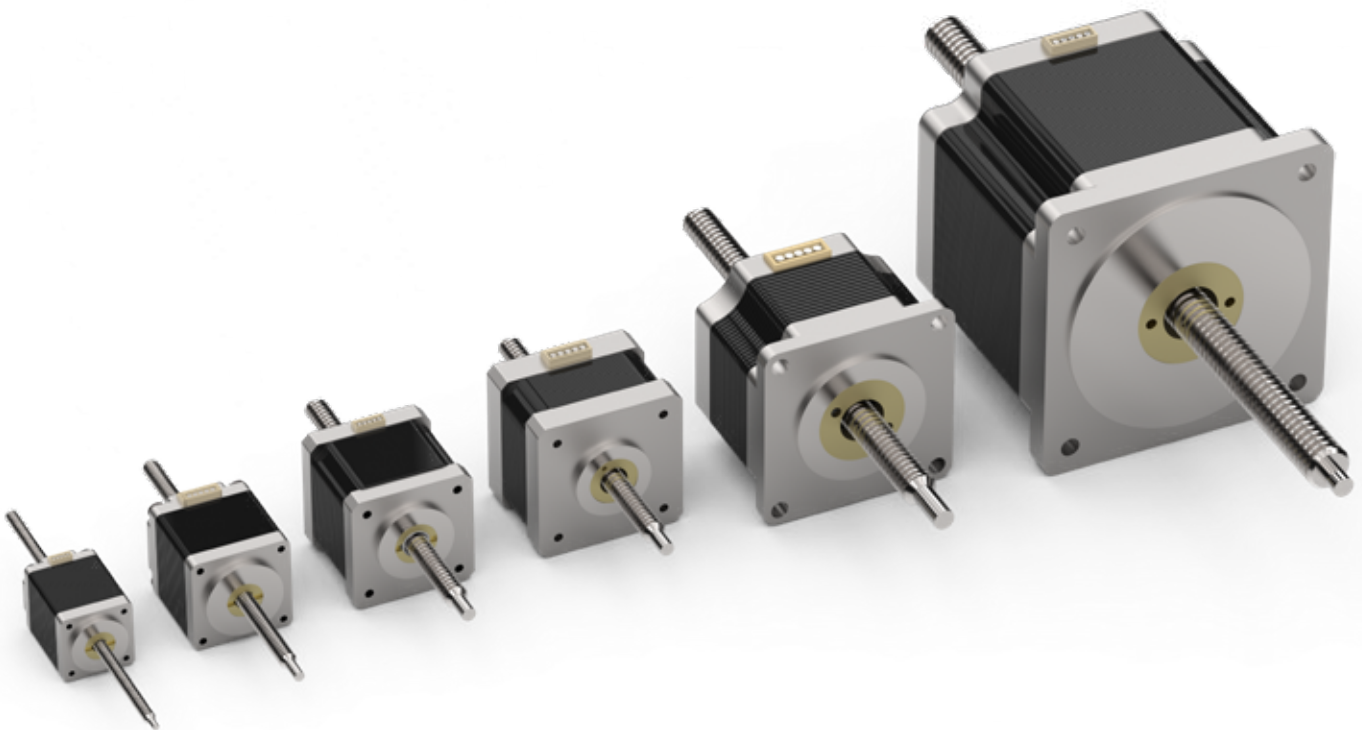




# NON-CAPTIVE LINEAR ACTUATORS

High Performance  
Stepper Motor Linear Actuators





Helix Linear Technologies, Inc., Beachwood, Ohio

## COMPANY

Helix is a global supplier to the Medical Device, Life Science, Security, Semiconductor, Aerospace, Electromechanical and Defense industries. Helix is a leader in the linear motion industry by manufacturing the highest quality linear actuation solutions in the world. We focus entirely on manufacturing electromechanical actuation systems that help our customer be more productive and profitable. Our execution of innovative product design solves real problems for our customers and build a foundation for long term success.

## HISTORY

Helix was founded in 2011 to manufacture high-quality lead screws for the growing electromechanical actuation industry. Helix's rapid growth has included the addition of linear actuator solutions to deliver integrated and turnkey solutions.




## CULTURE

Our culture is based on a team of smart, happy and competitive professionals focused on manufacturing innovative products centered on delivering precise electromechanical linear motion solutions. We are in the people business, as well as the product business. People make and sell our products and a team of smart, happy and competitive people make a company healthy.

## OPERATIONS

Our company is built to deliver high-quality, precision products and engineering support to solve the most demanding linear motion applications in any industry. We deliver components and subsystem solutions to high volume OEMs and custom machine builders to help secure their success.

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Helix Linear Non-Captive stepper motors are available in NEMA 8, 11, 14, 17, 23, 34 sizes.	4
	
Custom Solutions	
Helix Linear engineers high-performance, non-captive linear actuators for a variety of industries including healthcare, high-tech and aerospace/defense.	15
	
Lead Screw Options and End Machining	
Helix Linear non-captive linear actuators are available with standard sizes of precision lead screws. Additionally, custom sizes are easily integrated.	17
	

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**READY TO USE - RIGHT OUT OF THE BOX**  
PRE-ENGINEERED | ASSEMBLED | TESTED



**The Broadest Selection of Linear Stepper 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.

**NCA ORDERING GUIDE TABLE**

Series	Series Model	Motor Length	Voltage	Actuator Style	Lead Screw	Coating	Lead Screw Length	Machined End	Encoder	Encoder Position
SMA Stepper Motor Actuator	8	S Single Stack Motor	See product pages 5-14 for rated voltage availability	C Captive	DDD-LLL See Lead Screw Tables on Pages 5-14	00 No Coating	8.00" Length (inch) example:	00 Without Machined End	00 No Encoder	00
	11								R Encoder Ready	
	14								E200 (200 counts per rev.)	
	17			E500 (500 counts per rev.)		A Up				
	23			E1000 (1000 counts per rev.)						
	34			E2000 (2000 counts per rev.)		B Down				

EXAMPLE PART NUMBER: SMA - 8S2.1 - N - 012-025 - T - 8.00 - SE - 00 - 00





**FEATURES AND BENEFITS**

Helix Non-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. 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 machining
  - Custom wire connectors
  - Single, double and triple stack motors

