

# Rotork Fairchild PAX1 Linear Actuator

## User's Manual

### Product Overview

The PAX1 is a flexible low voltage DC powered linear actuator featuring a 25 mm maximum thrust rod stroke moving at speeds up to 60 mm/min and a maximum thrust of 2890 N all in a flameproof enclosure. The unit is inherently lock in last place as the thrust rod maintains its position upon loss of electrical power.

The actuator can be actuated open loop using two optically isolated switch closure inputs (Up and Down) to move the actuators thrust rod. The actuator will continue to move the thrust rod in response to the inputs until either of the adjustable stroke limits are reached.

The actuator can be controlled with an isolated 4-20 mA analog input to proportionally position the thrust rod anywhere within its 25 mm stroke. 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 actuator. There is an 8mm (5/16") female hex motor drive interface under the cover to allow manual actuator movement.

The actuator includes two fully adjustable SPDT alarm relays (one High and one Low) providing alarm function when the actuator's thrust rod reaches critical positions within its stroke. 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 isolated 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 Linear Electric Actuator 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 linear electric actuator. The installation, operation and maintenance of this actuator 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 I Groups ABCD T5/T6  
Class II, III Division I, Groups EFG T5/T6  
Class 1, Zone 1, AEx db IIC, T5/T6 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

## Hazardous Area Conditions of use

- Hazardous locations wiring must comply with ANSI/NFPA 70 (NEC<sup>®</sup>).
- Wiring must be rated 110°C or higher.
- Explosion proof certified seals are required within 18" for Groups A, B, C and D installations or within 2" for Group IIC installations.
- Use a damp cloth when cleaning the enclosure to prevent the buildup of electrostatic charge.
- The PAX1 Actuator includes flamepath joints. Consult Fairchild Inc. if repair of the flamepath joints are necessary.
- 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.

## Installation

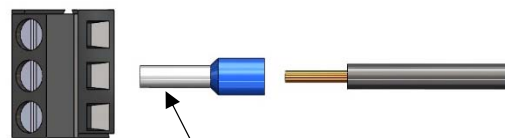
The PAX1 can be mounted in any position without affecting its operation. It can be mounted to a flat surface using the mounting holes on the actuator. For details, see Figure 1. "PAX1 Exterior Dimensions" above.

**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 connections 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.

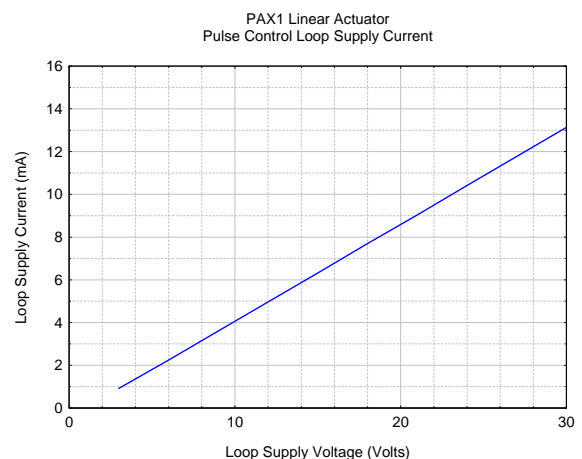
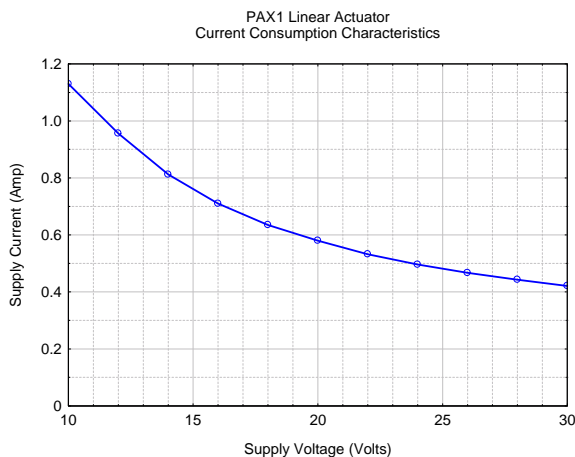


Crimp ferrule onto wire, then clamp it in the terminal block.

