



PROMATION ENGINEERING

Precision Actuation for Industry

Installation & Operation Manual

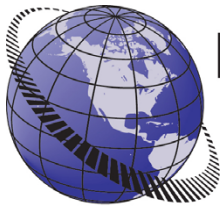
This IOM is for the following
ProMation Engineering Products:

PL2200-120PN4

PL2200-230PN4

PL4400-120PN4

PL4400-230PN4



PROMATION ENGINEERING

Precision Actuation for Industry

Field Manual PL2200/4400 Series Linear Actuator, Proportional Control 100mm maximum travel



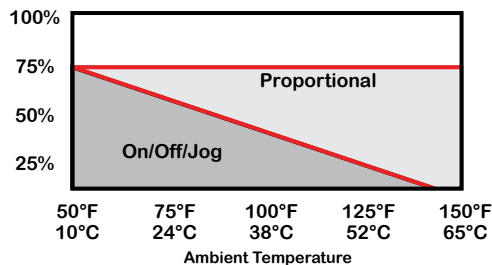
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Product Specifications

These units are equipped with internal force switches which protect the gear train, motor and controlled equipment from damage when high force conditions exist. These protective devices are NOT adjustable. More information on this technology is found throughout this manual.



Actuator Specifications	PL2200		PL4400	
Torque "lb/Nm	2200 lbs / 9.79 kN		4400 lbs / 19.57kN	
Supply Voltage	120vac	230vac	120vac	230vac
Max Inrush Current	0.5A	0.3A	0.4A	0.3A
Running Current	0.7A	1.5A	0.7A	1.5A
Motor	Split Phase Capacitor			
Full Travel Time	200 sec (0.5mm/sec) 100 mm max			
Duty Cycle	Proportional, 75% maximum			
Motor Starts	1200 per hour			
Weight	62lbs/28kg			
Mechanical Connections	ISO5211 F10 customizable stem coupling			
Electrical Entry	(2) 3/4" NPT			
Electrical Terminations	12-18ga			
Environmental Rating	NEMA 4/4X			
Manual Override	7.6" Handwheel			
Control	Proportional			
Aux Switches	(2) Dry Form C			
Actuator Case Material	Aluminum Alloy, Powder coated			
Motor Protection	230°F/110°C Thermal F* Class *Totally Enclosed Non-Ventilated Motors			
Ambient Temperature Operating Range	-22°F to +150°F -30°C to +65°C			

Introduction

This document provides necessary information for set-up, calibration, testing and use of the PL Series linear electric actuators stated on the cover page. Each unit is shipped from the factory with initial calibration of end stop, cams and switches completed for 0-50mm or 0-100mm operation, depending on actuator model. However, these are general settings and serve as a starting point for proper calibration of the actuator in its real-world application.

Safety

Safety is a basic factor any time you maintain and operate mechanical equipment. Appropriate handling methods and proper use of tools and clothes can help prevent serious accidents -- accidents which can cause injuries to you or a fellow worker. This manual was created to enable a trained user to install, adjust and troubleshoot your ProMation actuator.

Only competent and trained personnel should install, maintain and operate ProMation Actuators. Any work related to this actuator must be carried out in accordance with this manual and related codes and regulations. Local workplace health and safety rules should always be followed.

Duty cycle

Duty cycle is the percent of time that an actuator spends running as a fraction of the total time. Duty Cycle is directly related to heat; excessively repositioning an actuator typically results in motor overheating which can cause permanent damage and/or reduced service life.

Duty cycle can be calculated as follows: (example PL series actuator running 3 seconds ON and 30 seconds OFF) Runtime = 3s, Total time = 3s + 30s = 33s, therefore this duty cycle would be 9% (3/33)

Additionally, ProMation PL series actuators are designed for a maximum of 1200 starts per hour (one start every 3 seconds maximum).

Shipping and Handling

1. This actuator is **shipped in the full stem down position** with a temporary stem block. Do not remove the stem block until the actuator has been assembled to the controlled device.
2. **NOTE, THIS ACTUATOR MUST HAVE WATER TIGHT EMT FITTINGS, WITH CONDUIT DRAINAGE INSTALLED AND POWER SUPPLIED TO UNIT TO KEEP THE HEATER WARM AT THE TIME OF INSTALLATION.**
3. **Storage: This unit should NOT be stored outside unless it is powered up and has proper conduit terminations. When NOT powered up, it should be stored in a clean, dry environment at all times.**
4. The actuator has been fully calibrated and tested to provide full range response for stem travel up to 50mm [PL550/1100] or 100mm [PL2200/4400].
5. **There are NO adjustable mechanical travel stops on this actuator.** Travel is electronically adjusted to match the stroke of the valve.

