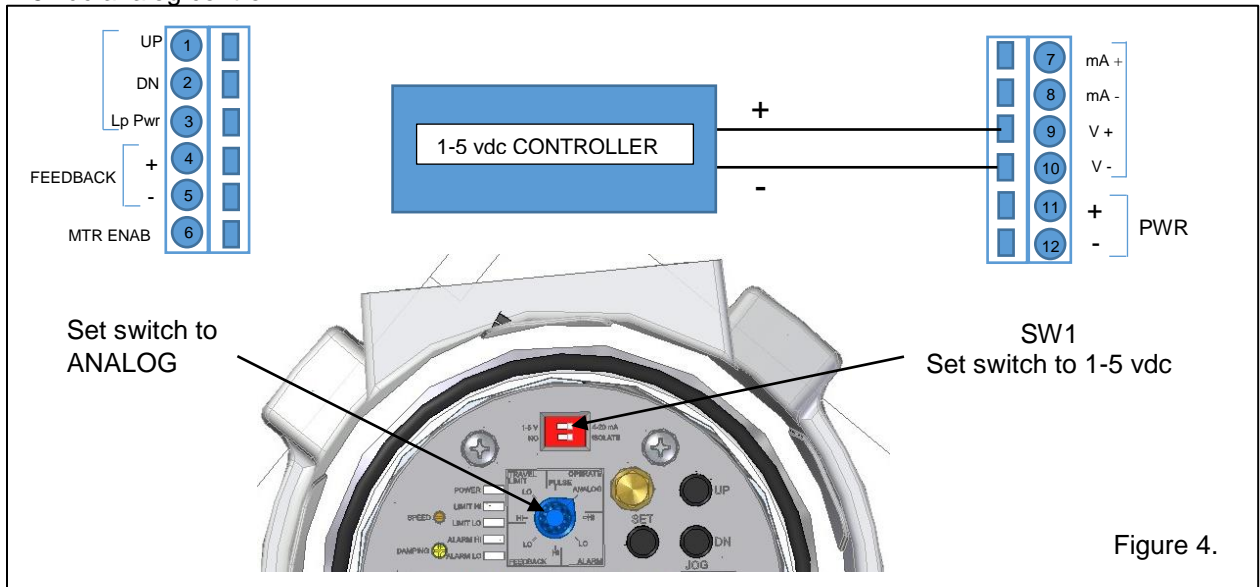


Figure 4.

Power and Feedback Connections

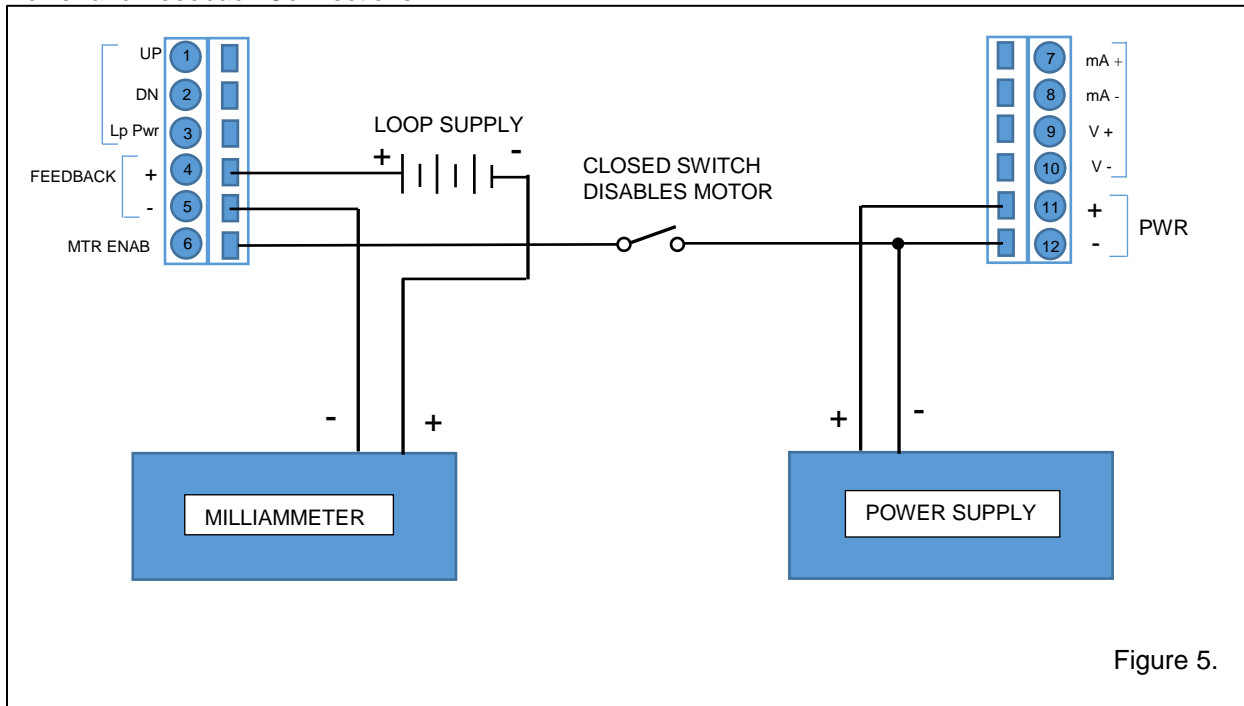


Figure 5.