## Power Supply Sizing

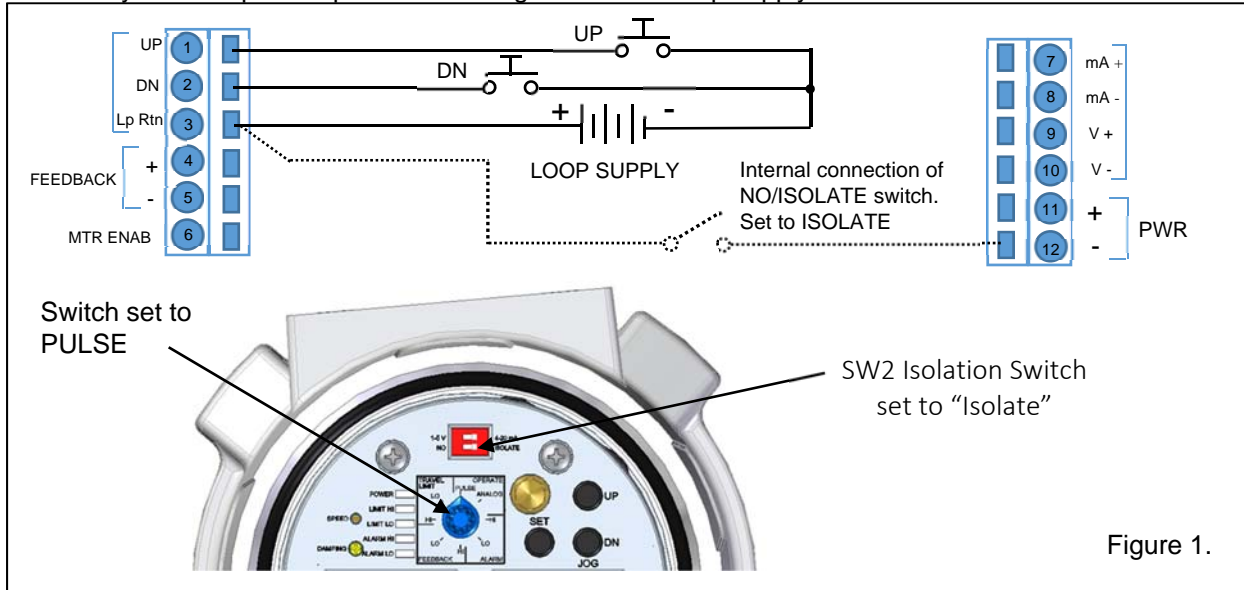
For 12 vdc operation, the recommended power supply should have 2 amp capacity.