**Single stack**

Non-captive Linear Actuators  
Available Sizes 8, 11, 14, 17, 23, 34



**Double stack**

Non-captive Linear Actuators  
Available Sizes 11, 14, 17, 23



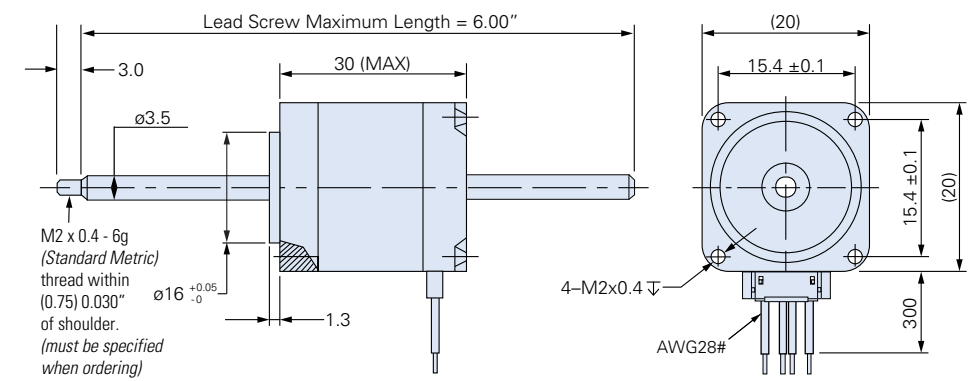
**SMA - 8**

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



**MOTOR CHARACTERISTICS**

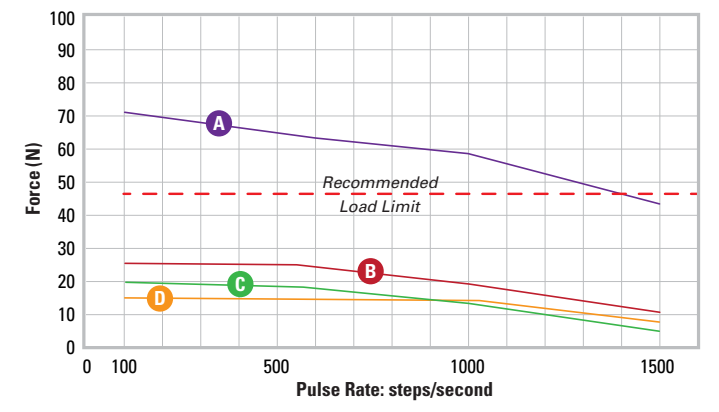
Size 8 - Single Stack Hybrid Linear Stepper Motor (1.8° Angle)									
Non-Captive	Wiring	Rated Voltage	Rated Current	Resistance/Phase	Inductance / Phase	Power Consumption	Temperature Rise	Weight	Insulation Resistance
SMA-8SN	Bipolar	2.5V	0.49A	5.1Ω	1.5mH	2.45W	75°C	43g	20MΩ
		5V	0.24A	20.4Ω	5.0mH				
		7.5V	0.16A	45.9Ω	11.7mH				



**LEAD SCREW SPECIFICATIONS**

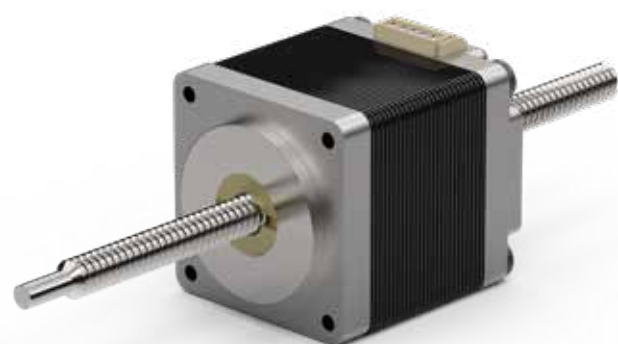
Code	Lead Screw Thread Dimension (inch)			
	Diameter	Step	Lead	
012-024	1/8	0.00012	0.024	A
012-048	1/8	0.00024	0.048	B
012-096	1/8	0.00048	0.096	C
012-157	1/8	0.00078	0.157	D

**FORCE vs. PULSE RATE**



### SMA - 11

Size 11 - Non-Captive Linear Actuator (1.8° Step Angle)

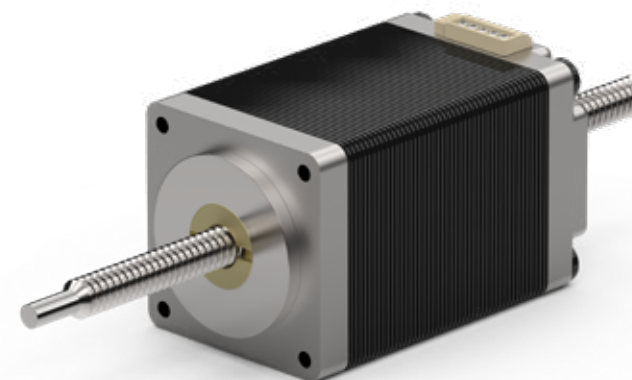


#### MOTOR CHARACTERISTICS

Size 11 - <b>Single Stack</b> Hybrid Linear Stepper Motor (1.8° Angle)									
Non Captive	Wiring	Rated Voltage	Rated Current	Resistance/Phase	Inductance / Phase	Power Consumption	Temperature Rise	Weight	Insulation Resistance
SMA-11SN	Bipolar	2.1V	1A	2.1Ω	1.5mH	4.2W	75°C	119g	20MΩ
		5V	0.42A	11.9Ω	6.7mH				
		12V	0.18A	68.6Ω	39mH				

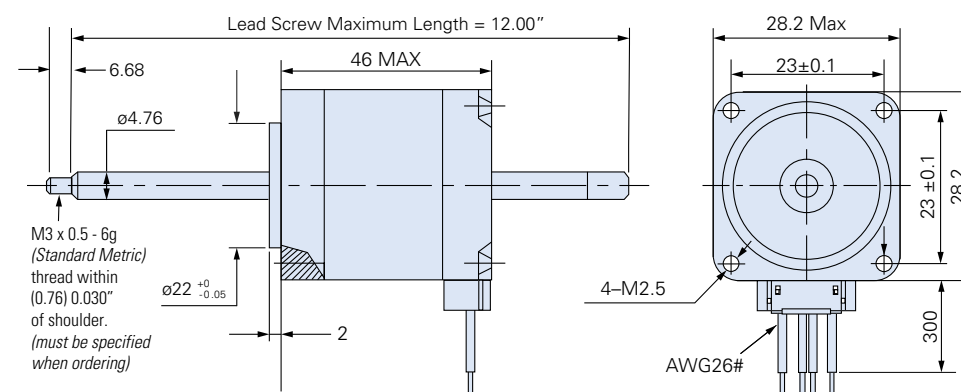
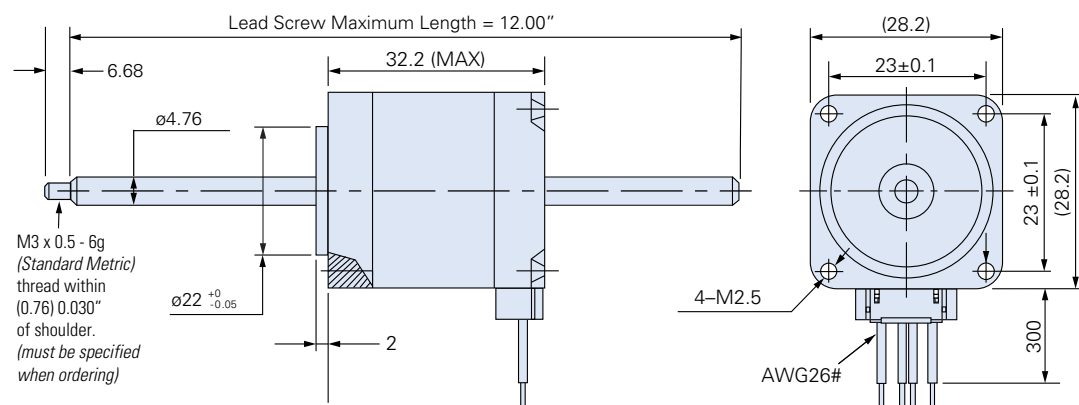
### SMA - 11

