

21000 Series Size 8 Hybrid Linear Actuators

Size 8 Hybrid Precision Stepper Motor is part of our extensive, award winning miniature motor product line and is one of the world's smallest linear actuators.

#### **More Compact Option for Motion Applications**

The 21000 Series Size 8 Linear Actuator occupies a minimal 0.8" (21 mm) space and includes numerous patented innovations that provide customers high performance and endurance in a very small package.

#### 3 Available Designs

- Captive
- Non-Captive
- External Linear

The 21000 Series is available in a wide variety of resolutions - from 0.00006" (.0015mm) per step to 0.00157" (0.0 mm) per step.

The Size 8 Actuator delivers thrust of up to 10 lbs (44 N).



#### **Specifications**

Size 8: 21 mm (0.8-in) Hybrid Linear Actuator (1.8° Step Angle)					
	Captive	21H4 –	- †		
Part No.	Non-Captive	21F4 –	- †		
	External Linear	E21H4 –			
Wiring	Bipolar				
Winding Voltage	2.5 VDC 5 VDC 7.5 VDC				
Current (RMS)/phase	.49 A .24 A		.16 A		
Resistance/phase	5.1 Ω	20.4 Ω	45.9 Ω		
Inductance/phase	1.5 mH	5.0 mH	11.7 mH		
Power Consumption		2.45 W Total			
Rotor Inertia		1.4 gcm <sup>2</sup>			
Insulation Class	Class B (Class F available)				
Weight	1.5 oz (43 g)				
Insulation Resistance		20 MΩ			

 $<sup>^{\</sup>dagger}\textsc{Part}$  numbering information on page 4

Linear Tra	Order		
Screw Ø.14-	Screw Ø.14-in (3.56mm)		
inches	mm	Code I.D.	
.00006	.0015*	U**	
.000098*	.0025	AA**	
.00012	.0030*	N	
.00019*	.005	AB	
.00024	.006*	K	
.00039*	.01	AC	
.00048	.0121*	J	
.00078*	.02	AD	
.00157	.04	AE	

\*Values truncated

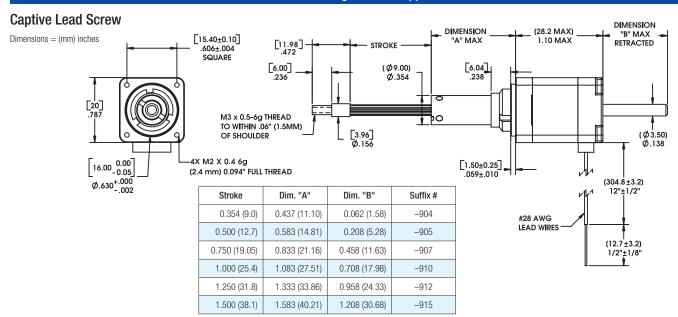
Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.

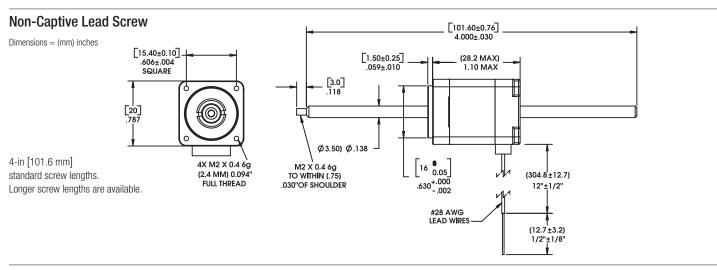


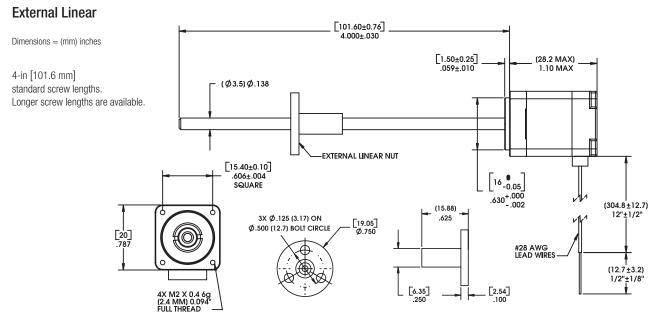
<sup>\*\*</sup>TFE coating not available

Standard motors are Class B rated for maximum temperature of 130  $^{\circ}\text{C}.$ 

#### 21000 Series • Size 8 Single Stack Stepper Motor Linear Actuators



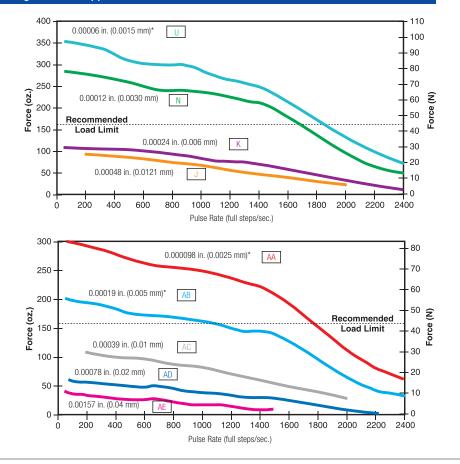




#### 21000 Series • Size 8 Single Stack Stepper Motor Linear Actuators

#### FORCE vs. PULSE RATE

- Chopper
- Bipolar
- 100% Duty Cycle
- $\emptyset$  .14 (3.56) Lead Screw



#### FORCE vs. LINEAR VELOCITY

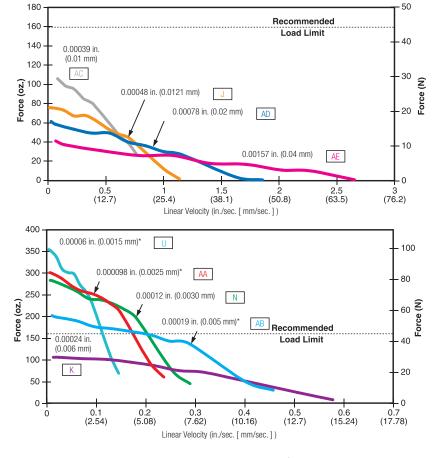
- Chopper
- Bipolar
- 100% Duty Cycle
- Ø .14 (3.56) Lead Screw

\*Care should be taken when utilizing these screw pitches to ensure that the physical load limits of the motor are not exceeded. Please consult the factory for advice in selecting the proper pitch for your application.

NOTE: All chopper drive curves were created with a 5 volt motor and a 40 volt power supply.

Ramping can increase the performance of a motor either by increasing the top speed or getting a heavier load accelerated up to speed faster. Also, deceleration can be used to stop the motor without overshoot.

With L/R drives peak force and speeds are reduced, using a unipolar drive will yield a further 30% force reduction.



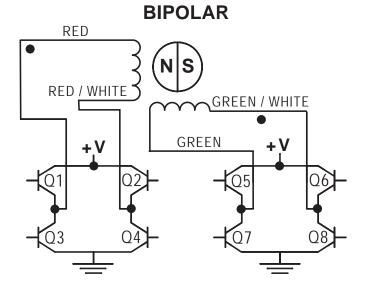
**AMETEK** 

#### Identifying the Hybrid Part Number Codes when Ordering

Е	21	Н	4	AB	7.5	910
Prefix	Series Number	Style	Coils	Code ID Resolution	Voltage	Suffix
(include only when	Designation	<b>F</b> = 1.8°	<b>4</b> = Bipolar	Travel/Step	<b>2.5</b> = 2.5 VDC	Stroke
using the following)	21 = 21000	Non-captive	(4 wire)	<b>U</b> * = .00006-in (.0015)	<b>05</b> = 5 VDC	Example: $-910 = 1$ -in
<b>E</b> = External	(Series numbers represent	H = 1.8°Captive or		<b>AA</b> *= .000098-in (.0025)	<b>7.5</b> = 7.5 VDC	(Refer to Stroke chart on Captive
<b>K</b> = External with	approximate	External (use "E"		<b>N</b> = .00012-in (.0030)	Custom V available	motor series product page.)
40° thread form	width of motor	or "K" Prefix for External version)		<b>AB</b> = .00019-in (.005)		Suffix also represents:
	body)	External version)		<b>K</b> = .00024-in (.006)		-800 = Metric
<b>P</b> = Proximity Sensor				<b>AC</b> = .00039-in (.01)		-900 = External Linear with grease and flanged nut
<b>S</b> = Home Position				$\mathbf{J} = .00048 - \text{in} (.0121)$		-XXX = Proprietary suffix
Switch				AD = .00078 - in (.02)		assigned to a specific customer
				<b>AE</b> = .00157-in (.04)		application. The identifier
				*TFE not available		can apply to either a standard or custom part.

NOTE: Dashes must be included in Part Number (-) as shown above. For assistance call our Engineering Team at 203 756 7441.

#### Hybrids: Wiring



#### Hybrids: Stepping Sequence

	Bipolar	Q2-Q3	Q1-Q4	Q6-Q7	Q5-Q8	
$\Xi$	Step					1
EXTEND CW	1	ON	OFF	ON	OFF	]    ≥
CW	2	OFF	ON	ON	OFF	CCW
	3	OFF	ON	OFF	ON	RACT
$\downarrow$	4	ON	OFF	OFF	ON	RFTR
	1	ON	OFF	ON	OFF	8

Note: Half stepping is accomplished by inserting an off state between transitioning phases.

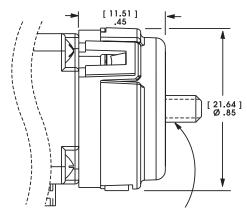
AMETEK®

# Encoders Designed for All Sizes of Hybrid Linear Actuators

All Haydon Hybrid Linear Actuators are available with specifically designed encoders for applications that require feedback. The compact optical incremental encoder design is available with two channel quadrature TTL squarewave outputs. An optional index is also available as a 3rd channel. The Size 8 Encoder provides resolutions for applications that require 250 and 300 counts per revolution. Encoders are available for all motor configurations — captive, non-captive and external linear.

Simplicity and low cost make Encoders ideal for both high and low volume motion control applications. The internal monolithic electronic module converts the real-time shaft angle, speed, and direction into TTL compatible outputs. The encoder module incorporates a lensed LED light source and monolithic photodetector array with signal shaping electronics to produce the two channel bounceless TTL outputs.

#### 21mm 21000 Series Size 8



NOTE: Lead Screw extends beyond encoder on specific captive and non-captive motors. External linear shaft extension is available upon request.

Single Ended Encoder - Pinout - Size 8				
Connector Pin #	Description			
1	+5 VDC Power			
2	Channel A			
3	Ground			
4	Channel B			



Electrical Specifications					
	Minimum	Typical	Maximum	Units	
Input Voltage	4.5	5.0	5.5	VDC	
Output Signals	4.5	5.0	5.5	VDC	

<sup>2</sup> channel quadrature TTL squarewave outputs.

Channel B leads A for a clockwise rotation of the rotor viewed from the encoder cover.

Tracks at speeds of 0 to 100,000 cycles/sec.

Optional index available as a 3rd channel (one pulse per revolution).

Operating Temperature		
Cino O	Minimum	Maximum
Size 8	- 10°C (14°F)	85°C (185°F)

Mechanical Specifications				
	Maximum			
Acceleration	250,000 rad/sec2			
Vibration (5 Hz to 2 kHz)	20 g			

Resolution					
4 Standard Cycles Per Revolution (CPR) or Pulses Per Revolution (PPR)					
CPR 250 300					
Size 8	PPR	1000	1200		

AMETEK®
ADVANCED MOTION SOLUTIONS



Encoder Ready Option Shown 34000 Series Size 17



Extended Rotor Journal Shown 34000 Series Size 17





#### **Encoder Ready Option for all Hybrid Sizes**

Our Hybrid Linear Actuators can now be manufactured as an Encoder Ready Actuator. Encoder Ready Actuators can be used to install several popular hollow shaft encoders. Available with an extended rotor journal and a threaded rear housing. The motor uses a proprietary manufacturing process which incorporates engineering thermoplastics in the rotor drive nut and a stainless steel Acme Lead Screw that allows the motor to be much more efficient and durable than today's more commonly used V-thread bronze nut configurations.

#### **Extended Rotor Journal for all Hybrid Sizes**

Available with an extended rotor journal. The extended rotor journal can be used for encoder installation, manual adjustment, or flag installation for a positioning sensor.

#### Home Position Switch for Hybrids

A miniature electronic Home Position Switch capable of monitoring the home positions of linear actuators. The switch mounts on the rear sleeve of captive linear motors and allows the user to identify start, stop or home positions.

When ordering motors with the home position switch the part number should be preceded by an "S" prefix.

#### End of Stroke Proximity Sensor for all Hybrid Sized

The Sensor incorporates a hall effect device, which is activated by a rare earth magnet embedded in the end of the internal screw. The compact profile of the sensor allows for installation in limited space applications. The sensor has a virtually unlimited cycle life. Special cabling and connectors can also be provided.

When ordering motors with the proximity sensor, the part number should be preceded by a "P" prefix.

#### Black Ice® and Kerkote® TFE Coated Lead Screws\*

TFE Coated Lead Screws for applications that require a *greaseless* screw and nut interface.

A *dry* (non-lubricated) TFE coated lead screw provides improved performance in both life and thrust as compared to a conventional stainless steel lead-screw. TFE can be applied to a wide variety of lead-screw pitches and is available for our brand captive, non-captive and external linear actuators. Not available for 0.00006-in (.0015 mm) and 0.000098-in (.0025 mm) resolutions.

\*Certain conditions apply.

#### Integrated Anti-Backlash Nut for Hybrids\*

Most sizes (except Size 34) of our captive and non-captive hybrid stepper motors can be equipped with an integral anti-backlash feature. There is a normal backlash between the lead screw and integral rotor nut.

Our actuators are designed for millions of cycles. However over time, additional backlash could increase and eventually double. Haydon Kerk Integrated Anti-Backlash Nut can eliminate all backlash. Designed specifically for our captive and non-captive hybrid motors, nuts use an opposing spring force to eliminate backlash between the screw and the nut interface. The nuts will self-compensate and accommodate any wear. Haydon Kerk Motion Solutions application engineers can help you select the appropriate preload for your application

\*Except Size 34.





# 21000 Series Size 8 Double Stack Hybrid Linear Actuators

Size 8 Double Stack Hybrid Stepper Motor Linear Actuators provide enhanced performance over a single stack.

Improved Performance & New Linear Motion Design Opportunities in a 20 mm Frame Size

#### 3 Available Designs

- Captive
- Non-Captive
- External Linear

The 21000 Series is available in a wide variety of resolutions - from 0.000098 in (.0025 mm) per step to 0.00157 in (0.04 mm) per step. The Size 8 actuator delivers thrust of up to 17 lbs. (75 N).

Assembly options include: Incremental encoders, proximity sensors (captive types only), anti-backlash and custom nuts, and TFE coated lead-screws.



#### **Specifications**

Size 8 Double Stack: 21 mm (0.8-in) Hybrid Linear Actuator (1.8° Step Angle)				
	Captive	21M4 –	- †	
Part No.	Non-Captive	21L4 –	-	
	External Linear	E21M4 –	†	
Wiring	Bipolar			
Winding Voltage	2.5 VDC 5 VDC 7.5 VDC			
Current (RMS)/phase	1.32 A	.65 A .43 A		
Resistance/phase	1.9 Ω	7.7 Ω	17.3 Ω	
Inductance/phase	0.8 mH 3.2 mH 6.1 mH			
Power Consumption		6.5 W Total		
Rotor Inertia		2.6 gcm <sup>2</sup>		
Insulation Class	Class B (Class F available)			
Weight	2.4 oz (43 g)			
Insulation Resistance		20 MΩ		

†Part numbering information on page 4

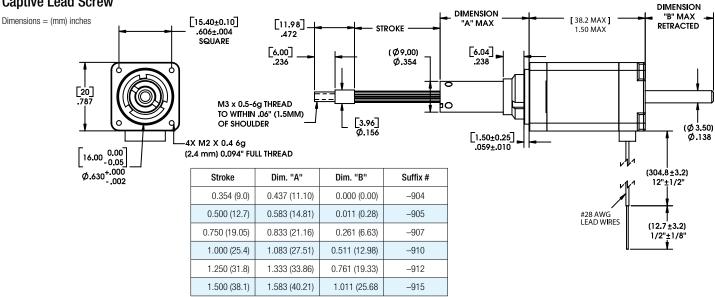
Linear Tra	vel / Step	Order	
Screw Ø.14-	Screw Ø.14-in (3.56mm)		
inches	mm	Code I.D.	
.000098*	.0025	AA	
.00012	.0030*	N	
.00019*	.005	AB	
.00024	.006*	K	
.00039*	0.01	AC	
.00048	.0121*	J	
.00078*	.02	AD	
.00157*	.04	AE	
.00157	.04	AE	

\*Values truncated Standard motors are Class B rated for maximum temperature of 130°C.

Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.



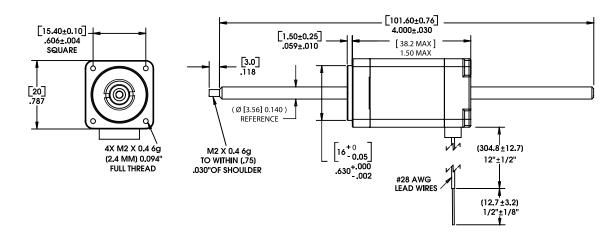




#### **Non-Captive Lead Screw**

Dimensions = (mm) inches

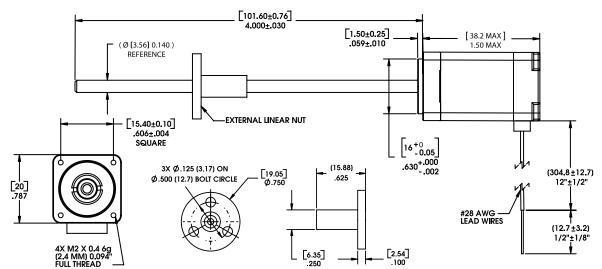




#### **External Linear**

Dimensions = (mm) inches

Up to 6 in (152 mm) standard screw lengths. Longer screw lengths are available.



**AMETEK**®

#### 21000 Series • Size 8 Double Stack Stepper Motor Linear Actuators

#### **FORCE vs. PULSE RATE**

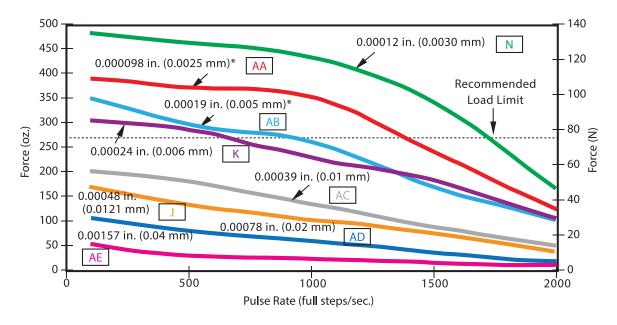
Chopper

- Ø .14 (3.56) Lead Screw

- Bipolar

- 8:1 Motor Coil to Drive Supply Voltage

- 100% Duty Cycle



#### **FORCE vs. LINEAR VELOCITY**

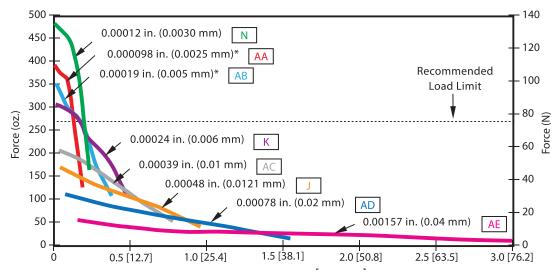
Chopper

 $- \emptyset$  .14 (3.56) Lead Screw

- Bipolar

- 8:1 Motor Coil to Drive Supply Voltage

- 100% Duty Cycle



\*Care should be taken when utilizing these screw pitches to ensure that the physical load limits of the motor are not exceeded. Please consult the factory for advice in selecting the proper pitch for your application. Ramping can increase the performance of a motor either by increasing the top speed or getting a heavier load accelerated up to speed faster. Also, deceleration can be used to stop the motor without overshoot.

NOTE: All chopper drive curves were created with a 5 volt motor and a 40 volt power supply.

With L/R drives peak force and speeds are reduced, using a unipolar drive will yield a further 30% force reduction.

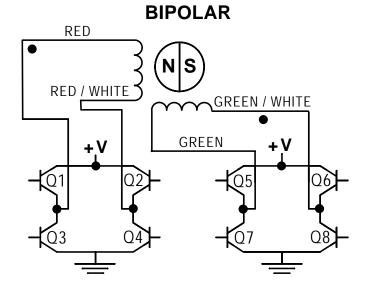
**AMETEK** 

#### Identifying the Hybrid Part Number Codes when Ordering

E	21	M	4	N	2.5	910
Prefix	Series Number	Style	Coils	Code ID Resolution	Voltage	Suffix
(include only when	Designation	<b>L</b> = 1.8°	<b>4</b> = Bipolar	Travel/Step	<b>2.5</b> = 2.5 VDC	Stroke
using the following)	21 = 21000	Non-captive	(4 wire)	<b>AA</b> *= .000098-in (.0025)	<b>05</b> = 5 VDC	Example: $-910 = 1$ -in
$\mathbf{A} = A \text{ Coil}$	(Series numbers	<b>M</b> = 1.8°Captive or		<b>N</b> = .00012-in (.0030)	<b>7.5</b> = 7.5 VDC	(Refer to Stroke chart on Captive
(See AC Synchronous	represent approximate	External (use		AB = .00019 - in (.005)	Custom V available	motor series product page.)
Data Sheet)	width of motor	"E" or "K" Prefix for External		<b>K</b> = .00024-in (.006)	odotom v dvanabio	Suffix also represents:
<b>E</b> = External	body)	version)		AC = .00039 - in (.01)		-800 = Metric
$\mathbf{K} = \text{External with}$		, , ,		<b>J</b> = .00048-in (.0121)		−900 = External Linear with
40° thread				AD = .00078 - in (.02)		grease and flanged nut
form				<b>AE</b> = .00157-in (.04)		–XXX = Proprietary suffix
<b>P</b> = Proximity				` ′		assigned to a specific customer
Sensor				*TFE not available		application. The identifier can apply to either a standard
						or custom part.

NOTE: Dashes must be included in Part Number (-) as shown above. For assistance call our Engineering Team at 203 756 7441.

#### Hybrids: Wiring



#### Hybrids: Stepping Sequence

	Bipolar	Q2-Q3	Q1-Q4	Q6-Q7	Q5-Q8	
$\Xi$	Step					1
EXTEND CW	1	ON	OFF	ON	OFF	]  ≥
CW	2	OFF	ON	ON	OFF	N.C.
	3	OFF	ON	OFF	ON	RACT
$\downarrow$	4	ON	OFF	OFF	ON	RFTR
	1	ON	OFF	ON	OFF	۳

Note: Half stepping is accomplished by inserting an off state between transitioning phases.

