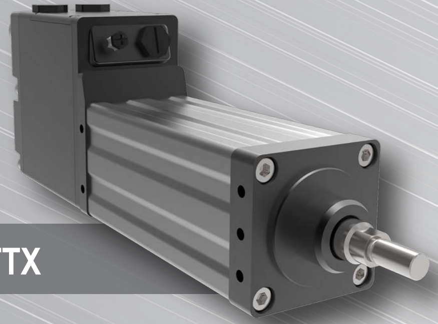
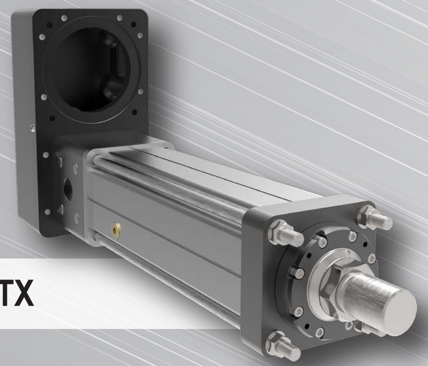
Standard Products

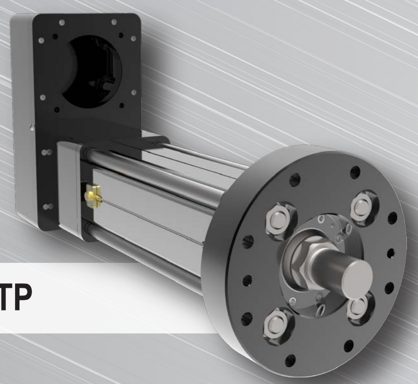
GTX



TTX



FTX



FTP

CURTISS-WRIGHT

EXLAR®

INDUSTRIAL ▪ ACTUATION ▪ SOLUTIONS

This document does not contain any export controlled technical data.

GTX Series

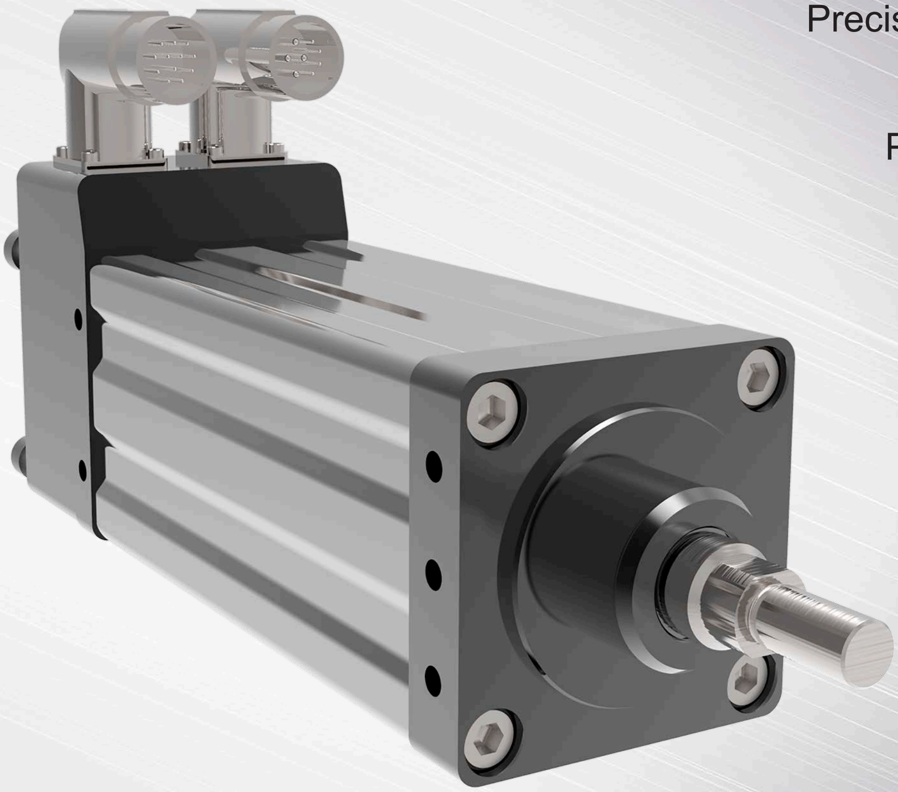
INTEGRATED SERVO MOTOR AND ACTUATOR

Ideal hydraulic replacement

Precise and programmable

Rugged and reliable

Powerful and compact



GTX Series

Description

For applications that require long life and continuous duty, even in harsh environments, the GTX Series actuator offers a robust solution. The life of these actuators can exceed that of a ball screw actuator by 15 times, all while delivering high speeds and high forces.