PL2200/4400 PN4 Series



Temporary Stem Block

Installation Notes

- **Do NOT apply power to this actuator until it has been mounted onto the controlled device and mechanically checked for proper assembly.**
- **Do NOT attempt to make any adjustments to the force limit control switches. These switches are NOT travel adjustment switches, and any adjustment will VOID the warranty of this device.**
- This is a proportional control actuator. Stem travel **MUST** be calibrated before putting the device into service. Failure to do so may result in poor control response. (ref Calibration sections of this document)
- The manual handwheel, when pulled OUT, allows full automatic operation of the actuator. Pushing IN the handwheel allows manual operation. Turning the handwheel CCW will drive the stem UP, while turning the handwheel CW will drive the stem DOWN. Be sure to pull the handwheel OUT to return to automatic operation.
- These actuators are designed to be used in either a horizontal or upright position. Do NOT mount the assembly with the actuator top below a horizontal position.
- When installing conduit, use proper techniques for entry into the actuator. Use drip loops to prevent conduit condensate from entering the actuator.
- Both NPT conduit ports **MUST** use proper equipment to protect the NEMA 4X integrity of the housing.
- Signal cable drain wire (highly recommended) must be grounded at **ONE END ONLY!** (Preferably at the supply end).
- The internal heater is to be used in ALL applications.
- Do NOT install the actuator outdoors or in humid environments unless it is powered up and the heater is functioning.
- Use proper wire size to prevent actuator failure (see chart on page 6 for proper wire sizing).
- All terminals accept 12-18AWG solid/stranded wire.

Product Mounting and Setup

Linkage System: This actuator requires additional mechanical components to connect to a valve or damper system. This actuator is NOT designed to be used without a linkage system which, when connected to a valve will limit stroke between the 0% and 100% marks on the actuator lower casting.

It is the responsibility of the valve/damper assembler to design and manufacture the required components to properly connect the actuator to the controlled device. These components may also be acquired from ProMation Engineering at additional cost. Lead times for linkage systems are dependent on the valve manufacture and model.

Assembly of a PL Actuator to a valve using ProMation's standard linkage system is detailed on pages 4 and 5.

Mechanical Setup

This mechanical setup uses a common valve and ProMation linkage to describe the basic procedure of mounting a PL Series actuator to the valve.

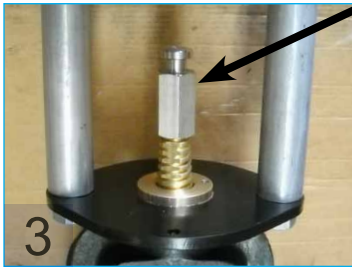


- There are a number of different types and configurations of valve design able to interface with the ProMation PL series actuator.
- Page 10 provides the necessary information to manufacture the required interface components to connect the actuator to the valve.
- For purposes of illustration, this instruction manual utilizes the ProMation Standard Pin & Plate Linkage design.
- The linkage shown in the following photos has been purpose designed and built to fit the valve shown.

1. Position the valve stem in the fully down position.



2. The linkage frame must sit evenly and completely on the valve mounting surface. Attach the securement nut and lock the linkage frame firmly and tightly against the valve mounting surface.



Valve stem adapter

3. Attach the valve stem adapter to the valve stem (this assumes the adapter has already been threaded to valve specifications). It should engage the valve stem thread a sufficient amount to be able to transfer the rated force of the actuator. **{WARNING: full thread engagement is critical to avoid damage to the valve stem threads}**



Actuator stem adapter

4. The actuator is shipped from the factory in the full stem DOWN position with a STEM BLOCK to prevent the actuator from moving BELOW the “0” graduated mark on the scale. Full stem down position is indicated by the position disc aligning with the “0” on the graduation plate.



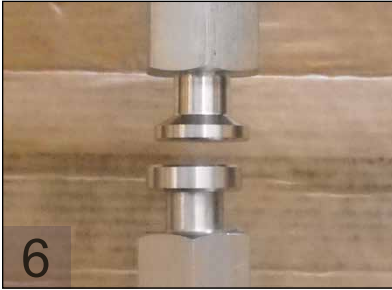
Screws and lock washers

Do NOT drive the stem down past the “0” indicator!
Do NOT remove the stem block until mechanical assembly to the valve is completed!

5. Attach the actuator to the linkage using (4) M8 SHCS screws and lock washers.

a. **Hand tighten the screws only, we want the actuator to be able to “float” a bit as we assemble and mate the stems.**

Mechanical Setup (continued)



6. With the valve fully stem DOWN and the actuator fully DOWN, it will now be necessary to adjust the stem adapters to align and couple them together.
 - a. Rotate the actuator stem adapter DOWN (unscrew from the actuator stem) to meet the valve stem adapter.

