CAPTIVE LINEAR ACTUATORS
High Performance Stepper Motor Linear Actuators
Helix Linear captive linear actuators are available with standard sizes of precision lead screws. Additionally, custom sizes are easily integrated.
## CAPTIVE LINEAR ACTUATOR ORDERING GUIDE TABLE

<table>
<thead>
<tr>
<th>SMA Series</th>
<th>Model</th>
<th>Motor Length</th>
<th>Voltage</th>
<th>Actuator Style</th>
<th>Lead Screw</th>
<th>Stroke Code</th>
<th>Machined End</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>S</td>
<td>Single Stack</td>
<td>See page for rated voltage</td>
<td>Captive</td>
<td>See Lead Screw Table on Page 16</td>
<td>00 Without Machined End</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>14</td>
<td>D</td>
<td>Double Stack</td>
<td></td>
<td></td>
<td>Code Example: 302</td>
<td>SE Standard Machined End</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>23</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**EXAMPLE PART NUMBER:** SMA - 8S2.5 - C - 012-025 - 302 - SE

### THE HELIX ADVANTAGE

**READY TO USE - RIGHT OUT OF THE BOX**

**PRE-ENGINEERED | ASSEMBLED | TESTED**

**THE BROADEST SELECTION OF LINEAR STEP ACTUATORS**

- Thousands of combinations of lead screws and lead screw nuts in stock
- No compromises of design and efficiency

**HELIX LINEAR STEPPER MOTORS ARE PRECISION MANUFACTURED**

- High performance
- Built with deep groove ball bearings
- Maximum thrust loads
- Long life
- Optional encoders and wiring harness are available

**RAPID PROTOTYPING SERVICES, CUSTOM DESIGN ACTUATORS OR A COMPLETE LINEAR SYSTEM.**

If there is a need for a custom motor, motor harness, lead or diameter, special coating, different materials or a custom nut configuration, please contact Helix for more information.
The specifications and data in this publication are believed to be accurate and reliable. However, it is the responsibility of the product user to determine the suitability of Helix products for a specific application. While defective products will be replaced without charge if promptly returned, no liability is assumed beyond such replacement.

Helix Captive Linear Actuators are offered in NEMA 8, 11,14, 17, 23 and 34 frame motors. These stepper motor linear actuators operate with a precision lead screw that translates through the motor housing to drive the lifting shaft. The lead screw nut is manufactured from high performance plastic to offer long life and maximum load carrying.

These linear actuators can be modified with:
- Custom screw end machining
- Custom length travels for quantities over 50 pieces
- Custom wire connectors
- Single, and double stack motors

Helix Linear Captive Linear Actuators
Available Sizes 8, 11, 14, 17, 23

**SMA - 8**

**Size 8 - Captive Linear Actuator (1.8° Step Angle)**

**MOTOR CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Size 8 - Single Stack Captive Linear Stepper Motor (1.8° Angle)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-Captive</strong> Wiring</td>
</tr>
<tr>
<td>SMA-8S Bipolar</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**FORCE vs. PULSE RATE**

**LEAD SCREW SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Lead Screw Thread Dimension (inch)</th>
<th>Diameter</th>
<th>Step</th>
<th>Lead</th>
</tr>
</thead>
<tbody>
<tr>
<td>012-024</td>
<td></td>
<td>1/8</td>
<td>0.03002</td>
<td>0.034</td>
</tr>
<tr>
<td>012-048</td>
<td></td>
<td>1/8</td>
<td>0.03024</td>
<td>0.048</td>
</tr>
<tr>
<td>012-099</td>
<td></td>
<td>1/8</td>
<td>0.00048</td>
<td>0.099</td>
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<tr>
<td>012-157</td>
<td></td>
<td>1/8</td>
<td>0.00076</td>
<td>0.157</td>
</tr>
</tbody>
</table>

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helixlinear.com
23200 Commerce Park Road | Beachwood, OH 44122 USA | 216-485-2232 or 1-855-435-4958 | email: sales@helixlinear.com

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MOTOR CHARACTERISTICS

Size 23 - Non-Captive
Linear Actuator
(1.8° Step Angle)

SMA-23S

<table>
<thead>
<tr>
<th>Code</th>
<th>Wiring</th>
<th>Rated Voltage</th>
<th>Rated Current</th>
<th>Resistance/ Inductance</th>
<th>Power Consumption</th>
<th>Temperature Rise</th>
<th>Weight</th>
<th>Insulation Resistance</th>
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<tbody>
<tr>
<td>037-062</td>
<td>Bipolar</td>
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<td>2A</td>
<td>1.6Ω</td>
<td>1.25H</td>
<td>13W</td>
<td>75°C</td>
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<tr>
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<td>3V</td>
<td>1.3A</td>
<td>3.85Ω</td>
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<td>037-100</td>
<td>5V</td>
<td>0.54A</td>
<td>22.5Ω</td>
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<td>75°C</td>
<td>47g</td>
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LEAD SCREW SPECIFICATIONS