Power and Feedback Connections

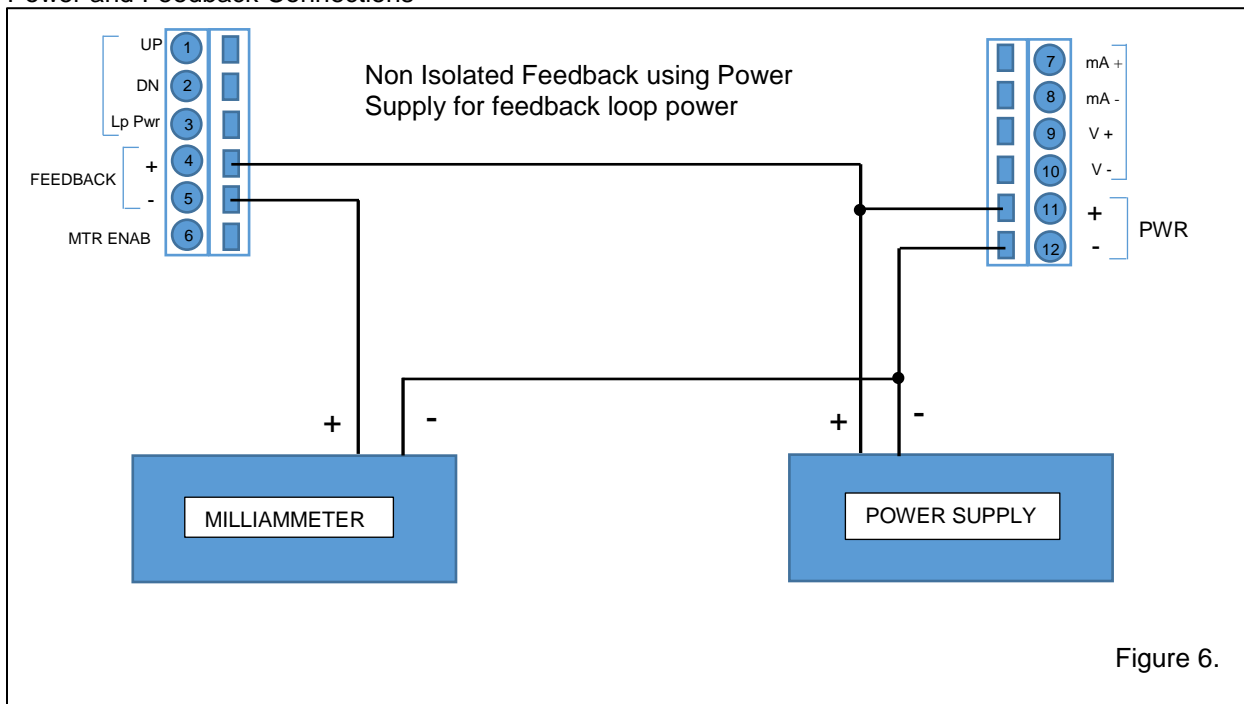


Figure 6.

Alarm Switch Connections

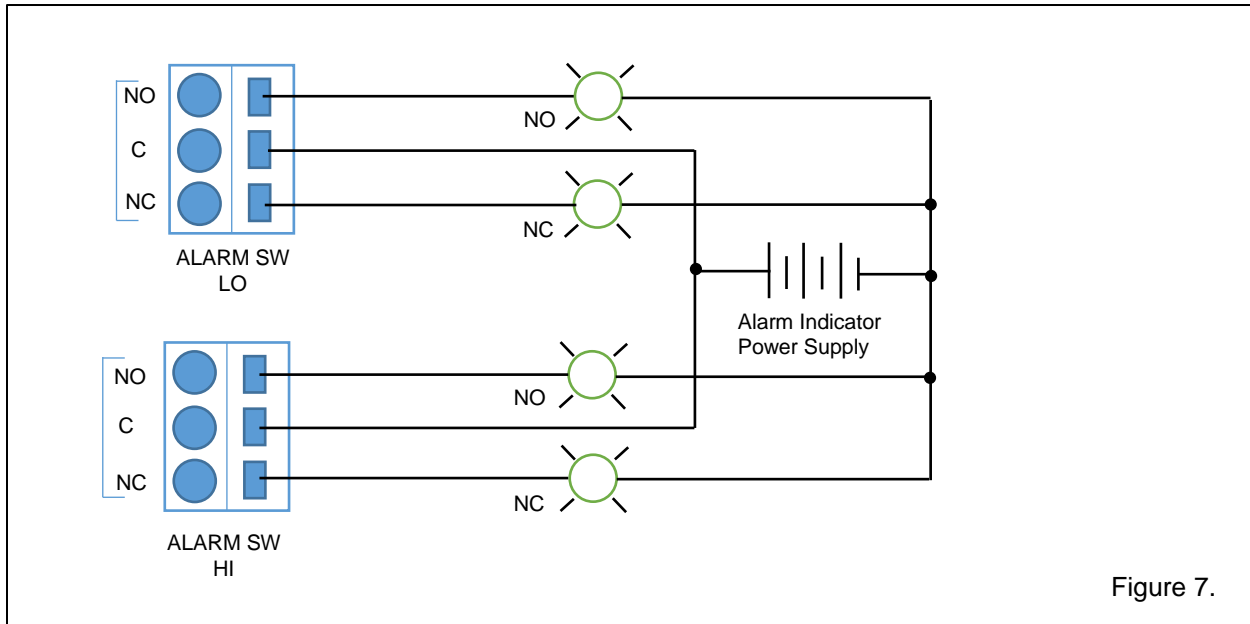


Figure 7.

User Interface

Setup Switch

Eight position rotary SETUP/OPERATE switch

Configuration dip switches,

SW1 selects either 1-5 vdc or 4-20 mA for analog control input

SW2, Isolate: The Pulse control inputs are isolated from the DC power supply providing power to the unit and must be powered from a separate external power source.

SW2, NO: The Pulse control input circuit is connected to the DC power supply providing power to the unit

Push button switches,

UP; Moves the pressure regulator setpoint to a higher pressure.

DN; Moves the pressure regulator setpoint to a lower pressure.

SET; Used in conjunction with the rotary SETUP switch to set the pressure limits, alarm points, and analog feedback calibration.

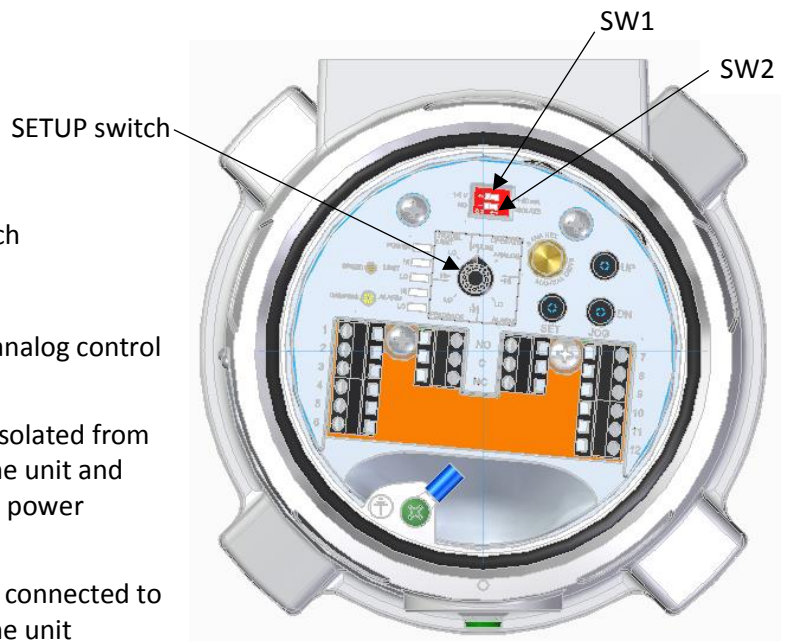


Figure 8.

LED Indicators

PWR: Green, Supply voltage is between 11 and 30 vdc. Red, Voltage is less than 11 vdc or greater than 30 VDC.

LIMIT HI: Green, Hi limit not reached, thrust rod will move in both directions. Red, Hi Limit reached, thrust rod will move down only.