Do NOT raise the valve stem UP to meet the actuator stem adapter.

Do not drive the actuator stem below "0" to meet the valve stem adapter.

The valve stem and actuator stem MUST have a sufficient amount of thread engagement to transfer the rated force of the actuator.



7. Once the adapters are aligned correctly attach one half of the coupling to the two adapters.



8. Assemble the other half of the coupling using the screws and lock washers provided.



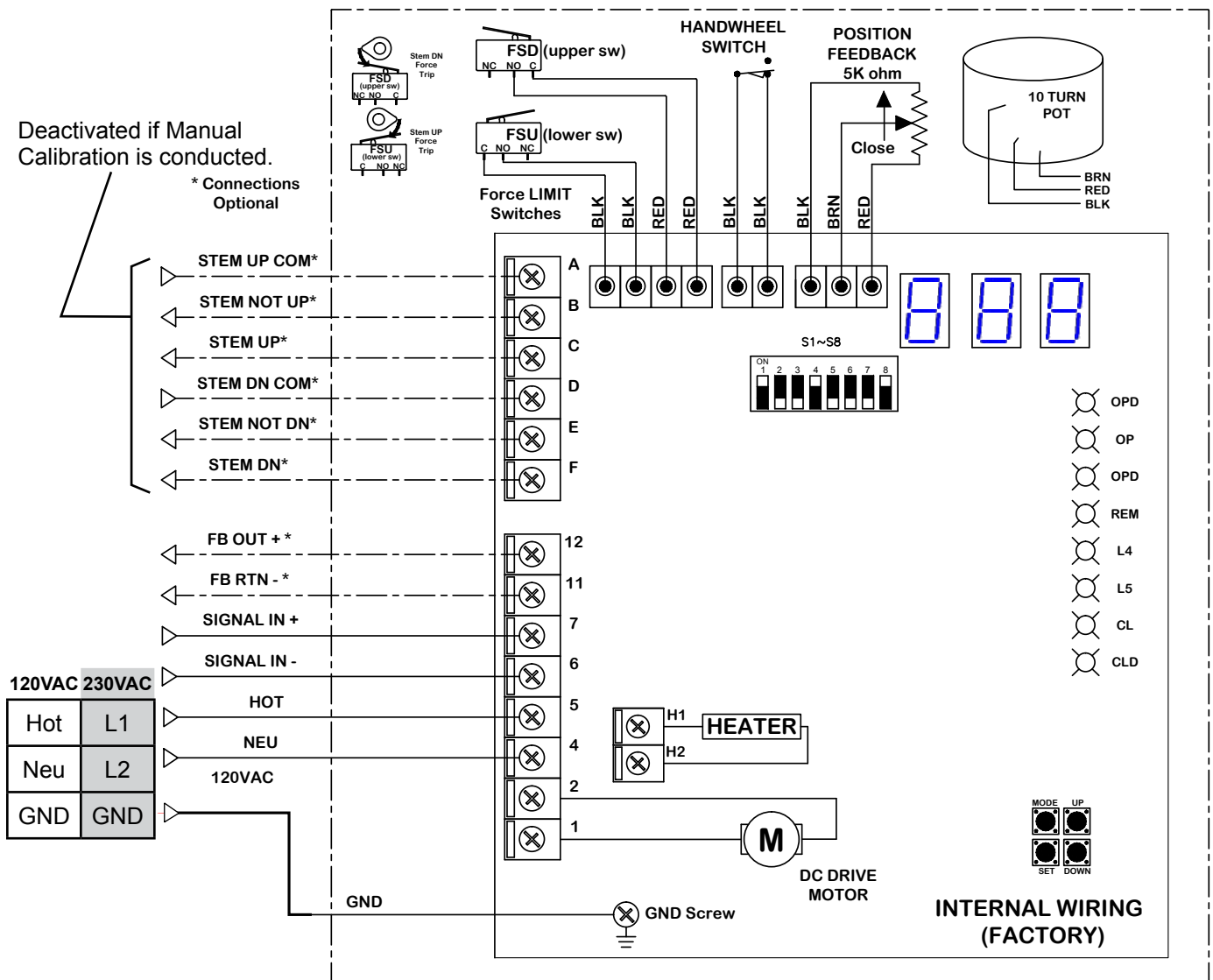
9. Tighten all mounting hardware at this time
10. Lock the actuator stem nut to the actuator stem adapter. Repeat for the valve stem, if applicable.
11. This completes the mechanical assembly of the actuator to the valve body.

Remove the STEM BLOCK at this time.

Next step is electrical calibration.