<table>
<thead>
<tr>
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<th>Lead Screw Thread Dimension (inch)</th>
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<tbody>
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<tr>
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<td>037-200</td>
<td>M6 x 1.0</td>
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<tr>
<td>037-400</td>
<td>M6 x 1.0</td>
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FORCE vs. PULSE RATE

LED SCREW SPECIFICATIONS

<table>
<thead>
<tr>
<th>Code</th>
<th>Lead Screw Thread Dimension (inch)</th>
</tr>
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<tbody>
<tr>
<td>037-062</td>
<td>M6 x 1.0</td>
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<td>037-063</td>
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<td>037-166</td>
<td>M6 x 1.0</td>
</tr>
<tr>
<td>037-200</td>
<td>M6 x 1.0</td>
</tr>
<tr>
<td>037-400</td>
<td>M6 x 1.0</td>
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</tbody>
</table>

FORCE vs. PULSE RATE
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The custom solutions team at Helix is focused on delivering custom actuation systems.

Our services include:
- Design support
- Prototyping / 3D printing
- Testing and qualification
- Production assembly and integration

Customized Linear Slides
- Non-captive stepper motor
- Motor mount
- Integrated profile rail
- Flags & switches
- Custom lead screw nut

Fully customized linear slide with non-captive stepper motor

Customized Linear Actuators
- Non-captive stepper motor
- Integrated profile rail
- Bearing supports for screw
- Customized carriage block

Linear Actuator with non-captive stepper motor and integrated profile rail

Customized Heavy Duty Slides
- Custom lead screw nut
- Custom carriage machining
- Motor mounts available
- Bronze ACME nut

Customized heavy duty slide with hybrid stepper motor and encoder

Non-captive Linear Actuator
- Custom wire connectors
- Custom Available Sizes 11, 14, 17, 23

Customized heavy duty non-captive linear actuator

Micro Precision Linear Actuator
- Integrated profile rail
- Custom lead screw nut
- Encoders available

Customized Hand, motor and belt micro precision linear actuator

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INCH LEAD SCREWS*

<table>
<thead>
<tr>
<th>Load (oz)</th>
<th>Linear Travel / Step (in)</th>
<th>NEMA 8</th>
<th>NEMA 11</th>
<th>NEMA 14</th>
<th>NEMA 17</th>
<th>NEMA 23</th>
<th>NEMA 34</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>0.125°</td>
<td>0.187°</td>
<td>0.250°</td>
<td>0.375°</td>
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<tr>
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<td>025-024</td>
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<td>025-031</td>
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<td>0.00500000</td>
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<tr>
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<td>037-999</td>
<td>062-999</td>
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<td></td>
</tr>
</tbody>
</table>

LEAD SCREW SPECIFICATIONS

Linear motion applications utilizing a ball screw or an acme screw require high tolerance screw end machining matched with precision bearing mounts. Helix Linear Technologies has designed a family of standard machined ends applicable to a variety of bearing arrangements.

Specifying standard machined ends results in quicker deliveries. The machined ends shown below represent designs that are compatible with common application requirements for either simple or fixed bearing support. Included in the chart are the locknut and lockwasher identification. These standard ends may be machined and ground to finish size.

HELIX END MACHINING FOR LEAD SCREWS*

<table>
<thead>
<tr>
<th>Material</th>
<th>Standard Lead Accuracy [in/ft (μm/300 mm)]</th>
<th>Straightness [in/ft (μm/300 mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 Series Stainless Steel</td>
<td>0.0003’/inch</td>
<td>0.005 (125)</td>
</tr>
</tbody>
</table>

CUSTOM END MACHINING FOR LEAD SCREWS*

*Visit helixlinear.com for end machining templates.
Detent or Residual Torque
The torque required to rotate the motor’s output shaft with no current applied to the windings.

Drives
Term depicting the external electrical components to run a Stepper Motor System. This will include power supplies logic sequencers, switching components and usually a variable frequency pulse source to determine the step rate.

Dynamic Torque
The torque generated by the motor at a given step rate. Dynamic torque can be represented by pull-in torque or pull-out torque.

Holding Torque
The torque required to rotate the motor’s output shaft while the windings are energized with a steady state D.C. current.

Inertia
The measure of a body’s resistance to acceleration or deceleration. Typically used in reference to the inertia of the load to be moved by a motor or the inertia of a motor’s rotor.

Linear Step Increment
The linear travel movement generated by the lead screw with each single step of the rotor.