Size 11 - Non-Captive Linear Actuator **Double Stack** (1.8° Step Angle)



#### MOTOR CHARACTERISTICS

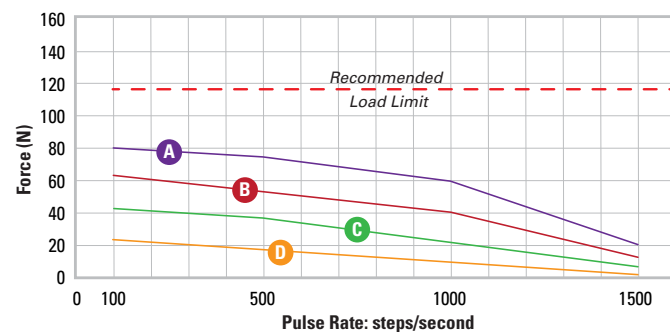
Size 11 - <b>Double Stack</b> Hybrid Linear Stepper Motor (1.8° Angle)									
Non Captive	Wiring	Rated Voltage	Rated Current	Resistance/Phase	Inductance / Phase	Power Consumption	Temperature Rise	Weight	Insulation Resistance
SMA-11DN	Bipolar	2.1V	1.9A	1.1Ω	1.1mH	7.5W	75°C	180g	20MΩ
		5V	0.75A	6.7Ω	5.8mH				
		12V	0.35A	34.8Ω	35.6mH				



#### LEAD SCREW SPECIFICATIONS

Code	Lead Screw Thread Dimension (inch)		
	Diameter	Step	Lead
018-025	3/16	0.00012	0.025
018-050	3/16	0.00025	0.050
018-100	3/16	0.0005	0.100
018-200	3/16	0.001	0.200

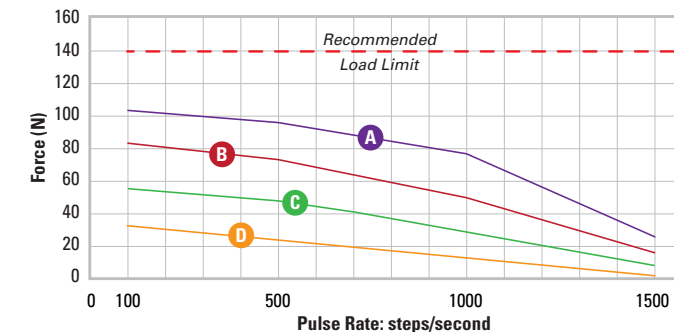
#### FORCE vs. PULSE RATE



#### LEAD SCREW SPECIFICATIONS

Code	Lead Screw Thread Dimension (inch)		
	Diameter	Step	Lead
018-025	3/16	0.00012	0.025
018-050	3/16	0.00025	0.050
018-100	3/16	0.0005	0.100
018-200	3/16	0.001	0.200

#### FORCE vs. PULSE RATE



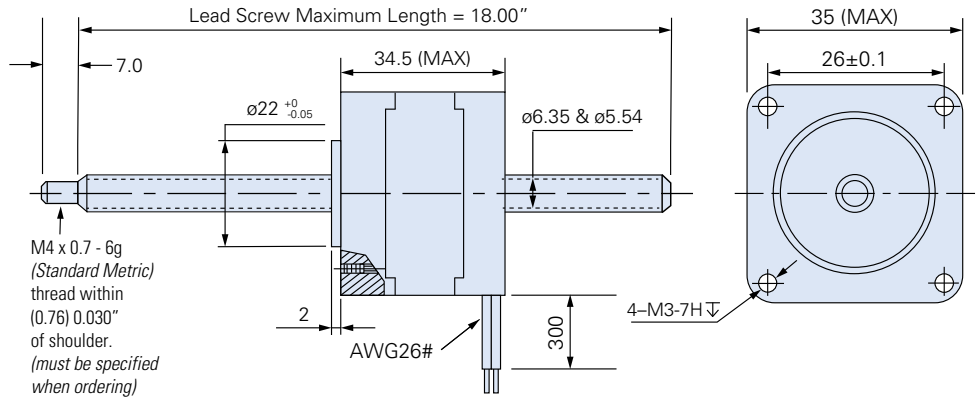
**SMA - 14**

Size 14 - Non-Captive Linear Actuator (1.8° Step Angle)



**MOTOR CHARACTERISTICS**

Size 14 - <b>Single Stack</b> Hybrid Linear Stepper Motor (1.8° Angle)									
Non Captive	Wiring	Rated Voltage	Rated Current	Resistance/Phase	Inductance / Phase	Power Consumption	Temperature Rise	Weight	Insulation Resistance
SMA-14SN	Bipolar	2.33V	1.25A	1.86Ω	2.8mH	5.7W	75°C	162g	20MΩ
		5V	0.57A	8.8Ω	13mH				
		12V	0.24A	50.5Ω	60mH				



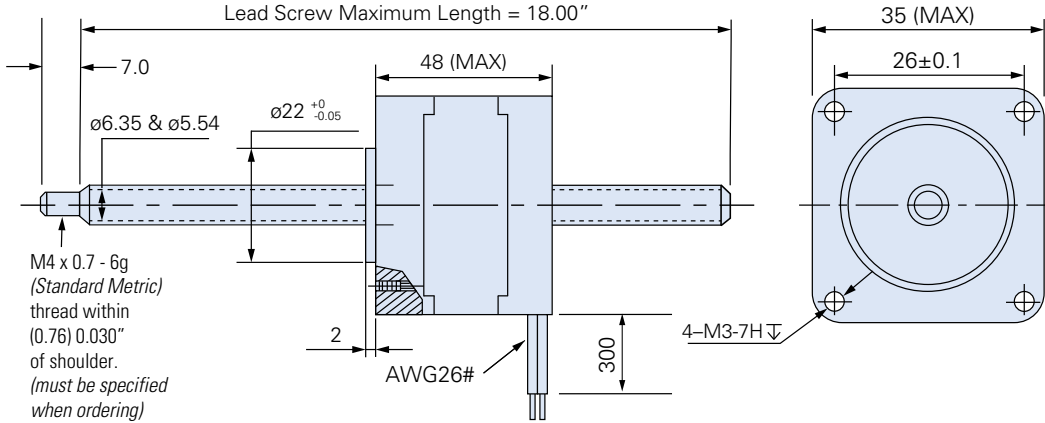
**SMA - 14**

Size 14 - Non-Captive Linear Actuator **Double Stack** (1.8° Step Angle)



