

MDrive® Linear Actuator

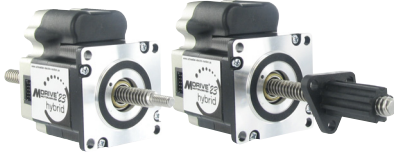
Compact, integrated all-in-one linear motion systems



MDrive 23 Hybrid Linear Actuator
Step • Torque • Speed

IMS
INTELLIGENT MOTION
SYSTEMS, INC.

Schneider
Electric



MDrive® Hybrid Step • Torque • Speed Linear Actuator
non-captive and external shaft styles

Presentation

The MDrive® Hybrid Step • Torque • Speed Linear Actuator is a very compact linear motion system that solves many servo applications with a low cost solution. The system includes a 1.8° 2-phase stepper motor linear actuator integrated with a high performance microstepping drive, internal encoder integral to system operation, and Hybrid Motion Technology™ (HMT). HMT combines the best of servo and stepper motor technologies, while delivering unique capabilities and enhancements over both.

MDrive Hybrid integrated motion control systems use RS-422/485 communications. The MDrive Hybrid Step • Torque • Speed Linear Actuator systems can be configured to operate in one of four modes:

- **Step** — in Step/Direction mode, the MDrive Hybrid is controlled by an external step clock signal.
- **Torque** — in Torque Control mode, the MDrive Hybrid maintains a constant, preset torque output of the motor. The torque may be set in software, or controlled via the analog input using a 0 to +5 V, 0 to +10 V or -10 to +10 V signal.
- **Speed** — in Speed Control mode, the MDrive Hybrid operates as an intelligent speed control, with velocity being controlled via the analog input by a 0 to +5 V, 0 to +10 V or -10 to +10 V signal.
- **Velocity** — in Velocity Control mode, the MDrive Hybrid operates at a constant velocity commanded by the slew parameter.

MDrive Hybrid Step • Torque • Speed Linear Actuator system settings are via a supplied configuration GUI featuring:

- Easy installation via web interface
- Automatic communication configuration
- Tool-tips display valid range settings for each option

Application areas

The MDrive Hybrid Linear Actuator is ideal for machine builders who want a low cost linear motion alternative to servo motors and brushed DC motors. The highly compact all-in-one system converts signals directly from rotary to linear motion, eliminating the need for belts and pulleys, rack and pinion, hydraulics, pneumatics or other mechanical system.

Integrated electronics of the MDrive Hybrid Linear Actuator reduce the potential for problems due to electrical noise by eliminating the cable between motor and drive. This stepper-based linear actuator system requires no tuning, and provides real-time closed loop control through an internal encoder.

These compact, powerful and cost effective linear motion control solutions deliver unsurpassed smoothness and performance that will reduce system cost, design and assembly time for a large range of motor applications — both servo and stepper.

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
- Hybrid Motion Technology™ control for exceptional performance
- Internal encoder, with signals available for external use
- RS-422/485 communication
- Single supply: from +12 to +60 VDC
- Cost effective
- Extremely compact
- 20 microstep resolutions up to 51,200 steps per rev including: Degrees, Metric, Arc Minutes
- Available options:
 - QuickStart Kit
 - Drive Protection Module
- Graphical user interface provided for quick and easy parameter setup

General specifications				
			MDrive 23	
Input power	Voltage	VDC	12 to 60	
	Current max (1)	amp	3.5	
Maximum thrust (2)	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 (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	Voltage range +5 to +24 VDC sourcing or sinking			
Motion	Digital filter range 50 nS to 12.9 μS (10 MHz to 38.8 kHz)			
	Clock types (Step mode) Step/direction, quadrature, step up/step down			
	Step frequency 5 MHz maximum			
	100 ns minimum pulse width			
	Microstep resolution	Number of settings	20	
		Steps per Binary revolution	200, 400, 800, 1600, 3200, 6400, 12800, 25600, 51200, 36000 (0.01 deg/μstep), 21600 (1 arc minute/μstep), 25400 (0.001 mm/μstep)	
		Decimal	1000, 2000, 5000, 10000, 20000, 25000, 40000, 50000	
Closed loop configuration	Internal magnetic encoder line counts	100, 200, 250, 256, 400, 500, 512, 1000		