LIMIT LO Green, Lo limit not reached, thrust rod will move in both directions. Red, Lo Limit reached, thrust rod will move up only.

ALARM HI: Green, Hi Alarm not reached, Hi Alarm relay not energized. Red, Hi Alarm reached, Hi Alarm relay is energized. NO contact are closed.

ALARM LO: Green, Lo Alarm not reached, Lo Alarm relay not energized. Red, Lo Alarm reached, Lo Alarm relay is energized. NO contact are closed.

Speed potentiometer.

20 turn. Adjusts actuator speed from 1.2 mm/min to 60 mm/min

Damping potentiometer.

1 turn. Adjusts start and stop ramp speed rate.

Manual Control:

The actuator can be manually moved by manually turning the motor through an 8mm (5/16") female hex socket located through the hole in the top PCA cover near the SET button. Turning the motor clockwise increases pressure, counter clockwise decreases pressure. Take care not to drive the actuator into its mechanical stops and over torque the gearbox as damage to the gear box may result.

Commissioning

Warning

- Note: multiple power sources possible. Do not remove cover in the field without first removing all power from the unit.
- Commissioning must be done in a safe area before installing in a hazardous area.
- Obtain special work permit before removing cover and making powered adjustments in the field.

1. Setting end travel limits

- 1.1. Turn on power to the unit.
- 1.2. Position the SETUP SWITCH to the TRAVEL LIMIT LO setting.
- 1.3. Using the UP and DN buttons under the cover, adjust the pressure regulator to its lowest desired output pressure.
- 1.4. Press the SET button and wait for the Limit Lo LED to turn from Green then red and back to green to set the low pressure limit.
- 1.5. Move the SETUP SWITCH to the TRAVEL LIMIT HI setting.
- 1.6. Using the UP and DN buttons under the cover, adjust the pressure regulator to its highest desired output pressure.

- 1.7. Press the SET button and wait for the Limit Hi LED to turn from Green then red and back to green to set the high pressure limit.
- 1.8. Position the SETUP switch to the OPERATE/PULSE or OPERATE/ANALOG to operate the actuator normally.
- 1.9. When in the OPERATE/PULSE mode, the actuator will respond to external pulse control inputs and will stop when the pressure regulator reaches either pressure limit. The LIMIT LO and LIMIT HI LEDs will change from Green to Red when the limit is reached. The internal UP and DN push buttons will respond likewise.
- 1.10. When in the TRAVEL LIMIT/LO or HI, mode, the external pulse control inputs are disabled. The internal UP and DN push buttons will be active and will ignore the previous pressure limits so that new limits may be set beyond the previously set limits. The LIMIT LO and LIMIT HI LEDs will continue to operate from the previously set limits until new limits are set.

2. Setting Analog Control Current

- 2.1. Turn on power to the unit.
- 2.2. Set SW1 to 4-20 mA.
- 2.3. Position the SETUP SWITCH to the TRAVEL LIMIT LO setting.
- 2.4. Using the UP and DN buttons under the cover, adjust the output pressure to the lowest desired pressure.
- 2.5. Apply the desired control current to the mA input terminals for this pressure setting.
- 2.6. Press the SET button and wait for the Limit Lo LED to turn from Green then Red and back to Green to set the low travel limit and corresponding control current.
- 2.7. Move the SETUP SWITCH to the TRAVEL LIMIT HI setting.
- 2.8. Using the UP and DN buttons under the cover, adjust the output pressure to the highest desired pressure.
- 2.9. Apply the desired control current to the mA input terminals for this pressure setting.
- 2.10. Press the SET button and wait for the Limit Lo LED to turn from Green then Red and back to Green to set the high travel limit and corresponding control current.
- 2.11. Position the SETUP switch to the OPERATE/ANALOG to operate the actuator from the mA input terminals.
- 2.12. ERROR SIGNALS – If both the Hi Limit and Lo Limit LED's blink red, then an error has occurred in setting the Analog Control signal. The most common error is setting the Lo and Hi Limit and forgetting to change the control current. In this case, the Lo Limit and Hi Limit are set with the same current. This signal also occurs if the difference in control current between the Lo Limit and Hi Limit is less than 4mA. Correcting either the Lo Limit or Hi Limit setting or both will resolve the problem.

3. Setting Analog Control Voltage

- 3.1. Turn on power to the unit.
- 3.2. Set SW1 to 1-5 V.
- 3.3. Position the Position the SETUP SWITCH to the TRAVEL LIMIT LO setting.
- 3.4. Using the UP and DN buttons under the cover, adjust the output pressure to the lowest desired pressure.
- 3.5. Apply the desired control voltage to the V input terminals for this pressure setting.
- 3.6. Press the SET button and wait for the Limit Lo LED to turn from Green then Red and back to Green to set the low travel limit and corresponding control current.
- 3.7. Move the SETUP SWITCH to the TRAVEL LIMIT HI setting.

- 3.8. Using the UP and DN buttons under the cover, adjust the output pressure to the highest desired pressure.
- 3.9. Apply the desired control voltage to the V input terminals for this pressure setting.
- 3.10. Press the SET button and wait for the Limit Lo LED to turn from Green then Red and back to Green to set the high travel limit and corresponding control current.
- 3.11. Position the SETUP switch to the OPERATE/ANALOG to operate the actuator from the V input terminals.
- 3.12. ERROR SIGNALS – If both the Hi Limit and Lo Limit LED's blink red, then an error has occurred in setting the Analog Control signal. The most common error is setting the Lo and Hi Limit and forgetting to change the control voltage. In this case, the Lo Limit and Hi Limit are set with the same voltage. This signal also occurs if the difference in control current between the Lo Limit and Hi Limit is less than 1 volt. Correcting either the Lo Limit or Hi Limit setting or both will resolve the problem.

4. Alarm Switches

- 4.1. Position the SETUP SWITCH to the ALARM SWITCH LO setting.
- 4.2. Using the UP and DN buttons, adjust the pressure regulator to its LO ALARM pressure.
- 4.3. Press the SET button and wait for the ALARM LO LED to turn from Green then red and back to green to set the ALARM SWITCH LO pressure setting.
- 4.4. Turn the SETUP SWITCH to the ALARM SWITCH HI setting.
- 4.5. Using the UP and DN buttons, adjust the pressure regulator to its HI ALARM pressure..
- 4.6. Press the SET button and wait for the ALARM HI LED to turn from Green then red and back to green to set ALARM SWITCH HI pressure setting.
- 4.7. Position the SETUP SWITCH to the OPERATE PULSE or ANALOG mode for normal operation.