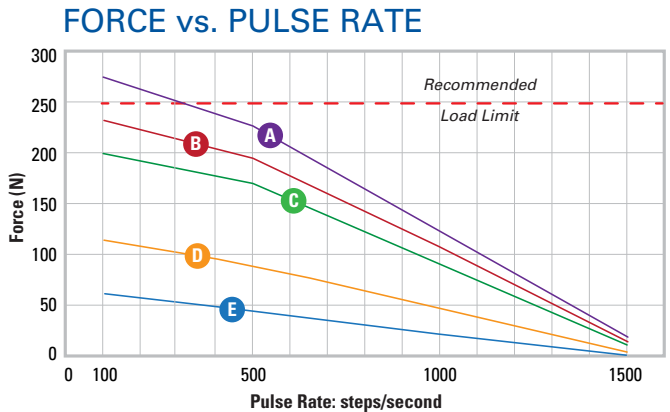
**MOTOR CHARACTERISTICS**

Size14 - <b>Double Stack</b> Hybrid Linear Stepper Motor (1.8° Angle)									
Non Captive	Wiring	Rated Voltage	Rated Current	Resistance/Phase	Inductance / Phase	Power Consumption	Temperature Rise	Weight	Insulation Resistance
SMA-14DN	Bipolar	2.33V	2A	1.2Ω	1.95mH	9.1W	75°C	240g	20MΩ
		5V	0.91A	5.5Ω	7.63mH				
		12V	0.38A	31.6Ω	65.1mH				



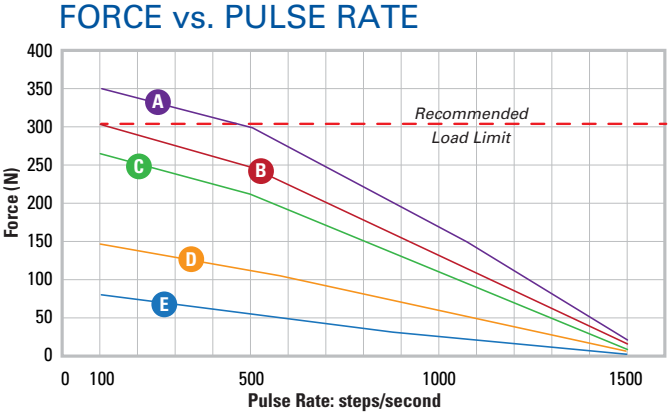
**LEAD SCREW SPECIFICATIONS**

Code	Lead Screw Thread Dimension (inch)			
	Diameter	Step	Lead	
025-031	1/4	0.00015625	0.031	A
025-062	1/4	0.0003125	0.062	B
025-096	1/4	0.00048	0.096	C
025-125	1/4	0.000625	0.125	D
025-250	1/4	0.00125	0.250	E



**LEAD SCREW SPECIFICATIONS**

Code	Lead Screw Thread Dimension (inch)			
	Diameter	Step	Lead	
025-031	1/4	0.00015625	0.031	A
025-062	1/4	0.0003125	0.062	B
025-096	1/4	0.00048	0.096	C
025-125	1/4	0.000625	0.125	D
025-250	1/4	0.00125	0.250	E



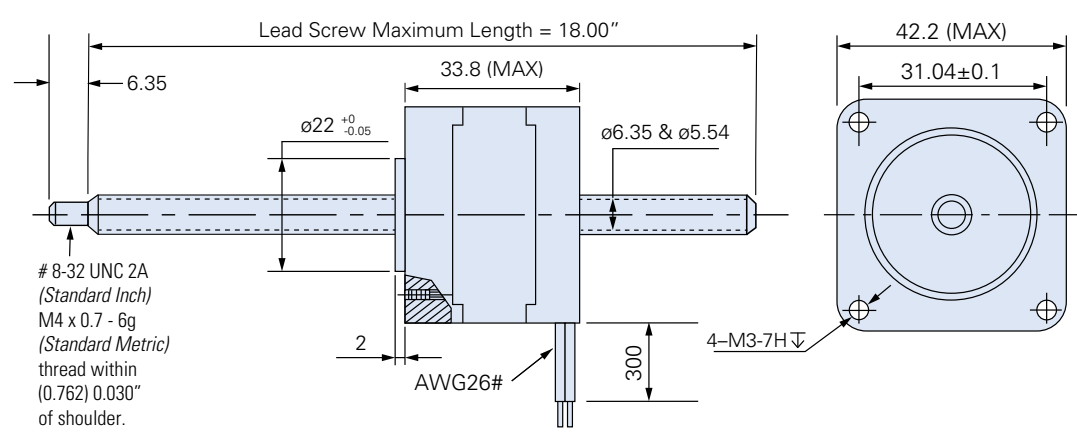
### SMA - 17

Size 17 - Non-Captive Linear Actuator (1.8° Step Angle)



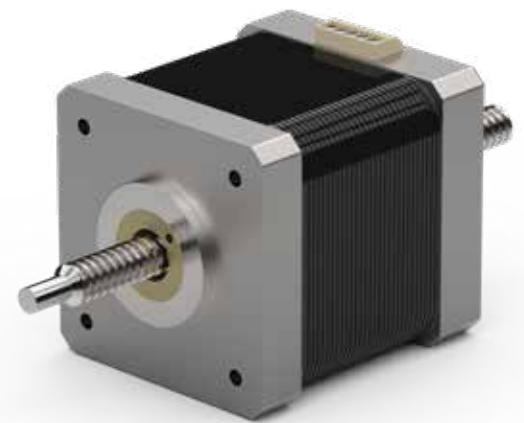
#### MOTOR CHARACTERISTICS

Size17 - Single Stack Hybrid Linear Stepper Motor (1.8° Angle)									
Non Captive	Wiring	Rated Voltage	Rated Current	Resistance/Phase	Inductance / Phase	Power Consumption	Temperature Rise	Weight	Insulation Resistance
SMA-17SN	Bipolar	2.33V	1.5A	1.56Ω	1.9mH	7W	75°C	241g	20MΩ
		5V	0.7A	7.2Ω	10.6mH				
		12V	0.29A	41.5Ω	73.3mH				