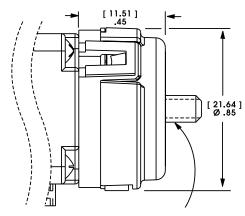
AMETEK\*

# Encoders Designed for All Sizes of Hybrid Linear Actuators

All Haydon Hybrid Linear Actuators are available with specifically designed encoders for applications that require feedback. The compact optical incremental encoder design is available with two channel quadrature TTL squarewave outputs. An optional index is also available as a 3rd channel. The Size 8 Encoder provides resolutions for applications that require 250 and 300 counts per revolution. Encoders are available for all motor configurations — captive, non-captive and external linear.

Simplicity and low cost make Encoders ideal for both high and low volume motion control applications. The internal monolithic electronic module converts the real-time shaft angle, speed, and direction into TTL compatible outputs. The encoder module incorporates a lensed LED light source and monolithic photodetector array with signal shaping electronics to produce the two channel bounceless TTL outputs.

#### 21mm 21000 Series Size 8



NOTE: Lead Screw extends beyond encoder on specific captive and non-captive motors. External linear shaft extension is available upon request.

Single Ended Encoder - Pinout - Size 8					
Connector Pin #	Description				
1	+5 VDC Power				
2	Channel A				
3	Ground				
4	Channel B				



Electrical Specifications							
	Minimum	Typical	Maximum	Units			
Input Voltage	4.5	5.0	5.5	VDC			
Output Signals	4.5	5.0	5.5	VDC			

<sup>2</sup> channel quadrature TTL squarewave outputs.

Channel B leads A for a clockwise rotation of the rotor viewed from the encoder cover.

Tracks at speeds of 0 to 100,000 cycles/sec.

Optional index available as a 3rd channel (one pulse per revolution).

Operating Temperature		
Size 8	Minimum	Maximum
	- 10°C (14°F)	85°C (185°F)

Mechanical Specifications				
	Maximum			
Acceleration	250,000 rad/sec2			
Vibration (5 Hz to 2 kHz)	20 g			

Resolution						
4 Standard Cycles Per Revolution (CPR) or Pulses Per Revolution (PPR)						
Cino O	CPR	250	300			
Size 8	PPR	1000	1200			

AMETEK®
ADVANCED MOTION SOLUTIONS



Encoder Ready Option Shown 34000 Series Size 17



Extended Rotor Journal Shown 34000 Series Size 17





**Encoder Ready Option for all Hybrid Sizes** 

Our Hybrid Linear Actuators can now be manufactured as an Encoder Ready Actuator. Encoder Ready Actuators can be used to install several popular hollow shaft encoders. Available with an extended rotor journal and a threaded rear housing. The motor uses a proprietary manufacturing process which incorporates engineering thermoplastics in the rotor drive nut and a stainless steel Acme Lead Screw that allows the motor to be much more efficient and durable than today's more commonly used V-thread bronze nut configurations.

#### **Extended Rotor Journal for all Hybrid Sizes**

Available with an extended rotor journal. The extended rotor journal can be used for encoder installation, manual adjustment, or flag installation for a positioning sensor.

#### Home Position Switch for Hybrids

A miniature electronic Home Position Switch capable of monitoring the home positions of linear actuators. The switch mounts on the rear sleeve of captive linear motors and allows the user to identify start, stop or home positions.

When ordering motors with the home position switch the part number should be preceded by an "S" prefix.

#### End of Stroke Proximity Sensor for all Hybrid Sized

The Sensor incorporates a hall effect device, which is activated by a rare earth magnet embedded in the end of the internal screw. The compact profile of the sensor allows for installation in limited space applications. The sensor has a virtually unlimited cycle life. Special cabling and connectors can also be provided.

When ordering motors with the proximity sensor, the part number should be preceded by a "P" prefix.

#### Black Ice® and Kerkote® TFE Coated Lead Screws\*

TFE Coated Lead Screws for applications that require a *greaseless* screw and nut interface.

A *dry* (non-lubricated) TFE coated lead screw provides improved performance in both life and thrust as compared to a conventional stainless steel lead-screw. TFE can be applied to a wide variety of lead-screw pitches and is available for our brand captive, non-captive and external linear actuators. Not available for 0.00006-in (.0015 mm) and 0.000098-in (.0025 mm) resolutions.

\*Certain conditions apply.

#### Integrated Anti-Backlash Nut for Hybrids\*

Most sizes (except Size 34) of our captive and non-captive hybrid stepper motors can be equipped with an integral anti-backlash feature. There is a normal backlash between the lead screw and integral rotor nut.

Our actuators are designed for millions of cycles. However over time, additional backlash could increase and eventually double. Haydon Kerk Integrated Anti-Backlash Nut can eliminate all backlash. Designed specifically for our captive and non-captive hybrid motors, nuts use an opposing spring force to eliminate backlash between the screw and the nut interface. The nuts will self-compensate and accommodate any wear. Haydon Kerk Motion Solutions application engineers can help you select the appropriate preload for your application

\*Except Size 34.





# 28000 Series Size 11 Hybrid Linear Actuators

#### Compact, production-proven precision in motion.

The various patented designs deliver high performance, opening avenues for equipment designers who require performance and endurance in a very small package.

#### 3 Available Designs

- Captive
- Non-Captive
- External Linear

The 28000 Series is available in a wide variety of resolutions - from 0.000125-in (.003175 mm) per step to 0.002-in (.0508 mm) per step.

The Size 11 actuator delivers thrust of -up to 20 lbs. (90 N).



Size 11: 28 mm (1.1-in) Hybrid Linear Actuator (1.8° Step Angle)						
	Captive	28H4 — — — †			28H6 – – †	
Part No.	Non-Captive	28F4		†	28F4 –	†
	External Linear	E28H4		†	E28H6 –	
	Wiring		Bipolar		Unipo	olar**
Wind	ding Voltage	2.1 VDC	5 VDC	5 VDC	12 VDC	
Curren	t (RMS)/phase	1.0 A 0.42 A 0.18 A			0.42 A	0.18 A
Resis	tance/phase	2.1	11.9 Ω	11.9 Ω	68.6 Ω	
Induc	tance/phase	1.5 mH	6.7 mH	39.0 mH	3.3 mH	19.5 mH
Power	Consumption			4.2 W		
Ro	tor Inertia			9.0 gcm <sup>2</sup>		
Insu	lation Class	Class B (Class F available)				
Weight 4.2 oz (119 g)						
Insulati	ion Resistance			20 MΩ		

Part numbering information on page 4. ** Unipolar drive gives approximately 30% less thrust than bipolar drive	).
--	----

Linear Tra	Order Code I.D.	
inches	mm	0000 1.5.
.000125	.0031*	7
.00025	.0063*	9
.0005	.0127	3
.001	.0254	1
.002	.0508	2

\*Values truncated.

Standard motors are Class B rated for maximum temperature of 130°C.

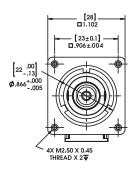
Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.

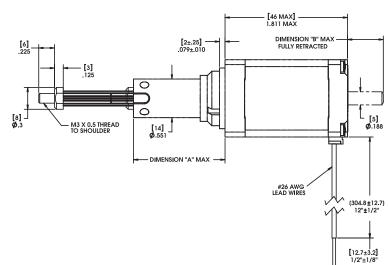


#### **Captive Lead Screw**

Dimensions = (mm) inches

Integrated connector option available





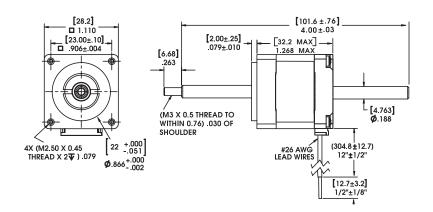
Stroke	Dim. "A"	Dim. "B"	Suffix #
0.500 (12.7)	0.806 (20.47)	0.208 (5.28)	-905
0.750 (19.05)	1.056 (26.82)	0.458 (11.63)	-907
1.000 (25.4)	1.306 (33.17)	0.708 (17.98)	-910
1.250 (31.8)	1.556 (39.52)	0.958 (24.33)	-912
1.500 (38.1)	1.806 (45.87)	1.208 (30.68)	-915
2.00 (50.8)	2.306 (58.57)	1.208 (30.68)	-920
2.500 (38.1)	2.806 (71.27)	1.208 (30.68)	-925

#### **Non-Captive Lead Screw**

Dimensions = (mm) inches

Integrated connector option available

4-in [101.6 mm] standard screw lengths. Longer screw lengths are available.

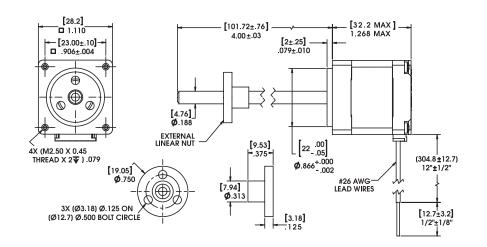


#### **External Linear**

Dimensions = (mm) inches

Integrated connector option available

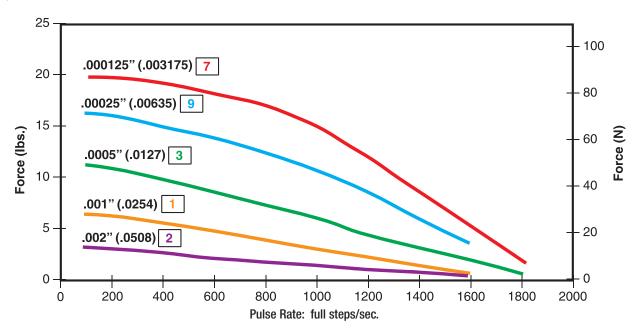
4-in [101.6 mm] standard screw lengths.
Longer screw lengths are available.





#### FORCE vs. PULSE RATE

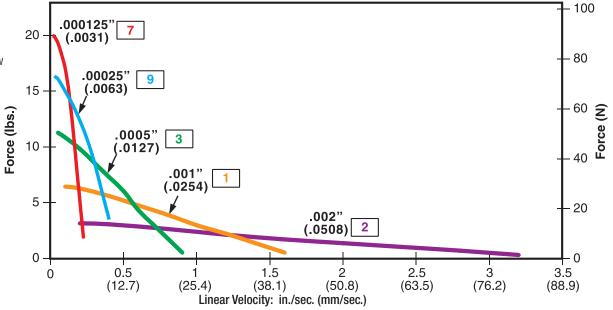
- Chopper
- Bipolar
- 100% Duty Cycle
- $\emptyset$  .1875 (4.75) Lead Screw



#### **FORCE vs. LINEAR VELOCITY**



- Bipolar
- 100% Duty Cycle
- $\emptyset$  .1875 (4.75) Lead Screw



NOTE: All chopper drive curves were created with a 5 volt motor and a 40 volt power supply.

Ramping can increase the performance of a motor either by increasing the top speed or getting a heavier load accelerated up to speed faster. Also, deceleration can be used to stop the motor without overshoot.

With L/R drives peak force and speeds are reduced, using a unipolar drive will yield a further 30% force reduction.

www.haydonkerkpittman.com

Advanced morton solutrions

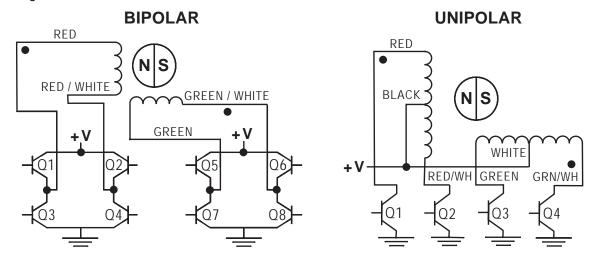
3

#### Identifying the Hybrid Part Number Codes when Ordering

Е	28	Н	4	7	05	910
Prefix	Series Number	Style	Coils	Code ID Resolution	Voltage	Suffix
(include only when using the following)  A = A Coil (See AC Synchronous Data Sheet)  E = External  K = External with 40° thread form  P = Proximity Sensor  S = Home Position	Designation  28 = 28000 (Series numbers represent approximate width of motor body)	F = 1.8° Non-captive H = 1.8°Captive or External (use "E" or "K" Prefix for External version)	4 = Bipolar (4 wire) 6 = Unipolar (6 wire)	Travel/Step  1 = .001-in (.0254)  2= .002-in (.0508)  3 = .0005-in (.0127)  7 = .000125-in (.0031)  9 = .00025-in (.0063)	2.1 = 2.1 VDC (Bipolar only) 05 = 5 VDC 12 = 12 VDC Custom V available	Stroke  Example: -910 = 1-in (Refer to Stroke chart on Captive motor series product page.)  Suffix also represents:  -800 = Metric  -900 = External Linear with grease and flanged nut  -XXX = Proprietary suffix assigned to a specific customer application. The identifier can apply to either a standard

NOTE: Dashes must be included in Part Number (-) as shown above. For assistance call our Engineering Team at 203 756 7441.

#### Hybrids: Wiring



#### Hybrids: Stepping Sequence

	Bipolar	Q2-Q3	Q1-Q4	Q6-Q7	Q5-Q8	
EXTEND CW	Step					1
$\mathbb{H}$	1	ON	OFF	ON	OFF	
CW	2	OFF	ON	ON	OFF	CCW
	3	OFF	ON	OFF	ON	ACT
$\downarrow$	4	ON	OFF	OFF	ON	RETRACT
	1	ON	OFF	ON	OFF	<u> </u>

Note: Half stepping is accomplished by inserting an off state between transitioning phases.

AMETEK\*

# Encoders Designed for All Sizes of Hybrid Linear Actuators

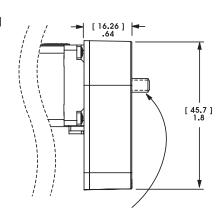
All Haydon Hybrid Linear Actuators are available with specifically designed encoders for applications that require feedback. The compact optical incremental encoder design is available with two channel quadrature TTL squarewave outputs. An optional index is also available as a 3rd channel. The Size 11 Encoder provides resolutions for applications that require 200, 400 and 1,000 counts per revolution. Encoders are available for all motor configurations.

Simplicity and low cost make the encoders ideal for both high and low volume motion control applications. The internal monolithic electronic module converts the real-time shaft angle, speed, and direction into TTL compatible outputs. The encoder module incorporates a lensed LED light source and monolithic photodetector array with signal shaping electronics to produce the two channel bounceless TTL outputs.



#### 30 mm 28000 Series Size 11

NOTE: Lead Screw extends beyond encoder on specific captive and non-captive motors. External linear shaft extension is available upon request.



Differential Ended Encod	er - Pinout - Size 11
Connector Pin #	Description
1	Ground
2	Ground
3	– Index
4	+ Index
5	Channel A –
6	Channel A +
7	+5 VDC Power
8	+5 VDC Power
9	Channel B —
10	Channel B +

Electrical Specifications							
	Minimum	Typical	Maximum	Units			
Input Voltage	4.5	5.0	5.5	VDC			
Output Signals	4.5	5.0	5.5	VDC			

2 channel quadrature TTL squarewave outputs.

Channel B leads A for a clockwise rotation of the rotor viewed from the encoder cover.

Tracks at speeds of 0 to 100,000 cycles/sec.

Optional index available as a 3rd channel (one pulse per revolution).

Operating Temperature		
Size 11	Minimum	Maximum
	- 40°C (- 40°F)	100°C (212°F)

Mechanical Specifications				
	Maximum			
Acceleration	250,000 rad/sec2			
Vibration (5 Hz to 2 kHz)	20 g			

Resolution						
4 Standard Cycles Per Revolution (CPR) or Pulses Per Revolution (PPR)						
Size 11	CPR	200	400	1000*		
	PPR	800	1600	4000*		

<sup>\*</sup>Index Pulse Channel not available

Single Ended Encoder - Pinout - Size 11					
Connector Pin #	Description	Connector Pin #	Description		
1	Ground	4	+5 VDC Power		
2	Index (optional)	5	Channel B		
3	Channel A				

# Integrated Connector for Hybrid Size 11

Offered alone or with a harness assembly, this connector is RoHS compliant and features a positive latch in order for high connection integrity. The connector is rated up to 3 amps and the mating connector will handle a range of wire gauges from 22 to 28. Ideal for those that want to plug in directly to pre-existing harnesses.

#### **Motor Connector:**

JST part # S06B-PASK-2

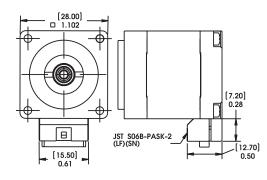
#### **Mating Connector:**

JST part # PAP-06V-S Haydon Kerk Part #56-1210-5 (12 in. Leads)

#### Wire to Board Connector:

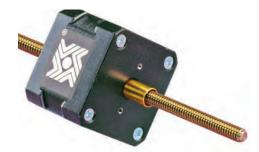
JST part number SPHD-001T-P0.5

Pin#	Bipolar	Unipolar	Color
1	Phase 2 Start	Phase 2 Start	G/W
2	Open	Phase 2 Common	-
3	Phase 2 Finish	Phase 2 Finish	Green
4	Phase 1 Finish	Phase 1 Finish	R/W
5	Open	Phase 1 Common	-
6	Phase 1 Start	Phase 1 Start	Red





Encoder Ready Option Shown 34000 Series Size 17



Extended Rotor Journal Shown 34000 Series Size 17





#### **Encoder Ready Option for all Hybrid Sizes**

Our Hybrid Linear Actuators can now be manufactured as an Encoder Ready Actuator. Encoder Ready Actuators can be used to install several popular hollow shaft encoders. Available with an extended rotor journal and a threaded rear housing. The motor uses a proprietary manufacturing process which incorporates engineering thermoplastics in the rotor drive nut and a stainless steel Acme Lead Screw that allows the motor to be much more efficient and durable than today's more commonly used V-thread bronze nut configurations.

#### **Extended Rotor Journal for all Hybrid Sizes**

Available with an extended rotor journal. The extended rotor journal can be used for encoder installation, manual adjustment, or flag installation for a positioning sensor.

#### Home Position Switch for Hybrids

A miniature electronic Home Position Switch capable of monitoring the home positions of linear actuators. The switch mounts on the rear sleeve of captive linear motors and allows the user to identify start, stop or home positions.

When ordering motors with the home position switch the part number should be preceded by an "S" prefix.

#### End of Stroke Proximity Sensor for all Hybrid Sized

The Sensor incorporates a hall effect device, which is activated by a rare earth magnet embedded in the end of the internal screw. The compact profile of the sensor allows for installation in limited space applications. The sensor has a virtually unlimited cycle life. Special cabling and connectors can also be provided.

When ordering motors with the proximity sensor, the part number should be preceded by a "P" prefix.

#### Black Ice® and Kerkote® TFE Coated Lead Screws\*

TFE Coated Lead Screws for applications that require a *greaseless* screw and nut interface.

A *dry* (non-lubricated) TFE coated lead screw provides improved performance in both life and thrust as compared to a conventional stainless steel lead-screw. TFE can be applied to a wide variety of lead-screw pitches and is available for our brand captive, non-captive and external linear actuators. Not available for 0.00006-in (.0015 mm) and 0.000098-in (.0025 mm) resolutions.

\*Certain conditions apply.

#### Integrated Anti-Backlash Nut for Hybrids\*

Most sizes (except Size 34) of our captive and non-captive hybrid stepper motors can be equipped with an integral anti-backlash feature. There is a normal backlash between the lead screw and integral rotor nut.

Our actuators are designed for millions of cycles. However over time, additional backlash could increase and eventually double. Haydon Kerk Integrated Anti-Backlash Nut can eliminate all backlash. Designed specifically for our captive and non-captive hybrid motors, nuts use an opposing spring force to eliminate backlash between the screw and the nut interface. The nuts will self-compensate and accommodate any wear. Haydon Kerk Motion Solutions application engineers can help you select the appropriate preload for your application

\*Except Size 34.





# 28000 Series Size 11 Double Stack Hybrid Linear Actuators

#### Enhanced performance in motion control

The 28000 Series is available in a wide variety of resolutions - from 0.000125" (.003175 mm) per step to 0.002" (.0508 mm) per step.

#### 3 Available Designs

- Captive
- Non-Captive
- External Linear

The Size 11 actuator delivers thrust of up to 30 lbs. (133 N).



	Size 11 Double Stack: 28 mm (1.1-in) Hybrid Linear Actuator (1.8° Step Angle)						
	Captive 28M4 +						
Part No.	Non-Captive	28L4 — — †					
	External Linear	E2	28M4 – –	Ť			
	Wiring		Bipolar				
Wind	ding Voltage	2.1 VDC	2.1 VDC 5 VDC 12 VDC				
Curren	t (RMS)/phase	1.9 A 750 mA 313 n					
Resis	stance/phase	1.1 Ω	6.7 Ω	34.8 Ω			
Induc	ctance/phase	1.1 mH	5.8 mH	35.6 mH			
Power	Consumption		7.5 W Total				
Ro	otor Inertia		13.5 gcm <sup>2</sup>				
Insu	lation Class	Class B (Class F available)					
	Weight	5.8 oz (180 g)					
Insulat	ion Resistance		20 MΩ				

 $^{\dagger}\!Part$  numbering information on page 4.

Linear Tra Screw Ø.187	Order Code I.D.	
inches	inches mm	
.000125	.0031*	7
.00025 .0063*		9
.0005	.0127	3
.001 .0254		1
.002	.0508	2

<sup>\*</sup>Values truncated.

Standard motors are Class B rated for maximum temperature of 130  $^{\circ}$ C.

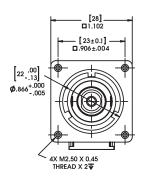
Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.

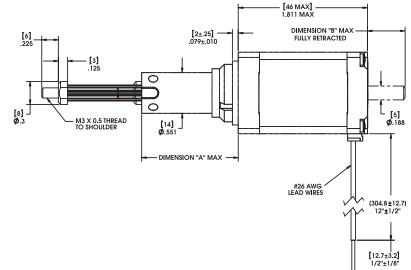


#### **Captive Lead Screw**

Dimensions = (mm) inches

Integrated connector option available





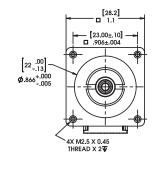
Stroke	Dim. "A"	Dim. "B"	Suffix #
0.500 (12.7)	0.80 (20.5)	0.09 (2.3)	-905
0.750 (19.05)	1.05 (26.8)	0.34 (8.6)	-907
1.000 (25.4)	1.30 (33.17)	0.59 (15.0)	-910
1.250 (31.8)	1.55 (39.5)	0.84 (21.35)	-912
1.500 (38.1)	2.86 (72.7)	1.09 (27.7)	-915
2.00 (50.8)	3.36 (85.4)	1.59 (40.4)	-920
2.500 (38.1)	3.86 (98.1)	2.09 (53.1)	-925

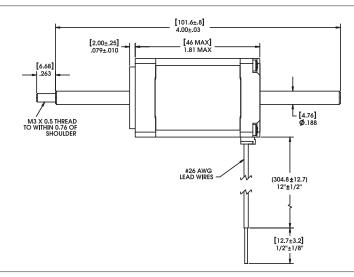
#### **Non-Captive Lead Screw**

Dimensions = (mm) inches

Integrated connector option available

4-in [101.6 mm] standard screw lengths.
Longer screw lengths are available.