5. Setting Feedback Output

- 5.1. Position the SETUP SWITCH to the OPERATE PULSE mode.
- 5.2. Using the internal DN push button, adjust the pressure regulator to its low pressure limit position.
- 5.3. Move the SETUP SWITCH to the FEEDBACK LO setting.
- 5.4. Using the UP and DN button, and monitoring the Analog Feedback current on the milliammeter, adjust the output current to the desired value (4 -12 mA) for this position.
- 5.5. Press the SET button and wait for the FEEDBACK LO LED to turn from Green then red and back to green to set the FEEDBACK LO output current.
- 5.6. Position the SETUP SWITCH to the OPERATE PULSE mode.
- 5.7. Using the internal UP push button, adjust the pressure regulator to its high pressure limit position.
- 5.8. Move the SETUP SWITCH to the FEEDBACK HI setting.
- 5.9. Using the UP and DN button, and monitoring the Analog Feedback current on the milliammeter, adjust the output current to the desired value (12 -20 mA) for this position.
- 5.10. Press the SET button and wait for the FEEDBACK LO LED to turn from Green then red and back to green to set the FEEDBACK HI output current.
- 5.11. Position the SETUP SWITCH to the OPERATE PULSE or ANALOG mode for normal operation.

6. Manual adjustment of Pressure Regulator.

Warning

- Manual adjustment must only be done when power is removed from the unit.
- Note: multiple power sources possible. Do not remove cover in the field without first removing all power from the unit.

- 6.1. The Pressure Regulator output may be manually adjusted via an 8mm (5/16") female hex interface located through the top of the unit with the cover removed.
- 6.2. Turn the adjustment clockwise to increase the output pressure and counter clockwise to decrease the output pressure.
- 6.3. Take care when manually adjusting the actuator as you can damage the unit if you force the actuator into its mechanical stops.

7. Motor Enable

- 7.1. The motor enable input (Terminal 6 on the terminal blocks) is provided for additional control of the actuator. For normal operation, no connection is required for this input. Grounding this input disables the motor and the actuator will ignore any command to move the thrust rod including commands from the internal push buttons.