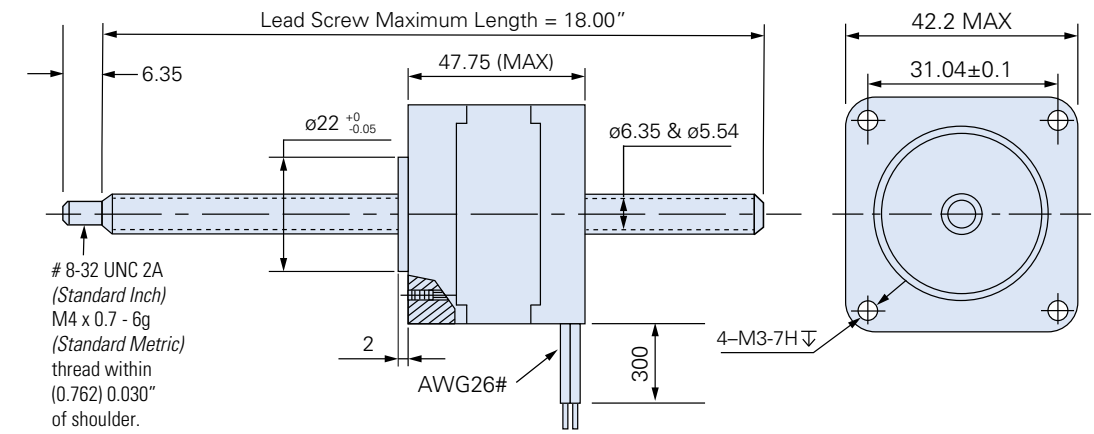
### SMA - 17

Size 17 - Non-Captive Linear Actuator **Double Stack** (1.8° Step Angle)



#### MOTOR CHARACTERISTICS

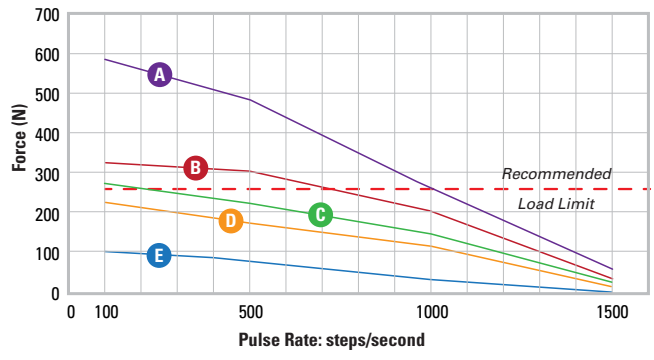
Size17 - Double Stack Hybrid Linear Stepper Motor (1.8° Angle)									
Non Captive	Wiring	Rated Voltage	Rated Current	Resistance/Phase	Inductance / Phase	Power Consumption	Temperature Rise	Weight	Insulation Resistance
SMA-17DN	Bipolar	2.33V	2.6A	0.9Ω	1.33mH	14W	75°C	352g	20MΩ
		5V	1.3A	3.8Ω	6.6mH				
		12V	0.55A	21.9Ω	45.1mH				



#### LEAD SCREW SPECIFICATIONS

Code	Lead Screw Thread Dimension (inch)		
	Diameter	Step	Lead
025-031	1/4	0.00015625	0.031
025-062	1/4	0.0003125	0.062
025-096	1/4	0.00048	0.096
025-125	1/4	0.000625	0.125
025-250	1/4	0.00125	0.250

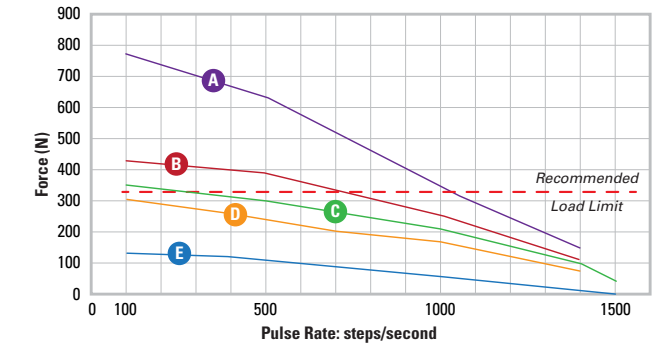
#### FORCE vs. PULSE RATE



#### LEAD SCREW SPECIFICATIONS

Code	Lead Screw Thread Dimension (inch)		
	Diameter	Step	Lead
025-031	1/4	0.00015625	0.031
025-062	1/4	0.0003125	0.062
025-096	1/4	0.00048	0.096
025-125	1/4	0.000625	0.125
025-250	1/4	0.00125	0.250

#### FORCE vs. PULSE RATE





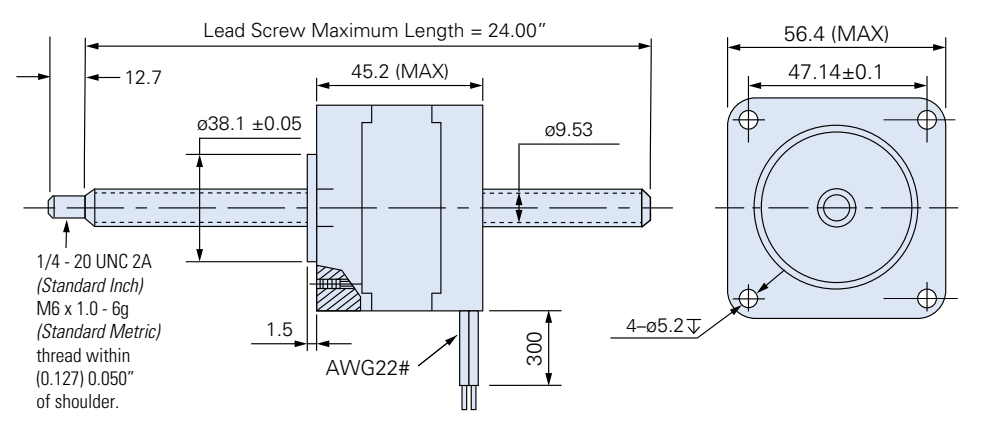
### SMA - 23

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



#### MOTOR CHARACTERISTICS

Size 23 - <b>Single Stack</b> Hybrid Linear Stepper Motor (1.8° Angle)									
Non Captive	Wiring	Rated Voltage	Rated Current	Resistance/Phase	Inductance / Phase	Power Consumption	Temperature Rise	Weight	Insulation Resistance
SMA-23SN	Bipolar	3.25V	2A	1.63Ω	3.5mH	13W	75°C	511g	20MΩ
		5V	1.3A	3.85Ω	10.5mH				
		12V	0.54A	22.2Ω	47mH				



