

MDrive® Linear Actuator

Compact, integrated all-in-one linear motion systems



MDrive 23Plus Linear Actuator
Step/direction input



MDrive® Plus Linear Actuator with step / direction input, non-captive and external shaft styles

Presentation

The MDrive® Plus Linear Actuator with step / direction input is an integrated product that combines a stepper motor linear actuator with mechanicals and electronics to form a single, compact system. It features a 1.8° 2-phase stepper motor linear actuator with on-board control electronics. Step/direction signals of a master controller, e.g. a motion controller, or A/B signals of an encoder, are converted directly into rotary-to-linear motion. This eliminates the need for belts and pulleys, rack and pinion, hydraulics, pneumatics or other mechanical system.

Settings for MDrive Plus Linear Actuators with step / direction input may be changed on-the-fly or downloaded and stored in nonvolatile memory using the SPI Motor Interface software provided. This eliminates the need for external switches or resistors. Parameters are changed via an SPI port.

Application areas

The MDrive Plus Linear Actuator with step / direction input is ideal for machine builders who want an optimized stepper motor linear actuator with on-board electronics. The integrated electronics of the MDrive product reduces the potential for problems due to electrical noise by eliminating the cable between motor and drive.

These compact, powerful and cost effective linear motion control solutions deliver exceptional smoothness and performance, and may reduce system cost, design and assembly time for a large range of applications.

Features

- Highly integrated microstepping drive and high torque 1.8° 2-phase stepper motor linear actuator
 - Non-captive or external shaft style
 - Load limit up to 200 lbs
 - Precision rolled lead screws
- Advanced current control for exceptional performance and smoothness
- Single supply: from +12 up to +75 VDC
- Cost effective
- Extremely compact
- 20 microstep resolutions up to 51,200 steps per rev including: Degrees, Metric, Arc Minutes
- Optically isolated input options:
 - Universal +5 to +24 VDC signals, sourcing or sinking
 - Differential +5 VDC signals
- Automatic current reduction
- Configurable:
 - Motor run / hold current
 - Motor direction via direction input
 - Microstep resolution
 - Clock type: step and direction, quadrature, step up and step down, clockwise and counterclockwise
 - Programmable digital filtering for clock and direction inputs
- Setup parameters may be switched on-the-fly
- Numerous connector interface choices
- Available options:
 - Externally-mounted encoder (1)
 - Drive Protection Module
- Graphical user interface (GUI) provided for quick and easy parameter setup

(1) Only available for External shaft linear actuators.

General specifications					
Input power	Voltage	VDC	MDrive 14	MDrive 17	MDrive 23
	Current maximum (1)	amp	1	2	2
Maximum thrust (2)	Non-captive shaft	lbs	50	50	200
		kg	22	22	91
	External shaft with general purpose nut	lbs	25	25	60
		kg	11	11	27
	External shaft with anti-backlash nut	lbs	5	5	25
		kg	2	2	11
Maximum repeatability	General purpose	inch	0.005		
		mm	0.127		
	Anti-backlash (3)	inch	0.0005		
		mm	0.0127		
Thermal	Operating temp non-condensing	Heat sink	–40° to +85°C		
		Motor	–40° to +100°C		
Isolated input	Universal		Voltage range: +5 to +24 VDC sourcing or sinking step clock, direction and enable		
	Differential		Voltage range: +5 VDC clockwise and counterclockwise		
Motion	Digital filter range		50 nS to 12.9 µS (10 MHz to 38.8 kHz)		
	Clock types		Step/direction, quadrature, step up/step down, clockwise/counterclockwise		
	Step frequency		2 MHz default / 5 MHz maximum		
	Microstep resolution	Number of settings	20		
		Steps per revolution	200, 400, 800, 1000, 1600, 2000, 3200, 5000, 6400, 10000, 12800, 20000, 25000, 25600, 40000, 50000, 51200, 36000 (0.01 deg/µstep), 21600 (1 arc minute/µstep), 25400 (0.001 mm/µstep)		

Setup parameters (4)				
SPI communication		Function	Range	Units
	MHC	Motor hold current	0 to 100	percent
	MRC	Motor run current	1 to 100	percent
	MSEL	Microstep resolution	1, 2, 4, 5, 8, 10, 16, 25, 32, 50, 64, 100, 108, 125, 127, 128, 180, 200, 250, 256	µsteps per full step
	DIR	Motor direction override	0/1	—
	HCDT	Hold current delay time	0 or 2–65535	mSec
	CLK TYPE	Clock type	Step/Dir, Quadrature, Up/Down, CW/CCW	—
	CLK IOF	Clock and direction filter	50 nS to 12.9 µS (10 MHz to 38.8 kHz)	nS (MHz)
	USER ID	User ID	Customizable	1–3 characters
	EN ACT	Enable active	High/Low	—
				Default
				5
				25
				256
				CW
				500
				Step/Dir
				200 nS (2 MHz)
				IMS
				High

(1) Actual power supply current will depend on voltage and load.