- BEFORE POWER IS APPLIED: The actuator must be mechanically mounted onto the controlled device.
- BEFORE POWER IS APPLIED: Utilize the handwheel to check for unobstructed manual operation from full STEM DOWN to full STEM UP positions.
- Connect POWER AND CONTROL to terminals marked 4, 5, 6, and 7
 - Note the polarity of the SIGNAL IN.
- Do NOT apply power at this time.



Field Wiring

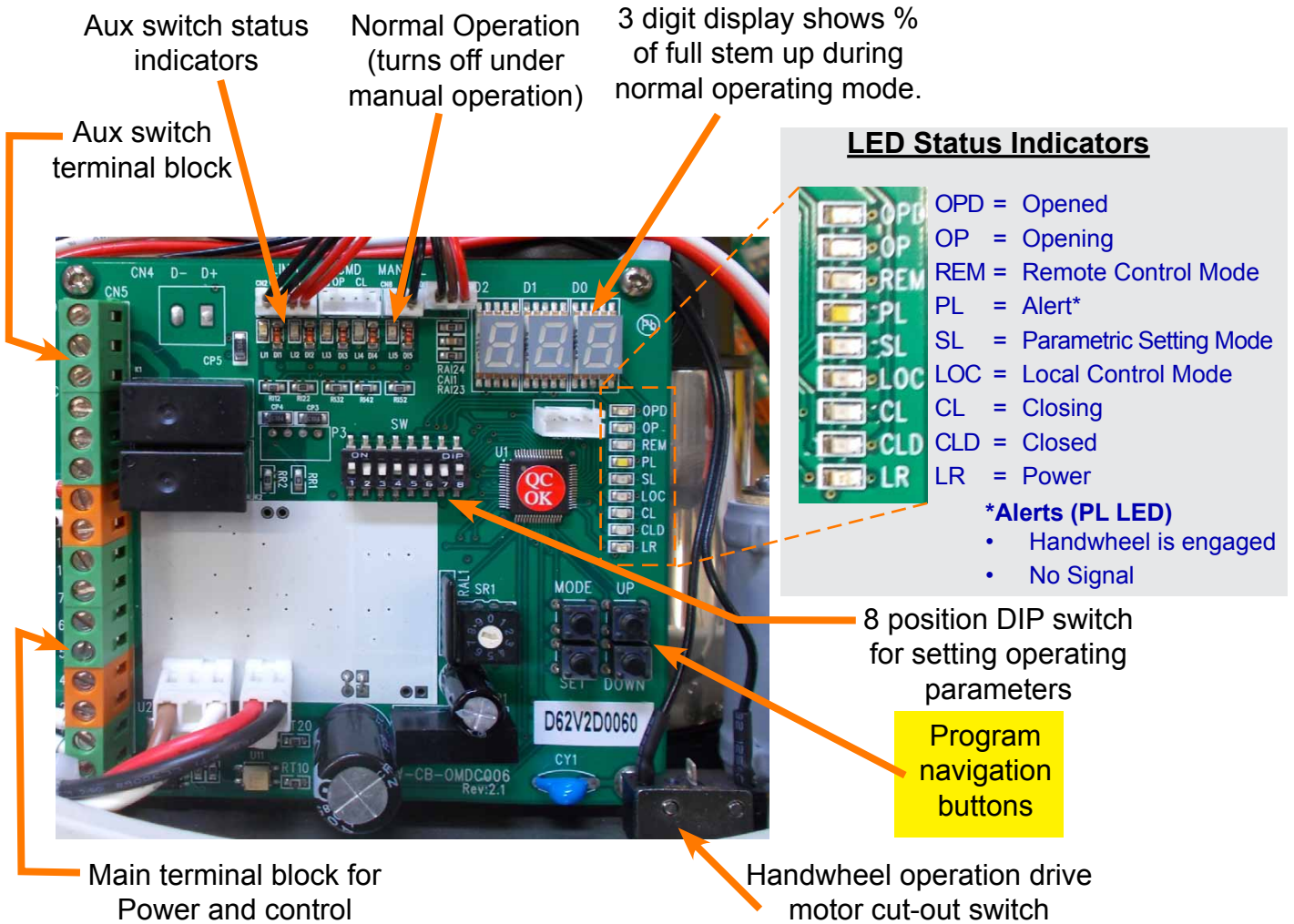
Internal Actuator Wiring

Wire Sizing Chart

MAX distance between Actuator and Supply (feet)		
Actuator/ Voltage	PL2200/4400 120VAC	PL2200/4400 230VAC
	Amps	0.7A
Wire Gage		
18	1181	1056
16	1855	1659
14	2997	2681
12	4584	4100
10	7792	6970
8	11630	10403

Wire sizing data is provided in the table to assist in the selection of the proper wire size for ProMation actuators using various wire sizes over distance. Please make sure to reference the correct voltage and do not exceed the indicated length of the wire run for each model.