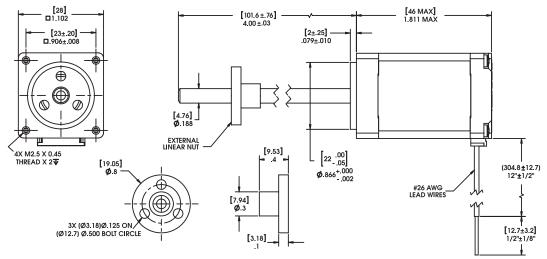
2

#### **External Linear**

Dimensions = (mm) inches

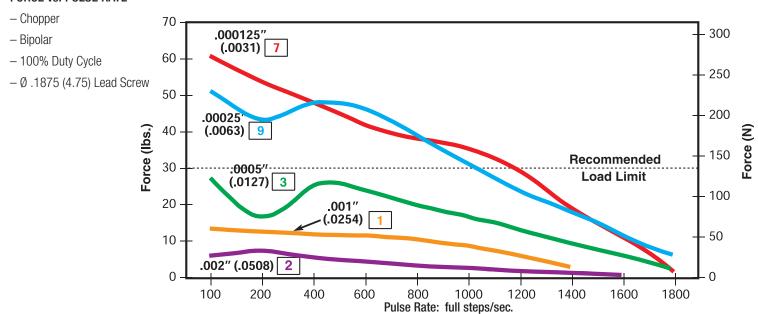
Integrated connector option available

4-in [101.6 mm] standard screw lengths. Longer screw lengths are available.



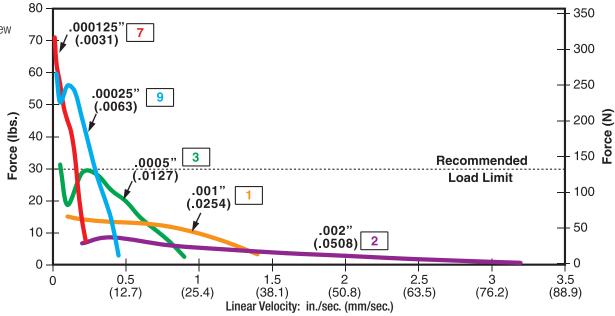
WWW.haydonkerkpittman.com

#### FORCE vs. PULSE RATE



#### **FORCE vs. LINEAR VELOCITY**

- Chopper
- Bipolar
- 100% Duty Cycle
- Ø .1875 (4.75) Lead Screw



NOTE: All chopper drive curves were created with a 5 volt motor and a 40 volt power supply.

Ramping can increase the performance of a motor either by increasing the top speed or getting a heavier load accelerated up to speed faster. Also, deceleration can be used to stop the motor without overshoot.

With L/R drives peak force and speeds are reduced, using a unipolar drive will yield a further 30% force reduction.

www.haydonkerkpittman.com

Advanced morton solutrions

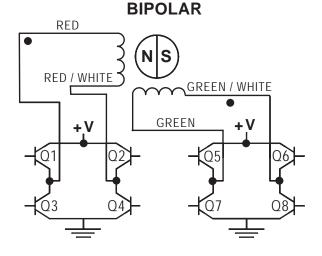
3

#### Identifying the Hybrid Part Number Codes when Ordering

E	28	M	4	7	05	910
Prefix	Series Number	Style	Coils	Code ID Resolution	Voltage	Suffix
(include only when	Designation	L = 1.8°	<b>4</b> = Bipolar	Travel/Step	<b>2.1</b> = 2.1 VDC	Stroke
using the following) <b>A</b> = A Coil (See AC	28 = 28000 (Series numbers	Non-captive	(4 wire)	<b>1</b> = .001-in (.0254)	(Bipolar only)	Example: -910 = 1-in
Synchronous	represent	<b>M</b> = 1.8°Captive or External (use		<b>2</b> = .002-in (.0508)	<b>05</b> = 5 VDC	(Refer to Stroke chart on Captive motor series product page.)
Data Sheet)	approximate	"E" or "K" Prefix		<b>3</b> = .0005-in (.0127) <b>7</b> = .000125-in (.0031)	<b>12</b> = 12 VDC	Suffix also represents:
E = External	width of motor body)	for External		<b>9</b> = .000125-in (.0063)	Custom V available	-800 = Metric
K = External with 40° thread form	,,	version)		<b>9</b> = .00025-III (.0003)		-900 = External Linear with grease and flanged nut
P = Proximity Sensor						-XXX = Proprietary suffix assigned to a specific customer
S = Home Position Switch						application. The identifier can apply to either a standard or custom part.

NOTE: Dashes must be included in Part Number (-) as shown above. For assistance call our Engineering Team at 203 756 7441.

#### Hybrids: Wiring



#### Hybrids: Stepping Sequence

	Bipolar	Q2-Q3	Q1-Q4	Q6-Q7	Q5-Q8	] ,
EX	Step					1
EXTEND CW	1	ON	OFF	ON	0FF	]  ≥
CW	2	OFF	ON	ON	OFF	M.J.
	3	OFF	ON	OFF	ON	RACT
$\downarrow$	4	ON	OFF	OFF	ON	RFTR
	1	ON	OFF	ON	OFF	Δ.

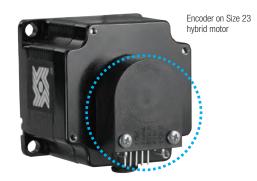
Note: Half stepping is accomplished by inserting an off state between transitioning phases.

AMETEK®
ADVANCED MOTION SOLUTION

# Encoders Designed for All Sizes of Hybrid Linear Actuators

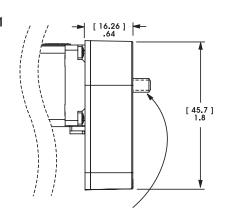
All Haydon Hybrid Linear Actuators are available with specifically designed encoders for applications that require feedback. The compact optical incremental encoder design is available with two channel quadrature TTL squarewave outputs. An optional index is also available as a 3rd channel. The Size 11 Encoder provides resolutions for applications that require 200, 400 and 1,000 counts per revolution. Encoders are available for all motor configurations.

Simplicity and low cost make the encoders ideal for both high and low volume motion control applications. The internal monolithic electronic module converts the real-time shaft angle, speed, and direction into TTL compatible outputs. The encoder module incorporates a lensed LED light source and monolithic photodetector array with signal shaping electronics to produce the two channel bounceless TTL outputs.



#### 30 mm 28000 Series Size 11

NOTE: Lead Screw extends beyond encoder on specific captive and non-captive motors. External linear shaft extension is available upon request.



Differential Ended Encoder - Pinout - Size 11				
Connector Pin #	Description			
1	Ground			
2	Ground			
3	- Index			
4	+ Index			
5	Channel A –			
6	Channel A +			
7	+5 VDC Power			
8	+5 VDC Power			
9	Channel B —			
10	Channel B +			

Electrical Specifications						
	Minimum	Typical	Maximum	Units		
Input Voltage	4.5	5.0	5.5	VDC		
Output Signals	4.5	5.0	5.5	VDC		

2 channel quadrature TTL squarewave outputs.

Channel B leads A for a clockwise rotation of the rotor viewed from the encoder cover.

Tracks at speeds of 0 to 100,000 cycles/sec.

Optional index available as a 3rd channel (one pulse per revolution).

Operating Temperature		
Circ 11	Minimum	Maximum
Size 11	- 40°C (- 40°F)	100°C (212°F)

Mechanical Specifications				
	Maximum			
Acceleration	250,000 rad/sec2			
Vibration (5 Hz to 2 kHz)	20 g			

Resolution						
4 Standard Cycles Per Revolution (CPR) or Pulses Per Revolution (PPR)						
Size 11	CPR	200	400	1000*		
Size 11	PPR	800	1600	4000*		

<sup>\*</sup>Index Pulse Channel not available.

Single Ended Encoder - Pinout - Size 11					
Connector Pin #	Description	Connector Pin #	Description		
1	Ground	4	+5 VDC Power		
2 Index (optional)		5	Channel B		
3	Channel A				

# Integrated Connector for Hybrid Size 11

Offered alone or with a harness assembly, this connector is RoHS compliant and features a positive latch in order for high connection integrity. The connector is rated up to 3 amps and the mating connector will handle a range of wire gauges from 22 to 28. Ideal for those that want to plug in directly to pre-existing harnesses.

#### **Motor Connector:**

JST part # S06B-PASK-2

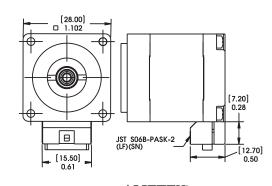
#### Mating Connector:

JST part # PAP-06V-S Haydon Kerk Part #56-1210-5 (12 in. Leads)

#### Wire to Board Connector:

JST part number SPHD-001T-P0.5

Pin#	Bipolar	polar Unipolar	
1	Phase 2 Start	Phase 2 Start	G/W
2	Open	Phase 2 Common	-
3	Phase 2 Finish	Phase 2 Finish	Green
4	Phase 1 Finish	Phase 1 Finish	R/W
5	Open	Phase 1 Common	-
6	Phase 1 Start	Phase 1 Start	Red





Encoder Ready Option Shown 34000 Series Size 17



Extended Rotor Journal Shown 34000 Series Size 17





#### **Encoder Ready Option for all Hybrid Sizes**

Our Hybrid Linear Actuators can now be manufactured as an Encoder Ready Actuator. Encoder Ready Actuators can be used to install several popular hollow shaft encoders. Available with an extended rotor journal and a threaded rear housing. The motor uses a proprietary manufacturing process which incorporates engineering thermoplastics in the rotor drive nut and a stainless steel Acme Lead Screw that allows the motor to be much more efficient and durable than today's more commonly used V-thread bronze nut configurations.

#### **Extended Rotor Journal for all Hybrid Sizes**

Available with an extended rotor journal. The extended rotor journal can be used for encoder installation, manual adjustment, or flag installation for a positioning sensor.

#### Home Position Switch for Hybrids

A miniature electronic Home Position Switch capable of monitoring the home positions of linear actuators. The switch mounts on the rear sleeve of captive linear motors and allows the user to identify start, stop or home positions.

When ordering motors with the home position switch the part number should be preceded by an "S" prefix.

#### End of Stroke Proximity Sensor for all Hybrid Sized

The Sensor incorporates a hall effect device, which is activated by a rare earth magnet embedded in the end of the internal screw. The compact profile of the sensor allows for installation in limited space applications. The sensor has a virtually unlimited cycle life. Special cabling and connectors can also be provided.

When ordering motors with the proximity sensor, the part number should be preceded by a "P" prefix.

#### Black Ice® and Kerkote® TFE Coated Lead Screws\*

TFE Coated Lead Screws for applications that require a *greaseless* screw and nut interface.

A *dry* (non-lubricated) TFE coated lead screw provides improved performance in both life and thrust as compared to a conventional stainless steel lead-screw. TFE can be applied to a wide variety of lead-screw pitches and is available for our brand captive, non-captive and external linear actuators. Not available for 0.00006-in (.0015 mm) and 0.000098-in (.0025 mm) resolutions.

\*Certain conditions apply.

#### Integrated Anti-Backlash Nut for Hybrids\*

Most sizes (except Size 34) of our captive and non-captive hybrid stepper motors can be equipped with an integral anti-backlash feature. There is a normal backlash between the lead screw and integral rotor nut.

Our actuators are designed for millions of cycles. However over time, additional backlash could increase and eventually double. Haydon Kerk Integrated Anti-Backlash Nut can eliminate all backlash. Designed specifically for our captive and non-captive hybrid motors, nuts use an opposing spring force to eliminate backlash between the screw and the nut interface. The nuts will self-compensate and accommodate any wear. Haydon Kerk Motion Solutions application engineers can help you select the appropriate preload for your application

\*Except Size 34.





# 35000 Series Size 14 Hybrid Linear Actuators

#### Higher force, longer life and improved performance

The various patented designs deliver exceptional performance and new linear motion design opportunities.

#### 3 Available Designs

- Captive
- Non-Captive
- External Linear

The 35000 Series is available in a wide variety of resolutions - from 0.00012-in (.003048 mm) per step to 0.00192-in (.048768 mm) per step. The motors can also be microstepped for even finer resolutions.

The Size 14 actuator delivers thrust of -up to 50 lbs. (222 N).



	Size 14: 35 mm (1.1-in) Hybrid Linear Actuator (1.8° Step Angle)					
	Captive	35H4		†	35H6 –	
Part No.	Non-Captive	35F4		Ť	35F4 –	†
	External Linear	E35H4		†	E35H6 –	†
	Wiring		Bipolar		Unipo	olar**
Wind	ding Voltage	2.33 VDC	5 VDC	12 VDC	5 VDC	12 VDC
Curren	t (RMS)/phase	1.25 A	0.57 A	0.24 A	0.57 A	0.24 A
Resis	stance/phase	1.86 Ω	8.8 Ω	50.5 Ω	8.8 Ω	50.5 Ω
Induc	ctance/phase	2.8 mH	13 mH	60 mH	6.5 mH	30 mH
Power	Consumption			5.7 W		
Ro	otor Inertia			16.0 gcm <sup>2</sup>		
Insu	lation Class	Class B (Class F available)				
	Weight	5.7 oz (162 g)				
Insulat	ion Resistance			20 MΩ		

 $^{\dagger}$ Part numbering information on page 5. \*\* Unipolar drive gives approximately 30% less thrust than bipolar drive.

Linear Tra		
Screw Ø .21	Order Code I.D.	
inches	inches mm	
.00012	.0030*	N
.00024	.0060*	K
.00048	.0121*	J
.00096	.0243*	Q
.00192	.0487*	R

Linear Tra		
Screw Ø .250	Order Code I.D.	
inches	0000 I.D.	
.00015625	.0039*	Р
.0003125	.0079*	А
.000625	.0158*	В
.00125	.0317*	С

\*Values truncated

Standard motors are Class B rated for maximum temperature of 130  $^{\circ}\text{C}.$ 

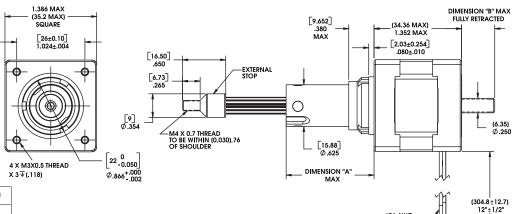
Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.



#### **Captive Lead Screw**

Dimensions = (mm) inches

Integrated connector option available



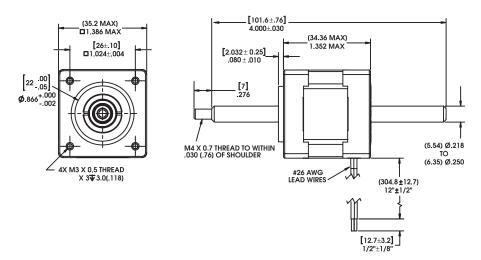
Stroke	Dim. "A"	Dim. "B"	Suffix #
0.500 (12.7)	0.82 (20.8)	0.04 (1.0)	-905
0.750 (19.05)	1.07 (27.2)	0.29 (7.4)	-907
1.000 (25.4)	1.32 (33.5)	0.54 (13.7)	-910
1.250 (31.8)	1.57 (39.9)	0.79 (20.1)	-912
1.500 (38.1)	1.82 (46.2)	1.04 (26.4)	-915
2.00 (50.8)	2.32 (58.9)	1.54 (39.1)	-920
2.500 (63.5)	2.82 (71.6)	2.04 (51.8)	-925

#### Non-Captive Lead Screw

Dimensions = (mm) inches

Integrated connector option available

4-in [101.6 mm] standard screw lengths.
Longer screw lengths are available.

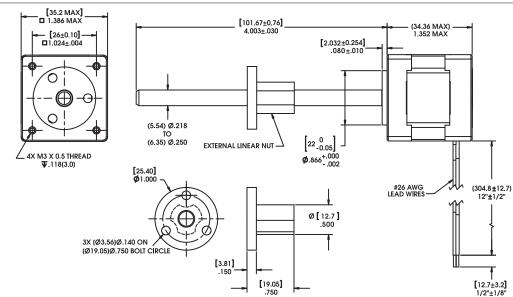


#### **External Linear**

Dimensions = (mm) inches

Integrated connector option available

4-in [101.6 mm] standard screw lengths.
Longer screw lengths are available.



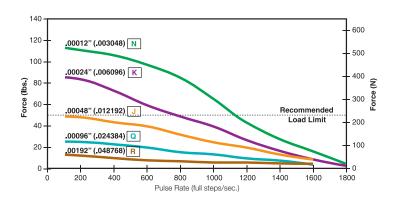
**AMETEK**°

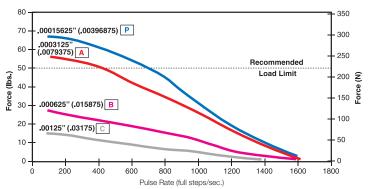
#26 AWG LEAD WIRES

#### **FORCE vs. PULSE RATE** - Chopper - Bipolar - 100% Duty Cycle

- Ø .218 (5.54) Lead Screw

- Ø .250 (6.35) Lead Screw

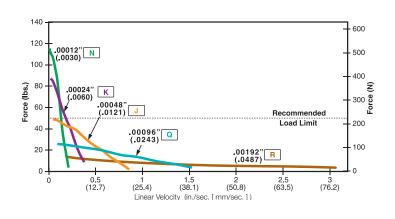


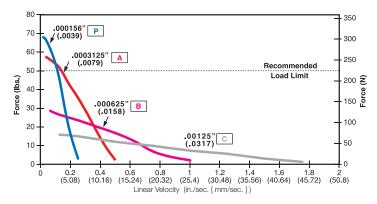


#### **FORCE vs. LINEAR VELOCITY** — Chopper — Bipolar — 100% Duty Cycle

- Ø .218 (5.54) Lead Screw







NOTE: All chopper drive curves were created with a 5 volt motor and a 40 volt power supply.

Ramping can increase the performance of a motor either by increasing the top speed or getting a heavier load accelerated up to speed faster. Also, deceleration can be used to stop the motor without overshoot.

With L/R drives peak force and speeds are reduced, using a unipolar drive will yield a further 30% force reduction.

**AMETEK**°

# 35000 Series Size 14, 0.9° High Resolution Motor

Compared to the standard resolution (1.8°) this motor has been engineered to precisely deliver reliable high speed, force, up to 50 lbs (222 N), as well as a full step movement as low as 1.5 microns.

	Size 14: 35 mm (1.1-in) Hybrid Linear Actuator (0.9° Step Angle)					
	Captive	35K4		Ť	35K6 –	†
Part No.	Non-Captive	35J4		†	35J4 –	†
	External Linear	E35K4		†	E35K6 –	†
	Wiring		Bipolar		Unipo	olar**
Wind	ding Voltage	2.33 VDC	5 VDC	12 VDC	5 VDC	12 VDC
Curren	t (RMS)/phase	1.25 A	0.57 A	0.24 A	0.57 A	0.24 A
Resis	tance/phase	$1.86\Omega$	8.8 Ω	50.5 Ω	8.8 Ω	50.5 Ω
Induc	ctance/phase	2.8 mH	13 mH	60 mH	6.5 mH	30 mH
Power	Consumption			5.7 W		
Ro	otor Inertia	16.0 gcm <sup>2</sup>				
Insu	lation Class	Class B (Class F available)				
	Weight	5.7 oz (162 g)				
Insulati	ion Resistance			20 MΩ		

<sup>\*\*</sup> Unipolar drive gives approximately 30% less thrust than bipolar drive.

Linear Tra	Order Code I.D.		
inches	inches mm		
.00006	.0015*	U	
.00012	.00012 .0030*		
.00024	.0060*	K	
.00048	.0121*	J	
.00096	.0243*	Q	

· · · · · · · · · · · · · · · · · · ·					
Linear Tra					
Screw Ø .250	Order Code I.D.				
inches	0000 1.5.				
.000078*	.00198*	V			
.00015625	.0039*	Р			
.0003125	.0079*	А			
.000625	.0158*	В			

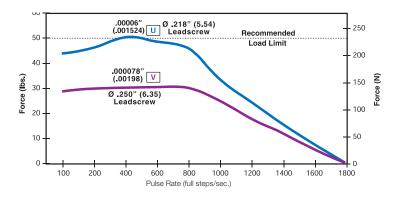
\*Values truncated.

Standard motors are Class B rated for maximum temperature of 130°C.

NOTE: Refer to performance curves on page 3 for codes N, K, J, Q, P, A, B  $\,$ 

Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.

**FORCE vs. PULSE RATE** — Chopper — Bipolar — 100% Duty Cycle with two available lead screw diameters

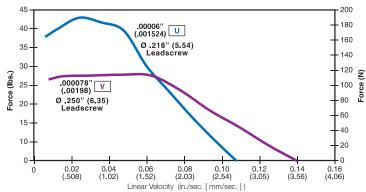


NOTE: All chopper drive curves were created with a 5 volt motor and a 40 volt power supply.

Ramping can increase the performance of a motor either by increasing the top speed or getting a heavier load accelerated up to speed faster. Also, deceleration can be used to stop the motor without overshoot.

With L/R drives peak force and speeds are reduced, using a unipolar drive will yield a further 30% force reduction.

**FORCE vs. LINEAR VELOCITY** – Chopper – Bipolar – 100% Duty Cycle with two available lead screw diameters

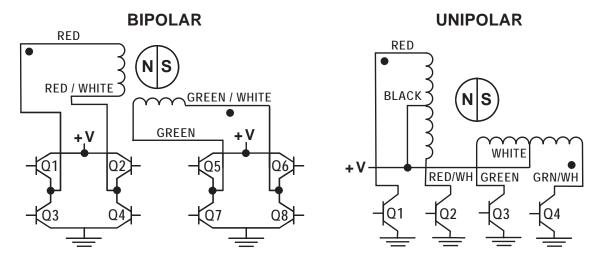


#### Identifying the Hybrid Part Number Codes when Ordering

E	35	Н	4	7	2.33	910
Prefix	Series Number	Style	Coils	Code ID Resolution	Voltage	Suffix
(include only when using the following)	Designation $35 = 35000$	F = 1.8° Non-captive	4 = Bipolar (4 wire)	<b>Travel/Step N</b> = .00012-in (.0030)	<b>2.33</b> = 2.33 VDC <b>05</b> = 5 VDC	<b>Stroke</b> Example: $-910 = 1$ -in
A = A Coil (See AC Synchronous	(Series numbers represent	H = 1.8° Captive or External (use "E"	<b>6</b> = Unipolar (6 wire)	$\mathbf{K} = .00024 \text{-in } (.0060)$ $\mathbf{J} = .00048 \text{-in } (.0121)$	<b>12</b> = 12 VDC Custom V available	(Refer to Stroke chart on Captive motor series product page.)
Data Sheet) <b>E</b> = External	approximate width of motor body)	or "K" Prefix for External version)		<b>Q</b> = .00096-in (.0243) <b>P</b> = .00015625-in (.0039)	Custoff v available	Suffix also represents: -800 = Metric
<b>K</b> = External with 40° thread form	,,	J = 0.9° Non-captive		<b>A</b> = .0003125-in (.0079)		-900 = External Linear with grease and flanged nut
P = Proximity Sensor		K = 0.9° Captive or External (use "E" or "K" Prefix for		<b>B</b> = .000625-in (.0158) <b>C</b> = .00125-in (.0317)		-XXX = Proprietary suffix assigned to a specific customer
S = Home Position Switch		External version)		R = .00192-in (.0478)  High Resolution		application. The identifier can apply to either a standard or custom part.
				<b>U</b> = .00006-in (.0015)		or odolom part.
				<b>V</b> = .000078-in (.00198)		

NOTE: Dashes must be included in Part Number (-) as shown above. For assistance call our Engineering Team at 203 756 7441.