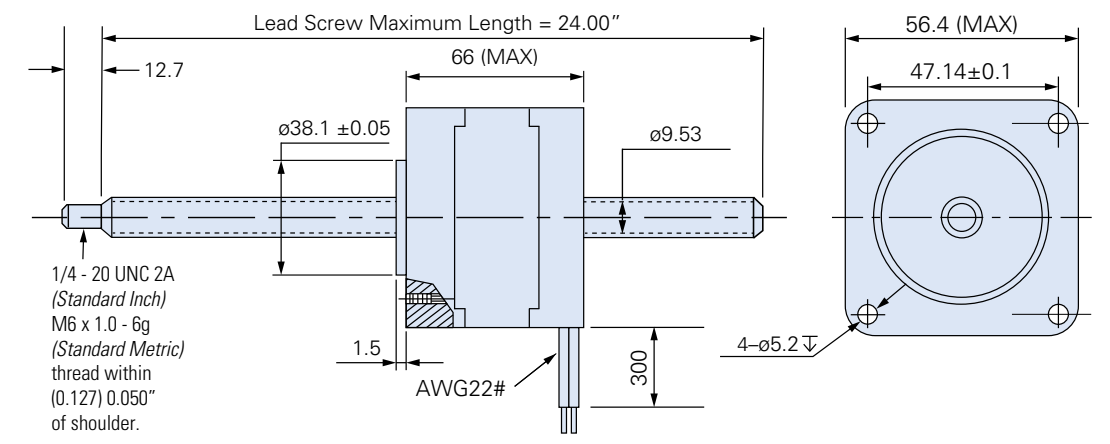
### SMA - 23

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



#### MOTOR CHARACTERISTICS

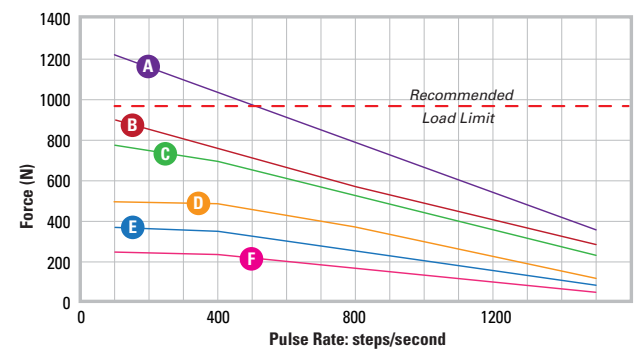
Size 23 - <b>Double Stack</b> Hybrid Linear Stepper Motor (1.8° Angle)									
Non Captive	Wiring	Rated Voltage	Rated Current	Resistance/Phase	Inductance / Phase	Power Consumption	Temperature Rise	Weight	Insulation Resistance
SMA-23DN	Bipolar	3.25V	3.32A	0.98Ω	1.33mH	14W	75°C	352g	20MΩ
		5V	2.16A	2.31Ω	6.6mH				
		12V	0.9A	13.33Ω	45.1mH				



#### LEAD SCREW SPECIFICATIONS

Code	Lead Screw Thread Dimension (inch)			
	Diameter	Step	Lead	
037-062	3/8	0.0003125	0.062	A
037-083	3/8	0.0004167	0.083	B
037-100	3/8	0.0005	0.100	C
037-166	3/8	0.0008333	0.166	D
037-200	3/8	0.001	0.200	E
037-400	3/8	0.002	0.400	F

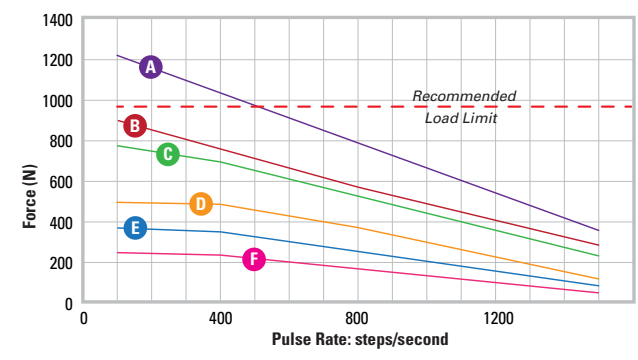
#### FORCE vs. PULSE RATE



#### LEAD SCREW SPECIFICATIONS

Code	Lead Screw Thread Dimension (inch)			
	Diameter	Step	Lead	
037-062	3/8	0.0003125	0.062	A
037-083	3/8	0.0004167	0.083	B
037-100	3/8	0.0005	0.100	C
037-166	3/8	0.0008333	0.166	D
037-200	3/8	0.001	0.200	E
037-400	3/8	0.002	0.400	F

#### FORCE vs. PULSE RATE





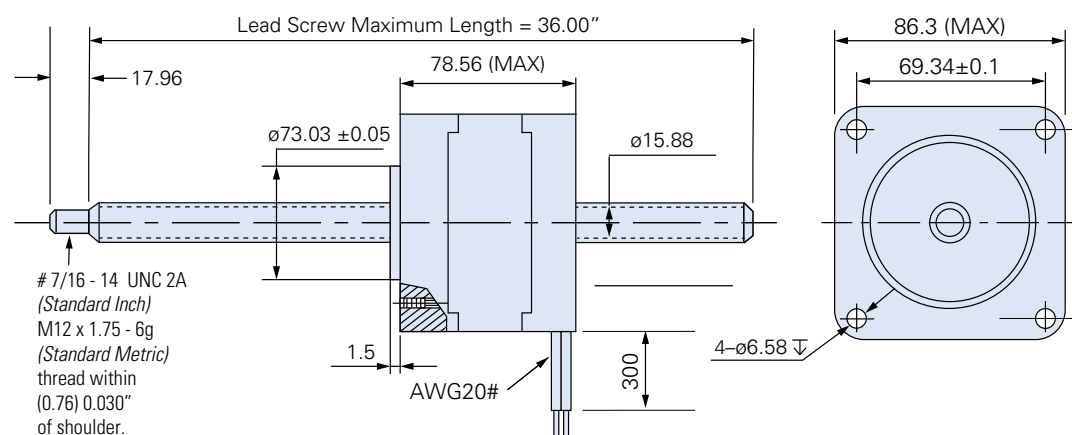
### SMA - 34

Size 34 - Non-Captive Linear Actuator (1.8° Step Angle)



#### MOTOR CHARACTERISTICS

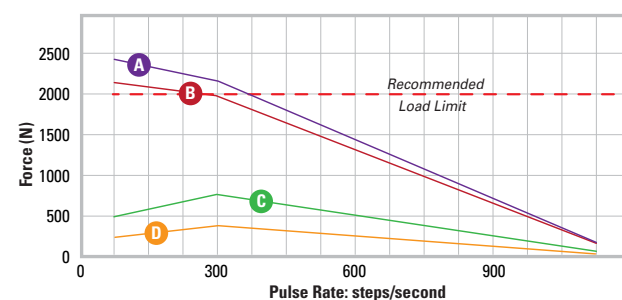
Size 34 - Single Stack Hybrid Linear Stepper Motor (1.8° Angle)									
Non Captive	Wiring	Rated Voltage	Rated Current	Resistance/Phase	Inductance / Phase	Power Consumption	Temperature Rise	Weight	Insulation Resistance
SMA-34SN	Bipolar	2.85V	5.47A	.52Ω	2.86mH	31.2W	75°C	2.3g	20MΩ
		5V	3.12A	1.6Ω	8.8mH				
		12V	1.3A	9.23Ω	51mH				