(2) Performance data for maximum force/load is based on a static load and will vary with a dynamic load.

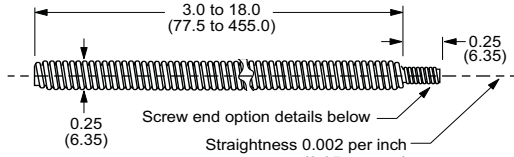
(3) Only applicable for External shaft linear actuator with anti-backlash nut.

(4) All parameters are set using the supplied SPI Motor Interface GUI and may be changed on-the-fly. An optional Communication Converter is recommended with first orders.

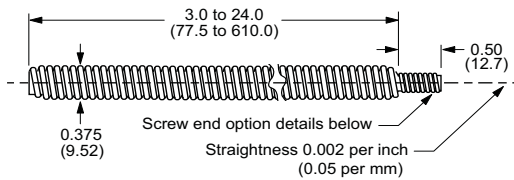


See User Manual for complete details: www.motion.schneider-electric.com/manuals.html

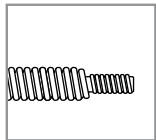
Dimensions in inches (mm)



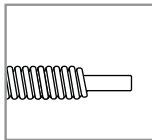
MDrive14 and MDrive17 screw dimensions



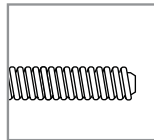
MDrive23 screw dimensions



Threaded end



Smooth end



None

Screw material

MDrive Linear Actuator precision rolled lead screws are designed specifically for motion control applications to deliver maximum life and quiet operation. Corrosion resistant and non-magnetic, screws are manufactured from premium grade stainless steel.

Coating

An optional Teflon® screw coating is available for smooth operation and extended life.

Length

Length (1)		MDrive 14 and MDrive 17		MDrive 23	
		minimum	maximum	minimum	maximum
	inches	3.0	18.0	3.0	24.0
	mm	77.5	455.0	77.5	610.0

(1) Screw lengths are available in 0.1" (2.5mm) increments.

Lead / pitch options

		MDrive 14 and MDrive 17		MDrive 23	
		per revolution	per full step	per revolution	per full step
Screw G	travel				
	inches	—	—	0.3750	0.001875
Screw A	mm	—	—	9.525	0.0476
	inches	0.250	0.00125	0.200	0.001
Screw B	mm	6.350	0.0317	5.08	0.0254
	inches	0.125	0.00063	0.1670	0.000835
Screw C	mm	3.175	0.0158	4.233	0.0212
	inches	0.063	0.00031	—	—
Screw D	mm	1.588	0.0079	—	—
	inches	—	—	0.0833	0.0004165
Screw D	mm	—	—	2.116	0.0106

End options

		MDrive 14 and MDrive 17	MDrive 23
Threaded	metric end	M4 x 0.7 mm thread to within 0.03"/0.76 mm of shoulder	M6 x 1.0 mm thread to within 0.03"/0.76 mm of shoulder
	UNC end	#8-32 UNC-2A thread to within 0.03"/0.76 mm of shoulder	1/4-20 UNC-2A thread to within 0.05"/1.3 mm of shoulder
Smooth	inches	Ø 0.1967 ±0.001	Ø 0.2362 ±0.001
	mm	Ø 5 ±0.003	Ø 6 ±0.003
None		—	—

Load limit

		MDrive 14 and MDrive 17	MDrive 23
Non-captive shaft (2)	lbs	50	200
	kg	22	91
External shaft	General purpose nut	lbs 25	60
		kg 11	27
	Anti-backlash nut	lbs 5	25
		kg 2	11

(2) Performance data for maximum force/load is based on a static load and will vary with a dynamic load.