Below is a photo for reference during the wiring and calibration of the proportional controller in the PL2200/4400 series actuators. The controller has been installed and calibrated at the factory before shipping. The unit has been calibrated for 0mm - 100mm travel corresponding to 4mA and 20mA (default) input signals respectively. (Other signals are calibrated if placed at time of order).

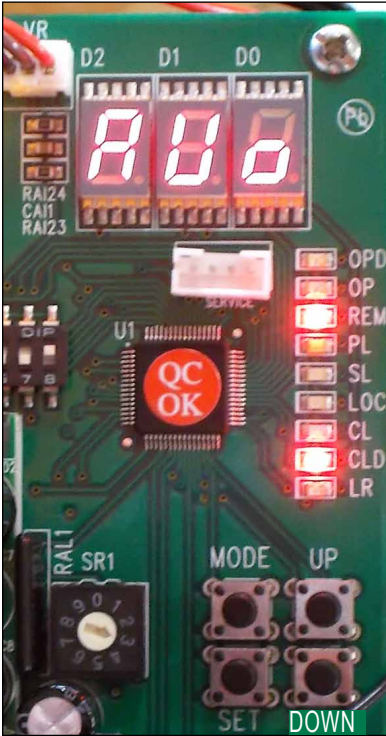


Input, Feedback, Direct Acting, and Loss of Signal Table

Default Settings

DIP Switch Setting	DIP Switch Setting	DIP Switch Setting	Functions
DIP 1 On	DIP 2 Off		4-20mA Signal Input
DIP 1 Off	DIP 2 Off		1-5V Signal Input
DIP 1 Off	DIP 2 On		2-10V Signal Input
DIP 3 Off	DIP 4 On	Dip 5 Off	4-20mA Signal Output
DIP 3 On	DIP 4 Off	Dip 5 On	2-10V Signal Output
DIP 6 Off			Direct Acting Mode
	DIP 7 On	DIP 8 On	Stay in Place on LOSS of Input Signal
	DIP 7 Off	DIP 8 On	Stem Down on LOSS of Input Signal
	DIP 7 On	DIP 8 Off	Stem Up on LOSS of Input Signal
DIP 6 On			Reverse Acting Mode
	DIP 7 On	DIP 8 On	Stay in Place on LOSS of Input Signal
	DIP 7 Off	DIP 8 On	Stem Up on LOSS of Input Signal
	DIP 7 On	DIP 8 Off	Stem Down on LOSS of Input Signal

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Begin Auto-Calibration

1. Do NOT apply power to this actuator until it has been mounted onto the controlled device and mechanically checked for proper assembly.

This Calibration Procedure utilizes the force limit switches to find the travel limits of the valve or actuated device. If the rated force of the actuator would cause damage to the valve or actuated device, do not proceed with Auto-Calibration proceed to Manual Calibration to set Travel Stops using the controller.

2. Apply power. Check to be sure handwheel is pulled out.
3. Press MODE five times until "AUo" shows on the three digit display.
4. Hold SET until "LOC" LED turns on, indicating that Auto-Calibration has commenced.

Remove the Stem Block if not already done.

Sequence of Operation for Auto-Calibration

- A. Actuator will drive stem UP until the end of the valve stroke is reached and the actuator stops linear motion due to the force limit switch tripping.
 - B. Actuator will drive stem DOWN until the end of the valve stroke is reached and the actuator stops linear motion due to the force limit switch tripping.
5. After Auto-Calibration the unit will return to automatic operation and respond to signal inputs, such as 4-20mA.
 - Input signal is automatically adjusted so a high signal (example: 20mA) will drive valve full stem up.

Force Limit Switches

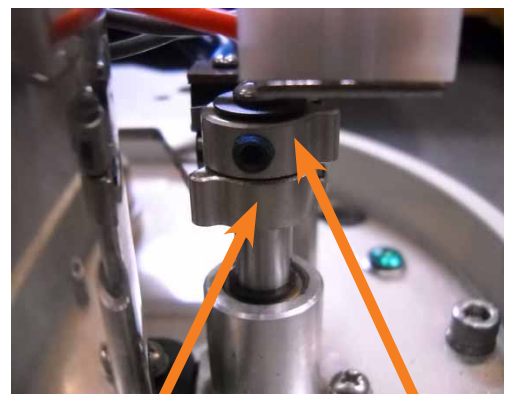
Drive Motor



Force Limit Switches: Over-travel protection is provided by load force control switches for both directions of travel. These switches are designed to stop electrical travel when the actuator reaches it's force load limit at each end of valve travel.

Do NOT attempt to make any adjustments to the force limit control switches. These switches are NOT travel adjustment switches, and any adjustment will VOID the warranty of this device.