#### Hybrids: Wiring



#### Hybrids: Stepping Sequence

	Bipolar	Q2-Q3	Q1-Q4	Q6-Q7	Q5-Q8	
EXTEND CW	Step					1
$\mathbb{H}$	1	ON	OFF	ON	OFF	
CW	2	OFF	ON	ON	OFF	CCW
	3	OFF	ON	OFF	ON	ACT
$\downarrow$	4	ON	OFF	OFF	ON	RETRACT
	1	ON	OFF	ON	OFF	<u> </u>

Note: Half stepping is accomplished by inserting an off state between transitioning phases.

AMETEK

# Encoders Designed for All Sizes of Hybrid Linear Actuators

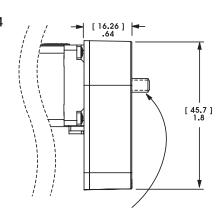
All Haydon Hybrid Linear Actuators are available with specifically designed encoders for applications that require feedback. The compact optical incremental encoder design is available with two channel quadrature TTL squarewave outputs. An optional index is also available as a 3rd channel. The Size 14 Encoder provides resolutions for applications that require 200, 400 and 1,000 counts per revolution. Encoders are available for all motor configurations.

Simplicity and low cost make the encoders ideal for both high and low volume motion control applications. The internal monolithic electronic module converts the real-time shaft angle, speed, and direction into TTL compatible outputs. The encoder module incorporates a lensed LED light source and monolithic photodetector array with signal shaping electronics to produce the two channel bounceless TTL outputs.



#### 30 mm 35000 Series Size 14

NOTE: Lead Screw extends beyond encoder on specific captive and non-captive motors. External linear shaft extension is available upon request.



Differential Ended Encoder - Pinout - Size 14			
Connector Pin #	Description		
1	Ground		
2	Ground		
3	– Index		
4	+ Index		
5	Channel A –		
6	Channel A +		
7	+5 VDC Power		
8	+5 VDC Power		
9	Channel B —		
10	Channel B +		

Electrical Specifications					
	Minimum	Typical	Maximum	Units	
Input Voltage	4.5	5.0	5.5	VDC	
Output Signals	4.5	5.0	5.5	VDC	

2 channel quadrature TTL squarewave outputs.

Channel B leads A for a clockwise rotation of the rotor viewed from the encoder cover.

Tracks at speeds of 0 to 100,000 cycles/sec.

Optional index available as a 3rd channel (one pulse per revolution).

Operating Temperature					
Size 14	Minimum	Maximum			
Size 14	- 40°C (- 40°F)	100°C (212°F)			

Mechanical Specifications			
	Maximum		
Acceleration	250,000 rad/sec2		
Vibration (5 Hz to 2 kHz)	20 g		

Resolution					
4 Standard Cycles Per Revolution (CPR) or Pulses Per Revolution (PPR)					
Size 14	CPR	200	400	1000*	
SIZE 14	PPR	800	1600	4000*	

<sup>\*</sup>Index Pulse Channel not available

Single Ended Encoder - Pinout - Size 14					
Connector Pin # Description Connector Pin # Description					
1	Ground	4	+5 VDC Power		
2	Index (optional)	5	Channel B		
3	Channel A				

# Integrated Connector for Hybrid Size 14

Offered alone or with a harness assembly, this connector is RoHS compliant and features a positive latch in order for high connection integrity. The connector is rated up to 3 amps and the mating connector will handle a range of wire gauges from 22 to 28. Ideal for those that want to plug in directly to pre-existing harnesses.

#### **Motor Connector:**

JST part # S06B-PASK-2

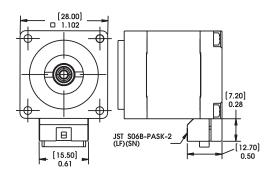
#### **Mating Connector**:

JST part # PAP-06V-S Haydon Kerk Part #56-1210-5 (12 in. Leads)

#### Wire to Board Connector:

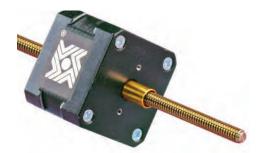
JST part number SPHD-001T-P0.5

Pin#	Bipolar	Unipolar	Color
1	Phase 2 Start	Phase 2 Start	G/W
2	Open	Phase 2 Common	-
3	Phase 2 Finish	Phase 2 Finish	Green
4	Phase 1 Finish	Phase 1 Finish	R/W
5	Open	Phase 1 Common	-
6	Phase 1 Start	Phase 1 Start	Red



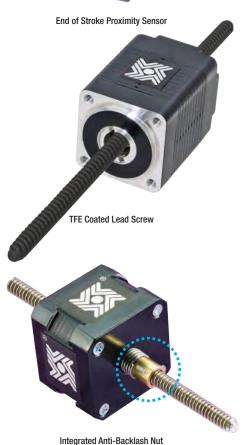


Encoder Ready Option Shown 34000 Series Size 17



Extended Rotor Journal Shown 34000 Series Size 17





**Encoder Ready Option for all Hybrid Sizes** 

Our Hybrid Linear Actuators can now be manufactured as an Encoder Ready Actuator. Encoder Ready Actuators can be used to install several popular hollow shaft encoders. Available with an extended rotor journal and a threaded rear housing. The motor uses a proprietary manufacturing process which incorporates engineering thermoplastics in the rotor drive nut and a stainless steel Acme Lead Screw that allows the motor to be much more efficient and durable than today's more commonly used V-thread bronze nut configurations.

#### **Extended Rotor Journal for all Hybrid Sizes**

Available with an extended rotor journal. The extended rotor journal can be used for encoder installation, manual adjustment, or flag installation for a positioning sensor.

#### Home Position Switch for Hybrids

A miniature electronic Home Position Switch capable of monitoring the home positions of linear actuators. The switch mounts on the rear sleeve of captive linear motors and allows the user to identify start, stop or home positions.

When ordering motors with the home position switch the part number should be preceded by an "S" prefix.

#### End of Stroke Proximity Sensor for all Hybrid Sized

The Sensor incorporates a hall effect device, which is activated by a rare earth magnet embedded in the end of the internal screw. The compact profile of the sensor allows for installation in limited space applications. The sensor has a virtually unlimited cycle life. Special cabling and connectors can also be provided.

When ordering motors with the proximity sensor, the part number should be preceded by a "P" prefix.

#### Black Ice® and Kerkote® TFE Coated Lead Screws\*

TFE Coated Lead Screws for applications that require a *greaseless* screw and nut interface.

A *dry* (non-lubricated) TFE coated lead screw provides improved performance in both life and thrust as compared to a conventional stainless steel lead-screw. TFE can be applied to a wide variety of lead-screw pitches and is available for our brand captive, non-captive and external linear actuators. Not available for 0.00006-in (.0015 mm) and 0.000098-in (.0025 mm) resolutions.

\*Certain conditions apply.

#### Integrated Anti-Backlash Nut for Hybrids\*

Most sizes (except Size 34) of our captive and non-captive hybrid stepper motors can be equipped with an integral anti-backlash feature. There is a normal backlash between the lead screw and integral rotor nut.

Our actuators are designed for millions of cycles. However over time, additional backlash could increase and eventually double. Haydon Kerk Integrated Anti-Backlash Nut can eliminate all backlash. Designed specifically for our captive and non-captive hybrid motors, nuts use an opposing spring force to eliminate backlash between the screw and the nut interface. The nuts will self-compensate and accommodate any wear. Haydon Kerk Motion Solutions application engineers can help you select the appropriate preload for your application

\*Except Size 34.





# 35000 Series Size 14 Double Stack Hybrid Linear Actuators

#### Improved force and performance

The 35000 Series is available in a wide variety of resolutions - from 0.000625-in (.0158 mm) per step to 0.005-in (.127 mm) per step. The motors can also be microstepped for even finer resolutions.

#### 3 Available Designs

- Captive
- Non-Captive
- External Linear

The Size 14 actuator delivers thrust of up to 50 lbs. (222 N).



	Size 14 Double Stack: 35 mm (1.4-in) Hybrid Linear Actuator (1.8° Step Angle)					
	Captive	35M4 — — — — <sup>†</sup>				
Part No.	Non-Captive	35L4 – — †				
	External Linear	E3	85M4 – –	Ť		
	Wiring	Bipolar				
Wind	ding Voltage	2.33 VDC 5 VDC 12 VDC				
Curren	t (RMS)/phase	2 A 910 mA 38		380 mA		
Resis	stance/phase	1.2 $\Omega$ 5.5 $\Omega$ 31.6 $\Omega$				
Induc	ctance/phase	1.95 mH	7.63 mH	65.1 mH		
Power	Consumption		9.1 W Total			
Ro	otor Inertia		30 gcm <sup>2</sup>			
Insu	lation Class	Class B (Class F available)				
	Weight	8.5 oz (240 g)				
Insulat	ion Resistance	20 ΜΩ				

ιge 4.
ιge 4.

	vel / Step 75"(4.76mm)	Order Code I.D.
inches	mm	Oodo I.D.
.000625	.0158*	В
.00125	.0317*	С
.0025	.0635	Y
.00375	.0953	AG
.005	.127	Z

<sup>\*</sup>Values truncated.

Standard motors are Class B rated for maximum temperature of 130  $^{\circ}$ C.

Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.



#### **Captive Lead Screw**

Dimensions = (mm) inches

Stroke

0.500 (12.7)

0.750 (19.05)

1.000 (25.4)

1.250 (31.8)

1.500 (38.1)

2.00 (50.8)

2.500 (38.1)

Dim. "A"

0.82 (20.8)

1.07 (27.2)

1.32 (33.5)

1.57 (39.9)

1.82 (46.2)

2.32 (58.9)

2.82 (71.6)

1.04 (26.4)

1.54 (39.1)

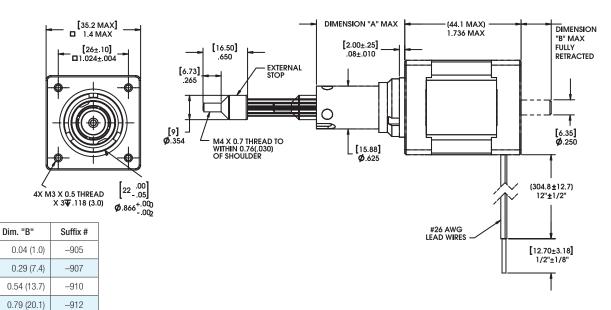
2.04 (51.8)

-915

-920

-925

Integrated connector option available

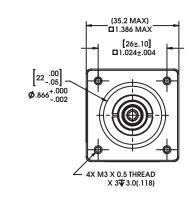


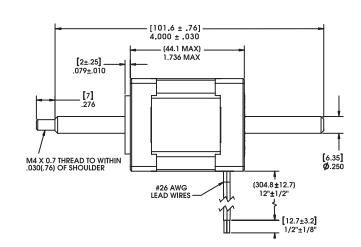
#### Non-Captive Lead Screw

Dimensions = (mm) inches

Integrated connector option available

4-in [101.6 mm] standard screw lengths. Longer screw lengths are available.



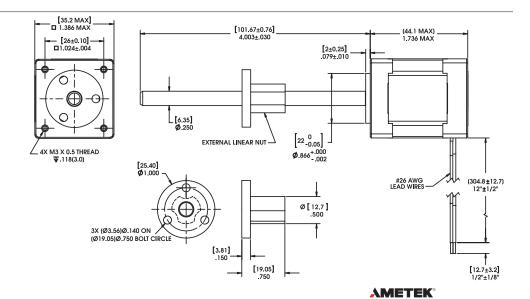


#### **External Linear**

Dimensions = (mm) inches

Integrated connector option available

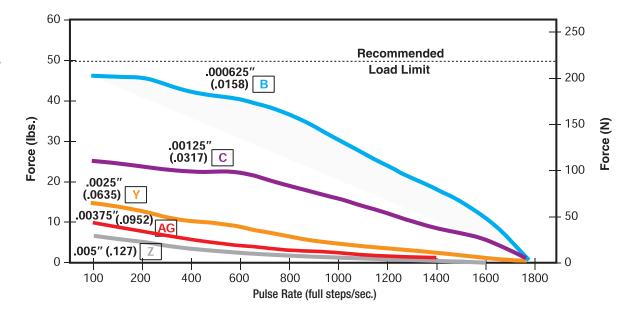
4-in [101.6 mm] standard screw lengths. Longer screw lengths are available.



www.haydonkerkpittman.com

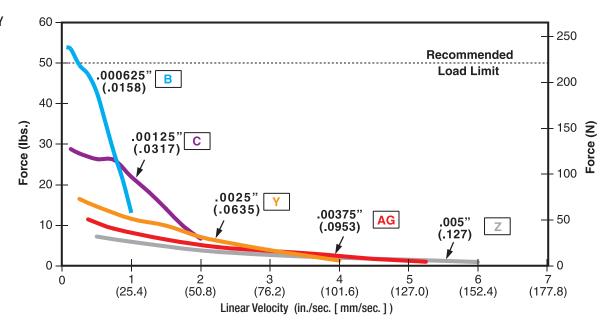
#### FORCE vs. PULSE RATE

- Chopper
- Bipolar
- 100% Duty Cycle
- Ø .250 (6.35)Lead Screw



#### FORCE vs. LINEAR VELOCITY

- Chopper
- Bipolar
- 100% Duty Cycle
- Ø .250 (6.35) Lead Screw



NOTE: All chopper drive curves were created with a 5 volt motor and a 40 volt power supply.

Ramping can increase the performance of a motor either by increasing the top speed or getting a heavier load accelerated up to speed faster. Also, deceleration can be used to stop the motor without overshoot.

With L/R drives peak force and speeds are reduced, using a unipolar drive will yield a further 30% force reduction.

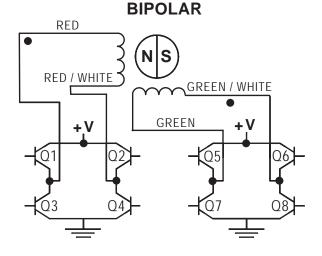
www.haydonkerkpittman.com 3

#### Identifying the Hybrid Part Number Codes when Ordering

E	35	L	4	В	12	910
Prefix	Series Number	Style	Coils	Code ID Resolution	Voltage	Suffix
(include only when	Designation	<b>L</b> = 1.8°	4 = Bipolar	Travel/Step	<b>2.33</b> = 2.33 VDC	Stroke
using the following)	35 = 35000	Non-captive	(4 wire)	$\mathbf{B} = .000625 \text{-in} (.0158)$	<b>05</b> = 5 VDC	Example: -910 = 1-in
A = A Coil (See AC	(Series numbers represent	$\mathbf{M} = 1.8^{\circ}$ Captive or		<b>C</b> = .00125-in (.0317)	<b>12</b> = 12 VDC	(Refer to Stroke chart on Captive motor series product page.)
Synchronous Data Sheet)	approximate	External (use "E" or "K" Prefix		<b>Y</b> = .0025-in (.0635))	Custom V available	,
E = External	width of motor	for External		AG = .00375 - in (.0953)		Suffix also represents:
<b>K</b> = External with	body)	version)		<b>Z</b> = .005-in (.127)		-800 = Metric
40° thread form						-900 = External Linear with grease and flanged nut
<b>P</b> = Proximity						–XXX = Proprietary suffix
Sensor						assigned to a specific customer application. The identifier
S = Home Position Switch						can apply to either a standard or custom part.
						,

NOTE: Dashes must be included in Part Number (-) as shown above. For assistance call our Engineering Team at 203 756 7441.

#### Hybrids: Wiring



#### Hybrids: Stepping Sequence

	Bipolar	Q2-Q3	Q1-Q4	Q6-Q7	Q5-Q8	
EX	Step					1
EXTEND CW	1	ON	OFF	ON	OFF	
CW	2	OFF	ON	ON	OFF	NO.
	3	OFF	ON	OFF	ON	RACT
$\downarrow$	4	ON	OFF	OFF	ON	RFTR
	1	ON	OFF	ON	OFF	B

Note: Half stepping is accomplished by inserting an off state between transitioning phases.

AMETEK®

# Encoders Designed for All Sizes of Hybrid Linear Actuators

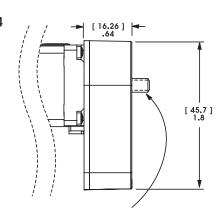
All Haydon Hybrid Linear Actuators are available with specifically designed encoders for applications that require feedback. The compact optical incremental encoder design is available with two channel quadrature TTL squarewave outputs. An optional index is also available as a 3rd channel. The Size 14 Encoder provides resolutions for applications that require 200, 400 and 1,000 counts per revolution. Encoders are available for all motor configurations.

Simplicity and low cost make the encoders ideal for both high and low volume motion control applications. The internal monolithic electronic module converts the real-time shaft angle, speed, and direction into TTL compatible outputs. The encoder module incorporates a lensed LED light source and monolithic photodetector array with signal shaping electronics to produce the two channel bounceless TTL outputs.

# Encoder on Size 23 hybrid motor

#### 30 mm 35000 Series Size 14

NOTE: Lead Screw extends beyond encoder on specific captive and non-captive motors. External linear shaft extension is available upon request.



Differential Ended Encoder - Pinout - Size 14				
Connector Pin #	Description			
1	Ground			
2	Ground			
3	– Index			
4	+ Index			
5	Channel A —			
6	Channel A +			
7	+5 VDC Power			
8	+5 VDC Power			
9	Channel B —			
10	Channel B +			

Electrical Specifications					
	Minimum	Typical	Maximum	Units	
Input Voltage	4.5	5.0	5.5	VDC	
Output Signals	4.5	5.0	5.5	VDC	

2 channel quadrature TTL squarewave outputs.

Channel B leads A for a clockwise rotation of the rotor viewed from the encoder cover.

Tracks at speeds of 0 to 100,000 cycles/sec.

Optional index available as a 3rd channel (one pulse per revolution).

Operating Temperature		
Size 14	Minimum	Maximum
SIZE 14	- 40°C (- 40°F)	100°C (212°F)

Mechanical Specifications		
	Maximum	
Acceleration	250,000 rad/sec2	
Vibration (5 Hz to 2 kHz)	20 g	

Resolution				
4 Standard Cycles Per Revolution (CPR) or Pulses Per Revolution (PPR)				
Size 14	CPR	200	400	1000*
SIZE 14	PPR	800	1600	4000*

<sup>\*</sup>Index Pulse Channel not available

Single Ended Encoder - Pinout - Size 14					
Connector Pin #	Description	Connector Pin #	Description		
1	Ground	4	+5 VDC Power		
2	Index (optional)	5	Channel B		
3	Channel A				

# Integrated Connector for Hybrid Size 14

Offered alone or with a harness assembly, this connector is RoHS compliant and features a positive latch in order for high connection integrity. The connector is rated up to 3 amps and the mating connector will handle a range of wire gauges from 22 to 28. Ideal for those that want to plug in directly to pre-existing harnesses.

#### **Motor Connector:**

JST part # S06B-PASK-2

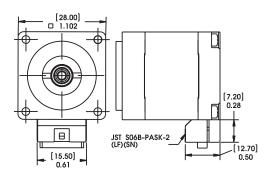
#### **Mating Connector**:

JST part # PAP-06V-S Haydon Kerk Part #56-1210-5 (12 in. Leads)

#### Wire to Board Connector:

JST part number SPHD-001T-P0.5

Pin#	Bipolar	Unipolar	Color
1	Phase 2 Start	Phase 2 Start	G/W
2	Open	Phase 2 Common	-
3	Phase 2 Finish	Phase 2 Finish	Green
4	Phase 1 Finish	Phase 1 Finish	R/W
5	Open	Phase 1 Common	-
6	Phase 1 Start	Phase 1 Start	Red



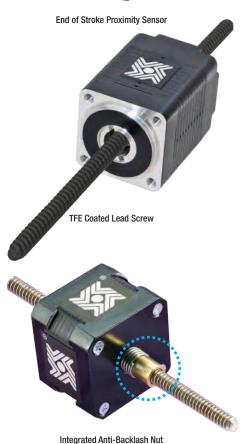


Encoder Ready Option Shown 34000 Series Size 17



Extended Rotor Journal Shown 34000 Series Size 17





### **Encoder Ready Option for all Hybrid Sizes**

Our Hybrid Linear Actuators can now be manufactured as an Encoder Ready Actuator. Encoder Ready Actuators can be used to install several popular hollow shaft encoders. Available with an extended rotor journal and a threaded rear housing. The motor uses a proprietary manufacturing process which incorporates engineering thermoplastics in the rotor drive nut and a stainless steel Acme Lead Screw that allows the motor to be much more efficient and durable than today's more commonly used V-thread bronze nut configurations.

### **Extended Rotor Journal for all Hybrid Sizes**

Available with an extended rotor journal. The extended rotor journal can be used for encoder installation, manual adjustment, or flag installation for a positioning sensor.

### Home Position Switch for Hybrids

A miniature electronic Home Position Switch capable of monitoring the home positions of linear actuators. The switch mounts on the rear sleeve of captive linear motors and allows the user to identify start, stop or home positions.

When ordering motors with the home position switch the part number should be preceded by an "S" prefix.

### End of Stroke Proximity Sensor for all Hybrid Sized

The Sensor incorporates a hall effect device, which is activated by a rare earth magnet embedded in the end of the internal screw. The compact profile of the sensor allows for installation in limited space applications. The sensor has a virtually unlimited cycle life. Special cabling and connectors can also be provided.

When ordering motors with the proximity sensor, the part number should be preceded by a "P" prefix.

### Black Ice® and Kerkote® TFE Coated Lead Screws\*

TFE Coated Lead Screws for applications that require a *greaseless* screw and nut interface.

A *dry* (non-lubricated) TFE coated lead screw provides improved performance in both life and thrust as compared to a conventional stainless steel lead-screw. TFE can be applied to a wide variety of lead-screw pitches and is available for our brand captive, non-captive and external linear actuators. Not available for 0.00006-in (.0015 mm) and 0.000098-in (.0025 mm) resolutions.

\*Certain conditions apply.