Calculating length

■ Non-captive shaft products

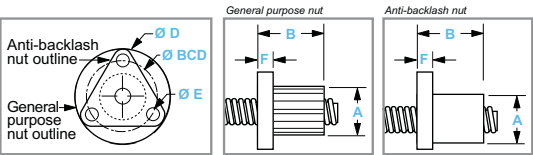
Screw length = [mounting surface plate thickness] + [desired stroke length] + [•]

- MDrive 14 = 1.4" / 35.6 mm
- MDrive 17 = 1.4" / 35.6 mm
- MDrive 23 = 1.8" / 45.7 mm

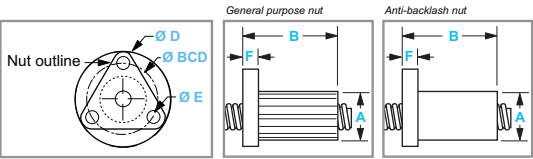
■ External shaft products

Available stroke length = [screw length] – [nut length] – [mounting surface plate thickness]

MDrive14 and MDrive17 nuts



MDrive23 nuts



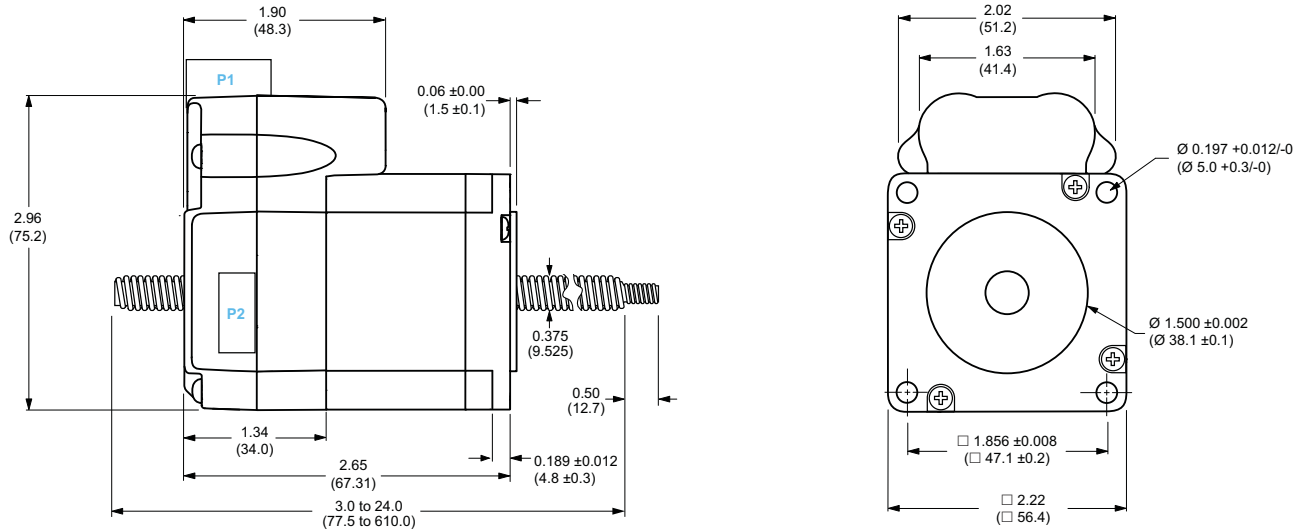
Nut styles

MDrive Linear Actuators with external shaft employ a nut which moves axially along the threaded shaft as the screw rotates. Two nut styles are available: general purpose and anti-backlash. While anti-backlash nuts provide higher accuracy and low drag torque, general purpose nuts are rated for higher load limits but are lacking wear compensation.