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

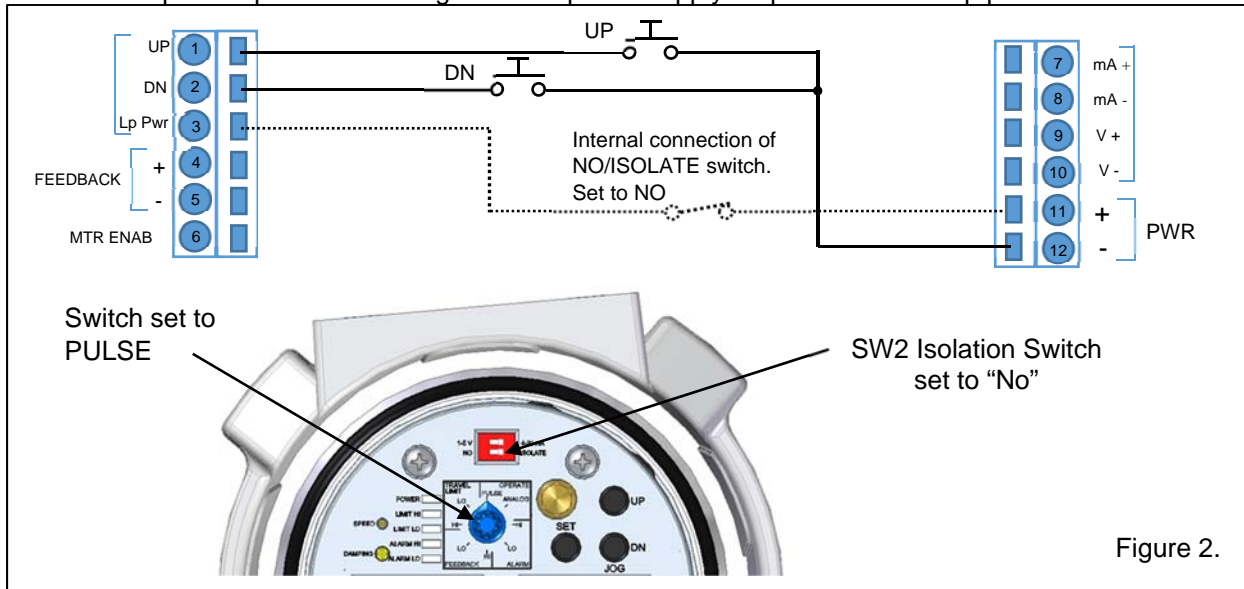


# Electrical Connections

## 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

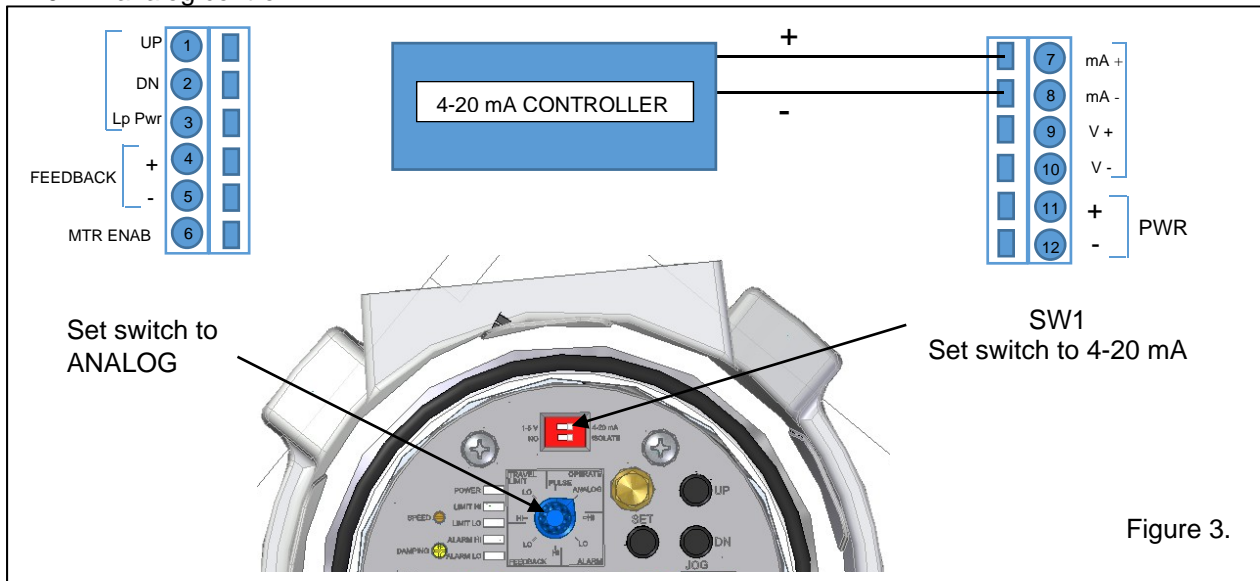


Figure 3.