### Integrated Anti-Backlash Nut for Hybrids\*

Most sizes (except Size 34) of our captive and non-captive hybrid stepper motors can be equipped with an integral anti-backlash feature. There is a normal backlash between the lead screw and integral rotor nut.

Our actuators are designed for millions of cycles. However over time, additional backlash could increase and eventually double. Haydon Kerk Integrated Anti-Backlash Nut can eliminate all backlash. Designed specifically for our captive and non-captive hybrid motors, nuts use an opposing spring force to eliminate backlash between the screw and the nut interface. The nuts will self-compensate and accommodate any wear. Our Engineers can help you select the appropriate preload for your application.

\*Except Size 34





# 43000 Series Size 17 Hybrid Linear Actuators

### Our best selling compact hybrid motors

Top selling designs deliver high performance, opening avenues for equipment designers who previously settled for products with inferior performance and endurance.

### 3 Available Designs

- Captive
- Non-Captive
- External Linear

The 43000 Series is available in a wide variety of resolutions from 0.00006-in. (.001524 mm) per step to 0.00192-in. (.048768 mm) per step, and delivers thrust of up to 50 lbs. (222 N), or speeds exceeding 3 inches (7.62 cm) per second.



	Size 17: 43 mm (1.7-in) Hybrid Linear Actuator (1.8° Step Angle)					
	Captive	43H4		†	43H6 –	†
Part No.	Non-Captive	43F4		†	43F4 –	†
	External Linear	E43H4		†	E43H6 –	†
	Wiring		Bipolar		Unipo	olar**
Wind	ding Voltage	2.33 VDC	2.33 VDC 5 VDC 12 VDC			12 VDC
Current (RMS)/phase		1.5 A	700 mA	290 mA	700 mA	290 mA
Resistance/phase		1.56 Ω	7.2 Ω	41.5 Ω	7.2 Ω	41.5 Ω
Induc	ctance/phase	1.9 mH	8.7 mH	54.0 mH	4.4 mH	27.0 mH
Power	Consumption			7 W		
Ro	otor Inertia	37 gcm <sup>2</sup>				
Insu	lation Class	Class B (Class F available)				
	Weight	8.5 oz (241 g)				
Insulat	ion Resistance			20 MΩ		

 $^\dagger\!Part\ numbering\ information\ on\ page\ 7.\ ^{\star\star}\ Unipolar\ drive\ gives\ approximately\ 30\%\ less\ thrust\ than\ bipolar\ drive.$ 

Linear Tra	Order		
Screw Ø .21	Screw Ø .218" (5.54 mm)		
inches	mm	Code I.D.	
.00012	.0030*	N	
.00024	.0060*	K	
.00048	.0121*	J	
.00096	.0243*	Q	
.00192	.0487*	R	

Linear Tra		
Screw Ø .250	Order Code I.D.	
inches	0000 1.5.	
.00015625	.0039*	Р
.0003125	.0079*	А
.000625	.0158*	В
.00125	.0317*	С

\*Values truncated

Standard motors are Class B rated for maximum temperature of 130°C. Also available, motors with high temperature capability windings up to 155°C.

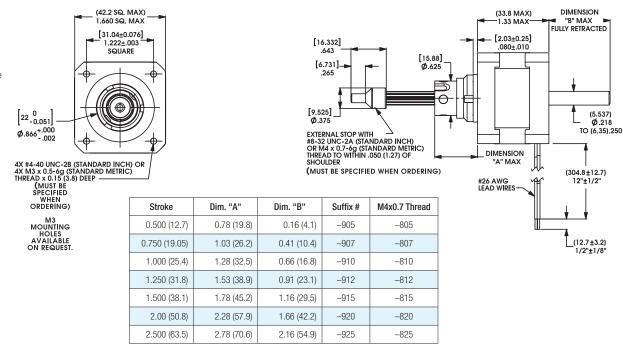
Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.



### **Captive Lead Screw**

Dimensions = (mm) inches

Integrated connector option available

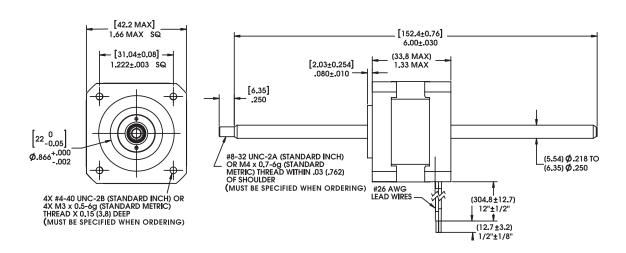


### Non-Captive Lead Screw

Dimensions = (mm) inches

Integrated connector option available

4-in [101.6 mm] standard screw lengths. Longer screw lengths are available.

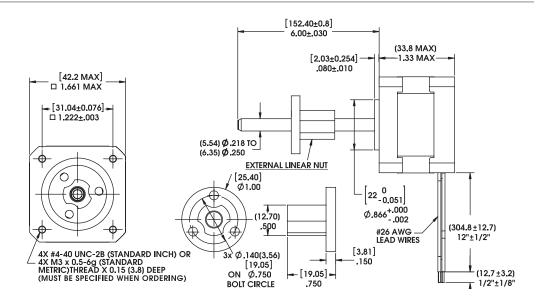


### **External Linear**

Dimensions = (mm) inches

Integrated connector option available

4-in [101.6 mm] standard screw lengths. Longer screw lengths are available.

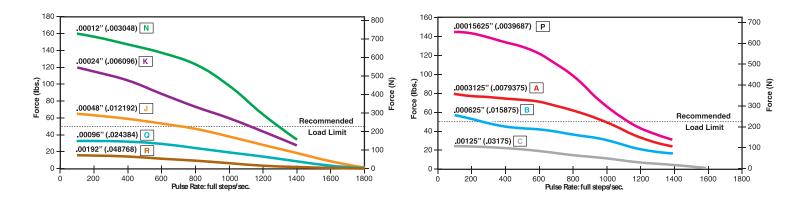


**AMETEK** 

FORCE vs. PULSE RATE - Chopper - Bipolar - 100% Duty Cycle - 8:1 Motor Coil to Drive Supply Voltage

- Ø .218 (5.54) Lead Screw

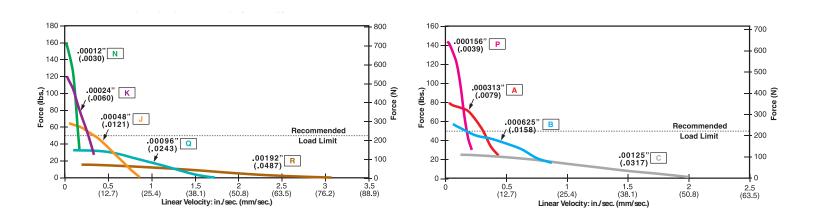
- Ø .250 (6.35) Lead Screw



FORCE vs. LINEAR VELOCITY - Chopper - Bipolar - 100% Duty Cycle - 8:1 Motor Coil to Drive Supply Voltage

- Ø .218 (5.54) Lead Screw

- Ø .250 (6.35) Lead Screw



NOTE: All chopper drive curves were created with a 5 volt motor and a 40 volt power supply.

Ramping can increase the performance of a motor either by increasing the top speed or getting a heavier load accelerated up to speed faster. Also, deceleration can be used to stop the motor without overshoot.

With L/R drives peak force and speeds are reduced, using a unipolar drive will yield a further 30% force reduction.

**AMETEK**°

# 43000 Series Size 17, 0.9° High Resolution Motor

The Size 17 High Resolution Actuator features a production-proven, patented rotor drive nut that delivers trouble-free, long-term performance.

	Size 17: 43 mm (1.7-in) Hybrid Linear Actuator (0.9° Step Angle)					
	Captive	43K4		†	43K6 –	
Part No.	Non-Captive	43J4		†	43J4 –	
	External Linear	E43K4		†	E43K6 –	
	Wiring		Bipolar		Unipo	olar**
Wind	ding Voltage	2.33 VDC	2.33 VDC 5 VDC 12 VDC			12 VDC
Current (RMS)/phase		1.5 A	700 mA	290 mA	700 mA	290 mA
Resistance/phase		$1.56\Omega$	7.2 Ω	41.5 Ω	7.2 Ω	41.5 Ω
Induc	tance/phase	2.6 mH	12 mH	70 mH	6 mH	35 mH
Power	Consumption			7 W		
Ro	otor Inertia	37 gcm <sup>2</sup>				
Insu	lation Class	Class B (Class F available)				
	Weight	8.5 oz (241 g)				
Insulati	ion Resistance			20 MΩ		

<sup>&</sup>lt;sup>†</sup>Part numbering information on page 7. \*\*Unipolar drive gives approximately 30% less thrust than bipolar drive.

Linear Tra	Order Code I.D.	
inches	mm	0000 1.D.
.00006	.0015*	U
.00012	.0030*	N
.00024	.0060*	K
.00048	.0121*	J
.00096	.0243*	Q

Linear Tra	Order		
Screw Ø .25	Screw Ø .250" (6.35 mm)		
inches mm		Code I.D.	
.000078*	.00198*	V	
.00015625	.0039*	Р	
.0003125	.0079*	А	
.000625	.0158*	В	

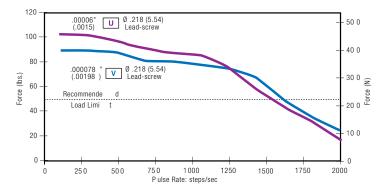
<sup>\*</sup>Values truncated.

Standard motors are Class B rated for maximum temperature of 130°C.

NOTE: Refer to performance curves on page 3 for codes N, K, J, Q, P, A, B

Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.

FORCE vs. PULSE RATE — Chopper — Bipolar — 100% Duty Cycle
— 18:1 Motor Coil to Drive Supply Voltage
with two available lead screw diameters

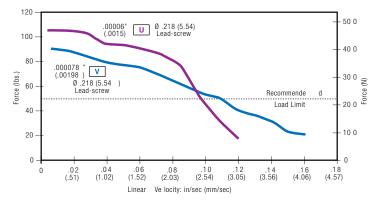


NOTE: All chopper drive curves were created with a 5 volt motor and a 40 volt power supply.

Ramping can increase the performance of a motor either by increasing the top speed or getting a heavier load accelerated up to speed faster. Also, deceleration can be used to stop the motor without overshoot.

With L/R drives peak force and speeds are reduced, using a unipolar drive will yield a further 30% force reduction.

FORCE vs. LINEAR VELOCITY — Chopper — Bipolar — 100% Duty Cycle
— 18:1 Motor Coil to Drive Supply Voltage
with two available lead screw diameters



AMETEK®
ADVANCED MOTION SOLUTIONS



# 43000 Series Size 17 Hybrid Linear Actuators with integrated IDEA™ Drive

### High performance in a compact package

The 43000 Series Single Stack actuator is available in a wide variety of resolutions – from 0.00006-in (.001524 mm) per step to 0.00192-in (.048768mm) per step. Delivers output force of up to 50 lbs (220N), or speeds exceeding 3 inches (7.62 cm) per second.

### 43000 Series with IDEA™ Drive features:

- Fully Programmable
- RoHS Compliant
- USB or RS-485 Communication
- Microstepping Capability: Full, 1/2, 1/4, 1/8, 1/16, 1/32, 1/64
- Graphic User Interface
- Auto-population of Drive Parameters
- Programmable Acceleration/Deceleration and Current Control

### 3 Available Designs

- Captive - Non-Captive - External Linear

NOTE: For more information see the Haydon Kerk IDEA™ Drive Data Sheet.

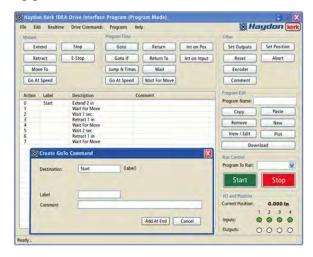


	Size 17 Single Stack: 43 mm (1.7-in) Hybrid Linear Actuator (1.8° Step Angle)				
	Captive	43HG — — — — †			
Part No.	Non-Captive	43FG †			
	External Linear	E43HG — — †			
	Wiring	Bipolar			
Winding Voltage		2.33 VDC**			

<sup>&</sup>lt;sup>T</sup>Part numbering information on page 7. \*\*Contact Haydon Kerk if a higher voltage motor is desired. Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.

# Simple to use IDEA™ Drive software with on-screen buttons and easy-to-understand programming guides

Software program generates motion profiles directly into the system and also contains a "debug" utility allowing lineby-line execution of a motion program for easy troubleshooting.



Linear Tra		
Screw Ø .218	Order Code I.D.	
inches	mm	oodo iibi
.00012	.0030*	N
.00024	.0060*	K
.00048	.0121*	J
.00096	.0243*	Q
.00192	.0487*	R

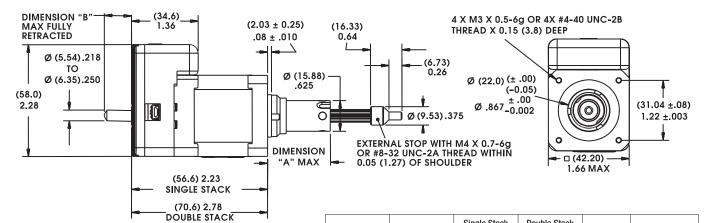
Linear Tra		
Screw Ø .250	Order Code I.D.	
inches mm		0000 1.5.
.00015625	.0039*	Р
.0003125	.0079*	А
.000625	.0158*	В
.00125	.0317*	С

<sup>\*</sup>Values truncated.



### **Captive Lead Screw**

Dimensions = (mm) inches

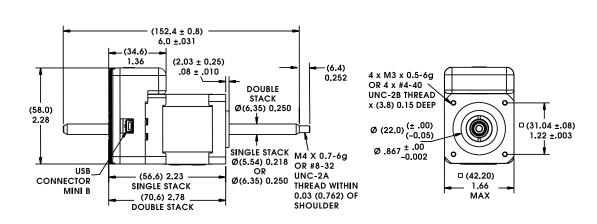


Stroke	Dim. "A"	Single Stack Dim. "B"	Double Stack Dim. "B"	Suffix #	M4x0.7 Thread
0.500 (12.7)	0.78 (19.8)	0	0	-905	-805
0.750 (19.05)	1.03 (26.2)	0	0	-907	-807
1.000 (25.4)	1.28 (32.5)	0	0	-910	-810
1.250 (31.8)	1.53 (38.9)	0	0	-912	-812
1.500 (38.1)	1.78 (45.2)	0.232 (5.9)	0.091 (2.5)	-915	-815
2.00 (50.8)	2.28 (57.9)	0.732 (18.6)	0.591 (15.0)	-920	-820
2.500 (63.5)	2.78 (70.6)	1.232 (31.3)	1.091 (27.7)	-925	-825

### **Non-Captive Lead Screw**

Dimensions = (mm) inches

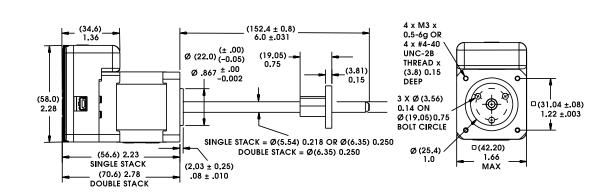
Up to 10-in (254 mm) standard screw lengths. Longer screw lengths are available.



### **External Linear**

Dimensions = (mm) inches

Up to 10-in (254 mm) standard screw lengths. Longer screw lengths are available.

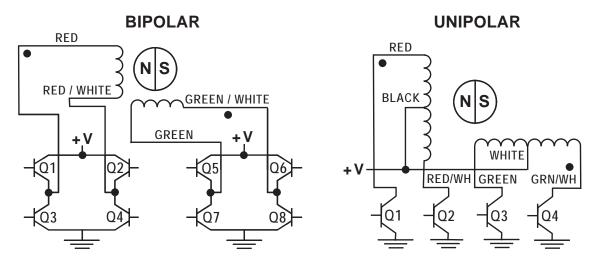


### Identifying the Hybrid Part Number Codes when Ordering

E	43	Н	6	N	2.33	910
Prefix	Series Number	Style	Coils	Code ID Resolution	Voltage	Suffix
(include only when using the following)	Designation 43 = 43000	F = 1.8° Non-captive	4 = Bipolar (4 wire)	Travel/Step N = .00012-in (.0030)	<b>2.33</b> = 2.33 VDC <b>05</b> = 5 VDC	<b>Stroke</b> Example: -910 = 1-in
A = A Coil (See AC Synchronous	(Series numbers represent	H = 1.8° Captive or External (use "E"	<b>6</b> = Unipolar (6 wire)	<b>K</b> = .00024-in (.0060)	<b>12</b> = 12 VDC	(Refer to Stroke chart on Captive motor series product page.)
Data Sheet) <b>E</b> = External	approximate width of motor	or "K" Prefix for External version)	<b>G</b> = IDEA Drive (Size	J = .00048-in (.0121) Q = .00096-in (.0243)	Custom V available	Suffix also represents:
K = External with 40° thread form	body)	J = 0.9° Non-captive	17, 43000 Series, Bipolar	<b>P</b> = .00015625-in (.0039) <b>A</b> = .0003125-in (.0079)		<ul><li>-800 = Metric</li><li>-900 = External Linear with grease and flanged nut</li></ul>
P = Proximity Sensor		<b>K</b> = 0.9° Captive or External (use "E" or "K" Prefix for	only)	B = .000625-in (.0158) C = .00125-in (.0317)		-XXX = Proprietary suffix assigned to a specific customer
<b>S</b> = Home Position Switch		External version)		R = .00192-in (.0478)  High Resolution		application. The identifier can apply to either a standard or custom part.
				<b>U</b> = .00006-in (.0015)		
				<b>V</b> = .000078-in (.00198)		

NOTE: Dashes must be included in Part Number (-) as shown above. For assistance call our Engineering Team at 203 756 7441.

### Hybrids: Wiring



### Hybrids: Stepping Sequence

	Bipolar	Q2-Q3	Q1-Q4	Q6-Q7	Q5-Q8	
EXTEND	Step					1
H	1	ON	OFF	ON	OFF	  ≥
CW	2	OFF	ON	ON	OFF	CCW
	3	OFF	ON	OFF	ON	ACT
$\downarrow$	4	ON	OFF	OFF	ON	RETRACT
	1	ON	OFF	ON	OFF	8

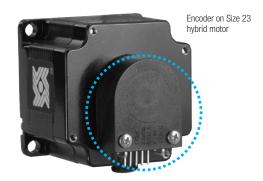
Note: Half stepping is accomplished by inserting an off state between transitioning phases.

AMETEK

# Encoders Designed for All Sizes of Hybrid Linear Actuators

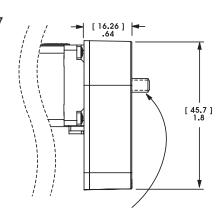
All Haydon Hybrid Linear Actuators are available with specifically designed encoders for applications that require feedback. The compact optical incremental encoder design is available with two channel quadrature TTL squarewave outputs. An optional index is also available as a 3rd channel. The Size 17 Encoder provides resolutions for applications that require 200, 400 and 1,000 counts per revolution. Encoders are available for all motor configurations.

Simplicity and low cost make the encoders ideal for both high and low volume motion control applications. The internal monolithic electronic module converts the real-time shaft angle, speed, and direction into TTL compatible outputs. The encoder module incorporates a lensed LED light source and monolithic photodetector array with signal shaping electronics to produce the two channel bounceless TTL outputs.



### 30 mm 43000 Series Size 17

NOTE: Lead Screw extends beyond encoder on specific captive and non-captive motors. External linear shaft extension is available upon request.



Differential Ended Encoder - Pinout - Size 17		
Connector Pin #	Description	
1	Ground	
2	Ground	
3	– Index	
4	+ Index	
5	Channel A —	
6	Channel A +	
7	+5 VDC Power	
8	+5 VDC Power	
9	Channel B —	
10	Channel B +	

Electrical Specifications				
	Minimum	Typical	Maximum	Units
Input Voltage	4.5	5.0	5.5	VDC
Output Signals	4.5	5.0	5.5	VDC

2 channel quadrature TTL squarewave outputs.

Channel B leads A for a clockwise rotation of the rotor viewed from the encoder cover.

Tracks at speeds of 0 to 100,000 cycles/sec.

Optional index available as a 3rd channel (one pulse per revolution).

Operating Temperature		
Size 17	Minimum	Maximum
	- 40°C (- 40°F)	100°C (212°F)

Mechanical Specifications		
	Maximum	
Acceleration	250,000 rad/sec2	
Vibration (5 Hz to 2 kHz)	20 g	

Resolution				
4 Standard Cycles Per Revolution (CPR) or Pulses Per Revolution (PPR)				
Size 17	CPR	200	400	1000*
Size 17	PPR	800	1600	4000*

<sup>\*</sup>Index Pulse Channel not available

Single Ended Encoder - Pinout - Size 17			
Connector Pin #	Description	Connector Pin #	Description
1	Ground	4	+5 VDC Power
2	Index (optional)	5	Channel B
3	Channel A		

# Integrated Connectors

Hybrid Size 17 linear actuators are available with an integrated connector. Offered alone or with a harness assembly, this connector is RoHS compliant and features a positive latch in order for high connection integrity. The connector is rated up to 3 amps and the mating connector will handle a range of wire gauges from 22 to 28. This motor is ideal for those that want to plug in directly to pre-existing harnesses.

### **Motor Connector:**

JST part # S06B-PASK-2

### Mating Connector:

JST part # PAP-06V-S

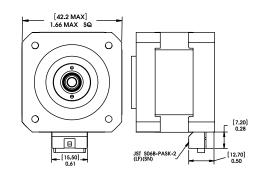
Haydon Kerk Part #56-1210-5 (12 in. Leads)

### Wire to Board Connector:

JST part number SPHD-001T-P0.5

www.haydonkerkpittman.com

Pin#	Bipolar	Unipolar	Color
1	Phase 2 Start	Phase 2 Start	G/W
2	Open	Phase 2 Common	_
3	Phase 2 Finish	Phase 2 Finish	Green
4	Phase 1 Finish	Phase 1 Finish	R/W
5	Open	Phase 1 Common	-
6	Phase 1 Start	Phase 1 Start	Red







Encoder Ready Option Shown 34000 Series Size 17



Extended Rotor Journal Shown 34000 Series Size 17





### **Encoder Ready Option for all Hybrid Sizes**

Our Hybrid Linear Actuators can now be manufactured as an Encoder Ready Actuator. Encoder Ready Actuators can be used to install several popular hollow shaft encoders. Available with an extended rotor journal and a threaded rear housing. The motor uses a proprietary manufacturing process which incorporates engineering thermoplastics in the rotor drive nut and a stainless steel Acme Lead Screw that allows the motor to be much more efficient and durable than today's more commonly used V-thread bronze nut configurations.

### Size 23 Mounting Face Plate for Size 17 Hybrids

Size 23 mounting pattern for our Hybrid Size 17 Linear Actuators.

### **Extended Rotor Journal for all Hybrid Sizes**

Available with an extended rotor journal. The extended rotor journal can be used for encoder installation, manual adjustment, or flag installation for a positioning sensor.