Operating Conditions and Usage		
Accuracy:		
Screw Lead Error	μm / 300 mm	25
	in/ft	0.001
Screw Travel Variation	μm / 300 mm	30
	in/ft	0.0012
Ambient Operating Temperature	°C	0 to 25
	°F	0 to 77
Elevated Ambient Operating Temperature	°C	65*
	°F	149*
Friction Torque (typical)	Frame Size (Nm)	060 (0.12) 080 (0.23) 100 (0.34)
IP Rating		IP66S

* With derating

Elevated Ambient Temperature Operation

The speed/torque curves are based on 25° C ambient conditions. The actuators may be operated at ambient temperatures up to 85° C.

Elevated Ambient Temp Factor (%) =

$$100\% \text{ X } \sqrt{\frac{\text{Max Rated Temp [~130° C] - Environment Temp [in °C]}}{\text{Max Rated Temp [~130° C] - Rated Ambient [~25° C]}}} =$$

$$100\% \text{ X } \sqrt{\frac{\text{130° C - Environment Temp}}{\text{105° C}}}$$ = % of published continuous @ 25° C

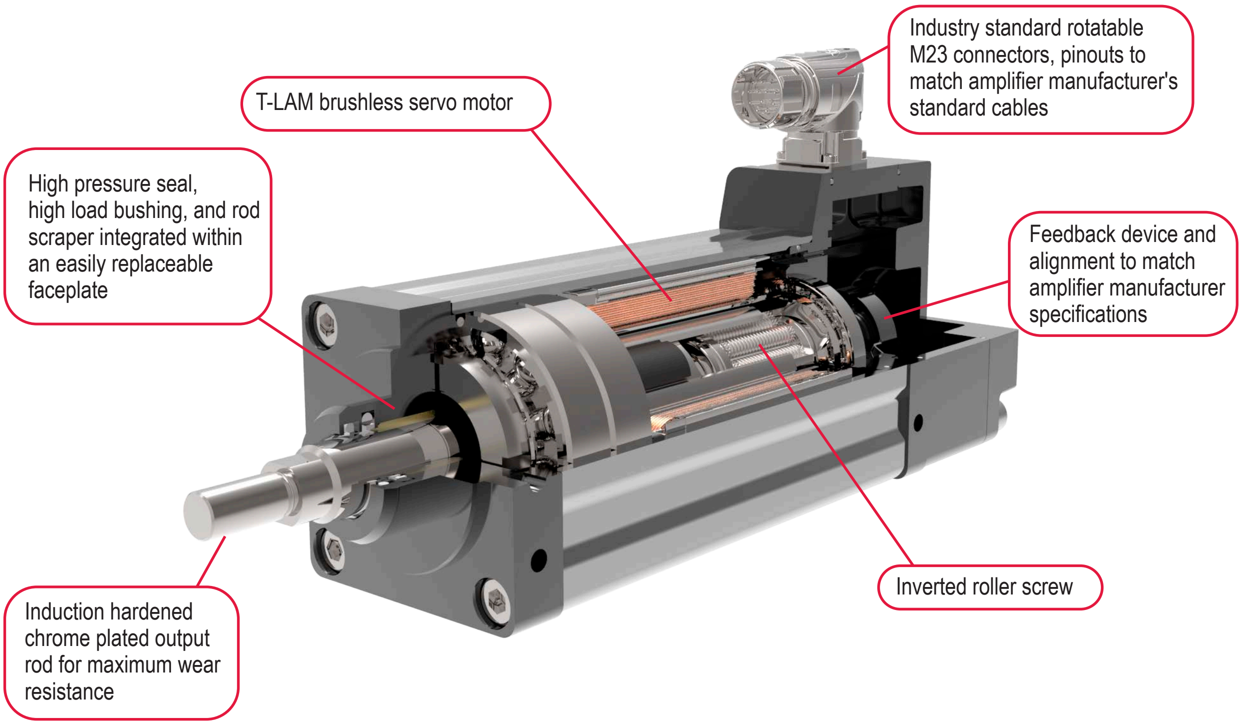
Sealed for Long Life with Minimum Maintenance