### 1-5 vdc analog control

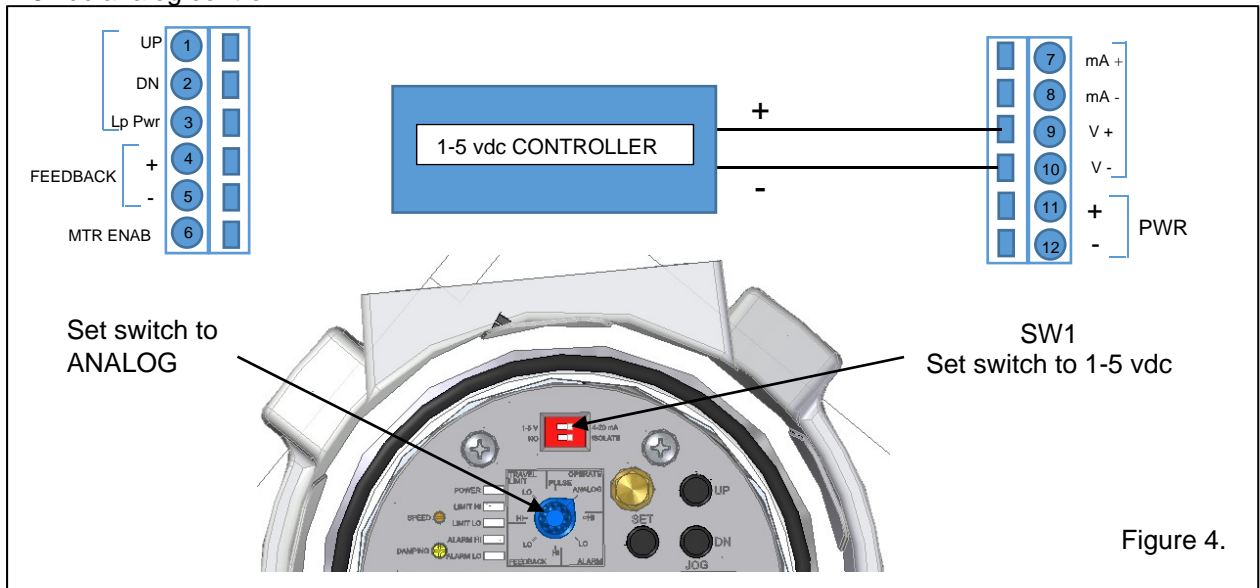


Figure 4.

### Power and Feedback Connections

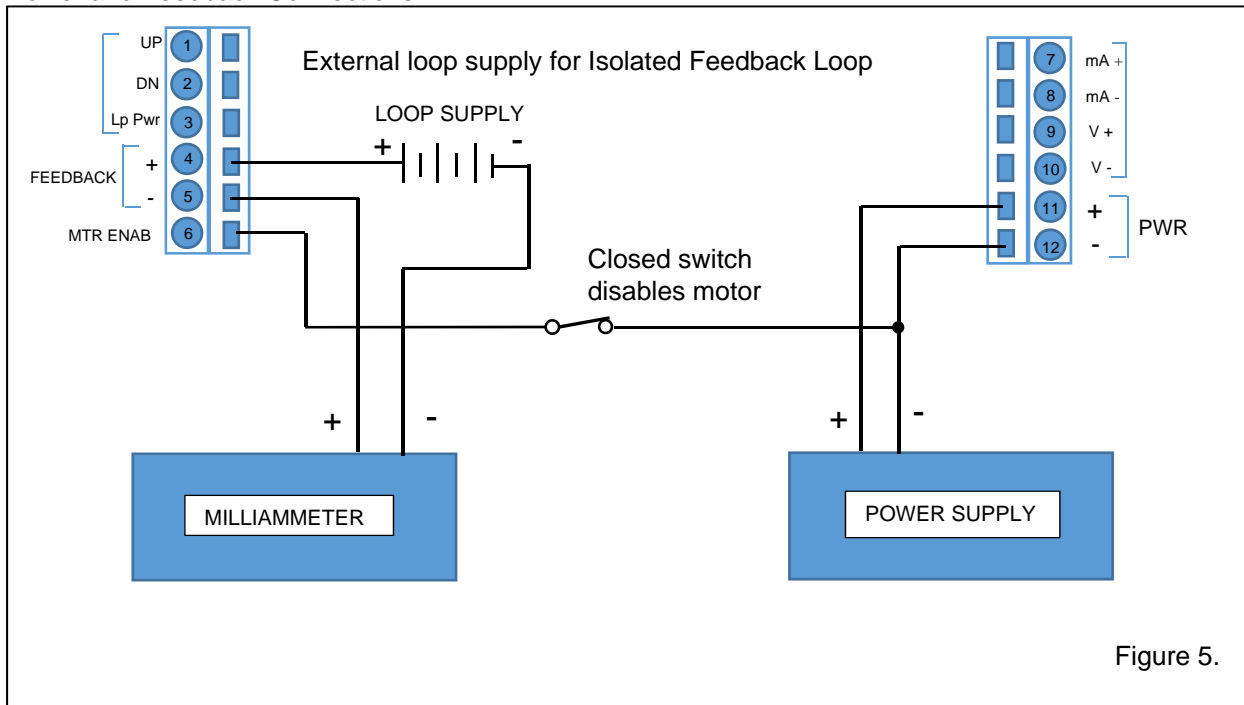


Figure 5.