Setup parameters overview (4)		
		Description
Operating modes	Step & Direction	For point-to-point positioning, clock types: step/direction, quadrature, step up/step down
	Torque Control	Operates in relation to an analog input for positioning to torque setting Resolution: 0 – 100% Accuracy, to scale: ± 5%
	Speed Control	Operates as an independent velocity control device, no external controller required
Hybrid Motion Technology™ settings	Setup/configuration	Turn HMT off/on in fixed or variable mode; set and confirm encoder line count
	Operation	Set control bounds for motor torque and speed, lead, lag, and make-up of lost steps
	Hybrid Motion Technology status	Display status alerts of 8 pre-programmed fields, read-only
General settings	Calibration	To maintain synchronization, select options for motor's rotor-to-stator physical position
	Analog	Enable active
	Communication	Set baud rate; enable/disable parity mode and features; Check Sum integrity quality assurance
	I/O	Clock and filter settings; Attention Output with 11 pre-programmed fields to select among
Defaults	Motion	Set various motion settings which vary with the operating mode selected, ex. Current, MSEL The Speed Control Mode also includes settings for acceleration, deceleration, velocity and flags
		Restore system defaults or previously stored settings; view current communication settings

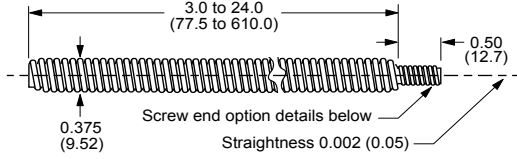
(1) Actual power supply current will depend on voltage and load.

(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 system configuration GUI. Available settings vary with operating mode. An optional Communication Converter is recommended with first orders.

Dimensions in inches (mm)



MDrive23 screw dimensions

Screw specifications

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

		MDrive 23	
		minimum	maximum
Length (1)	inches	3.0	24.0
	mm	77.5	610.0

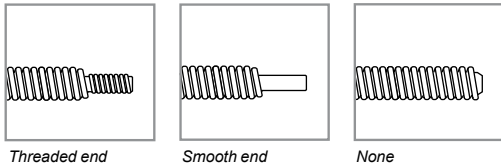
(1) Screw lengths are available in 0.1" (2.5mm) increments.

Lead/pitch options

		MDrive 23	
		per revolution	per full step
Screw G	travel		
	inches	0.3750	0.001875
	mm	9.525	0.0476
Screw A	inches	0.200	0.001
	mm	5.08	0.0254
Screw B	inches	0.1670	0.000835
	mm	4.233	0.0212
Screw D	inches	0.0833	0.0004165
	mm	2.116	0.0106

End options

		MDrive 23
Threaded	metric end	M6 x 1.0 mm thread to within 0.03"/0.76 mm of shoulder
	UNC end	1/4-20 UNC-2A thread to within 0.05"/1.3 mm of shoulder
Smooth	inches	Ø 0.2362 ±0.001
	mm	Ø 6 ±0.003
None		—



Load limit

		MDrive 23
Non-captive shaft (2)	lbs	200
	kg	91
External shaft	General purpose nut	lbs 60
		kg 27
	Anti-backlash nut	lbs 25
		kg 11

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

Calculating length

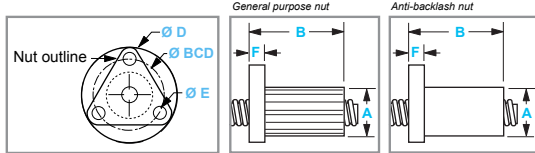
■ Non-captive shaft products
 Screw length = [mounting surface plate thickness] + [desired stroke length] + [1.8" (45.7mm)]

■ External shaft products
 Available stroke length = [screw length] – [nut length] – [mounting surface plate thickness]

Nut specifications

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 lack wear compensation.