Dimensions and performance

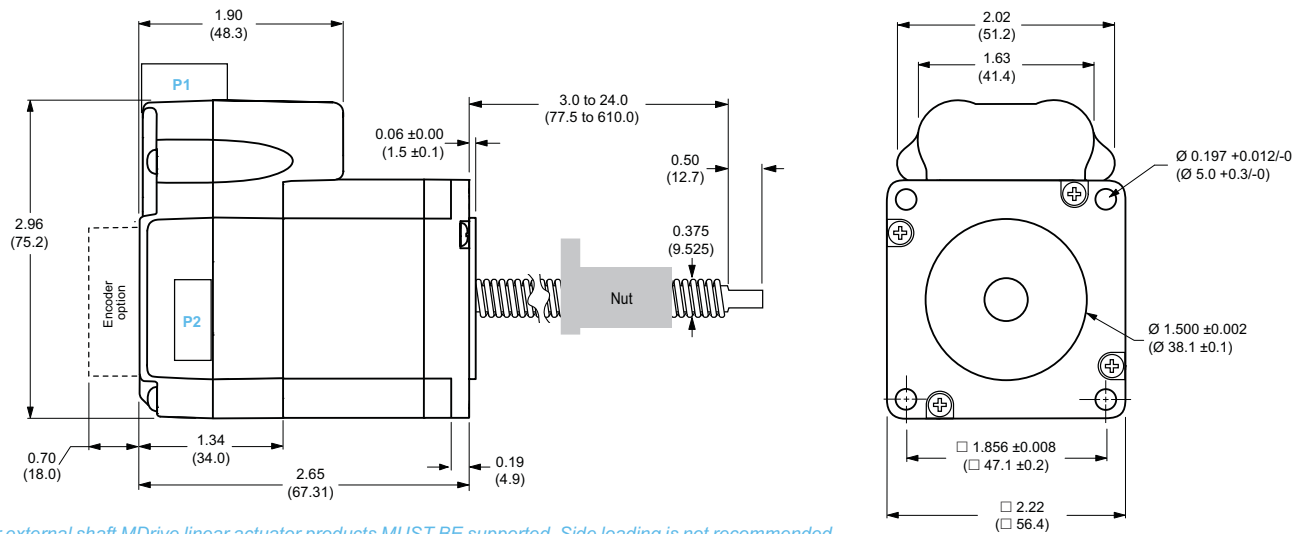
		MDrive 14 and MDrive 17		MDrive 23	
A	nut type	general purpose	anti-backlash	general purpose	anti-backlash
	inches	0.50	0.50	0.71	0.82
B	inches	0.75	0.9 max	1.50	1.875 max
	mm	19.1	22.86 max	38.1	47.63 max
D	inches	1.0	1.0	1.5	1.5
	mm	25.4	25.4	38.1	38.1
E	inches	0.14	0.143	0.20	0.20
	mm	3.6	3.63	5.08	5.08
F	inches	0.15	0.18	0.20	0.20
	mm	3.81	4.57	5.08	5.08
BCD	inches	0.75	0.75	1.125	1.125
	mm	19.1	19.1	28.6	28.6
Load limit	lbs	25	5	60	25
	kg	11	2	27	11
Drag torque		free wheeling	< 1.0 oz-in	free wheeling	1 to 3
			< 0.7 N-cm		

– Non-captive shaft – mechanical specifications, dimensions in inches (mm)



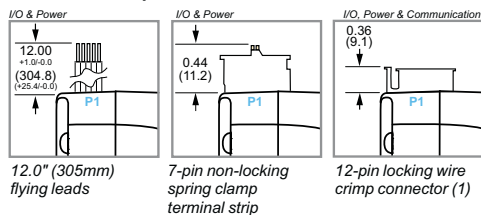
Unsupported loads and side loading are not recommended for non-captive shaft MDrive linear actuator products.

– External shaft – mechanical specifications, dimensions in inches (mm)

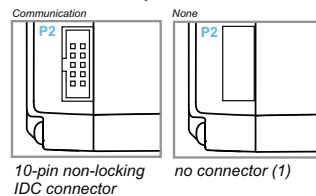


Loads for external shaft MDrive linear actuator products **MUST BE** supported. Side loading is not recommended.

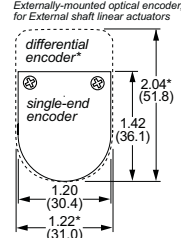
P1 connector options



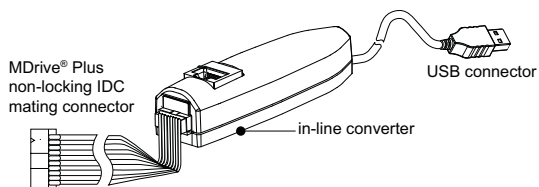
P2 connector options



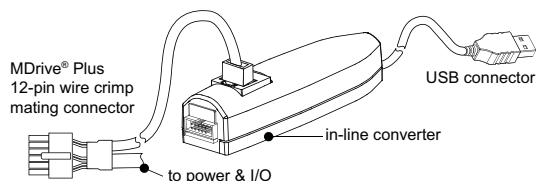
Encoder option



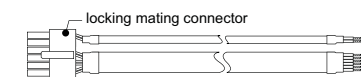
(1) 12-pin locking wire crimp connector at P1 eliminates the P2 connector.