Maximum Temperature Rise
Allowable increase in motor temperature by design. Motor temperature rise is caused by the internal power dissipation of the motor as a function of load. This power dissipation is the sum total from I 2R (copper loss), iron (core) loss, and friction. The final motor temperature is the sum of the temperature rise and ambient temperature.

Pulse Rate
The number of pulses per second (pps) applied to the windings of the motor. The pulse rate is equivalent to the motor step rate.

Pulses Per Second (PPS)
The number of steps that the motor takes in one second (sometimes called “steps per second”). This is determined by the frequency of pulses produced by the motor drive.

Ramping
A drive technique to accelerate a given load from a low step rate, to a given maximum step rate and then to decelerate to the initial step rate without the loss of steps.

Single Step Response
Time required for the motor to make one complete step.

Step
The angular rotation produced by the rotor each time the motor receives a pulse. For linear actuators a step translates to a specific linear distance.

Step Angle
The rotation of the rotor caused by each step, measured in degrees.

Steps Per Revolution
The total number of steps required for the rotor to rotate 360°.

Torque
The sum of the frictional load torque and inertial torque.

Pull Out Torque
The maximum torque the motor can deliver once the motor is running at constant speed. Since there is no change in speed there is no inertial torque. Also, the kinetic energy stored in the rotor and load inertia help to increase the pull of the torque.

Pull In Torque
The torque required to accelerate the rotor inertia and any rigidly attached external load up to speed plus whatever friction torque must be overcome. Pull-in torque, therefore, is always less than pull-out torque.

Torque to Inertia Ratio
Holding torque divided by rotor inertia.

GLOSSARY AND DEFINITIONS

STEPS MOTOR DRIVES
The Helix stepper motor drives are designed to match the motor when shipped from the factory. The drives are acceptable to use in most industrial environments (including automotive). Functionality of the drive can be customized to match any application and spare parts are readily available. Drives interconnect with other safety/controls systems.

Benefits:
- Drives match the motor with no design time required
- Drives are acceptable to use in most industrial environments (including automotive)
- Spare parts are readily available
- Functionality of the control can be customized to match any application
- Drives interconnect with other safety/controls systems

POWER SUPPLIES
These heavy-duty power supplies are a recommended accessory for Helix Linear non-captive linear actuators. Their superior build quality assures accurate, consistent voltage virtually eliminating the possibility of overheating.

Benefits:
- Specifically designed to power stepping / servo drives
- Internal EMI Filter
- 85-132 or 176 -265 VAC Input voltage
- 60 VDC output voltage
- 8.5A continuous output current.
- 100% full load burn-in test
- Output short circuit, over-current and over-voltage protection

ACCESSORIES

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QUALITY TOOLS:
- Design for Six Sigma manufacturing
- D.O.E (Design of Experiments)
- APQP (Advanced Product Quality Planning)
- DFMEA, PFEMA
- FEA (Finite Element Analysis)
- DVP&R (Design Verification Plan & Report)
- Reliability testing
- Process validation to 21 CFR Part 82 (Medical Device)

TESTING
Efficiency Measurement - Helix Engineering has designed test machines to measure and validate screw assembly efficiency.

Torque Measurement - Preloaded lead screw assemblies are evaluated to determine compliance with engineering specifications utilizing a dynamic torque testing machine.

FUNCTIONAL TESTING
Helix test systems and engineered testing processes perform analysis and verification of life, durability, and performance. The functional testing defines operating limits in specifications and helps set defined targets in product launch process and assurance plans.

The engineered testing provides predictive tools, generates data for prognostics, and validates performance wear models. Life tests help determine performance in multiple operating conditions as well. Helix offers proof testing for customers developing new systems and actuators to help accelerate product release dates.
LINEAR MOTION APPLICATIONS
High Quality, Precision Linear Motion Solutions

LIFE SCIENCES
- Pipeting automation
- Syringe pumps
- Microscopes
- MRI scanners
- CT scanners
- Radiographic machines
- In-vitro diagnostics
- Genomics
- Blood gas chemistry

PRINTING & BINDING
- “Z” axis actuators
- Multi-axis gantries
- 3D printing
- Automation / Material handling
- Additive manufacturing (AD)
- Large format sign printing
- Digital offset printing process
- Folding and sealing equipment
- Thermal CTP systems

SECURITY - MILITARY
- Automated door locking systems
- Pan-tilt-zoom cameras
- Automated gates
- Tactical automated security cameras
- Missile fin actuation
- Tank sighting systems
- Drones and UAVs
- Torpedo fin actuation
- Guided munitions

SEMICONDUCTOR
- Burnishing stages
- Stacking systems
- Vision inspection machines
- X, Y, Z gantries
- Wafer elevators / Wafer handling
- Acoustic microscopes
- Ultrasonic imaging
- Tuning coils
- Vacuum chamber doors

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