### Power and Feedback Connections

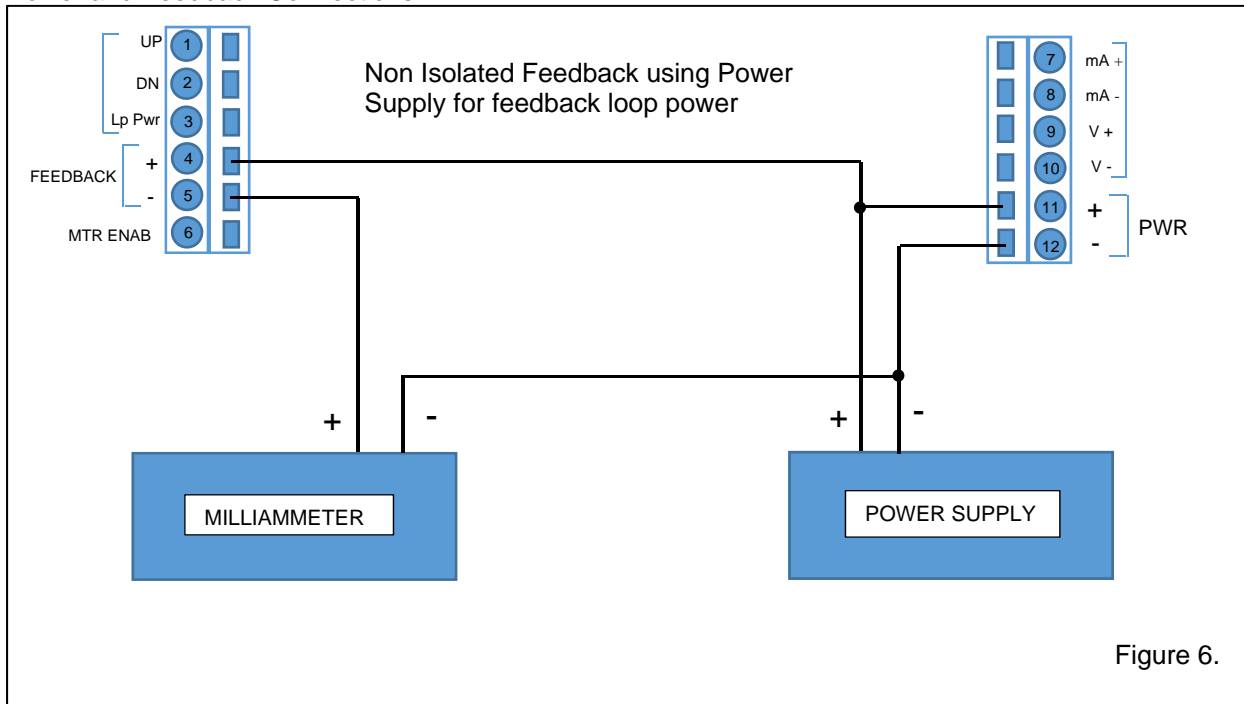


Figure 6.