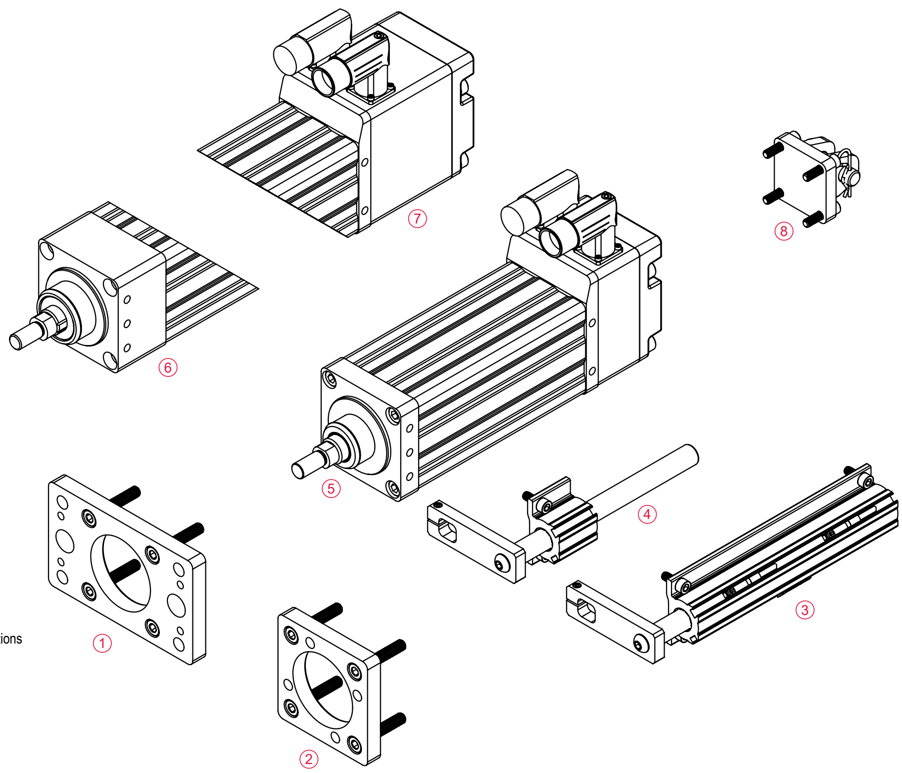
GTX Series actuators have strong advantages wherever outside contaminants are an issue. In most rotary-to-linear devices, critical mechanisms are exposed to the environment. Thus, these actuators must be frequently inspected, cleaned and lubricated.

In contrast, the converting components in all Exlar GTX units are mounted within sealed motor housing. With a simple bushing and seal on the smooth extending rod, abrasive particles or other contaminants are prevented from reaching the actuator's critical mechanisms. This assures trouble-free operation even in the most harsh environments.

Agency Standards & Approvals		
UL		UL 1004-1
		UL 1004-6
CSA		CSA C22.2 NO. 100
CE	EMC	EN 55014-1
		EN 55014-2
	Safety	IEC/EN 60034-1
	RoHS	RoHS 2011/65/EU and amended with directive 2015/863

Product Features





1 - Front Flange Kit*
2 - Face Mount Kit
3 - External Limit Switch Kit**
4 - External Anti-Rotate Kit
5 - Multiple Rod End Threads***
6 - Internal Anti-Rotate (Splined Rod)***
7 - Rear Brake Option
8 - Rear Clevis Kit*

* Metric/Imperial Options
** Limit Switches Sold Separately
*** Male/Female and Metric/Imperial Options