Force Limit Switches



Handwheel
Override Switch

Force Trip
Switches

Full Stem Up
Force Cam
(Do NOT Adjust)

Full Stem Down
Force Cam
(Do NOT Adjust)

Handwheel Operation

The handwheel mechanically activates the handwheel override switch (see photo at right) which supplies power to the motor. The manual handwheel, when pulled OUT, allows full automatic operation of the actuator. Pushing IN the handwheel switches off motor power and allows manual operation.



Handwheel Override Switch

- Turning the handwheel CCW will drive the stem UP.
- Turning the handwheel CW will drive the stem DOWN.
- **Be sure to pull the handwheel OUT to return to automatic operation.**
- **Do NOT use power tools to turn the manual override as this will DAMAGE the gear train or motor and VOID the warranty.**

Manual Calibration

Note: Completing Manual Calibration deactivates the dry contact auxiliary switches (Terminals A-C for stem up and Terminals D-F for stem down, see Wiring Diagram). Use the 4-20FB Signal (FB Out) for positive position feedback when running the actuator under manual calibration parameters.

Actuator must be in Direct Acting Mode (Dip 6 is OFF)

Setting Full Stem Down Travel Limit (Before Force Limit is reached):

Using the Program navigation buttons, press:

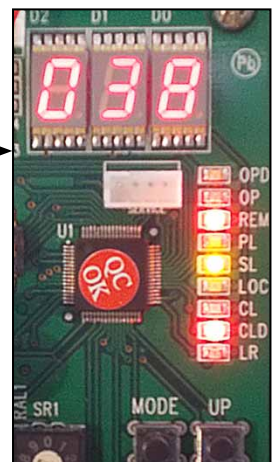
- | | | | |
|---------|--------|--|--|
| MODE | | until display shows: PAR | |
| SET | (x1) | until display shows: SPd | |
| DOWN | (x1) | until display shows: LoL | |
| SET | (x1) | until display shows: 000 or 001 | <div style="border-left: 1px solid black; padding-left: 5px;"> <p>000 = Full stem down position is controlled by Force Limit Switches.</p> <p>001 = Full stem down position is controlled by Proportional Controller.</p> </div> |
| SET | (hold) | until LED "SL" is lit and display starts blinking | |
| UP/DOWN | | until display shows: 001 | |
| SET | (x1) | to save setting. | |
| MODE | | until display shows: LoL | |
| SET | (hold) | until LED "LOC" is lit, display shows % of full stem travel . 000 to 100 | |
| UP/DOWN | (hold) | to position the actuator and controlled device to the desired full stem down position. | |

Once the desired Full Stem Down position is reached, physically push in the Manual Handwheel. This is done so that the actuator does not move when the controller leaves the "LOC" mode (Local Control Mode).



Continue using the Program navigation buttons, press:

- | | | | |
|---------|------------------------|---|--|
| MODE | | until display shows: PAR | |
| SET | (x1) | until display shows: SPd | |
| UP/DOWN | | until display shows: Lo | |
| SET | (x1) | until display shows potentiometer setting: 000 to 300 | |
| SET | (hold) | until LED "SL" is lit and display starts blinking | |
| DOWN | (press multiple times) | until LED "CLD" turns off. If already off, skip this step. | |
| UP | (press multiple times) | until LED "CLD" turns on. | |
| SET | (x1) | to save setting. | |
| MODE | | until display shows % of full stem travel. | |



Display should show **000** indicating the current position is at the Full Stem Down position. Pull Handwheel out to return to automatic operation (i.e. 4mA = Full Stem Down).

Stem Down Auxiliary Switch (Terminals D-F) has been deactivated.

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Manual Calibration (continued)

Note: Completing Manual Calibration deactivates the dry contact auxiliary switches (Terminals A-C for stem up and Terminals D-F for stem down, see Wiring Diagram). Use the 4-20FB Signal (FB Out) for positive position feedback when running the actuator under manual calibration parameters.

Actuator must be in Direct Acting Mode (Dip 6 is OFF)

Using the Program navigation buttons, press:

MODE		until display shows: PAR
SET	(x1)	until display shows: SPd
DOWN	(x2)	until display shows: oPL
SET	(x1)	until display shows: 000 or 001
SET	(hold)	until LED "SL" is lit and display starts blinking
UP/DOWN		until display shows: 001
SET	(x1)	to save setting.
MODE		until display shows: LoC
SET	(hold)	until LED "LOC" is lit, display shows % of full stem travel. 000 to 100
UP/DOWN	(hold)	to position the actuator and controlled device to the desired full stem up position.