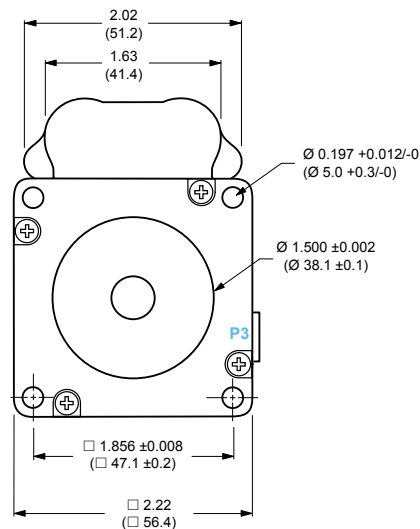
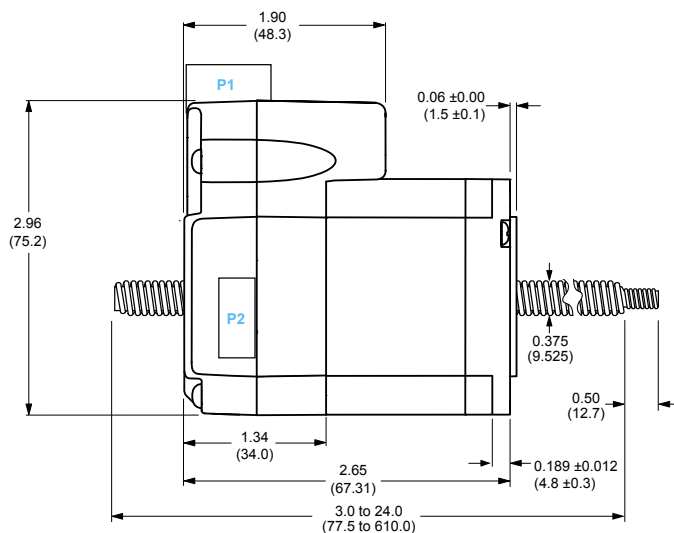
MDrive 23 nuts



Dimensions and performance

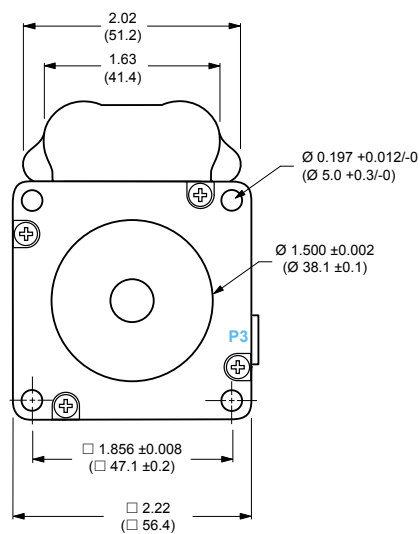
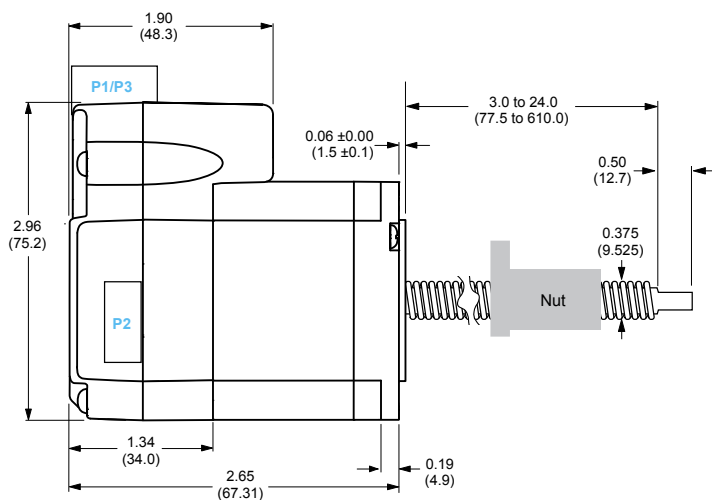
		MDrive23	
		general purpose	anti-backlash
A	nut type		
	inches	0.71	0.82
B	mm	18.0	20.8
	inches	1.50	1.875 max
D	mm	38.1	47.63 max
	inches	1.5	1.5
E	mm	38.1	38.1
	inches	0.20	0.20
F	mm	5.08	5.08
	inches	0.20	0.20
BCD	mm	5.08	5.08
	inches	1.125	1.125
Load limit	mm	28.6	28.6
	lbs	60	25
Drag torque	kg	27	11
		free wheeling	1 to 3

