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Smart Linear Actuator Reference and Maintenance Manual





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Overview

This user guide will help you install, develop, and maintain your application. This section will help you use the information in this user guide.

Introduction

This manual is intended for use by application engineers and technicians involved in using Primatics positioning equipment.

Each Primatics linear actuator is designed for precision movement in one axis. The actuators can be stacked to make X-Y, or X-Y-Z systems.

Installation Overview

- *Step 1* Review this entire user guide. Become familiar with all installation and safety procedures prior to integrating your system.
- *Step 2* Read the safety summary to develop an understanding of standard safety practices when installing and operating automated equipment.
- *Step 3* Familiarize yourself with the conventions summary.
- *Step 4* Review installation procedures. To obtain the stated specifications, these procedures must be followed precisely.
- *Step 5* Once you successfully complete all the installation procedures, you will be ready to install and operate your actuator.
- Step 6 Review preventive maintenance section for proper lubrication schedule.



Safety Summary

Observe common industrial safety practices when installing and operating automated equipment.

- □ Have power connections made by qualified personnel.
- □ Provide a safe access route and adequate room for servicing.
- Perform the recommended periodic maintenance described in this document.
- □ Verify that the work envelope is free of obstructions before the actuator is powered.
- Insure that you have the feedback wired properly to the controller before applying power to the actuator. Improper feedback connections can cause a motor run-away condition that has the potential to damage the actuator and injure an operator.
- Only trained operators of the actuator should be allowed near the work environment.
- Note the places in the workcell where pinch points occur, and provide adequate safety clearance or safety curtain.



Conventions

This section will familiarize you with the conventions used in this manual.

Units of Measure

Primatics uses the metric system for all specifications and dimensions. All dimensions are specified in millimeters. Accuracy, repeatability, resolution, flatness and straightness specifications are specified in microns. Load capacity is specified in kilograms and moment capacity is given in Newton-Meters. All torque specifications are given in Newton-Meters. Thrust specifications are given in Newtons.

The following table gives some common conversions into English units:

Metric Unit	English Unit
1 Kilogram equals	2.2 lbs
1 micron equals	0.0000394 inch
1 millimeter equals	0.0394 inch
1 Newton-Meter equals	8.85 in-lbs
1 Newton equals	0.225 lbs

Direction of Motion

The positive direction of motion is defined as a motion away from the motor end of an actuator. A positive direction of motion also signifies the encoder count is increasing. All cables and connectors are located at the motor end of the actuator. The reverse limit switch is located on the motor end and the forward limit switch is located on the opposite side of the positioner. Figure 1 clarifies this convention.

DIRECTION OF INCREASING ENCODER COUNTS



Figure 1. Positive direction convention



All limit and home switches are normally open. A switch is considered low when it is closed and pulled to ground. A switch in the open state is considered high and can float up to 5-12VDC.

SLA Series Linear Actuators

The information in this section will enable you to:

- Install and mount the actuator properly
- Verify that the complete system is installed properly
- Perform preventive maintenance

Installation Precautions

Electrical Noise

You can minimize the potential for electrical noise by observing the following installation precautions:

- Do not route high-voltage wires and low-level signals together in conduit longer than 8 meters.
- Ensure that all components are properly grounded.
- Ensure that all wiring is properly shielded.

Heat and Humidity

All actuators are assembled at 20°C. Any deviation from this value will cause thermal expansion effects that will affect the accuracy of the actuator. Avoid radiant heat from large heat sources such as welders and furnaces. Avoid extreme electromagnetic waves, radiation, magnetic fields, and ultraviolet rays.

Ballscrew driven actuators are susceptible to thermal expansion effects. The ballscrew nut can create a localized thermal gradient if driven at high speeds.

Humidity should be less than 85% and there should be no condensation.

Contamination

Avoid exposing the actuator to corrosive and combustible gases and oil or cutting fluid mists. Applications in contaminated environments require the electrical, optical and mechanical components to be protected. Additional protection must be designed for actuators that will be splashed with fluids.

Installation Procedures

To ensure proper installation of your actuator, this section is organized in linear steps. Deviating from this prescribed format may result in system problems.

- 1) Unpacking
- 2) Tools you will need
- 3) Mounting surface preparation



- 4) Limit switches
- 5) Signal connections
- 6) Recommended system test

Unpacking

Carefully remove the actuator from its shipping crate and inspect it for evidence of shipping damage. Report any damage immediately to your authorized dealer.

Improper handling of the actuator may negatively affect its performance. Follow these guidelines when handling and mounting your positioner.

- Do not drop the actuator onto its mounting surface. Place the actuator gently on the mounting surface. Impact loads can cause flat spots on bearing surfaces, misalignment of drive components and warping of the base.
- 2) Do not drill holes into the actuator. If additional holes are necessary, contact your local distributor.
- 3) Lift the actuator by its base structure only. Do not lift the positioner by the motor drive assembly.

Tools you will need

The SLA90 actuator uses M5x20mm sockethead cap screws in the base plate mounting as well as the carriage plate. The SLA120 and PLA150 both use M6x30mm sockethead cap screws. A 3mm hex key will remove the top cover on all three actuators to gain access to the actuator base mounting holes.





Mounting Surface Preparation

The characteristics of the surface the actuator is mounted to will have a large effect on system performance. The actuator will conform to the shape of its mounting surface resulting in binding, excessive wear, and decreased life if the mounting surface is not sufficiently flat. In addition, the mounting surface should have sufficient rigidity so it does not deflect under large loads and to minimize vibrations. We suggest the following:

- 1) The flatness of the machine base/mounting structure should be less than 0.05mm.
- 2) Provide adequate space around the perimeter to ensure access, in particular clearance so the top cover can be removed for maintenance/lubrication.
- 3) Inspect for burrs or dings on the actuator mounting surfaces.
- 4) Clean all mounting surfaces with acetone.
- 5) When mounting the base down to the surface plate, tighten the bolts at one end of the actuator first and move towards the other end.