### Home Position Switch for Hybrids

A miniature electronic Home Position Switch capable of monitoring the home positions of linear actuators. The switch mounts on the rear sleeve of captive linear motors and allows the user to identify start, stop or home positions.

When ordering motors with the home position switch the part number should be preceded by an "S" prefix.

### End of Stroke Proximity Sensor for all Hybrid Sized

The Sensor incorporates a hall effect device, which is activated by a rare earth magnet embedded in the end of the internal screw. The compact profile of the sensor allows for installation in limited space applications. The sensor has a virtually unlimited cycle life. Special cabling and connectors can also be provided.

When ordering motors with the proximity sensor, the part number should be preceded by a "P" prefix.

### Black Ice® and Kerkote® TFE Coated Lead Screws\*

TFE Coated Lead Screws for applications that require a *greaseless* screw and nut interface.

A *dry* (non-lubricated) TFE coated lead screw provides improved performance in both life and thrust as compared to a conventional stainless steel lead-screw. TFE can be applied to a wide variety of lead-screw pitches and is available for our brand captive, non-captive and external linear actuators. Not available for 0.00006-in (.0015 mm) and 0.000098-in (.0025 mm) resolutions.

\*Certain conditions apply.

### Integrated Anti-Backlash Nut for Hybrids\*

Most sizes (except Size 34) of our captive and non-captive hybrid stepper motors can be equipped with an integral anti-backlash feature. There is a normal backlash between the lead screw and integral rotor nut.

Our actuators are designed for millions of cycles. However over time, additional backlash could increase and eventually double. Haydon Kerk Integrated Anti-Backlash Nut can eliminate all backlash. Designed specifically for our captive and non-captive hybrid motors, nuts use an opposing spring force to eliminate backlash between the screw and the nut interface. The nuts will self-compensate and accommodate any wear. Haydon Kerk Motion Solutions application engineers can help you select the appropriate preload for your application.

\*Except Size 34.





# 43000 Series Double Stack Size 17 Hybrid Linear Actuators

Exceptional performance and new linear motion design opportunities

The 43000 Series is available in a wide variety of resolutions from 0.000625-in (.0158 mm) per step to 0.005-in (.127 mm) per step. The motors can also be microstepped for even finer resolutions. The Size 17 Double Stack actuator delivers thrust of up to 75 lbs. (337 N).

### 3 Available Designs

- Captive
- Non-Captive
- External Linear



	Size 17 Double Stack: 43 mm (1.7-in) Hybrid Linear Actuator (1.8° Step Angle)			
	Captive	43M4 — — — †		Ť
Part No.	Non-Captive	43L4 — — †		†
	External Linear	E4	3M4 – –	†
	Wiring		Bipolar	
Wind	ding Voltage	2.33 VDC	5 VDC	12 VDC
Curren	t (RMS)/phase	2.6 A	1.3 A	550 mA
Resis	stance/phase	0.9 Ω	3.8 Ω	21.9 Ω
Induc	ctance/phase	1.33 mH	8.21 mH	45.1 mH
Power	Consumption		13.2 W	
Ro	otor Inertia	78 gcm <sup>2</sup>		
Insu	lation Class	Class B (Class F available)		
	Weight	12.5 oz (352 g)		
Insulati	ion Resistance		20 MΩ	

inductance/pnase	1.33 11111	0.21 11111	45.1 11111
Power Consumption	13.2 W		
Rotor Inertia	78 gcm <sup>2</sup>		
Insulation Class	Class B (Class F available)		
Weight	12.5 oz (352 g)		
Insulation Resistance	20 ΜΩ		
<sup>1</sup> Part numbering information on page 6.			

<b>Linear Travel / Step</b> Screw Ø.1875"(4.76mm)		Order Code I.D.
inches	mm	0000 1151
.000625	.0158*	В
.00125	.0317*	С
.0025	.0635	Υ
.00375	.0953	AG
.005	.127	Z

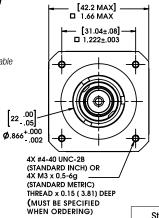
Standard motors are Class B rated for maximum temperature of 130°C.

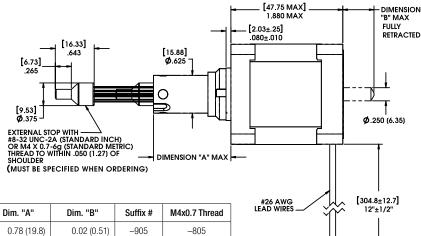
Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.

### **Captive Lead Screw**

Dimensions = (mm) inches

Integrated connector option available





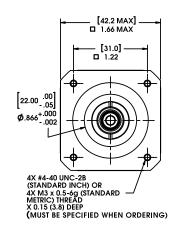
Stroke	Dim. "A"	Dim. "B"	Suffix #	M4x0.7 Thread
0.500 (12.7)	0.78 (19.8)	0.02 (0.51)	-905	-805
0.750 (19.05)	1.03 (26.2)	0.27 (6.86)	-907	-807
1.000 (25.4)	1.28 (32.5)	0.52 (13.21)	-910	-810
1.250 (31.8)	1.53 (38.9)	0.77 (19.56)	-912	-812
1.500 (38.1)	1.78 (45.2)	1.02 (25.91)	-915	-815
2.00 (50.8)	2.28 (57.9)	1.52 (38.61)	-920	-820
2.500 (63.5)	2.78 (70.6)	2.02 (51.31)	-925	-825

### **Non-Captive Lead Screw**

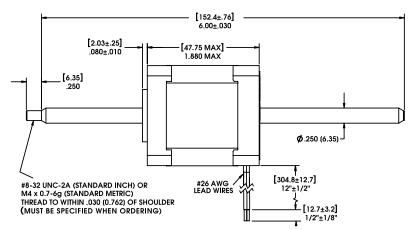
Dimensions = (mm) inches

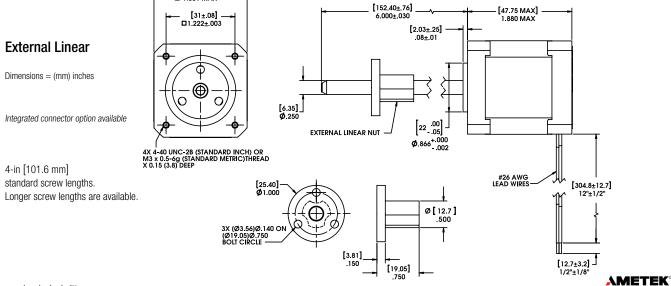
Integrated connector option available

4-in [101.6 mm] standard screw lengths. Longer screw lengths are available.

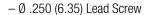


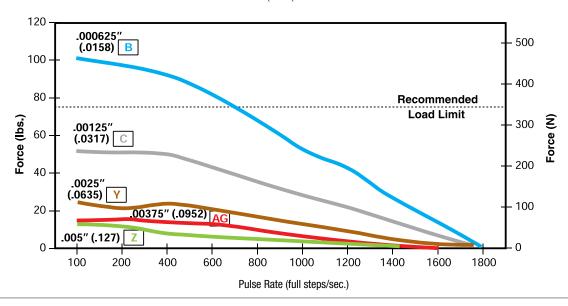
[42.2 MAX]





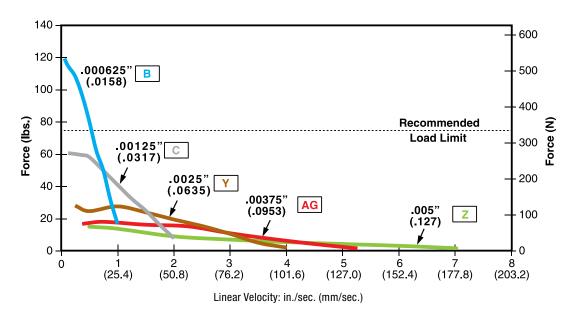
[12.7±3.2] 1/2"±1/8" FORCE vs. PULSE RATE - Chopper - Bipolar - 100% Duty Cycle - 8:1 Motor Coil to Drive Supply Voltage





FORCE vs. LINEAR VELOCITY - Chopper - Bipolar - 100% Duty Cycle - 8:1 Motor Coil to Drive Supply Voltage

### - Ø .250 (6.35) Lead Screw



NOTE: All chopper drive curves were created with a 5 volt motor and a 40 volt power supply.

Ramping can increase the performance of a motor either by increasing the top speed or getting a heavier load accelerated up to speed faster. Also, deceleration can be used to stop the motor without overshoot.

With L/R drives peak force and speeds are reduced, using a unipolar drive will yield a further 30% force reduction.

WWW.haydonkerkpittman.com

3



# 43000 Series Size 17 Double Stack Hybrid Linear Actuators with integrated IDEA™ Drive

### High performance in a compact package

The 43000 Series Double Stack actuator is available in a wide variety of resolutions – from 0.000625-in (.0158 mm) per step to 0.005-in (.127 mm) per step. Delivers output force of up to 75 lbs (337N).

### 43000 Series with IDEA™ Drive features:

- Fully Programmable
- RoHS Compliant
- USB or RS-485 Communication
- Microstepping Capability: Full, 1/2, 1/4, 1/8, 1/16, 1/32, 1/64
- Graphic User Interface
- Auto-population of Drive Parameters
- Programmable Acceleration/Deceleration and Current Control

### 3 Available Designs

- Captive - Non-Captive - External Linear



	Size 17 Double Stack: 43 mm (1.7-in) Hybrid Linear Actuator (1.8° Step Angle)			
	Captive	43MG ———— <sup>†</sup>		
Part No.	Non-Captive	43LG – – †		
	External Linear	E43MG — — †		
	Wiring	Bipolar		
Wind	ding Voltage	2.33 VDC**		

Part numbering information on page 7. **Contact Haydon Kerk if a higher voltage motor is desired	l.
Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.	

Linear Tra	vel / Step	
Screw Ø .250	Order Code I.D.	
inches	mm	oodo iibi
.000625	.0158*	В
.00125	.0317*	С
.0025	.0635*	Υ
.00375	.0953*	AG
.005	.127*	Z

# Simple to use IDEA<sup>™</sup> Drive software with on-screen buttons and easy-to-understand programming guides

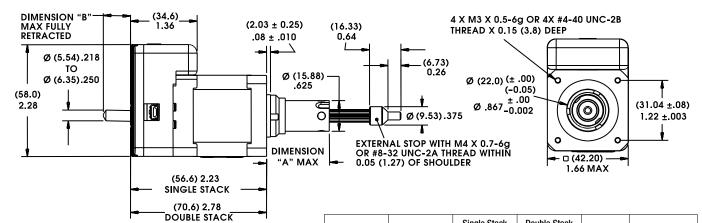
Software program generates motion profiles directly into the system and also contains a "debug" utility allowing line-by-line execution of a motion program for easy troubleshooting.





### **Captive Lead Screw**

Dimensions = (mm) inches

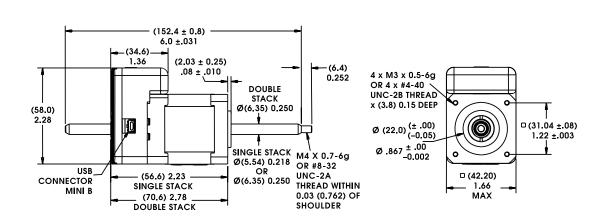


Stroke	Dim. "A"	Single Stack Dim. "B"	Double Stack Dim. "B"	Suffix #	M4x0.7 Thread
0.500 (12.7)	0.78 (19.8)	0	0	-905	-805
0.750 (19.05)	1.03 (26.2)	0	0	-907	-807
1.000 (25.4)	1.28 (32.5)	0	0	-910	-810
1.250 (31.8)	1.53 (38.9)	0	0	-912	-812
1.500 (38.1)	1.78 (45.2)	0.232 (5.9)	0.091 (2.5)	-915	-815
2.00 (50.8)	2.28 (57.9)	0.732 (18.6)	0.591 (15.0)	-920	-820
2.500 (63.5)	2.78 (70.6)	1.232 (31.3)	1.091 (27.7)	-925	-825

### **Non-Captive Lead Screw**

Dimensions = (mm) inches

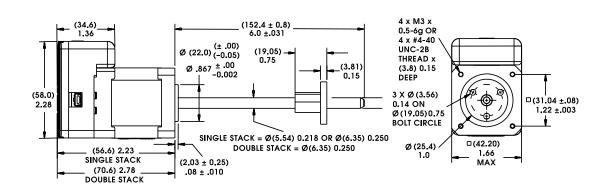
Up to 10-in (254 mm) standard screw lengths. Longer screw lengths are available.



### **External Linear**

Dimensions = (mm) inches

Up to 10-in (254 mm) standard screw lengths. Longer screw lengths are available.



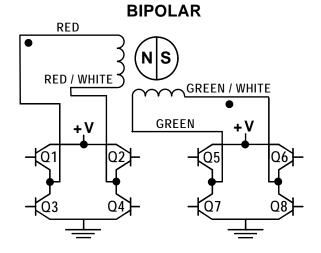
**AMETEK**°

### **Identifying the Hybrid Part Number Codes when Ordering**

E	43	M	G	C	2.33	910
Prefix	Series Number	Style	Coils	Code ID Resolution	Voltage	Suffix
(include only when	Designation	<b>L</b> = 1.8°	<b>4</b> = Bipolar	Travel/Step	<b>2.33</b> = 2.33 VDC	Stroke
using the following)	43 = 43000	Non-captive	(4 wire)	$\mathbf{B} = .000625 \text{-in} (.0158)$	<b>05</b> = 5 VDC	Example: $-910 = 1$ -in
A = A Coil (See AC Synchronous	(Series numbers represent	<b>M</b> = 1.8° Captive or External (use	<b>G</b> = IDEA Drive (Size	<b>C</b> = .00125-in (.0317) <b>Y</b> = .0025-in (.0635)	<b>12</b> = 12 VDC	(Refer to Stroke chart on Captive motor series product page.)
Data Sheet)	approximate width of motor	"E" or "K" Prefix	17, 43000	AG = .00375 - in (.0953)	Custom V available	Suffix also represents:
<b>E</b> = External	body)	for External	Series,	, ,		-800 = Metric
<b>K</b> = External with 40° thread form	body	version)	Bipolar only)	<b>Z</b> = .005-in (.127)		-900 = External Linear with grease and flanged nut
<b>P</b> = Proximity Sensor						<ul><li>–XXX = Proprietary suffix assigned to a specific customer application. The identifier</li></ul>
<b>S</b> = Home Position Switch						can apply to either a standard or custom part.

NOTE: Dashes must be included in Part Number (-) as shown above. For assistance call our Engineering Team at 203 756 7441.

### Hybrids: Wiring



### Hybrids: Stepping Sequence

	Bipolar	Q2-Q3	Q1-Q4	Q6-Q7	Q5-Q8	١.
EXTEND	Step					1
END	1	ON	0FF	ON	OFF	  ≽
CW	2	0FF	ON	ON	OFF	CCW
	3	OFF	ON	0FF	ON	ACT
$\downarrow$	4	ON	OFF	OFF	ON	RETRACT
	1	ON	0FF	ON	0FF	8

Note: Half stepping is accomplished by inserting an off state between transitioning phases.

AMETEK®

# Encoders Designed for All Sizes of Hybrid Linear Actuators

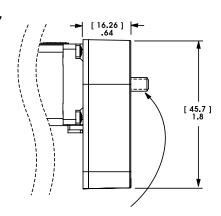
All Haydon Hybrid Linear Actuators are available with specifically designed encoders for applications that require feedback. The compact optical incremental encoder design is available with two channel quadrature TTL squarewave outputs. An optional index is also available as a 3rd channel. The Size 17 Encoder provides resolutions for applications that require 200, 400 and 1,000 counts per revolution. Encoders are available for all motor configurations.

Simplicity and low cost make the encoders ideal for both high and low volume motion control applications. The internal monolithic electronic module converts the real-time shaft angle, speed, and direction into TTL compatible outputs. The encoder module incorporates a lensed LED light source and monolithic photodetector array with signal shaping electronics to produce the two channel bounceless TTL outputs.

# Encoder on Size 23 hybrid motor

### 30 mm 43000 Series Size 17

NOTE: Lead Screw extends beyond encoder on specific captive and non-captive motors. External linear shaft extension is available upon request.



Differential Ended Encod	Differential Ended Encoder - Pinout - Size 17			
Connector Pin #	Description			
1	Ground			
2	Ground			
3	– Index			
4	+ Index			
5	Channel A –			
6	Channel A +			
7	+5 VDC Power			
8	+5 VDC Power			
9	Channel B —			
10	Channel B +			

Electrical Specifications						
Minimum Typical Maximum Units						
Input Voltage	4.5	5.0	5.5	VDC		
Output Signals	4.5	5.0	5.5	VDC		

2 channel quadrature TTL squarewave outputs.

Channel B leads A for a clockwise rotation of the rotor viewed from the encoder cover.

Tracks at speeds of 0 to 100,000 cycles/sec.

Optional index available as a 3rd channel (one pulse per revolution).

Operating Temperature					
Size 17	Minimum	Maximum			
Size 17	- 40°C (- 40°F)	100°C (212°F)			

Mechanical Specifications				
	Maximum			
Acceleration	250,000 rad/sec2			
Vibration (5 Hz to 2 kHz)	20 g			

Resolution						
4 Standard Cycles Per Revolution (CPR) or Pulses Per Revolution (PPR)						
Size 17	CPR	200	400	1000*		
Size 17	PPR	800	1600	4000*		

<sup>\*</sup>Index Pulse Channel not available

Single Ended Encoder - Pinout - Size 17							
Connector Pin # Description Connector Pin # Description							
1 Ground		4	+5 VDC Power				
2 Index (optional)		5	Channel B				
3	Channel A						

# Integrated Connectors

Hybrid Size 17 linear actuators are available with an integrated connector. Offered alone or with a harness assembly, this connector is RoHS compliant and features a positive latch in order for high connection integrity. The connector is rated up to 3 amps and the mating connector will handle a range of wire gauges from 22 to 28. This motor is ideal for those that want to plug in directly to pre-existing harnesses.

### **Motor Connector:**

JST part # S06B-PASK-2

### **Mating Connector:**

JST part # PAP-06V-S

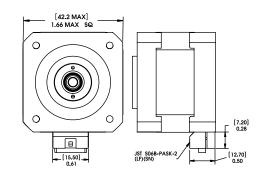
Haydon Kerk Part #56-1210-5 (12 in. Leads)

### Wire to Board Connector:

JST part number SPHD-001T-P0.5

www.haydonkerkpittman.com

Pin#	Bipolar	Unipolar	Color
1	Phase 2 Start	Phase 2 Start	G/W
2	Open	Phase 2 Common	-
3	Phase 2 Finish	Phase 2 Finish	Green
4	Phase 1 Finish	Phase 1 Finish	R/W
5	Open	Phase 1 Common	-
6	Phase 1 Start	Phase 1 Start	Red





Encoder Ready Option Shown 34000 Series Size 17



Extended Rotor Journal Shown 34000 Series Size 17





### **Encoder Ready Option for all Hybrid Sizes**

Our Hybrid Linear Actuators can now be manufactured as an Encoder Ready Actuator. Encoder Ready Actuators can be used to install several popular hollow shaft encoders. Available with an extended rotor journal and a threaded rear housing. The motor uses a proprietary manufacturing process which incorporates engineering thermoplastics in the rotor drive nut and a stainless steel Acme Lead Screw that allows the motor to be much more efficient and durable than today's more commonly used V-thread bronze nut configurations.

### Size 23 Mounting Face Plate for Size 17 Hybrids

Size 23 mounting pattern for our Hybrid Size 17 Linear Actuators.

### **Extended Rotor Journal for all Hybrid Sizes**

Available with an extended rotor journal. The extended rotor journal can be used for encoder installation, manual adjustment, or flag installation for a positioning sensor.

### **Home Position Switch for Hybrids**

A miniature electronic Home Position Switch capable of monitoring the home positions of linear actuators. The switch mounts on the rear sleeve of captive linear motors and allows the user to identify start, stop or home positions.

When ordering motors with the home position switch the part number should be preceded by an "S" prefix.

### End of Stroke Proximity Sensor for all Hybrid Sized

The Sensor incorporates a hall effect device, which is activated by a rare earth magnet embedded in the end of the internal screw. The compact profile of the sensor allows for installation in limited space applications. The sensor has a virtually unlimited cycle life. Special cabling and connectors can also be provided.

When ordering motors with the proximity sensor, the part number should be preceded by a "P" prefix.

### Black Ice® and Kerkote® TFE Coated Lead Screws\*

TFE Coated Lead Screws for applications that require a *greaseless* screw and nut interface.

A *dry* (non-lubricated) TFE coated lead screw provides improved performance in both life and thrust as compared to a conventional stainless steel lead-screw. TFE can be applied to a wide variety of lead-screw pitches and is available for our brand captive, non-captive and external linear actuators. Not available for 0.00006-in (.0015 mm) and 0.000098-in (.0025 mm) resolutions.

\*Certain conditions apply.

### Integrated Anti-Backlash Nut for Hybrids\*

Most sizes (except Size 34) of our captive and non-captive hybrid stepper motors can be equipped with an integral anti-backlash feature. There is a normal backlash between the lead screw and integral rotor nut.

Our actuators are designed for millions of cycles. However over time, additional backlash could increase and eventually double. Haydon Kerk Integrated Anti-Backlash Nut can eliminate all backlash. Designed specifically for our captive and non-captive hybrid motors, nuts use an opposing spring force to eliminate backlash between the screw and the nut interface. The nuts will self-compensate and accommodate any wear. Haydon Kerk Motion Solutions application engineers can help you select the appropriate preload for your application.

\*Except Size 34.





# 57000 Series Size 23 Hybrid Linear Actuators

### For applications that require forces up to 200 lbs. (890 N).

Size 23 incorporates the same high performance and durable design as the Size 17.

### 3 Available Designs

- Captive
- Non-Captive
- External Linear

The 57000 Series Hybrid Linear Actuator is available in a wide variety of resolutions, from 0.0003125-in. (.0079375 mm) per step to 0.002-in. (.0508 mm) per step. They deliver a thrust of up to 200 lbs. (890 N) or speeds exceeding 2.0-in. (5.08 cm) per second.



Size 23: 57 mm (2.3-in) Hybrid Linear Actuator (1.8° Step Angle)						
	Captive	57H4		†	57H6 –	†
Part No.	Non-Captive	57F4		Ť	57F4 –	†
	External Linear	E57H4		Ť	E57H6 –	†
	Wiring		Bipolar		Unipo	olar**
Wind	ding Voltage	3.25 VDC	5 VDC	12 VDC	5 VDC	12 VDC
Curren	t (RMS)/phase	2.0 A	1.3 A	.54 A	1.3 A	.54 A
Resis	Resistance/phase		$3.85\Omega$	22.2 Ω	3.85 Ω	22.2 Ω
Inductance/phase		3.5 mH	10.5 mH	58 mH	5.3 mH	23.6 mH
Power Consumption		13 W				
Rotor Inertia				166 gcm <sup>2</sup>		
Insulation Class		Class B (Class F available)				
	Weight	18 oz (511 g)				
Insulati	ion Resistance			20 MΩ		

†Part numbering information on page 5.	** Unipolar drive gives approximately 30% less thrust than bipolar drive.