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



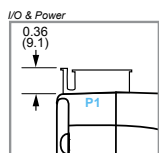
Unsupported loads and side loading are not recommended for non-captive shaft MDrive® linear actuator products.

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



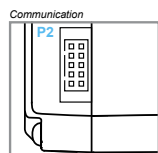
Loads for external shaft MDrive® linear actuator products **MUST BE** supported. Side loading is not recommended.

P1 connector



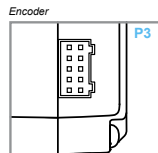
12-pin locking wire crimp connector

P2 connector

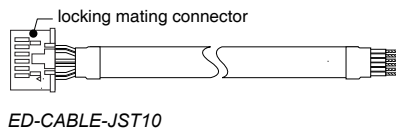
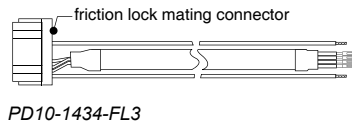
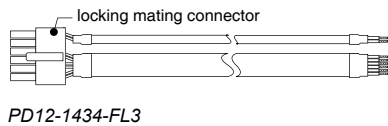
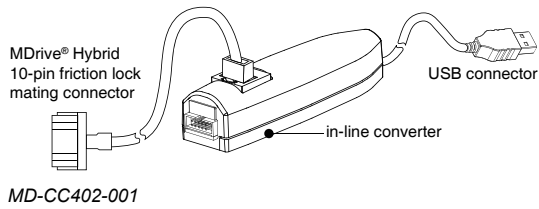


10-pin friction lock wire crimp connector

P3 connector



10-pin locking wire crimp connector



Installation accessories

Description	Length feet (m)	Part number
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QuickStart Kit

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

- For MDrive 23 Hybrid Step • Torque • Speed systems — **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 Hybrid Linear Actuator via a PC's USB port.

- Mates to 10-pin friction lock wire crimp connector 12.0 (3.6) **MD-CC402-001**

Prototype development cable

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

- Mates to 12-pin locking wire crimp connector for I/O and power 10.0 (3.0) **PD12-1434-FL3**
- Mates to 10-pin friction lock wire crimp connector for communication 10.0 (3.0) **PD10-1434-FL3**
- Mates to 10-pin locking wire crimp connector for encoder 6.0 (1.8) **ED-CABLE-JST10**

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.

- 12-pin locking wire crimp connector for I/O and power — **CK-03**
- 10-pin friction lock wire crimp connector for communication — **CK-02**
- 10-pin locking wire crimp connector for encoder — **CK-13**

Drive protection module

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

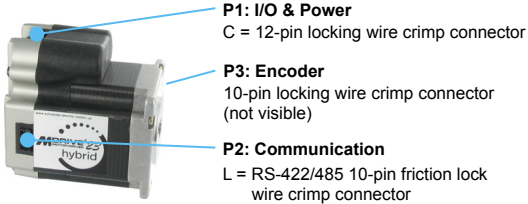
- For all MDrive Linear Actuator systems — **DPM75**

(1) See page 8.