Payload Mounting

The actuator has two convenient mounting points for customer payloads. Typically payloads are mounted on the moving carriage. Dowel pin holes are included for ease in alignment/realignment. Use only one of the dowel pin holes when fine adjustments to the perpendicularity are required. There is a matching set of dowel pin holes on the base to aid in alignment for stacked configurations.

The secondary mounting point is on the rear endplate. This connection point is useful for when the actuator carriage is fixed and the base acts as an extending arm. These should not be used to secure the actuator in a vertical or Z-axis orientation.



Do not exceed the direct payload and moment load ratings in the datasheets for the actuator. The applied moment loads, including those due to accelerating offset loads, must be less than the rated specifications or a decrease in life will result.

Accessory Mounting

The actuator has several convenient attachment points for accessories such as sensors, brackets, wire guides etc. First, a T-slot is located on either side of the base which is sized to accommodate a standard M4 hex nut for the SLA90 and SLA120 and for a standard M5 square nut for the SLA150. Take care not to over tighten or overload the nuts. For more secure attachment, long rectangular sheet metal nuts should be used to displace the loads.



The second attachment point is on the motor end of the actuator. These M4 tapped holes should only be used for mounting accessories and never for mounting the actuator itself.



Limit Switches

The limit switch positions have been preset at the factory and cannot be adjusted. Both limit switches are normally opened. The reverse limit is towards the motor end and the forward limit is towards the rear end.



Electrical Connections

The following tables list the internal electrical connections. This information is provided for reference only.

Motor Phases,	3	Pin
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Pin	Name	Function
1	MOT A	Motor phase A
2	MOT B	Motor phase B
3	MOT C	Motor phase C

Motor Commutation Sensors and Temperature Switch, o pin

Pin	Name	Function
1	HALL V+	Power for commutation sensors (5VDC)
2	HALL V-	Power for commutation sensors (5V return), signal common
3	HALL A	Commutation sensor A
4	HALL B	Commutation sensor B
5	HALL C	Commutation sensor C
6	No connect	
7	TEMP	Temperature sensor input
8	TEMPC	Temperature sensor common

Encoder, 10 pin

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Pin	Name	Function
1	ENC V+	Power for encoder (5VDC)
2	ENC V-	Power for encoder (5V return), signal common
3	ENC A	Encoder channel A
4	No connect	
5	ENC B	Encoder channel B
6	No connect	
7	ENC I	Encoder channel I (Index)
8	No connect	
9	No connect	
10	No connect	

Limit sensors, 6 pin

Pin	Name	Function
1	LIMIT V+	Power for forward limit sensor (5VDC)
2	FLS	Forward limit sensor. Normally open. Closes on limit violation
3	LIMIT V-	Power for forward limit sensors(5V return), signal common
4	LIMIT V+	Power for reverse limit sensor (5VDC)
5	RLS	Reverse limit sensor. Normally open. Closes on limit violation
6	LIMIT V-	Power for reverse limit sensors(5V return), signal common

Optional Brake, 4 pin

Pin	Name	Function
1	BRAKE+	Power to release optional brake
2		
3		
4	BRAKE-	Power to release optional brake



Recommended System Test

Before attaching a load or applying power to your actuator, verify the encoder and limit switches are working properly. Move the carriage by hand in the positive direction and verify the encoder count is increasing. Runaway conditions caused by miswired encoders can result in actuator damage and personal injury. Move carriage to each end of travel to ensure limit switches are working properly. When closing the position loop for the first time, set the torque limit of your controller to 1 volt or less, and use conservative tuning gains. Once the control loop is working properly, payloads can be added to the carriage.

Preventive Maintenance

Performing preventive maintenance procedures on your actuator will extend its life and improve its long-term performance. When doing maintenance, the following safety items should be observed.

1) Always shut down the controller power first when doing maintenance work.

2) When doing maintenance, make sure no one can inadvertently turn the power ON. Make sure there is a sign clearly indicating maintenance is being performed.

3) If several people are working on maintenance, check before turning power ON. Let others know if you are doing work involving axis movement.

Lubrication

Use a #2 lithium based grease to lubricate ballscrew and linear guide components. We recommend NSK grease part #GRS AV2. For low duty cycle applications, it is recommended that the ballscrew and linear guides are re-greased every six months. High duty cycle applications may require more frequent re-lubrication. Lubrication intervals depend on duty cycle, load and ambient conditions. Inspection of the drivetrain elements may be required to determine the proper lubrication interval.

To gain access to components to be lubricated, remove the actuator top cover. On the SLA120 and SLA150 carriage is a grease nipple to lubricate the ballscrew. On the SLA90 or if access to the grease nipple is not possible, slather grease on the screw and cycle the carriage back and forth. Repeat several times to ensure a uniform coating of grease on the screw and in the ballnut.

On the SLA90, each bearing block has a small hole where grease is injected using a syringe. The SLA120 and SLA150 do not require a syringe and can be lubricated with a grease gun and the appropriate fitting.

Cycle the carriage back and forth several times after re-lubricating and wipe off any excess grease.

Cleaning

The following is recommended:

- 1) Clean the exterior and interior surfaces from time to time.
- 2) Wipe off dirt with a soft cloth.
- 3) For stubborn dirt, use acetone and a soft cloth.
- 4) Do not spray compressed air in the actuator as it may force particulates into crevices.