## Alarm Switch Connections

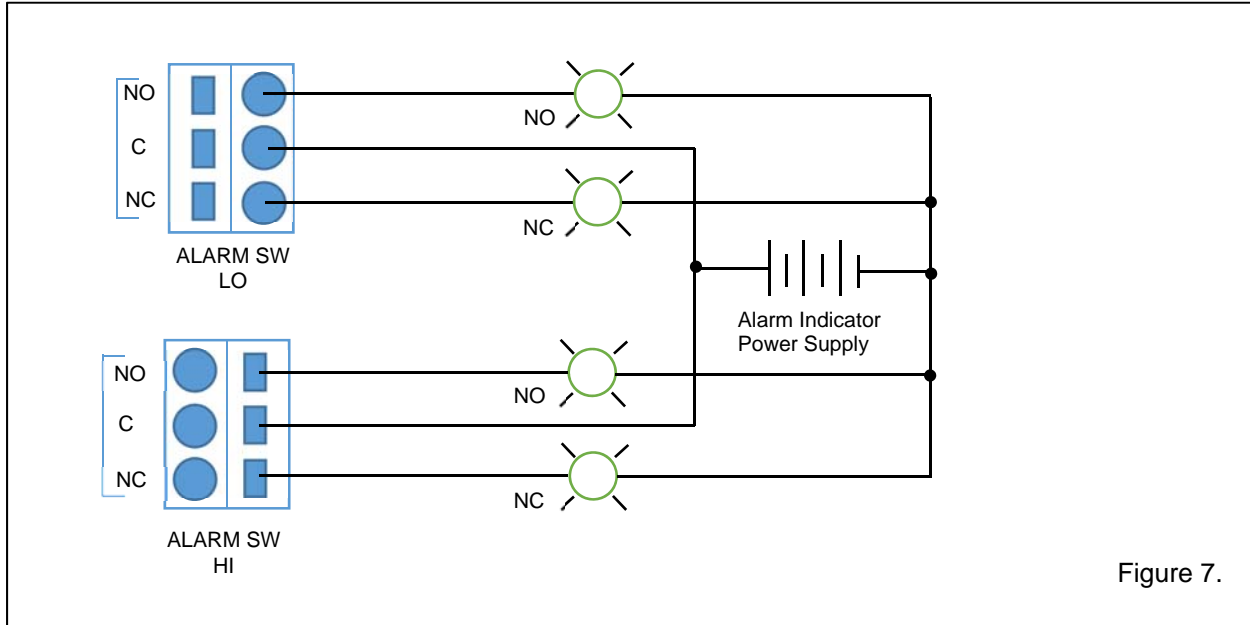


Figure 7.

## User Interface

### Setup Switch

Eight position rotary SETUP 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 actuators thrust rod out of the unit.

DN; Moves the actuators thrust rod into the unit.

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

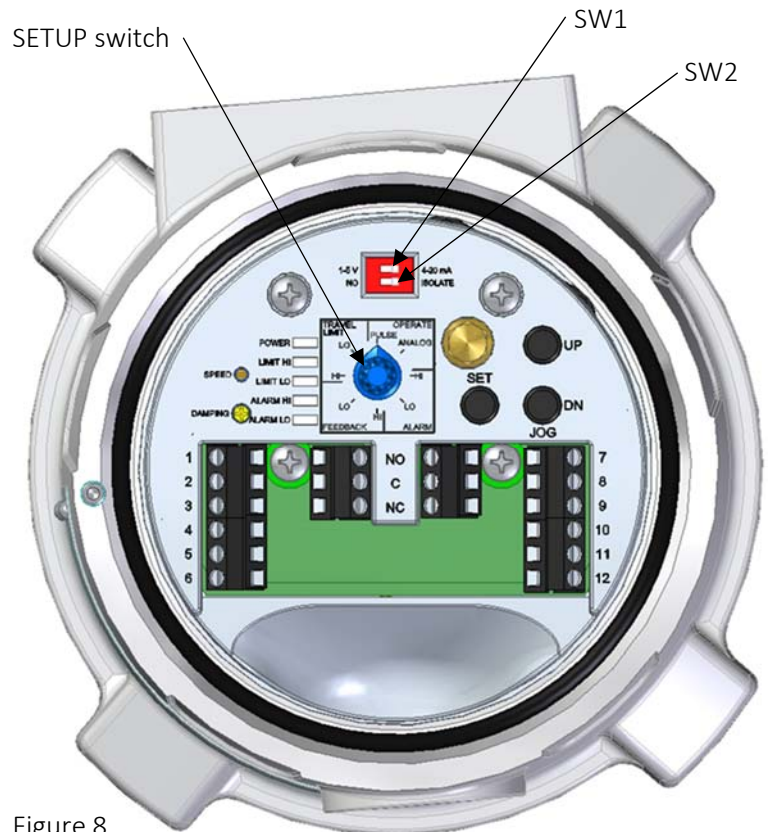


Figure 8.

## LED Indicators

PWR: Green, Supply voltage is between 11 and 30 vdc. Red, Voltage is less than 11vdc or greater than 28VDC.

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.