Figure 9. PAX1 & Model 10 Pressure Regulator Installation

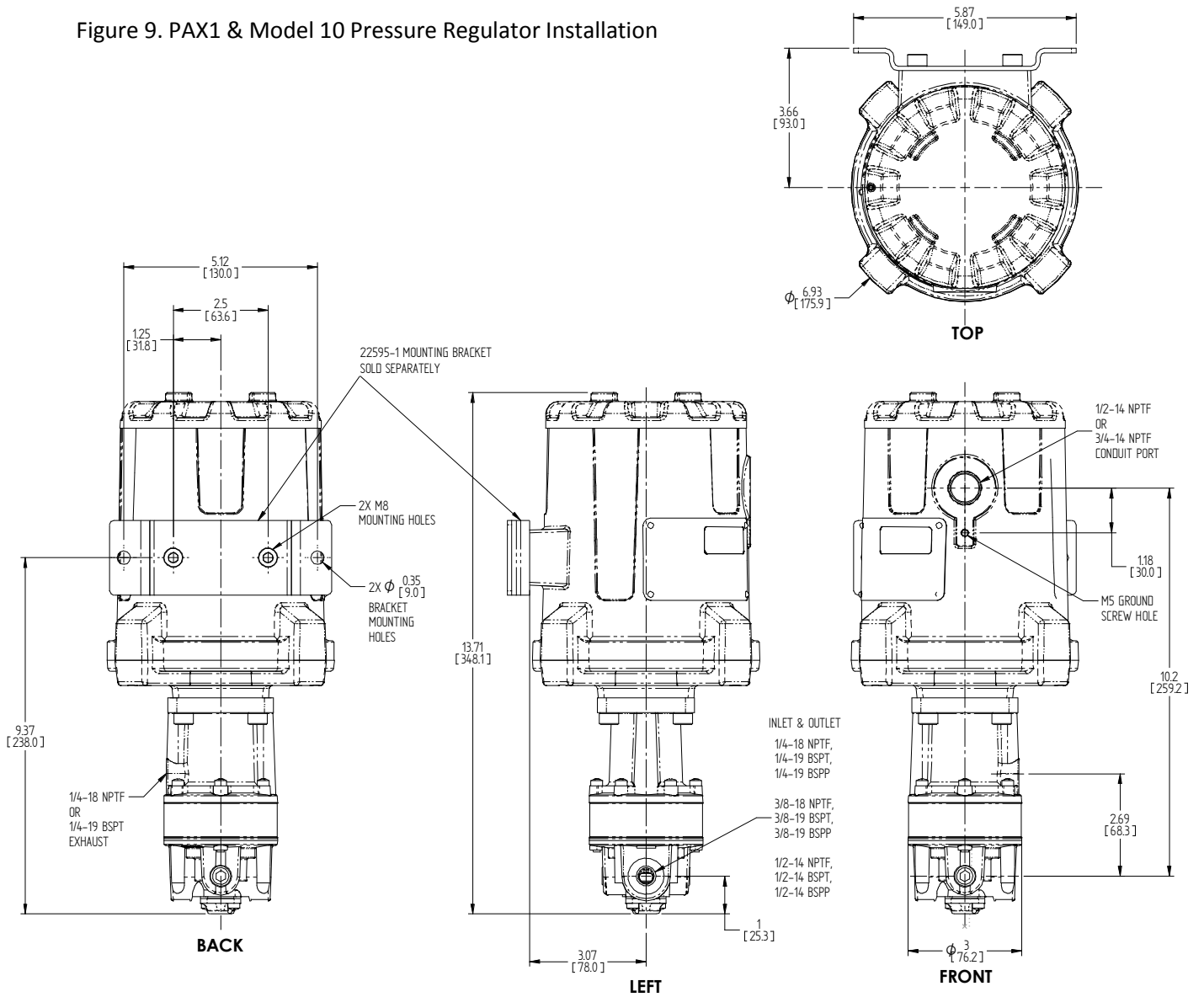


Figure 10. PAX1 & Model 11 Pressure Regulator Installation

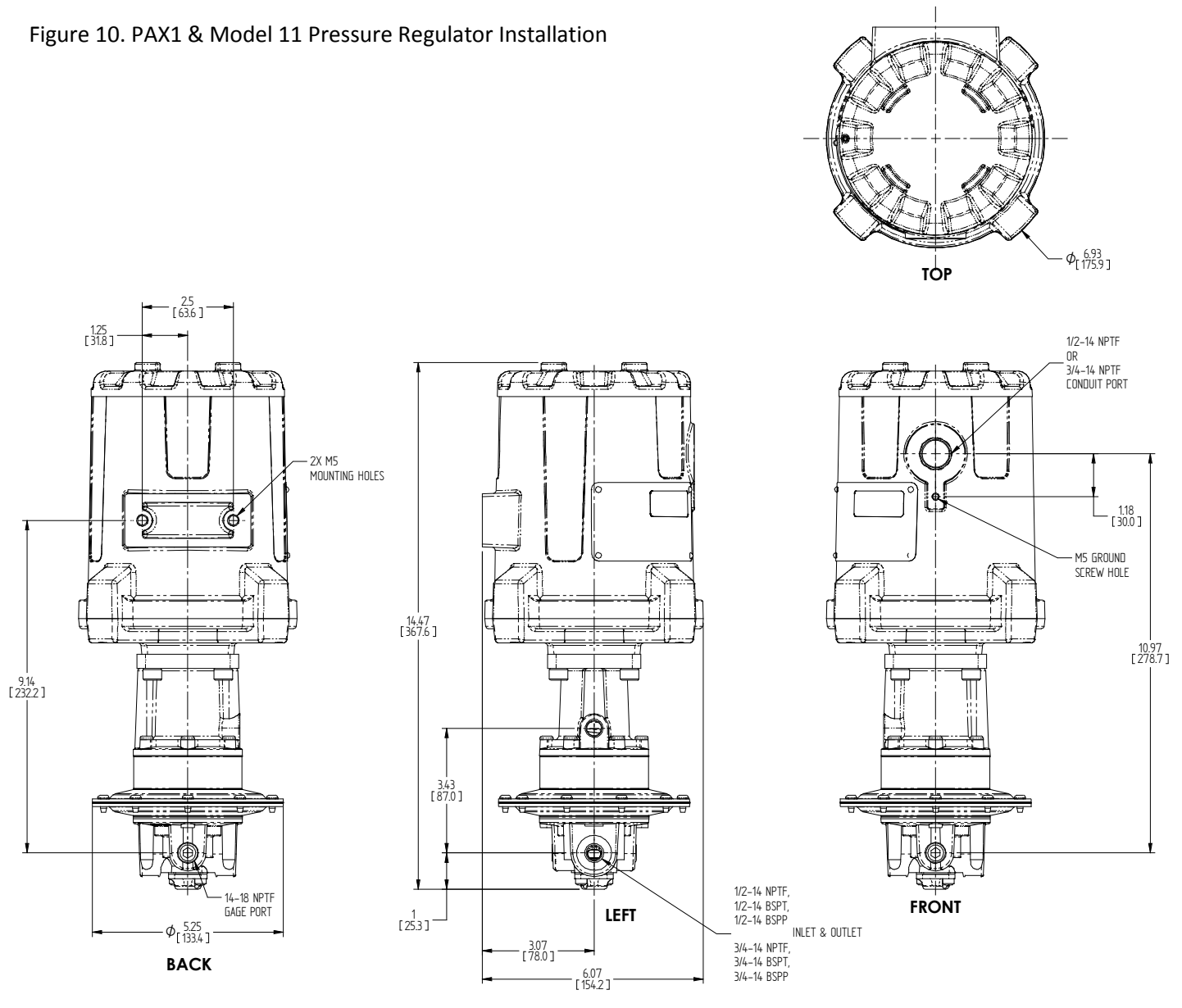