#### LEAD SCREW SPECIFICATIONS

Code	Lead Screw Thread Dimension (inch)		
	Diameter	Step	Lead
062-100	5/8	0.0005	0.100
062-125	5/8	0.000625	0.125
062-500	5/8	0.0025	0.500
062-984	5/8	0.005	0.984

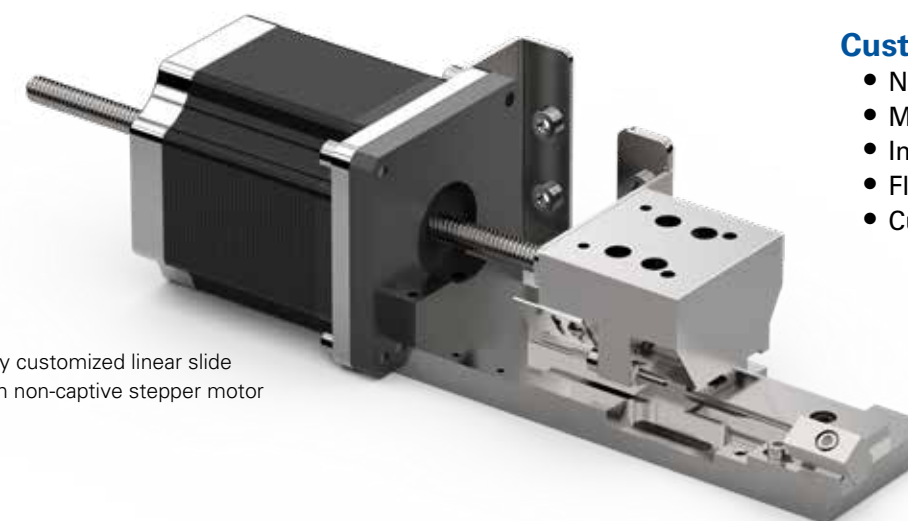
#### FORCE vs. PULSE RATE



#### CUSTOM SOLUTIONS

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



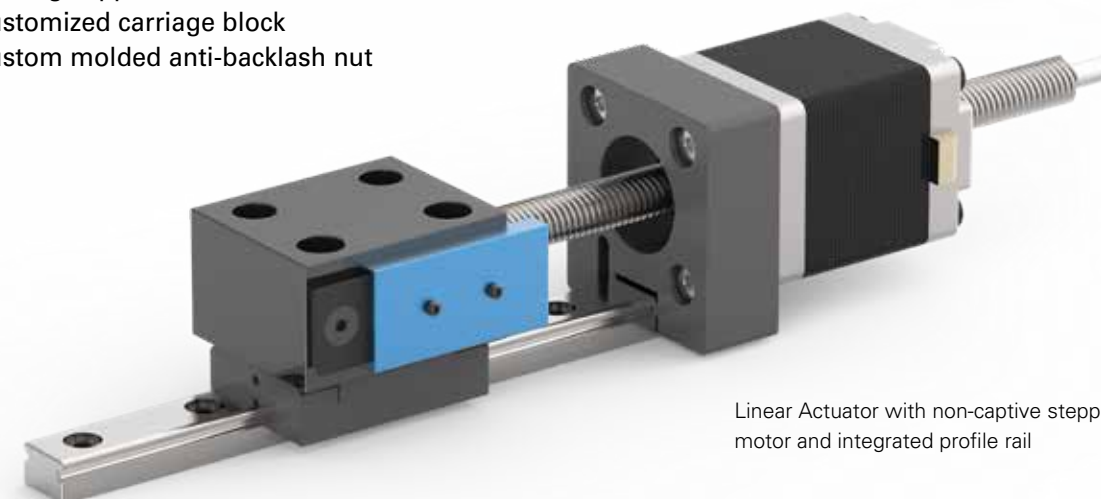
Fully customized linear slide with non-captive stepper motor

#### Customized Linear Slides

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

#### Customized Linear Actuators

- Non-captive stepper motor
- Integrated profile rail
- Bearing supports for screw
- Customized carriage block
- Custom molded anti-backlash nut



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

INCH LEAD SCREWS\*

Lead (in)	Linear Travel / Step (in)	NEMA 8	NEMA 11	NEMA 14	NEMA 17	NEMA 23	NEMA 34
		0.125" Ø	0.188" Ø	0.250" Ø	0.250" Ø	0.375" Ø	0.625" Ø
0.0120	0.0006000	012-012					
0.0240	0.00012000	012-024	018-024	025-024	025-024		
0.0313	0.00015625			025-031	025-031		
0.0480	0.00024000	012-048					
0.0500	0.00025000		018-050				
0.0625	0.00031250			025-062	025-062	037-062	
0.0787	0.00039350	012-078					
0.0960	0.00048000	012-096		025-096	025-096		
0.1000	0.00050000		018-100			037-100	062-100
0.1250	0.00062500	012-125		025-125	025-125		062-125
0.1660	0.00083000					037-166	
0.196	0.00098				025-196		
0.2000	0.00100000		018-200			037-200	
0.2500	0.00125000			025-250	025-250	037-250	
0.333	0.001665			025-333	025-333		
0.3750	0.00187500					037-375	
0.4000	0.00200000					037-400	
0.5000	0.00250000			025-500	025-500	037-500	062-500
1.0000	0.00500000					037-999	062-999

LEAD SCREW SPECIFICATIONS

Material	Standard Lead Accuracy [in/ft (µm/300 mm)]	Straightness [in/ft (µm/300 mm)]
300 Series Stainless Steel	0.0003"/inch	0.005 (125)

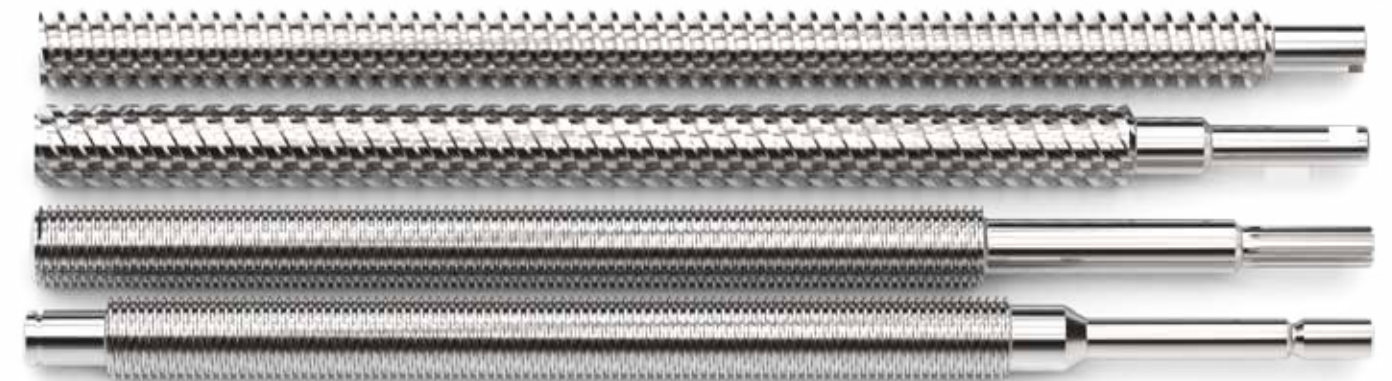
LEAD SCREW NUT SPECIFICATIONS

Standard Material	High Performance Material	Extreme Strength Material
Helix Precision Acetal (internally Lubricated)	Helix Precision Thermoplastic (internally Lubricated)	Helix Bronze