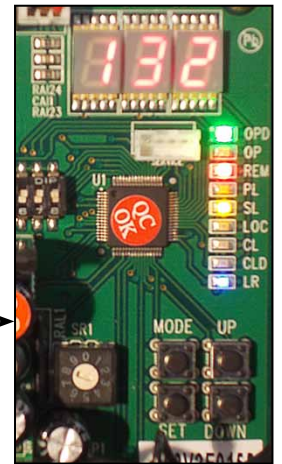
000 = Full stem down position is controlled by Force Limit Switches.
001 = Full stem down position is controlled by Proportional Controller.



Once the desired Full Stem Up position is reached, physically push in the Manual Handwheel. This is done so that the actuator does not move when the controller leaves the "LOC" mode (Local Control Mode).

Continue using the Program navigation buttons, press:

MODE		until display shows: PAR
SET	(x1)	until display shows: SPd
UP/DOWN		until display shows: HI
SET	(x1)	until display shows potentiometer setting: 000 to 300
SET	(hold)	until LED "SL" is lit and display starts blinking
UP	(press multiple times)	until LED "OPD" turns off. If already off, skip this step.
DOWN	(press multiple times)	until LED "OPD" turns on.
SET	(x1)	to save setting.
MODE		until display shows % of full stem travel.

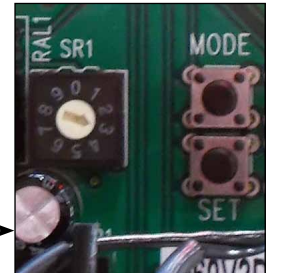


Display should show **100** indicating the current position is at the Full Stem Up position. Pull Handwheel out to return to automatic operation (i.e. 20mA = Full Stem Up).

Stem Up Auxiliary Switch (Terminals A-C) has been deactivated.

Calibration complete.

After completing a Manual Calibration, if after all parameters are set and, with a stable control signal the actuator is "hunting" set the sensitivity switch (SR1) to the next higher number (less sensitive response).