MDrive® 23 Hybrid Linear Actuator

Step • Torque • Speed

MDrive® 23 Hybrid



Part numbers											
Example:	K	M	A	M	3	C	R	L	2	3	A 6 -EAM -●
QuickStart Kit K = kit option, or leave blank if not wanted	K	M	A	M	3	C	R	L	2	3	A 6 -EAM -●
MDrive Hybrid Linear Actuator version MAM = Step•Torque•Speed	K	M	A	M	3	C	R	L	2	3	A 6 -EAM -●
Type 3 = Hybrid Motion Technology	K	M	A	M	3	C	R	L	2	3	A 6 -EAM -●
P1 connector C = wire crimp	K	M	A	M	3	C	R	L	2	3	A 6 -EAM -●
Communication R = RS-422/485	K	M	A	M	3	C	R	L	2	3	A 6 -EAM -●
P2 connector L = wire crimp	K	M	A	M	3	C	R	L	2	3	A 6 -EAM -●
Motor size 23 = NEMA 23 (2.3" / 57 mm)	K	M	A	M	3	C	R	L	2	3	A 6 -EAM -●
Motor length A = single stack	K	M	A	M	3	C	R	L	2	3	A 6 -EAM -●
Drive voltage 6 = +12 to +60 VDC	K	M	A	M	3	C	R	L	2	3	A 6 -EAM -●
Encoder, differential internal magnetic encoder with index mark, signals available for external use -EAM = 100 line count -EBM = 200 line count -ECM = 250 line count -EWM = 256 line count -EDM = 400 line count -EHM = 500 line count -EXM = 512 line count -EJM = 1000 line count	K	M	A	M	3	C	R	L	2	3	A 6 -EAM -●
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	-L	G	1	M	0	6	0	Z	T		
Screw lead / pitch 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	-L	G	1	M	0	6	0	Z	T		
Shaft style 1 = Non-captive 3 = External	-L	G	1	M	0	6	0	Z	T		
Screw end finish M = metric threaded U = UNC threaded S = smooth Z = none	-L	G	1	M	0	6	0	Z	T		
Screw length 030 = 3.0" (77.5 mm) minimum up to 240 = 24.0" (610.0 mm) maximum, in 0.1" (2.5 mm) increments	-L	G	1	M	0	6	0	Z	T		
Nut Z = none, only with Non-captive shaft products G = general purpose, only with External shaft products (1) A = anti-backlash, only with External shaft products (2)	-L	G	1	M	0	6	0	Z	T		
Coating T = Teflon Z = None	-L	G	1	M	0	6	0	Z	T		

(1) Dynamic load limit to 60lbs / 22 kg.
(2) Dynamic load limit to 25lbs / 11 kg.

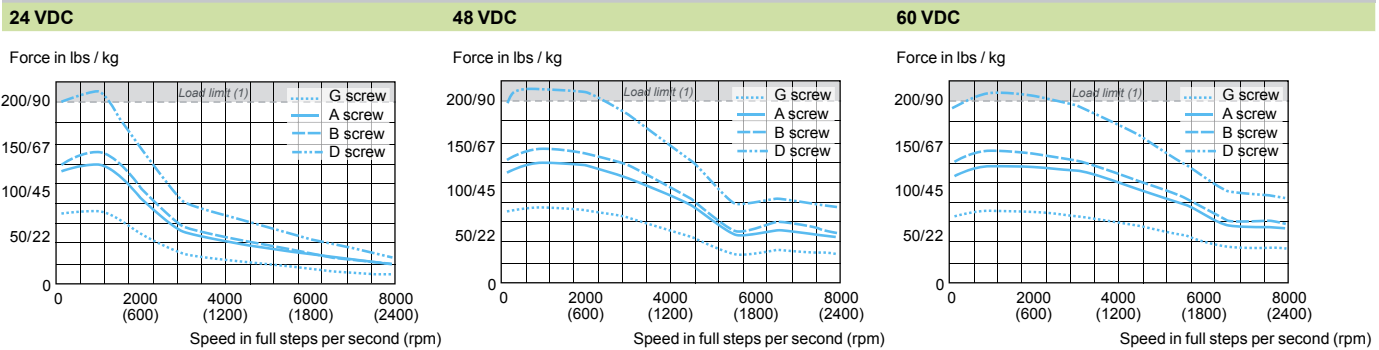


Easy MDrive part numbers via an interactive tool at:
www.imshome.com/MDriveLinear.html

Motor specifications			
Stack length			Single
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



(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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