Figure 11. PAX1 & Model 4100A Pressure Regulator Installation

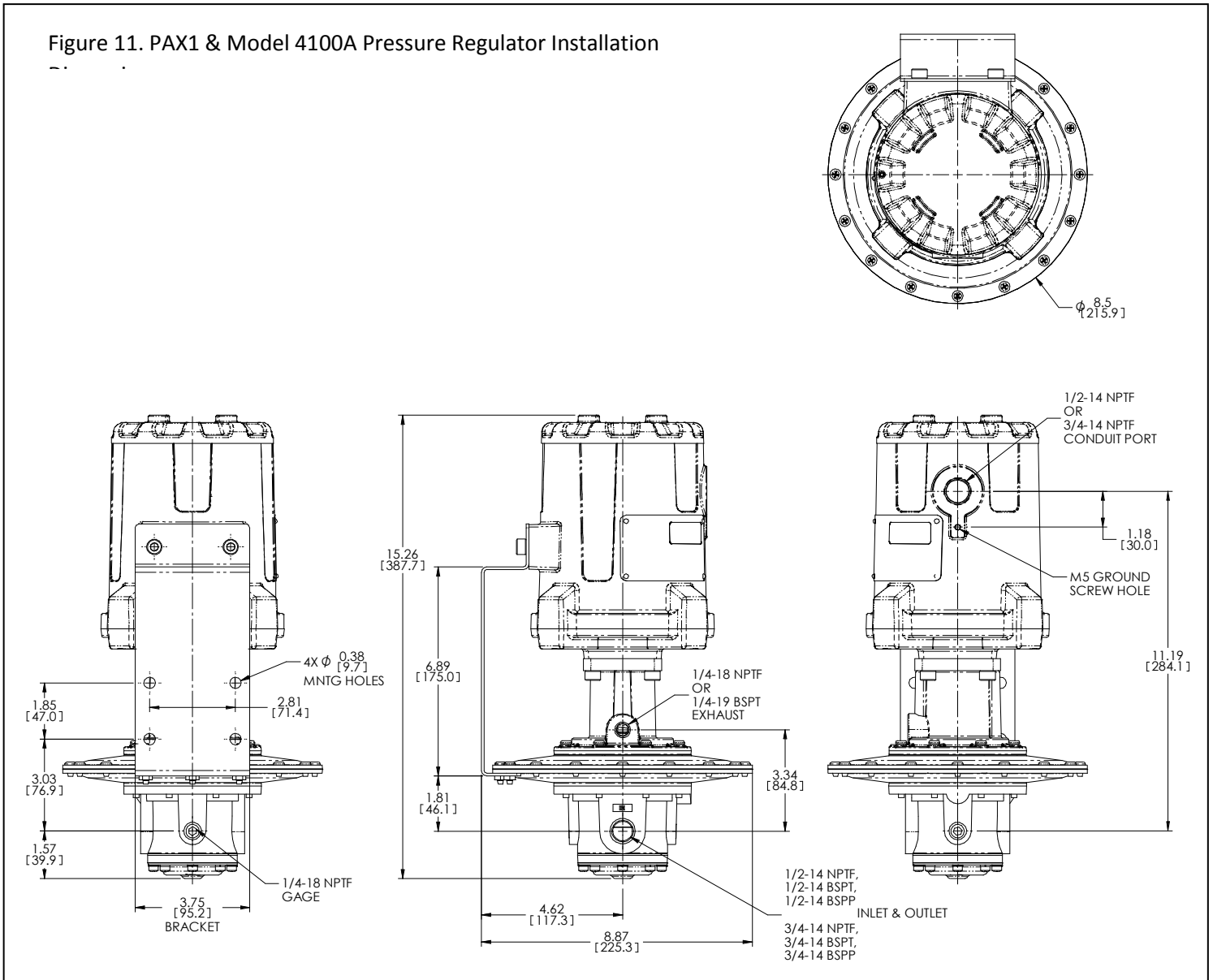


Figure 12. PAX1 & Model HPD or HPP Pressure Regulator Installation

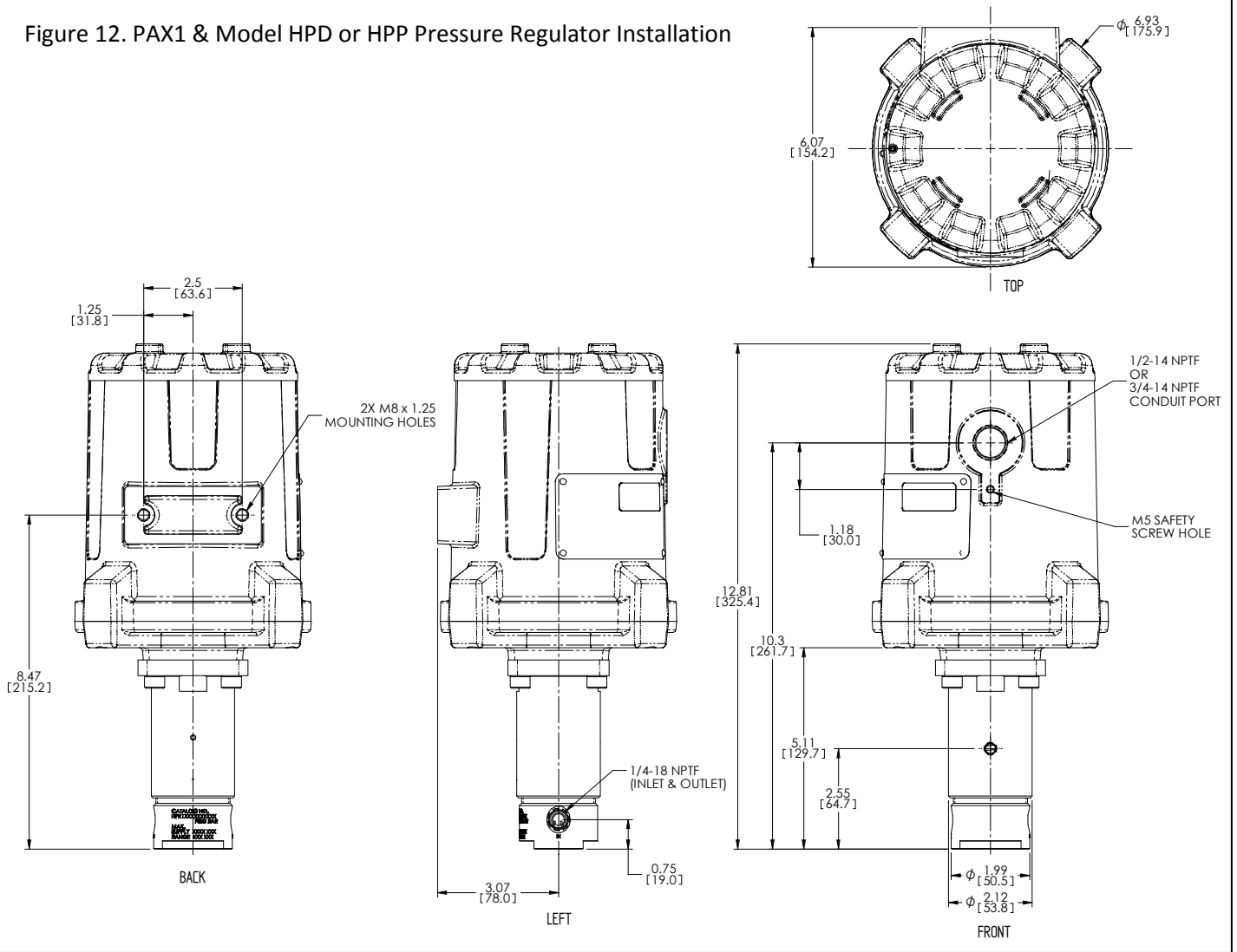