MD-CC300-001



MD-CC303-001



PD12-1434-FL3

Installation accessories

Description	Length feet (m)	Part number
-------------	-----------------	-------------

QuickStart Kit

For rapid design verification, all-inclusive QuickStart Kits include connectivity, instructions and CD for MDrive Plus Linear Actuator initial functional setup and system testing.

- For MDrive 23 Plus step/direction input products — add "K" to part number (1)

Communication converter

Electrically isolated, in-line converter pre-wired with mating connector to conveniently set/program communication parameters for a single MDrive Plus Linear Actuator via a PC's USB port.

- | Description | Length feet (m) | Part number |
|--|-----------------|--------------|
| ■ Mates to 10-pin non-locking IDC connector | 12.0 (3.6) | MD-CC300-001 |
| ■ Mates to 12-pin locking wire crimp connector | 12.0 (3.6) | MD-CC303-001 |

Prototype development cable

Speed test/development with pre-wired mating connector with other cable end open.

- | Description | Length feet (m) | Part number |
|---|-----------------|---------------|
| ■ Mates to 12-pin locking wire crimp connector for I/O, communication and power | 10.0 (3.0) | PD12-1434-FL3 |

Encoder cables

Pre-wired mating connector with other cable end open.

- | Description | Length feet (m) | Part number |
|--|-----------------|-------------|
| ■ For external single-end optical encoder | 1.0 (0.3) | ES-CABLE-2 |
| ■ For external differential optical encoder with locking connector | 6.0 (1.8) | ED-CABLE-6 |

Mating connector kit

Connectors for assembly of cables, cable material not supplied. Sold in lots of 5. Manufacturer's crimp tool recommended for crimp connectors.

- | Description | Length feet (m) | Part number |
|--|-----------------|-------------|
| ■ 10-pin non-locking IDC connector for communication | — | CK-01 |
| ■ 12-pin locking wire crimp connector for I/O, communication and power | — | CK-03 |

Drive protection module

Limits surge current and voltage to a safe level when DC input power is switched on-and-off to an MDrive product.

- | Description | Length feet (m) | Part number |
|---|-----------------|-------------|
| ■ For all MDrive Linear Actuator products | — | DPM75 |

(1) See page 8.



MDrive® 23 Plus Linear Actuator

Step / direction input

MDrive® 23 Plus



P1: I/O & Power
 F = 12" flying leads
 P = non-locking spring clamp terminal strip
 C = 12-pin locking wire crimp (includes I/O, Power & Comm)

P2: Communication
 D = SPI with 10-pin IDC non-locking connector
 Z = None. Used with 12-pin locking wire crimp in position P1, which includes communication.

Part numbers

Example:	K M L M 1 F S D 2 3 A 7 - E1 -
QuickStart Kit	K M L M 1 F S D 2 3 A 7 - E1 -
K = kit option, or leave blank if not wanted	
MDrive Plus Linear Actuator version	K M L M 1 F S D 2 3 A 7 - E1 -
MLM = Step / direction input	
Input type	K M L M 1 F S D 2 3 A 7 - E1 -
1 = Universal input	
5 = Differential CW/CCW input	
P1 connector	K M L M 1 F S D 2 3 A 7 - E1 -
F = flying leads	
P = pluggable	
C = wire crimp (1)	
Communication	K M L M 1 F S D 2 3 A 7 - E1 -
S = SPI	
P2 connector	K M L M 1 F S D 2 3 A 7 - E1 -
D = IDC	
Z = none (1)	
Motor size	K M L M 1 F S D 2 3 A 7 - E1 -
23 = NEMA 23 (2.3" / 57 mm)	
Motor length	K M L M 1 F S D 2 3 A 7 - E1 -
A = single stack	
Drive voltage	K M L M 1 F S D 2 3 A 7 - E1 -
7 = +12 to +75 VDC	
Optional encoder (2)	- E1 -
Leave blank if not wanted	
-E = externally-mounted optical encoder with index mark	
line count	100 200 250 256 400 500 512 1000 1024
single-end part #	E1 E2 E3 EP E4 E5 EQ E6 ER
differential part #	EAL EBL ECL EWL EDL EHL EXL EJL EYL