Linear Tra Screw Ø .379 inches	Order Code I.D.	
.0003125	.0079*	А
.0004167	.0105*	S
.0005	.0127	3
.0008333	.0211*	T
.001	.0254	1
.002	.0508	2

<sup>\*</sup>Values truncated.

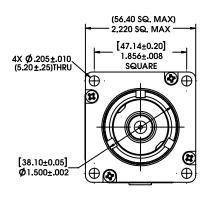
Standard motors are Class B rated for maximum temperature of 130  $^{\circ}\text{C}.$ 

Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.

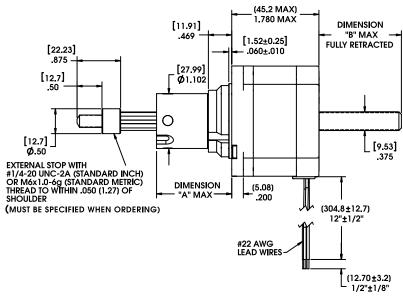
AMETEK®

### **Captive Lead Screw**

Dimensions = (mm) inches



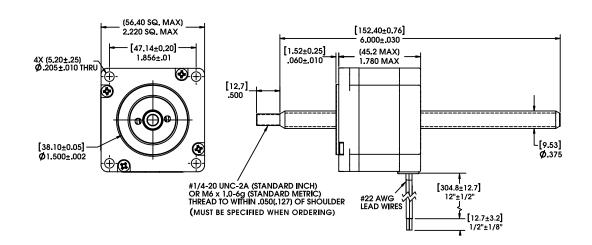
Stroke	Dim. "A"	Dim. "B"	Suffix #	M6x1.0 thread
0.500 (12.7)	1.01 (25.7)	0.06 (1.5)	-905	-805
0.750 (19.05)	1.26 (32.0)	0.31 (7.9)	-907	-807
1.000 (25.4)	1.51 (38.4)	0.56 (14.2)	-910	-810
1.250 (31.8)	1.76 (44.7)	0.81 (20.6)	-912	-812
1.500 (38.1)	2.01 (51.1)	1.06 (26.9)	-915	-815
2.00 (50.8)	2.51 (63.8)	1.56 (39.6)	-920	-820
2.500 (63.5)	3.01 (76.5)	2.06 (52.3)	-925	-825



### Non-Captive Lead Screw

Dimensions = (mm) inches

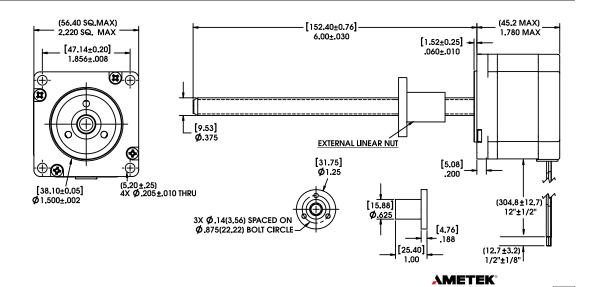
Up to 10-in (254 mm) standard screw lengths. Longer screw lengths are available.



### **External Linear**

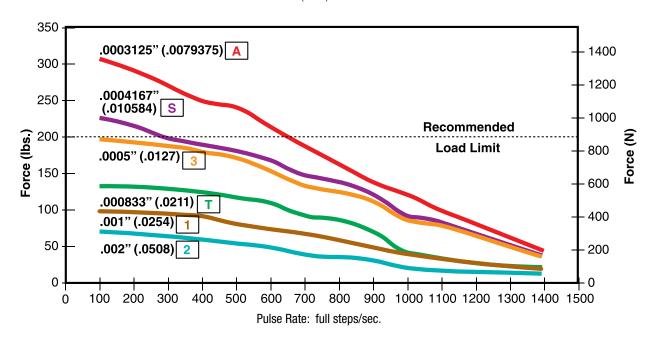
Dimensions = (mm) inches

Up to 12-in (305 mm) standard screw lengths. Longer screw lengths are available.

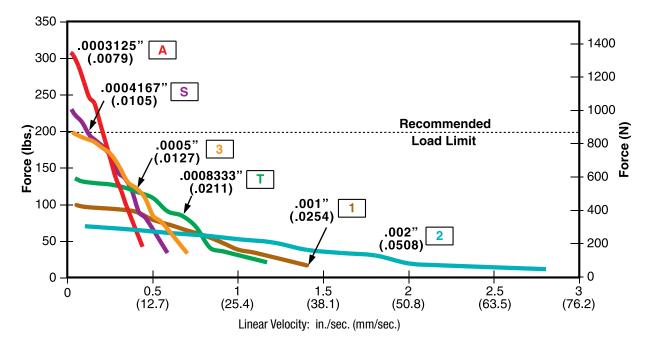


www.haydonkerkpittman.com

**FORCE vs. PULSE RATE** 
$$-$$
 Chopper  $-$  Bipolar  $-$  100% Duty Cycle  $-$  Ø .375 (9.53) Lead Screw



**FORCE vs. LINEAR VELOCITY** – Chopper – Bipolar – 100% Duty Cycle  $- \emptyset$  .375 (9.53) Lead Screw



NOTE: All chopper drive curves were created with a 5 volt motor and a 75 volt power supply.

Ramping can increase the performance of a motor either by increasing the top speed or getting a heavier load accelerated up to speed faster. Also, deceleration can be used to stop the motor without overshoot.

With L/R drives peak force and speeds are reduced, using a unipolar drive will yield a further 30% force reduction.

www.haydonkerkpittman.com



3

# 57000 Series Size 23, 0.9° High Resolution Motor

The Size 23, 0.9° high resolution hybrid offers precise, excellent motion control with a full linear step movement as low as 2 microns and a thrust capability up to 200 lbs (890 N).

	Size 23: 57 mm (2.3-in) Hybrid Linear Actuator (0.9° Step Angle)					
	Captive	57K4		Ť	57K6 –	†
Part No.	Non-Captive	57J4		†	57J6 –	
	External Linear	E57K4		†	E57K6 –	
	Wiring		Bipolar		Unipo	olar**
Wind	ding Voltage	3.25 VDC	5 VDC	12 VDC	5 VDC	12 VDC
Curren	t (RMS)/phase	2.0 A	1.3 A	0.54 A	1.3 A	0.54 A
Resis	stance/phase	1.63 Ω	1.63 Ω 3.85 Ω 22		3.85 Ω	22.2 Ω
Induc	tance/phase	4.2 mH	13 mH	68 mH	6 mH	27 mH
Power Consumption		13 W				
Ro	otor Inertia	166 gcm <sup>2</sup>				
Insu	lation Class	Class B (Class F available)				
	Weight 18 oz (511 g)					
Insulati	ion Resistance			20 MΩ		

Linear Tra	_	
Screw Ø .250	O" (6.35 mm)	Order Code I.D.
inches	mm	Oodo I.D.
.000125	.0031*	7
.00015625	.003969	Р
.00020833	.00529166	Х
.00025	.00635	9
.0004167	.01058418	S
.0005	.0127	3
.001	.0254	1

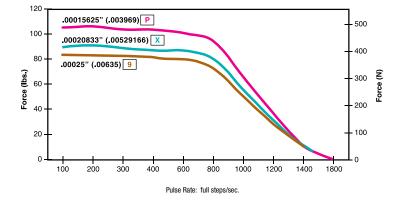
\*Values truncated.

NOTE: Refer to performance curves on page 3 for codes S, 3, 1.

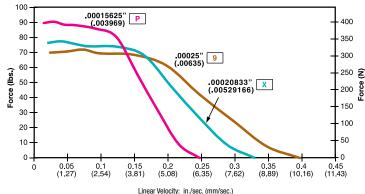
Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.

4

**FORCE vs. PULSE RATE** – Chopper – Bipolar – 100% Duty Cycle with two available lead screw diameters



**FORCE vs. LINEAR VELOCITY** – Chopper – Bipolar – 100% Duty Cycle with two available lead screw diameters



NOTE: All chopper drive curves were created with a 5 volt motor and a 75 volt power supply.

Ramping can increase the performance of a motor either by increasing the top speed or getting a heavier load accelerated up to speed faster. Also, deceleration can be used to stop the motor without overshoot.

With L/R drives peak force and speeds are reduced, using a unipolar drive will yield a further 30% force reduction.

WWW.haydonkerkpittman.com

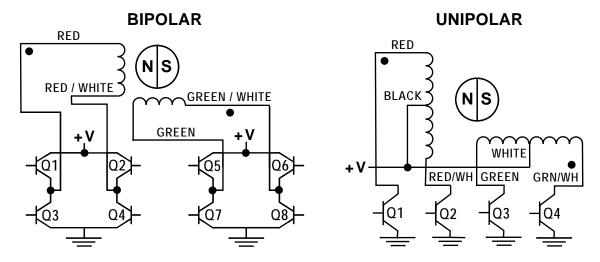
<sup>&</sup>lt;sup>†</sup>Part numbering information on page 5. \*\*Unipolar drive gives approximately 30% less thrust than bipolar drive.

### Identifying the Hybrid Part Number Codes when Ordering

Е	57	Н	6	7	3.25	910
Prefix	Series Number	Style	Coils	Code ID Resolution	Voltage	Suffix
(include only when	Designation	<b>F</b> = 1.8°	<b>4</b> = Bipolar	Travel/Step	<b>3.25</b> = 3.25 VDC	Stroke
using the following)	<b>57 = 57000</b> (Series numbers	Non-captive	(4 wire)	<b>7</b> = .000125-in (.0031)	<b>05</b> = 5 VDC	Example: $-910 = 1$ -in
<b>A</b> = A Coil (See AC Synchronous	represent	<b>H</b> = 1.8° Captive or External (use "E"	<b>6</b> = Unipolar (6 wire)	<b>S</b> = .0004167-in (.01058418)	<b>12</b> = 12 VDC	(Refer to Stroke chart on Captive motor series product page.)
Data Sheet)	approximate width of motor	or "K" Prefix for External version)		<b>3</b> = .0005-in (.0127)	Custom V available	Suffix also represents:
<b>E</b> = External	body)	,		<b>1</b> = .001-in (.0254)		-800 = Metric
<b>K</b> = External with 40° thread		<b>J</b> = 0.9° Non-captive		<b>A</b> = .0003125-in (.0079)		−900 = External Linear with
form		<b>K</b> = 0.9° Captive or		<b>T</b> = .0008333-in (.0211)		grease and flanged nut
<b>P</b> = Proximity		External (use "E"		<b>2</b> = .002-in (.0508)		–XXX = Proprietary suffix assigned to a specific customer
Sensor <b>S</b> = Home Position		or "K" Prefix for External version)		High Resolution		application. The identifier
Switch				<b>P</b> = .00015625-in (.003969)		can apply to either a standard or custom part.
				<b>X</b> = .00020833-in (.00529166)		
				<b>9</b> = .00025-in (.0635)		

NOTE: Dashes must be included in Part Number (-) as shown above. For assistance call our Engineering Team at 203 756 7441.

## Hybrids: Wiring



### Hybrids: Stepping Sequence

	Bipolar	Q2-Q3	Q1-Q4	Q6-Q7	Q5-Q8	
EXTEND	Step					1
END	1	ON	0FF	ON	OFF	  ≥
CW	2	0FF	ON	ON	OFF	CCW
	3	OFF	ON	OFF	ON	ACT
$\downarrow$	4	ON	0FF	OFF	ON	RETRACT
	1	ON	0FF	ON	OFF	8

Note: Half stepping is accomplished by inserting an off state between transitioning phases.

**AMETEK** 

# Encoders Designed for All Sizes of Hybrid Linear Actuators

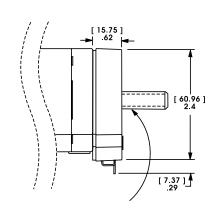
All Haydon Hybrid Linear Actuators are available with specifically designed encoders for applications that require feedback. The compact optical incremental encoder design is available with two channel quadrature TTL squarewave outputs. An optional index is also available as a 3rd channel. The Size 23 encoder is offered in resolutions of 200, 400, 1,000 and 2,000 counts per revolution. Encoders are available for all motor configurations: captive, non-captive and external linear.

Simplicity and low cost make the encoders ideal for both high and low volume motion control applications. The internal monolithic electronic module converts the real-time shaft angle, speed, and direction into TTL compatible outputs. The encoder module incorporates a lensed LED light source and monolithic photodetector array with signal shaping electronics to produce the two channel bounceless TTL outputs.



### 57 mm 57000 Series Size 23

NOTE: Lead Screw extends beyond encoder on specific captive and non-captive motors. External linear shaft extension is available upon request.



Differential Ended Encod	Differential Ended Encoder - Pinout - Size 23		
Connector Pin #	Description		
1	Ground		
2	Ground		
3	– Index		
4	+ Index		
5	Channel A –		
6	Channel A +		
7	+5 VDC Power		
8	+5 VDC Power		
9	Channel B –		
10	Channel B +		

Electrical Specifications						
	Minimum	Typical	Maximum	Units		
Input Voltage	4.5	5.0	5.5	VDC		
Output Signals	4.5	5.0	5.5	VDC		

2 channel quadrature TTL squarewave outputs.

Channel B leads A for a clockwise rotation of the rotor viewed from the encoder cover.

Tracks at speeds of 0 to 100,000 cycles/sec.

Optional index available as a 3rd channel (one pulse per revolution).

Operating Temperature		
Cinc 02	Minimum	Maximum
Size 23	- 40°C (- 40°F)	100°C (212°F)

Mechanical Specifications				
	Maximum			
Acceleration	250,000 rad/sec2			
Vibration (5 Hz to 2 kHz)	20 g			

Resolution						
4 Standard Cycles Per Revolution (CPR) or Pulses Per Revolution (PPR)						
CPR 200 400°				1000	2000	
Size 23	PPR	800	1600*	4000	8000	

<sup>\*</sup>Index Pulse Channel not available.

Single Ended Encoder - Pinout - Size 23					
Connector Pin #	Description	Connector Pin #	Description		
<b>1</b> Ground		4	+5 VDC Power		
2	Index (optional)	5	Channel B		
3	Channel A				

6

www.haydonkerkpittman.com

Encoder Ready Option Shown 34000 Series Size 17



Extended Rotor Journal Shown 34000 Series Size 17





### **Encoder Ready Option for all Hybrid Sizes**

Our Hybrid Linear Actuators can now be manufactured as an Encoder Ready Actuator. Encoder Ready Actuators can be used to install several popular hollow shaft encoders. Available with an extended rotor journal and a threaded rear housing. The motor uses a proprietary manufacturing process which incorporates engineering thermoplastics in the rotor drive nut and a stainless steel Acme Lead Screw that allows the motor to be much more efficient and durable than today's more commonly used V-thread bronze nut configurations.

### **Extended Rotor Journal for all Hybrid Sizes**

Available with an extended rotor journal. The extended rotor journal can be used for encoder installation, manual adjustment, or flag installation for a positioning sensor.

### Home Position Switch for Hybrids

A miniature electronic Home Position Switch capable of monitoring the home positions of linear actuators. The switch mounts on the rear sleeve of captive linear motors and allows the user to identify start, stop or home positions.

When ordering motors with the home position switch the part number should be preceded by an "S" prefix.

### End of Stroke Proximity Sensor for all Hybrid Sized

The Sensor incorporates a hall effect device, which is activated by a rare earth magnet embedded in the end of the internal screw. The compact profile of the sensor allows for installation in limited space applications. The sensor has a virtually unlimited cycle life. Special cabling and connectors can also be provided.

When ordering motors with the proximity sensor, the part number should be preceded by a "P" prefix.

### Black Ice® and Kerkote® TFE Coated Lead Screws\*

TFE Coated Lead Screws for applications that require a *greaseless* screw and nut interface.

A *dry* (non-lubricated) TFE coated lead screw provides improved performance in both life and thrust as compared to a conventional stainless steel lead-screw. TFE can be applied to a wide variety of lead-screw pitches and is available for our brand captive, non-captive and external linear actuators. Not available for 0.00006-in (.0015 mm) and 0.000098-in (.0025 mm) resolutions.

\*Certain conditions apply.

### Integrated Anti-Backlash Nut for Hybrids\*

Most sizes (except Size 34) of our captive and non-captive hybrid stepper motors can be equipped with an integral anti-backlash feature. There is a normal backlash between the lead screw and integral rotor nut.

Our actuators are designed for millions of cycles. However over time, additional backlash could increase and eventually double. Haydon Kerk Integrated Anti-Backlash Nut can eliminate all backlash. Designed specifically for our captive and non-captive hybrid motors, nuts use an opposing spring force to eliminate backlash between the screw and the nut interface. The nuts will self-compensate and accommodate any wear. Haydon Kerk Motion Solutions application engineers can help you select the appropriate preload for your application.

\*Except Size 34.





# 57000 Series Size 23 Double Stack Hybrid Linear Actuators

### Greater performance in a compact size

The various patented designs deliver exceptional performance and new linear motion design opportunities. The 57000 Series is available in a wide variety of resolutions, from 0.0005-in (.0127 mm) per step to 0.005-in (.127 mm) per step. The motors can also be microstepped for even finer resolutions.

### 3 Available Designs

- Captive
- Non-Captive
- External Linear

The Size 23 actuator delivers thrust of up to 200 lbs. (890 N).



	Size 23 Double Stack: 57 mm (2.3-in) Hybrid Linear Actuator (1.8° Step Angle)							
	Captive	5	57M4 — — — †					
Part No.	Non-Captive	5	57L4 — — — — †					
	External Linear	E5	57M4 – –	Ť				
Wiring Bipolar								
Winding Voltage 3.25 VDC 5 VDC 12 VDC				12 VDC				
Curren	t (RMS)/phase	3.85 A	2.5 A	1 A				
Resis	tance/phase	0.98 Ω	2.0 Ω	12.0 Ω				
Induc	tance/phase	2.3 mH	7.6 mH	35.0 mH				
Power	Consumption		25 W Total					
Rotor Inertia 321 gcm <sup>2</sup>			321 gcm <sup>2</sup>					
Insulation Class								
Weight 32 oz (958 g)								
Insulat	ion Resistance		20 MΩ					

†Part numbering information on page 4.

Linear Tra Screw Ø.375	Order Code I.D.			
inches	inches mm			
.0005	.0127*	3		
.001	.0254*	1		
.002	.0508	2		
.0025	.0635	Υ		
.005	.005 .127			
.0025	.0635	2 Y Z		

\*Values truncated.

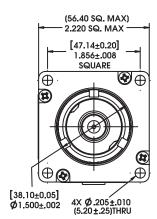
Standard motors are Class B rated for maximum temperature of 130  $^{\circ}$ C.

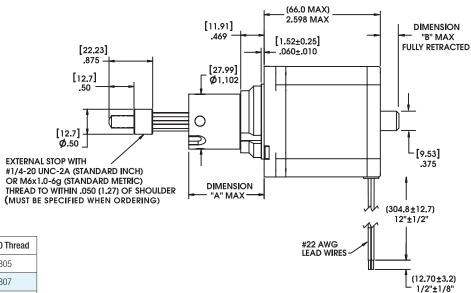
Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.



### **Captive Lead Screw**

Dimensions = (mm) inches



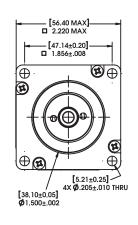


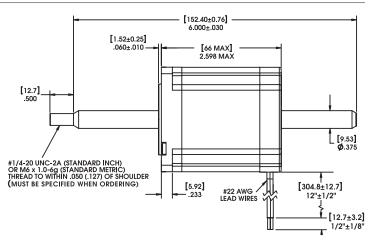
Stroke	Dim. "A"	Dim. "B"	Suffix #	M6x1.0 Thread
0.500 (12.7)	1.01 (25.7)	0 (0)	-905	-805
0.750 (19.05)	1.26 (32.0)	0.110 (2.77)	-907	-807
1.000 (25.4)	1.51 (38.4)	0.360 (7.37)	-910	-810
1.250 (31.8)	1.76 (44.7)	0.610 (15.47)	-912	-812
1.500 (38.1)	2.01 (51.1)	0.860 (21.83)	-915	-815
2.00 (50.8)	2.51 (63.8)	1.360 (34.52)	-920	-820
2.500 (63.5)	3.01 (76.5)	1.860 (47.22)	-925	-825

### **Non-Captive Lead Screw**

Dimensions = (mm) inches

Up to 18-in (457 mm) standard screw lengths. Longer screw lengths are available.

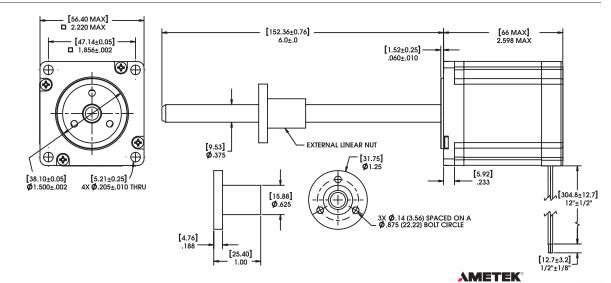




### **External Linear**

Dimensions = (mm) inches

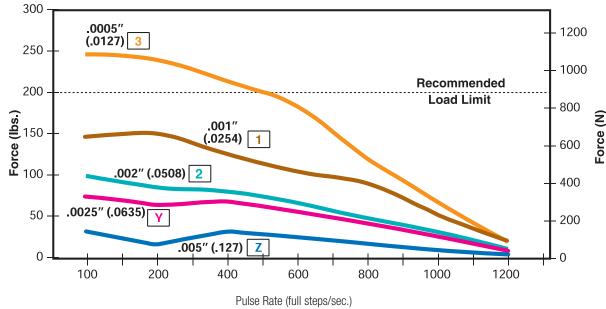
Up to 12-in (305 mm) standard screw lengths. Longer screw lengths are available.



www.haydonkerkpittman.com

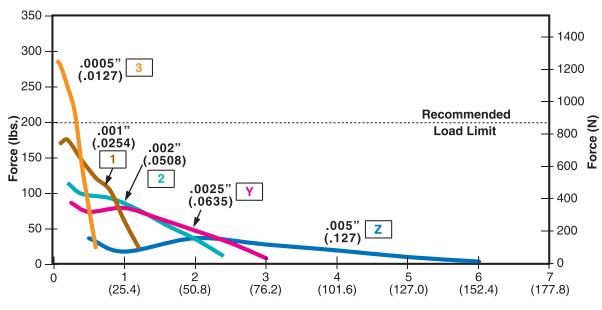
### FORCE vs. PULSE RATE

- Chopper
- Bipolar
- 100% Duty Cycle
- Ø .375 (9.53) Lead Screw



### FORCE vs. LINEAR VELOCITY

- Chopper
- Bipolar
- 100% Duty Cycle
- Ø .375 (9.53) Lead Screw



Linear Velocity: in./sec. (mm/sec.)