Figure 13. PAX1 & Model 81

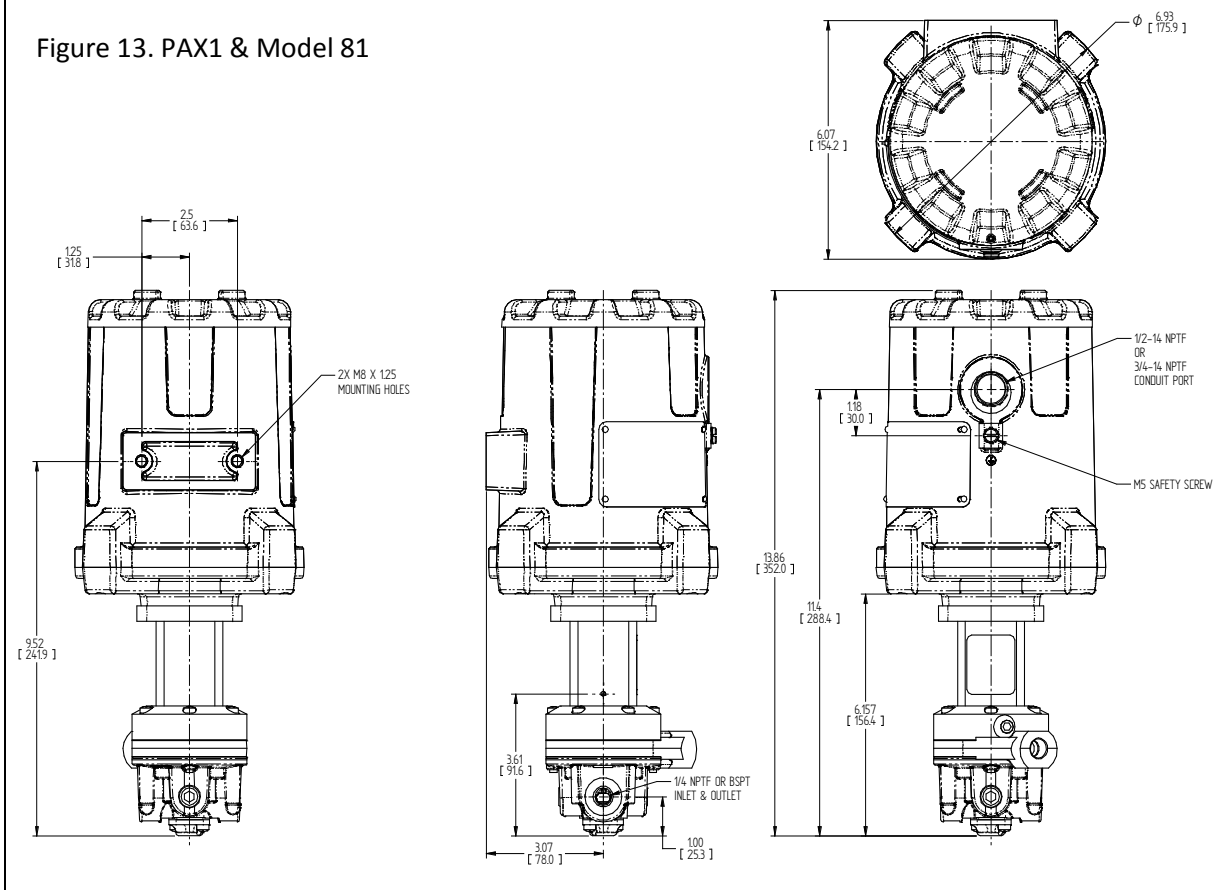


Figure 14. PAX1 & Model 80

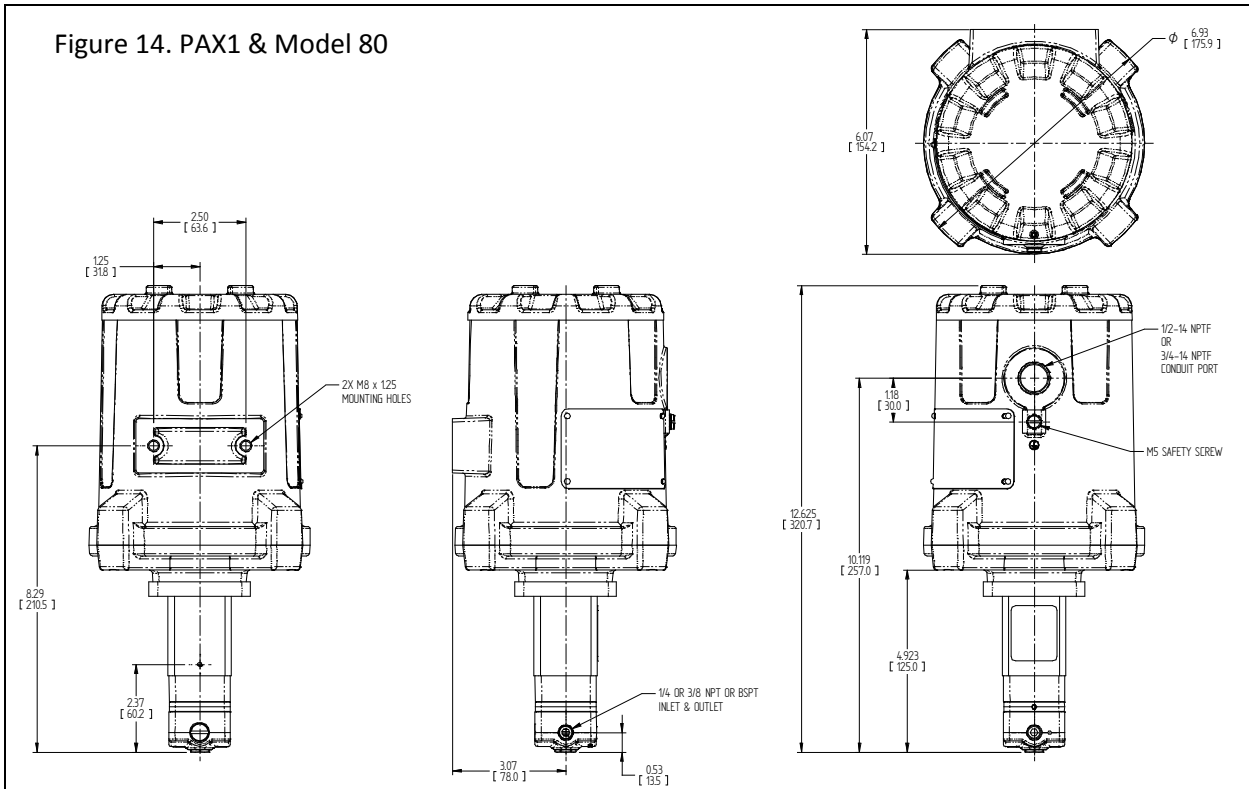
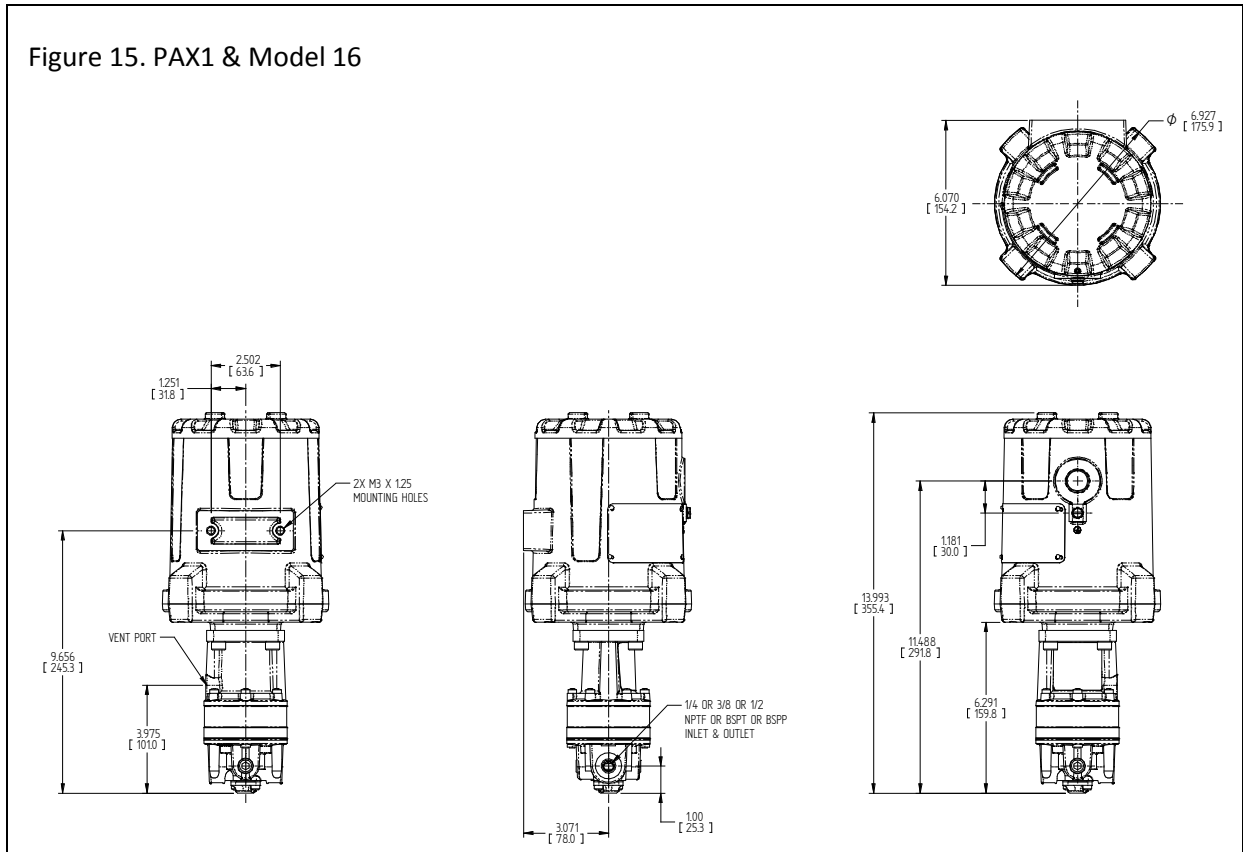