## 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. Disconnect Analog Inputs from 4-20 and 1-5 vdc input terminals.
- 1.2. Turn on power to the unit.
- 1.3. Position the SETUP SWITCH to the TRAVEL LIMIT LO setting.
- 1.4. Using the UP and DN buttons under the cover, position the thrust rod to the desired most retracted position.
- 1.5. 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.
- 1.6. Move the SETUP SWITCH to the TRAVEL LIMIT HI setting.
- 1.7. Using the UP and DN buttons under the cover, position the thrust rod to the desired most extended position.
- 1.8. 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 travel limit.
- 1.9. Position the SETUP switch to the OPERATE/PULSE or OPERATE/ANALOG for normal operation.
- 1.10. When in the OPERATE/PULSE mode, the actuator will respond to the Up and Dn external pulse control inputs and will stop when the thrust rod reaches either end travel 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.
- 1.11. When in the TRAVEL LIMIT/LO or HI, mode, the Up and Dn external pulse control inputs are disabled. The internal UP and DN push buttons will be active and will ignore the previous end



of travel 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. Connect a 4-20mA signal source to the mA input terminals.
- 2.2. Turn on power to the unit.
- 2.3. Set SW1 to 4-20 mA.
- 2.4. Position the SETUP SWITCH to the TRAVEL LIMIT LO setting.
- 2.5. Using the UP and DN buttons under the cover, position the thrust rod to the desired most retracted position.
- 2.6. Apply the desired control current to the mA input terminals for this thrust rod position.
- 2.7. 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.
- 2.8. Move the SETUP SWITCH to the TRAVEL LIMIT HI setting.
- 2.9. Using the UP and DN buttons under the cover, position the thrust rod to the desired most extended position.
- 2.10. Apply the desired control current to the mA input terminals for this thrust rod position.
- 2.11. 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.
- 2.12. Position the SETUP switch to the OPERATE/ANALOG to operate the actuator from the mA input terminals.

## **3. Setting Analog Control Voltage**

- 3.1. Connect a 1-5 vdc signal source to the V input terminals.
- 3.2. Turn on power to the unit.
- 3.3. Set SW1 to 1-5 V.
- 3.4. Position the SETUP SWITCH to the TRAVEL LIMIT LO setting.
- 3.5. Using the UP and DN buttons under the cover, position the thrust rod to the desired most retracted position.
- 3.6. Apply the desired control voltage to the V input terminals for this thrust rod position.
- 3.7. 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.
- 3.8. Move the SETUP SWITCH to the TRAVEL LIMIT HI setting.
- 3.9. Using the UP and DN buttons under the cover, position the thrust rod to the desired most extended position.
- 3.10. Apply the desired control voltage to the V input terminals for this thrust rod position.
- 3.11. 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.
- 3.12. Position the SETUP switch to the OPERATE/ANALOG to operate the actuator from the V input terminals.

## **4. Alarm Switches**

- 4.1. Position the SETUP SWITCH to the ALARM SWITCH LO setting.
- 4.2. Using the UP and DN buttons, position the thrust rod to the desired LO ALARM position.
- 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 position.
- 4.4. Turn the SETUP SWITCH to the ALARM SWITCH HI setting.
- 4.5. Using the UP and DN buttons, position the thrust rod to the desired HI ALARM position.
- 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 position.

4.7. Position the SETUP SWITCH to the OPERATE PULSE or ANALOG mode for normal operation.

## 5. Setting Feedback Output

- 5.1. Move the SETUP SWITCH to the FEEDBACK LO setting.
- 5.2. 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 the LO Limit position.
- 5.3. 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.
- 5.4. Move the SETUP SWITCH to the FEEDBACK HI setting.
- 5.5. 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 the HI Limit position.
- 5.6. 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.
- 5.7. Position the SETUP SWITCH to the OPERATE PULSE or ANALOG mode for normal operation.