NOTE: All chopper drive curves were created with a 5 volt motor and a 75 volt power supply.

Ramping can increase the performance of a motor either by increasing the top speed or getting a heavier load accelerated up to speed faster. Also, deceleration can be used to stop the motor without overshoot.

With L/R drives peak force and speeds are reduced, using a unipolar drive will yield a further 30% force reduction.

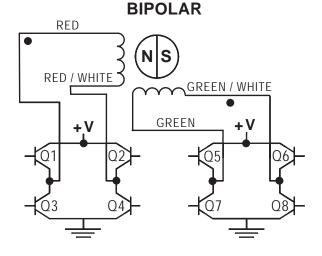
**AMETEK**°

### Identifying the Hybrid Part Number Codes when Ordering

Е	57	M	4	3	3.25	910
Prefix	Series Number	Style	Coils	Code ID Resolution	Voltage	Suffix
(include only when	Designation	<b>L</b> = 1.8°	4 = Bipolar	Travel/Step	<b>3.25</b> = 3.25 VDC	Stroke
using the following)	57 = 57000	Non-captive	(4 wire)	<b>3</b> = .0005-in (.0127)	<b>05</b> = 5 VDC	Example: $-910 = 1$ -in
A = A Coil (See AC Synchronous	(Series numbers represent	$\mathbf{M} = 1.8^{\circ}$ Captive or		<b>1</b> = .001-in (.0254)	<b>12</b> = 12 VDC	(Refer to Stroke chart on Captive motor series product page.)
Data Sheet)	approximate	External (use "E" or "K" Prefix		<b>2</b> = .002-in (.0508)	Custom V available	,
<b>E</b> = External	width of motor	for External		<b>Y</b> = .0025-in (.0635)		Suffix also represents:
<b>K</b> = External with	body)	version)		<b>Z</b> = .005-in (.127)		-800 = Metric
40° thread form						-900 = External Linear with grease and flanged nut
<b>P</b> = Proximity						-XXX = Proprietary suffix
Sensor						assigned to a specific customer application. The identifier
<b>S</b> = Home Position Switch						can apply to either a standard or custom part.
						2. 2.2.2 parti

NOTE: Dashes must be included in Part Number (-) as shown above. For assistance call our Engineering Team at 203 756 7441.

### Hybrids: Wiring



### Hybrids: Stepping Sequence

	Bipolar	Q2-Q3	Q1-Q4	Q6-Q7	Q5-Q8	
EX	Step					1
EXTEND CW	1	ON	OFF	ON	0FF	]  ≥
CW	2	OFF	ON	ON	OFF	W.C.W
	3	OFF	ON	OFF	ON	RACT
$\downarrow$	4	ON	OFF	OFF	ON	RFTR
	1	ON	OFF	ON	OFF	B

Note: Half stepping is accomplished by inserting an off state between transitioning phases.

AMETEK®
ADVANCED MOTION SOLUTION

# Encoders Designed for All Sizes of Hybrid Linear Actuators

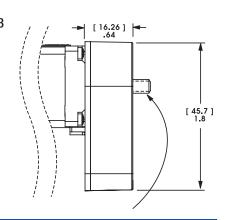
All Haydon Hybrid Linear Actuators are available with specifically designed encoders for applications that require feedback. The compact optical incremental encoder design is available with two channel quadrature TTL squarewave outputs. An optional index is also available as a 3rd channel. The Size 23 encoder is offered in resolutions of 200, 400, 1,000 and 2,000 counts per revolution. Encoders are available for all motor configurations, captive, non-captive and external linear.

Simplicity and low cost make the encoders ideal for both high and low volume motion control applications. The internal monolithic electronic module converts the real-time shaft angle, speed, and direction into TTL compatible outputs. The encoder module incorporates a lensed LED light source and monolithic photodetector array with signal shaping electronics to produce the two channel bounceless TTL outputs.



### 57 mm 57000 Series Size 23

NOTE: Lead Screw extends beyond encoder on specific captive and non-captive motors. External linear shaft extension is available upon request.



Differential Ended Encod	Differential Ended Encoder - Pinout - Size 23				
Connector Pin #	Description				
1	Ground				
2	Ground				
3	– Index				
4	+ Index				
5	Channel A –				
6	Channel A +				
7	+5 VDC Power				
8	+5 VDC Power				
9	Channel B –				
10	Channel B +				

Electrical Specifications							
	Minimum	Typical	Maximum	Units			
Input Voltage	4.5	5.0	5.5	VDC			
Output Signals	4.5	5.0	5.5	VDC			

2 channel quadrature TTL squarewave outputs.

Channel B leads A for a clockwise rotation of the rotor viewed from the encoder cover.

Tracks at speeds of 0 to 100,000 cycles/sec.

Optional index available as a 3rd channel (one pulse per revolution).

Operating Temperature		
Size 23	Minimum	Maximum
	- 40°C (- 40°F)	100°C (212°F)

Mechanical Specifications				
	Maximum			
Acceleration	250,000 rad/sec2			
Vibration (5 Hz to 2 kHz)	20 g			

Resolution						
4 Standard Cycles Per Revolution (CPR) or Pulses Per Revolution (PPR)						
Size 23	CPR	200	400*	1000	2000	
3126 23	PPR	800	1600*	4000	8000	

<sup>\*</sup>Index Pulse Channel not available.

Single Ended Encoder - Pinout - Size 23						
Connector Pin #	Description	Connector Pin #	Description			
<b>1</b> Ground		4	+5 VDC Power			
2 Index (optional)		5	Channel B			
3	Channel A					

5

WWW.haydonkerkpittman.com



Encoder Ready Option Shown 34000 Series Size 17



Extended Rotor Journal Shown 34000 Series Size 17





### **Encoder Ready Option for all Hybrid Sizes**

Our Hybrid Linear Actuators can now be manufactured as an Encoder Ready Actuator. Encoder Ready Actuators can be used to install several popular hollow shaft encoders. Available with an extended rotor journal and a threaded rear housing. The motor uses a proprietary manufacturing process which incorporates engineering thermoplastics in the rotor drive nut and a stainless steel Acme Lead Screw that allows the motor to be much more efficient and durable than today's more commonly used V-thread bronze nut configurations.

### **Extended Rotor Journal for all Hybrid Sizes**

Available with an extended rotor journal. The extended rotor journal can be used for encoder installation, manual adjustment, or flag installation for a positioning sensor.

### Home Position Switch for Hybrids

A miniature electronic Home Position Switch capable of monitoring the home positions of linear actuators. The switch mounts on the rear sleeve of captive linear motors and allows the user to identify start, stop or home positions.

When ordering motors with the home position switch the part number should be preceded by an "S" prefix.

### End of Stroke Proximity Sensor for all Hybrid Sized

The Sensor incorporates a hall effect device, which is activated by a rare earth magnet embedded in the end of the internal screw. The compact profile of the sensor allows for installation in limited space applications. The sensor has a virtually unlimited cycle life. Special cabling and connectors can also be provided.

When ordering motors with the proximity sensor, the part number should be preceded by a "P" prefix.

### Black Ice® and Kerkote® TFE Coated Lead Screws\*

TFE Coated Lead Screws for applications that require a *greaseless* screw and nut interface.

A *dry* (non-lubricated) TFE coated lead screw provides improved performance in both life and thrust as compared to a conventional stainless steel lead-screw. TFE can be applied to a wide variety of lead-screw pitches and is available for our brand captive, non-captive and external linear actuators. Not available for 0.00006-in (.0015 mm) and 0.000098-in (.0025 mm) resolutions.

\*Certain conditions apply.

### Integrated Anti-Backlash Nut for Hybrids\*

Most sizes (except Size 34) of our captive and non-captive hybrid stepper motors can be equipped with an integral anti-backlash feature. There is a normal backlash between the lead screw and integral rotor nut.

Our actuators are designed for millions of cycles. However over time, additional backlash could increase and eventually double. Haydon Kerk Integrated Anti-Backlash Nut can eliminate all backlash. Designed specifically for our captive and non-captive hybrid motors, nuts use an opposing spring force to eliminate backlash between the screw and the nut interface. The nuts will self-compensate and accommodate any wear. Our Engineers can help you select the appropriate preload for your application.

\*Except Size 34





# 87000 Series Size 34 Hybrid Linear Actuators

### Our largest, most powerful linear actuator

Size 34 incorporates the same precision, high performance and durable patented designs featured in our entire hybrid product line.

### 3 Available Designs

- Captive
- Non-Captive
- External Linear

The 87000 series delivers forces up to 500 lbs. (2224 N) in a compact, 3.4-in (87 mm) square package. Available in a wide variety of resolutions, from 0.0005-in (.0127 mm) per step to 0.005-in (.127 mm) per step. Speeds exceed 3.0-in (7.62 cm) per second.

In addition to our standard configurations, we can custom build this powerful motor to meet your specific motion requirements.



	Size 34: 87 mm (3.4-in) Hybrid Linear Actuator (1.8° Step Angle)						
	Captive	87H4		†	87H6 –	†	
Part No.	Non-Captive	87F4		Ť	87F4 –		
	External Linear	E87H4		†	E87H6 –		
	Wiring	Bipolar Unipolar**				olar**	
Wind	ding Voltage	2.85 VDC	5 VDC	12 VDC	5 VDC	12 VDC	
Curren	t (RMS)/phase	5.47 A	3.12 A	1.3 A	3.12 A	1.3 A	
Resis	tance/phase	0.52 Ω	1.6 Ω	9.23 Ω	1.6 Ω	9.23 Ω	
Induc	tance/phase	2.86 mH	8.8 mH	51 mH	4.4 mH	25.5 mH	
Power	Consumption			31.2 W			
Ro	otor Inertia	1760 gcm <sup>2</sup>					
Insu	lation Class	Class B (Class F available)					
	Weight	5.1 lbs. (2.3 Kg)					
Insulati	ion Resistance			20 MΩ			

Insulation Resistance	20 ΜΩ	
†Part numbering information on page 4. **	Unipolar drive gives approximately 30% less thrust than bipolar dr	ive.

Linear Tra Screw Ø .625	Order Code I.D.	
inches mm		0000 1.5.
.0005 .0127		3
.000625	.000625 .0158*	
.00125	.00125 .0317*	
.0025	.0025 .0635	
.005	.127	Z

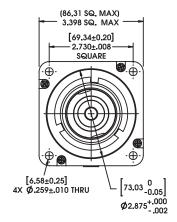
\*Values truncated.

Standard motors are Class B rated for maximum temperature of 130°C.

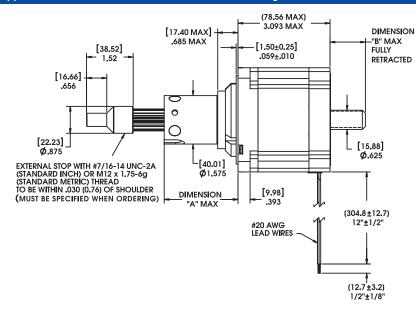
Special drive considerations may be necessary when leaving shaft fully extended or fully retracted.

### **Captive Lead Screw**

Dimensions = (mm) inches



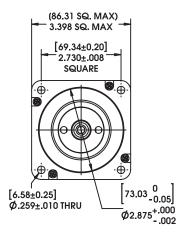
Stroke	Dim. "A"	Dim. "B"	Suffix #	M12x1.75 Thread
0.500 (12.7)	1.225 (31.12)	0 (0)	-905	-805
1.000 (25.4)	1.725 (43.82)	0.25 (6.35)	-910	-810
1.500 (38.1)	2.225 (56.52)	0.75 (19.05)	-915	-815
2.00 (50.8)	2.725 (69.22)	1.25 (31.75)	-920	-820
2.500 (63.5)	3.225 (81.92)	1.75 (44.45)	-925	-825

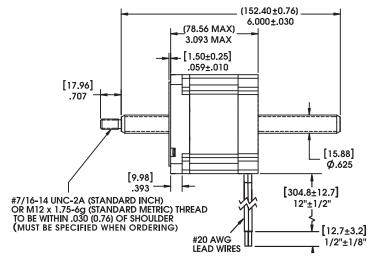


### Non-Captive Lead Screw

Dimensions = (mm) inches

Up to 18-in (457 mm) standard screw lengths. Longer screw lengths are available.

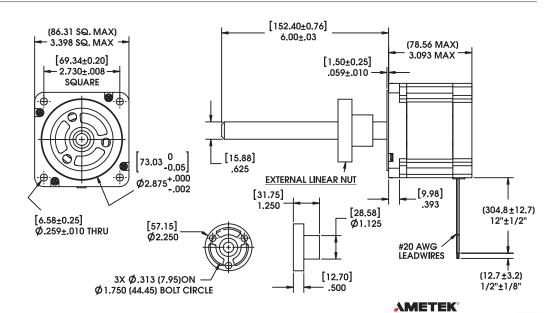




### **External Linear**

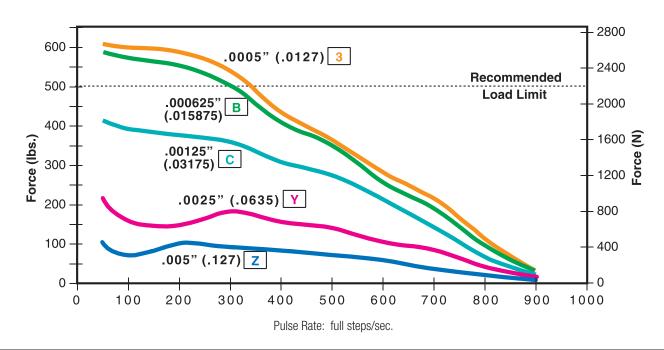
Dimensions = (mm) inches

Up to 12-in (305 mm) standard screw lengths. Longer screw lengths are available.

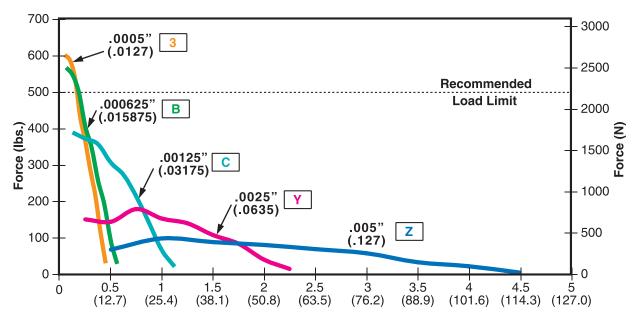


www.haydonkerkpittman.com

**FORCE vs. PULSE RATE** 
$$-$$
 Chopper  $-$  Bipolar  $-$  100% Duty Cycle  $-$  Ø .625 (15.88) Lead Screw



**FORCE vs. LINEAR VELOCITY** - Chopper - Bipolar - 100% Duty Cycle - Ø .625 (15.88) Lead Screw



Linear Velocity: in./sec. (mm/sec.)

NOTE: All chopper drive curves were created with a 5 volt motor and a 75 volt power supply.

Ramping can increase the performance of a motor either by increasing the top speed or getting a heavier load accelerated up to speed faster. Also, deceleration can be used to stop the motor without overshoot.

With L/R drives peak force and speeds are reduced, using a unipolar drive will yield a further 30% force reduction.

WWW.haydonkerkpittman.com

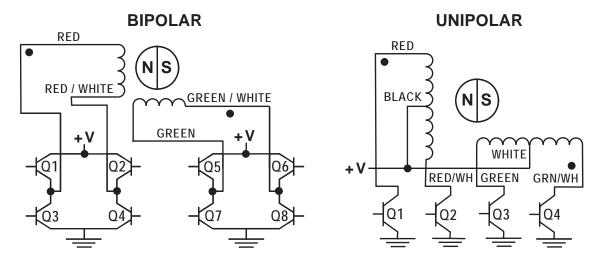
3

### Identifying the Hybrid Part Number Codes when Ordering

Е	87	Н	4	С	2.85	910
Prefix	Series Number	Style	Coils	Code ID Resolution	Voltage	Suffix
(include only when using the following) <b>A</b> = A Coil (See AC Synchronous Data Sheet)	Designation 87 = 87000 (Series numbers represent approximate width of motor	F = 1.8° Non-captive H = 1.8° Captive or External (use "E" or "K" Prefix for	4 = Bipolar (4 wire) 6 = Unipolar (6 wire)	Travel/Step 3 = .0005-in (.0127) B = .000625-in (.0158) C = .00125-in (.0317) Y = .0025-in (.0635)	2.85 = 2.85 VDC 05 = 5 VDC 12 = 12 VDC Custom V available	Stroke Example: -910 = 1-in (Refer to Stroke chart on Captive motor series product page.) Suffix also represents:
<ul> <li>E = External</li> <li>K = External with 40° thread form</li> <li>P = Proximity Sensor</li> <li>S = Home Position Switch</li> </ul>	body)	External version)		<b>Z</b> = .005-in (.127)		-800 = Metric -900 = External Linear with grease and flanged nut -XXX = Proprietary suffix assigned to a specific customer application. The identifier can apply to either a standard or custom part.

NOTE: Dashes must be included in Part Number (-) as shown above. For assistance call our Engineering Team at 203 756 7441.

### Hybrids: Wiring



### Hybrids: Stepping Sequence

	Bipolar	Q2-Q3	Q1-Q4	Q6-Q7	Q5-Q8	
EXTEND	Step					1
ND	1	ON	0FF	ON	OFF	
CW	2	OFF	ON	ON	OFF	CCW
	3	OFF	ON	OFF	ON	ACT
<b>V</b>	4	ON	0FF	OFF	ON	RETRACT
	1	ON	OFF	ON	OFF	8

Note: Half stepping is accomplished by inserting an off state between transitioning phases.

**AMETEK** 

# Encoders Designed for All Sizes of Hybrid Linear Actuators

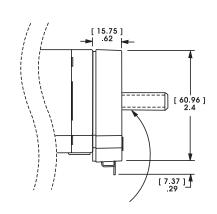
All Haydon Hybrid Linear Actuators are available with specifically designed encoders for applications that require feedback. The compact optical incremental encoder design is available with two channel quadrature TTL squarewave outputs. An optional index is also available as a 3rd channel. The Size 34 encoder is offered in resolutions of 200, 400, 1,000 and 2,000 counts per revolution. Encoders are available for all motor configurations: captive, non-captive and external linear.

Simplicity and low cost make the encoders ideal for both high and low volume motion control applications. The internal monolithic electronic module converts the real-time shaft angle, speed, and direction into TTL compatible outputs. The encoder module incorporates a lensed LED light source and monolithic photodetector array with signal shaping electronics to produce the two channel bounceless TTL outputs.



### 57 mm 87000 Series Size 34

NOTE: Lead Screw extends beyond encoder on specific captive and non-captive motors. External linear shaft extension is available upon request.



Differential Ended Encod	Differential Ended Encoder - Pinout - Size 34				
Connector Pin #	Description				
1	Ground				
2	Ground				
3	– Index				
4	+ Index				
5	Channel A –				
6	Channel A +				
7	+5 VDC Power				
8	+5 VDC Power				
9	Channel B –				
10	Channel B +				

Electrical Specifications							
	Minimum	Typical	Maximum	Units			
Input Voltage	4.5	5.0	5.5	VDC			
Output Signals	4.5	5.0	5.5	VDC			

2 channel quadrature TTL squarewave outputs.

Channel B leads A for a clockwise rotation of the rotor viewed from the encoder cover.

Tracks at speeds of 0 to 100,000 cycles/sec.

Optional index available as a 3rd channel (one pulse per revolution).

Operating Temperature		
Cino 24	Minimum	Maximum
Size 34	- 40°C (- 40°F)	100°C (212°F)

Mechanical Specifications				
	Maximum			
Acceleration	250,000 rad/sec2			
Vibration (5 Hz to 2 kHz)	20 g			

Resolution							
4 Standard Cycles Per Revolution (CPR) or Pulses Per Revolution (PPR)							
Size 34	Circ. 04 CPR 200 400* 1000 2000						
SIZE 34	PPR	800	1600*	4000	8000		

<sup>\*</sup>Index Pulse Channel not available.

Single Ended Encoder - Pinout - Size 34			
Connector Pin #	Description	Connector Pin #	Description
1	Ground	4	+5 VDC Power
2	Index (optional)	5	Channel B
3	Channel A		

5

www.haydonkerkpittman.com



Encoder Ready Option Shown 34000 Series Size 17



Extended Rotor Journal Shown 34000 Series Size 17





**Encoder Ready Option for all Hybrid Sizes** 

Our Hybrid Linear Actuators can now be manufactured as an Encoder Ready Actuator. Encoder Ready Actuators can be used to install several popular hollow shaft encoders. Available with an extended rotor journal and a threaded rear housing. The motor uses a proprietary manufacturing process which incorporates engineering thermoplastics in the rotor drive nut and a stainless steel Acme Lead Screw that allows the motor to be much more efficient and durable than today's more commonly used V-thread bronze nut configurations.

### **Extended Rotor Journal for all Hybrid Sizes**

Available with an extended rotor journal. The extended rotor journal can be used for encoder installation, manual adjustment, or flag installation for a positioning sensor.

### Home Position Switch for Hybrids

A miniature electronic Home Position Switch capable of monitoring the home positions of linear actuators. The switch mounts on the rear sleeve of captive linear motors and allows the user to identify start, stop or home positions.

When ordering motors with the home position switch the part number should be preceded by an "S" prefix.

### End of Stroke Proximity Sensor for all Hybrid Sized

The Sensor incorporates a hall effect device, which is activated by a rare earth magnet embedded in the end of the internal screw. The compact profile of the sensor allows for installation in limited space applications. The sensor has a virtually unlimited cycle life. Special cabling and connectors can also be provided.

When ordering motors with the proximity sensor, the part number should be preceded by a "P" prefix.

### Black Ice® and Kerkote® TFE Coated Lead Screws\*

TFE Coated Lead Screws for applications that require a *greaseless* screw and nut interface.

A *dry* (non-lubricated) TFE coated lead screw provides improved performance in both life and thrust as compared to a conventional stainless steel lead-screw. TFE can be applied to a wide variety of lead-screw pitches and is available for our brand captive, non-captive and external linear actuators. Not available for 0.00006-in (.0015 mm) and 0.000098-in (.0025 mm) resolutions.

\*Certain conditions apply.

### Integrated Anti-Backlash Nut for Hybrids\*

Most sizes (except Size 34) of our captive and non-captive hybrid stepper motors can be equipped with an integral anti-backlash feature. There is a normal backlash between the lead screw and integral rotor nut.

Our actuators are designed for millions of cycles. However over time, additional backlash could increase and eventually double. Haydon Kerk Integrated Anti-Backlash Nut can eliminate all backlash. Designed specifically for our captive and non-captive hybrid motors, nuts use an opposing spring force to eliminate backlash between the screw and the nut interface. The nuts will self-compensate and accommodate any wear. Haydon Kerk Motion Solutions application engineers can help you select the appropriate preload for your application.

\*Except Size 34.