Figure 15. PAX1 & Model 16



Specifications

Electrical Supply:

Power Supply Voltage 11-30VDC
 Power Consumption 22 watts max, <1 watt standby

Actuation Electrical, Analog

Actuation Control 4-20 mA, 1500V optically isolated from power supply, Switch for common power supply. 1-5VDC non isolated, 50K Ω impedance

Actuation Supply 11-30VDC (Loop Supply)

Min Current Span 4 mA; the difference in the control current setting between the Lo Limit, and Hi Limit

Min Voltage Span 1 volt; the difference in the control voltage setting between the Lo Limit, and Hi Limit

Actuation Electrical, Pulse

Actuation Control	Switch Closure Sinking, (1) increase, (1) decrease
Actuation Current	10mA sink, optically isolated 1500V, Switch for common power supply
Actuation Supply	4 VDC minimum, 30VDC maximum

Monitor

Alarm Switches	Customer use, (2) SPDT each switch, 1A 250VAC, (Mag latching relay)
Position Feedback	Optional, Isolated 4-20 mA, 11-30VDC loop supply

Electrical Design Limits

Supply Voltage Limits	11VDC min, 30VDC max
Analog input Limits	3.5mA min, 21mA max, 100 mA w/o damage
Analog Output Limits	3.5mA min, 21mA max
External loop supply limits	4VDC min, 30VDC max
Alarm Switches	1A 250VAC SPDT

Customer interface:

Electrical Connections	Screw terminal block under cover, 14-30 AWG
Actuator speed	Multi-turn pot, 1.2 – 60 mm/min*
Limit adjustments	Push button switch to accept current thrust rod position for (2) End of Travel limit, & (2) Alarm Switch, and Analog Feedback Calibration
Setup Switch	8 position rotary switch.
Damping	Single-turn pot, 8:1 turn down
Isolation Switch	Pulse Control Loop – Isolated/common to power supply

Actuator Performance:

Maximum Stroke	25 mm
Maximum Force	2000 N (450 lbf) Continuous Duty 2890 N (650 lbf) for Low Duty Cycle Applications
Max Linear Speed	60 mm/min
Actuator shaft	M10 x 1.5 mm screw thd.
Power Up Initialization Time	Analog Control: 2.1 sec. Pulse Control: 0.9 sec. Feedback output: 0.9 sec.

Environmental Ratings

Oper. Temp. Range	-40°C to +80°C, <50% Duty Cycle, <10 min cycle period (Motor Actuated) -40°C to +70°C, Continuous Duty (Motor Actuated)
Ingress Protection NEMA	IP66 & IP68 / FM, CSA Type 4X & 6P (FM)

*Actuation speed may need to be limited to achieve rated thrust at lower supply voltages.

Maintenance

Caution

- Shutting off Motor Set Pressure Regulator and disconnecting associated equipment can cause dangerous system conditions to exist. Ensure the System is properly prepared for maintenance to be performed on the unit before taking it out of service.

Periodic lubrication of Thrust Rod

After 20,000 operating cycles, re-lubricate the actuator thrust rod.

Make sure it is safe to depressurize the system. Move the setup knob to the Operate Pulse mode and pressing the Jog Dn button, retract the thrust rod to its most retracted position (Zero output pressure from the pressure regulator). To expose the thrust rod remove the four bolts that attaches the pressure regulator to the actuator housing. Remove the pressure regulator and Thrust Rod Cap exposing the Thrust Rod. With the setup knob to the Operate Pulse mode and pressing the Jog Up button, extend the thrust rod to its most extended opposition. Apply Dow Corning G-n lubricant to the exposed thrust rod thread. Using the Jog Dn button, retract the thrust rod to its most retracted position. Re-install the thrust rod cap and pressure regulator.

PAX1 & Pressure Regulator Assembly

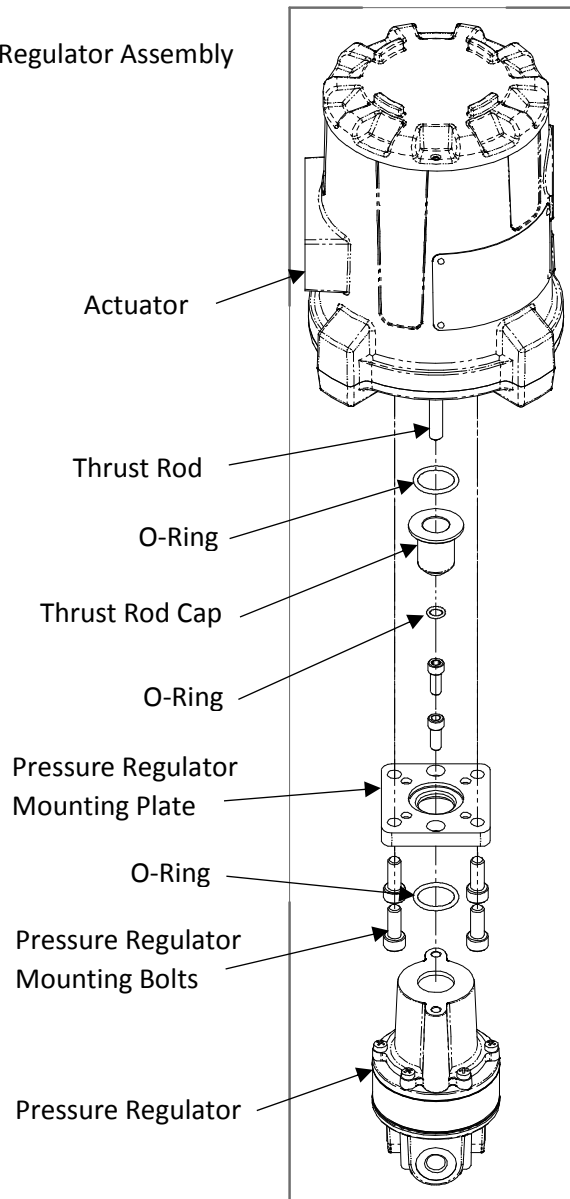


Figure 16.

Contact Factory for Service Kits



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