HELIX END MACHINING FOR LEAD SCREWS\*

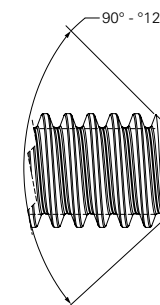
Linear motion applications utilizing a ball screw or an acme screw require high tolerance screw end machining matched with precision bearing mounts. Helix Linear Technologies has designed a family of standard machined ends applicable to a variety of bearing arrangements.

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.

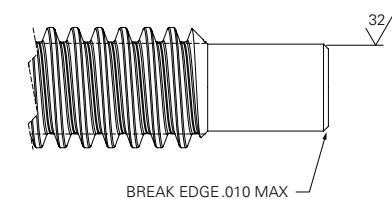


CUSTOM END MACHINING FOR LEAD SCREWS\*

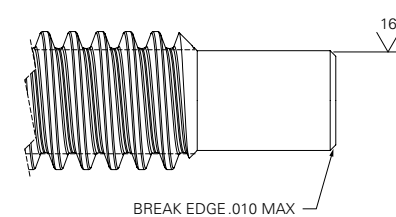
Standard Edge Break



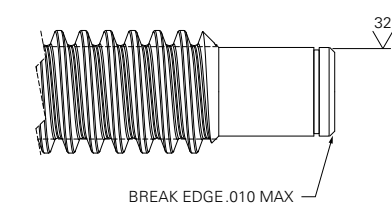
Turned Journal



Ground Journal



Snap Ring Groove



\*Visit helixlinear.com for end machining templates.

## ACCESSORIES

**STEPPER 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/control 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/control systems

**POWER SUPPLIES**

These heavy-duty power supplies are a recommended accessory for Helix Linear non-captive linear actuators. Their superior build quality insures 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

**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.



**HIGH TECH QUALITY EXPERIENCE**

When you select Helix Linear Technologies as a supplier, you can be assured that your product will be designed and tested to rigorous product planning. Pre-design activity includes understanding of customer requirements applied to predictive models, engineering calculations and linear modeling through prototype development, stereo-lithography samples of form, fit, and function that verify design criteria.

**VALIDATION AND VERIFICATION**

Through years of rigorous development, Helix has proven its designs and manufacturing processes against the most stringent standards and specifications. Design and process verification and validation tools are employed throughout the product life cycle.

**CERTIFICATIONS**

Helix serves many customers in the Aerospace and Medical device markets and has complied with common Quality System Requirements.



**ITAR**

Helix is registered with the Department of State For International Traffic In Arms Compliance.

The Department of State is responsible for the export and temporary import of defense articles and services governed by 22 U.S.C. 2778 of the Arms Export Control Act.



International Traffic in Arms Regulations Compliant

**INSPECTION CAPABILITY**

**Roundness Measurement** - Critical to quality, characteristics such as roundness are monitored throughout the screw manufacturing process.

**Lead Accuracy Measurement** - Precise lead accuracy measurement systems are utilized to validate process to conform to Helix internal specifications and customer requirements.



**Contour Readers** - Prior to the start of any production run, thread form geometry is precisely measured to stringent engineering specifications.



**QUALITY TOOLS:**

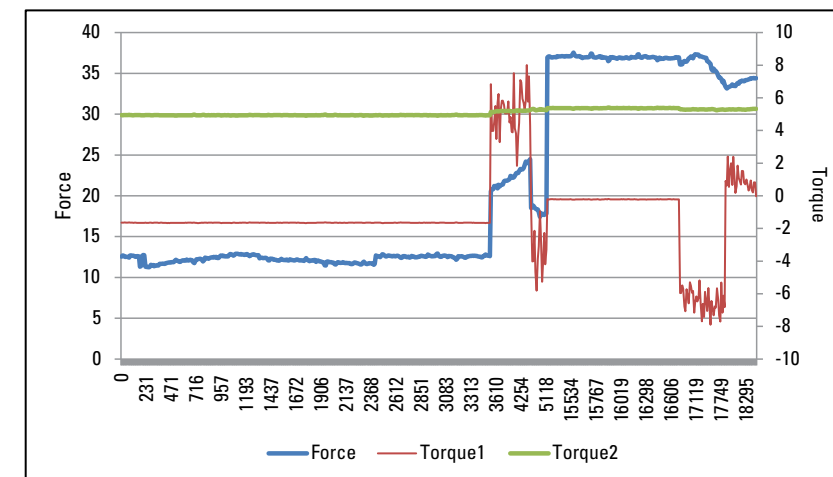
- Design for Six Sigma manufacturing
- D.O.E. (Design of Experiments)
- APQP (Advanced Product Quality Planning)
- DFMEA, PFEMA
- FEA (Finite Element Analysis)
- DVP&R (Design Verification Plan & Report)
- Reliability testing
- Process validation to 21 CFR Part 82 (Medical Device)

**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.

**HELIX QUALITY EVOLUTION**

- Developed Manufacturing Systems
- Quality Systems and Accreditations
- Supply Chain Approval Process
- State of the Art Management Systems
- APQP Launch Protocols
- System and Process Protocols
- Engineering Analysis and Predictive Tools
- Reliability Engineering and Testing
- Custom Engineered and Built Test Instrumentation
- Design and Test for Fault Tolerance and Prognostics
- Certification Testing

# 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



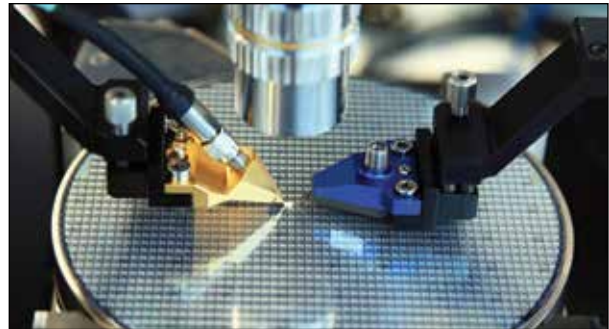
- "Z" axis actuators
- Multi-axis gantries
- 3D printing
- Automation / Material handling
- Additive manufacturing (AD)
- Large format sign printing
- Digital offset printing process
- Folding and sealing equipment
- Thermal CTP systems

## 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