## 6. Manual adjustment of thrust rod position.

### 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.

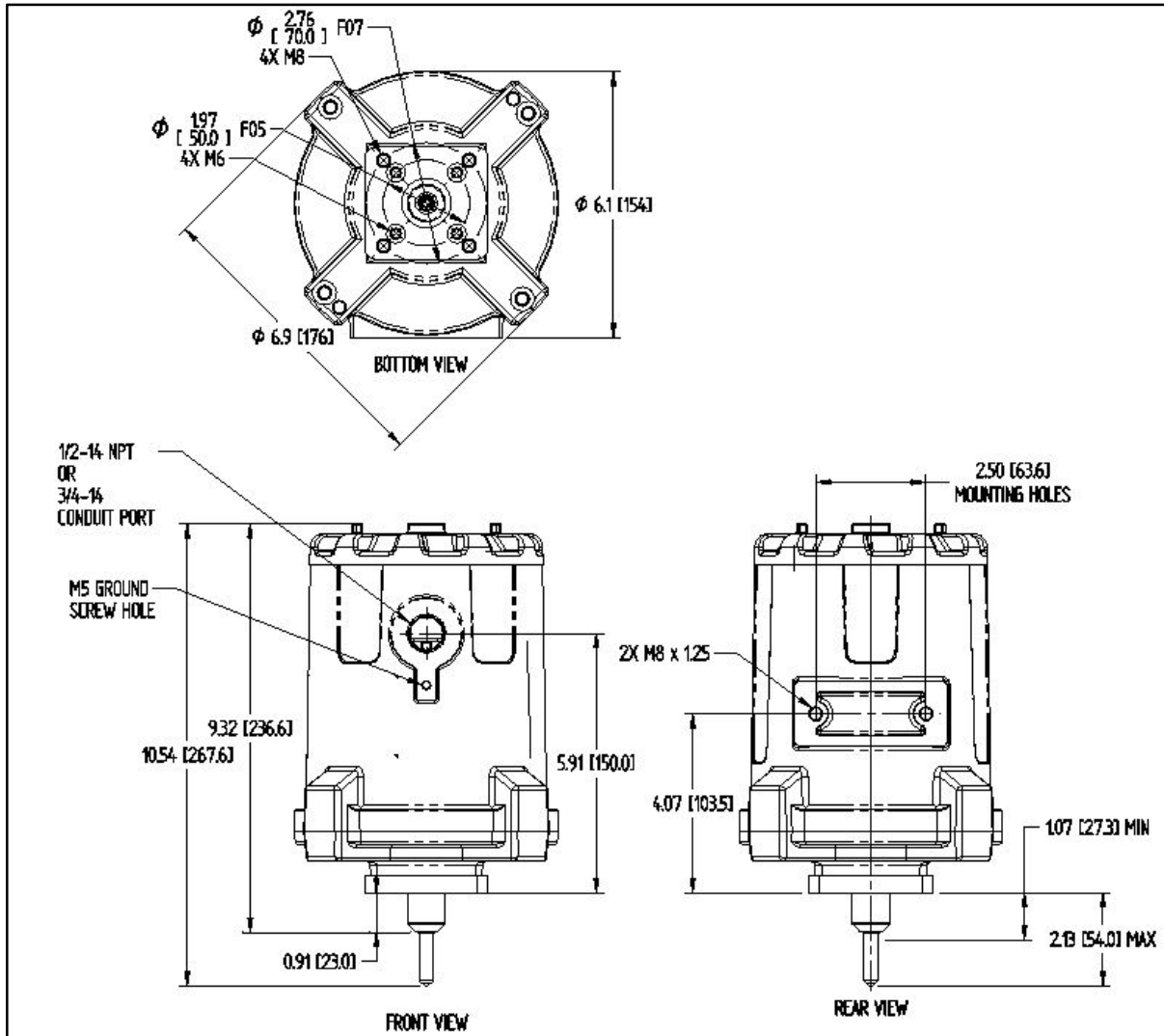
- 6.1. The thrust rod of the actuator may be manually adjusted via an 8mm (5/16") female hex interface located through the top of the unit with the cover removed.
- 6.2. Turn the adjustment clockwise to extend the thrust rod out of the unit and counter clockwise to retract the thrust rod into the unit.
- 6.3. Take care when manually adjusting the actuator as you can damage the unit if you force the thrust rod 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.

# PAX1 Actuator Installation Dimensions

Figure 9.



## Maintenance

### Caution

- Shutting off actuator and disconnecting associated equipment can cause dangerous system conditions to exist. Ensure the System is properly prepared for maintenance to be performed on the actuator.

### Periodic lubrication of Thrust Rod

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

Make sure it is safe to disable the actuator in the system. Move the setup knob to the Operate Pulse mode and using the UP and DN push buttons, position the thrust rod to a position that removes any thrust on the thrust rod. To expose the thrust rod remove the four bolts that attaches the actuator housing to the actuated device. Remove the 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 the PAX1 actuator to the actuated device.

## Specifications

### Electrical Supply:

Power Supply Voltage 11-30VDC  
Power Consumption 18 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  $\Omega$  impedance  
Actuation Supply 11-30VDC (Loop Supply)

### 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	2890 N (650 lbf)
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/ NEMA 4X Type 4X & 6P

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



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