Linear actuator specifications

Complete the part number from the table below

Continued – Part numbers

Example - linear actuator specifications:	- L G 1 M 0 6 0 Z T
Linear actuator	- L G 1 M 0 6 0 Z T
-L	
Screw lead / pitch	- L G 1 M 0 6 0 Z T
G = 0.375" / 9.525 mm travel per rev	
A = 0.200" / 5.08 mm travel per rev	
B = 0.167" / 4.233 mm travel per rev	
D = 0.083" / 2.116 mm travel per rev	
Shaft style	- L G 1 M 0 6 0 Z T
1 = Non-captive	
3 = External	
Screw end finish	- L G 1 M 0 6 0 Z T
M = metric threaded	
U = UNC threaded	
S = smooth	
Z = none	
Screw length	- L G 1 M 0 6 0 Z T
030 = 3.0" (77.5 mm) minimum up to	
240 = 24.0" (610.0 mm) maximum, in 0.1" (2.5 mm) increments	
Nut	- L G 1 M 0 6 0 Z T
Z = none, only with Non-captive shaft products	
G = general purpose, only with External shaft products (3)	
A = anti-backlash, only with External shaft products (4)	
Coating	- L G 1 M 0 6 0 Z T
T = Teflon	
Z = None	

(1) Wire crimp connector at P1 includes communication, so the P2 designator is Z=none.

(2) Only available with External shaft linear actuators.

(3) Dynamic load limit to 60 lbs / 22 kg.

(4) Dynamic load limit to 25 lbs / 11 kg.



Non-captive shaft style



External shaft style



Easy MDrive part numbers via an interactive tool at:
www.motion.schneider-electric.com/MDriveLinear.html

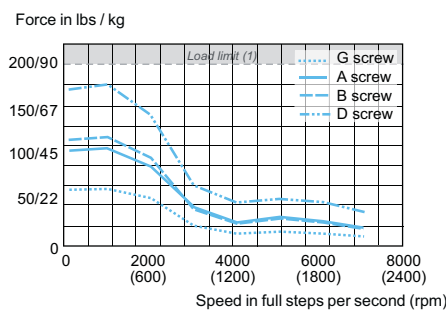
Motor specifications			
Motor frame size	NEMA		23
	mm		57
Motor length	stacks		1
Holding torque	oz-in		90.0
	N-cm		64.0
Rotor inertia	oz-in-sec ²		0.0025
	kg-cm ²		0.18
Maximum screw misalignment	°		± 1
Weight without screw	oz		22.0
	g		625.0
Maximum thrust (1)	Non-captive shaft	lbs	200
		kg	91
	External shaft with general purpose nut	lbs	60
		kg	27
	External shaft with anti-backlash nut	lbs	25
		kg	11
Maximum repeatability	General purpose	inch	0.005
		mm	0.127
	Anti-backlash (2)	inch	0.0005
		mm	0.0127

(1) Performance data for maximum force/load is based on a static load and will vary with a dynamic load.

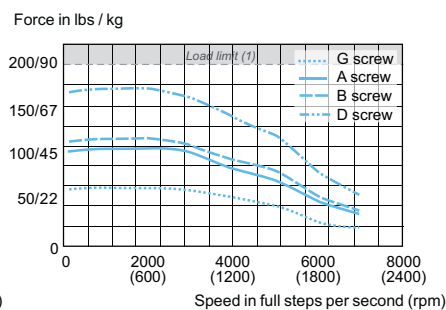
(2) Only applicable for External shaft linear actuator with anti-backlash nut.

Speed force characteristics

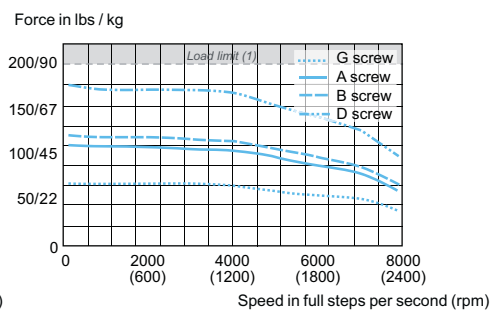
24 VDC



48 VDC



75 VDC



(1) Load limits are for non-captive shaft linear actuators: 200lbs/91kg.

Load limits for external shaft linear actuators are determined by the nut selected.

Note: Performance data for maximum force/load is based on a static load and will vary with a dynamic load.

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