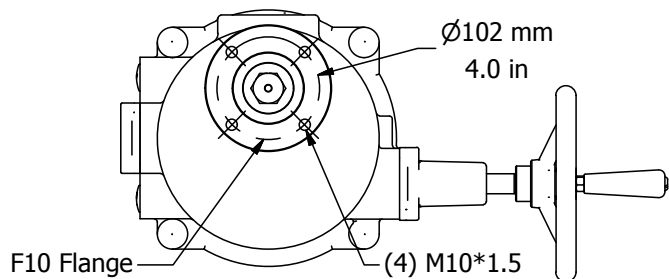
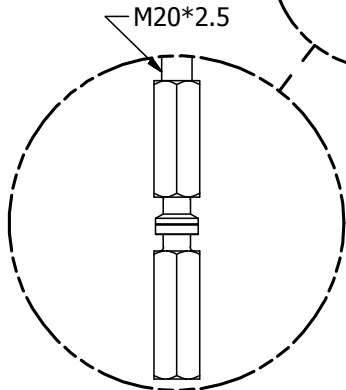
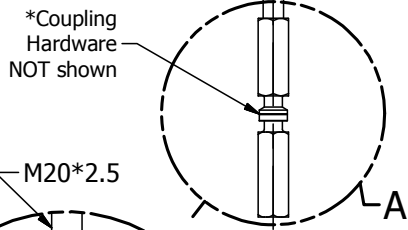
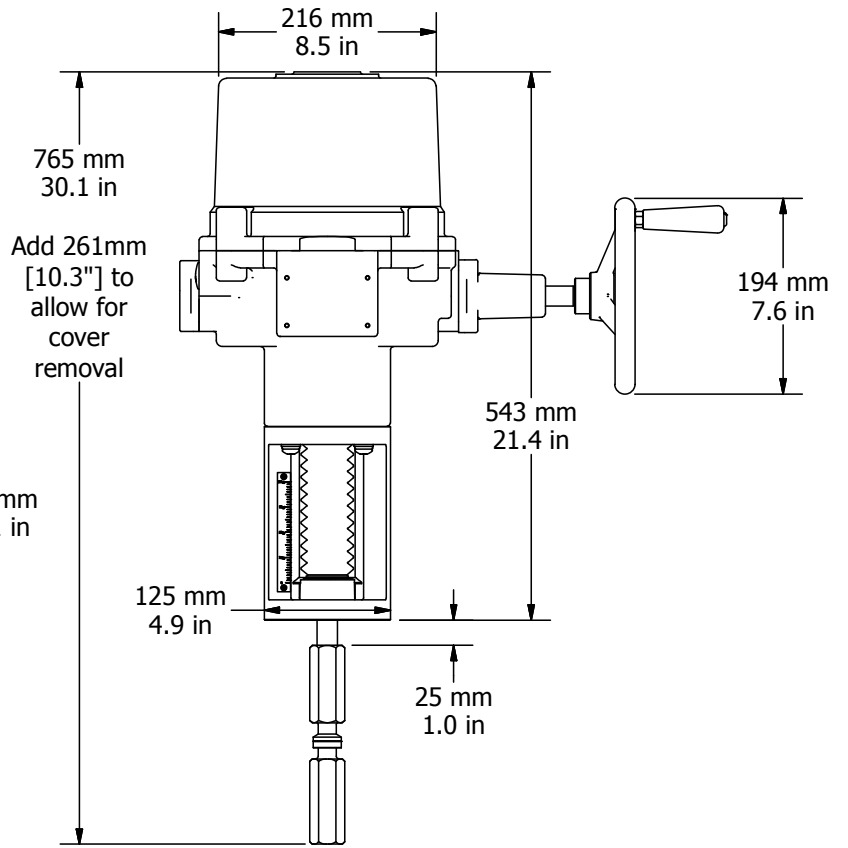
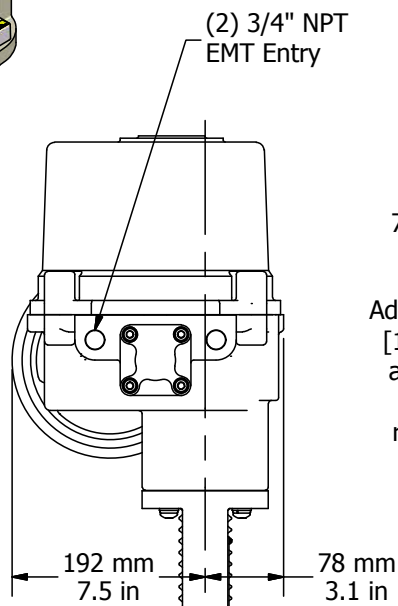
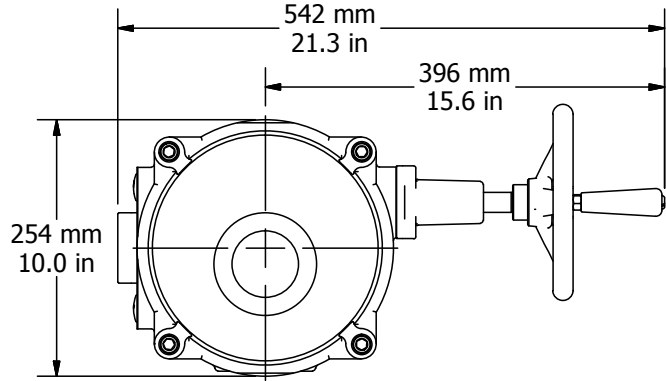
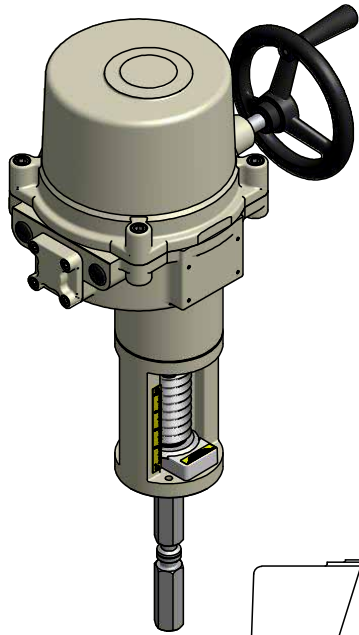
Commissioning

After completing all mounting and wiring procedures and main power is available, it is now possible to commission the actuator.

1. Utilize the handwheel to move the actuator and damper, valve or other connected device through its full travel from full stem UP to full stem DOWN and back again to check for any possible interference.
Do NOT utilize any mechanical advantage devices to rotate the handwheel (pipes, wrenches, extension bars, etc.).
2. Apply correct power to the unit.
3. Measure correct power on terminals 5 (Hot / L1) & 4 (Neu / L2) on the switch board.
4. Command the field device to generate a signal to drive the actuator towards the stem UP position.
5. Actuator will stop when it reaches it's full stem UP position.
6. Command the field device to generate a signal to drive the actuator towards the stem DOWN position
7. Actuator will stop when it reaches it's full stem DOWN position.
8. Actuator is now commissioned and operational.

Mechanical Data

PL2200/4400 Series Dimensional Data



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Industrial Applications

ProMation Engineering actuators have been installed to operate process controls such as butterfly valves, ball valves, high performance valves, plug valves, gate valves and dampers, in a broad range of demanding industrial applications.

**Power
Generation**



**Water
Processes**



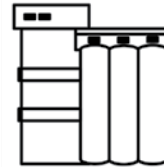
Mining



Oil and Gas



Agriculture



Chemicals



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