Mechanical Specifications

GTX060

	Stroke Length mm (in)	Screw Lead mm (in)	Continuous Force Rating N (lbf)		Max Velocity mm/s (in/s)		Dynamic Load Rating N (lbf)	Armature Inertia kg-m^2 (in-lb-s^2)
			4 (VAC)	D (VDC)	4 (VAC)	D (VDC)		
GTX060-80-01	80 (3.2)	2.54 (0.1)	2,668 (600)	2,668 (600)	318 (12.5)	212 (8.3)	9,230 (2,075)	0.00007367 (0.000652)
GTX060-80-02		5.08 (0.2)	1,900 (427)	1,610 (392)	635 (25.0)	423 (16.7)	6,850 (1,540)	
GTX060-80-04		10.2 (0.4)	1,006 (226)	852 (192)	1,270 (50.0)	847 (33.3)	5,471 (1,230)	
GTX060-150-01	150 (5.9)	2.54 (0.1)	2,668 (600)	2,668 (600)	318 (12.5)	212 (8.3)	9,230 (2,075)	0.00008689 (0.000769)
GTX060-150-02		5.08 (0.2)	1,900 (427)	1,610 (392)	635 (25.0)	423 (16.7)	6,850 (1,540)	
GTX060-150-04		10.2 (0.4)	1,006 (226)	852 (192)	1,270 (50.0)	847 (33.3)	5,471 (1,230)	
GTX060-300-01	300 (11.8)	2.54 (0.1)	2,668 (600)	2,668 (600)	318 (12.5)	212 (8.3)	9,230 (2,075)	0.00011537 (0.001021)
GTX060-300-02		5.08 (0.2)	1,900 (427)	1,610 (392)	635 (25.0)	423 (16.7)	6,850 (1,540)	
GTX060-300-04		10.2 (0.4)	1,006 (226)	852 (192)	1,270 (50.0)	847 (33.3)	5,471 (1,230)	

Maximum velocities listed at maximum voltages
Configured stroke lengths available. Consult Exlar sales representative.

Do not exceed 2X the continuous force rating during operation
Continuous force rating based upon 25° C ambient conditions

GTX080

	Stroke Length mm (in)	Screw Lead mm (in)	Continuous Force Rating N (lbf)		Max Velocity mm/s (in/s)		Dynamic Load Rating N (lbf)	Armature Inertia kg-m^2 (in-lb-s^2)
			4 (VAC)	D (VDC)	4 (VAC)	D (VDC)		
GTX080-100-01	100 (3.9)	2.54 (0.1)	8,365 (1,881)	7,101 (1,596	254 (10.0)	102 (4.0)	24,535 (5,516)	0.000340 (0.003013)
GTX080-100-02		5.08 (0.2)	4,740 (1,066)	4,024 (905)	508 (20.0)	203 (8.0)	25,798 (5,800)	
GTX080-100-05		12.7 (0.5)	2,008 (451)	1,704 (383)	1,270 (50.0)	508 (20.0)	21,795 (4,900)	
GTX080-150-01	150 (5.9)	2.54 (0.1)	8,365 (1,881)	7,101 (1,596	254 (10.0)	102 (4.0)	24,535 (5,516)	0.000369 (0.003267)
GTX080-150-02		5.08 (0.2)	4,740 (1,066)	4,024 (905)	508 (20.0)	203 (8.0)	25,798 (5,800)	
GTX080-150-05		12.7 (0.5)	2,008 (451)	1,704 (383)	1,270 (50.0)	508 (20.0)	21,795 (4,900)	
GTX080-300-01	300 (11.8)	2.54 (0.1)	8,365 (1,881)	7,101 (1,596	254 (10.0)	102 (4.0)	24,535 (5,516)	0.000455 (0.004029)
GTX080-300-02		5.08 (0.2)	4,740 (1,066)	4,024 (905)	508 (20.0)	203 (8.0)	25,798 (5,800)	
GTX080-300-05		12.7 (0.5)	2,008 (451)	1,704 (383)	1,270 (50.0)	508 (20.0)	21,795 (4,900)	
GTX080-450-01	450 (17.7)	2.54 (0.1)	8,365 (1,881)	7,101 (1,596	254 (10.0)	102 (4.0)	24,535 (5,516)	0.000541 (0.004790)
GTX080-450-02		5.08 (0.2)	4,740 (1,066)	4,024 (905)	508 (20.0)	203 (8.0)	25,798 (5,800)	
GTX080-450-05		12.7 (0.5)	2,008 (451)	1,704 (383)	1,270 (50.0)	508 (20.0)	21,795 (4,900)	

Maximum velocities listed at maximum voltages
Configured stroke lengths available. Consult Exlar sales representative.

Do not exceed 2X the continuous force rating during operation
Continuous force rating based upon 25° C ambient conditions

GTX100

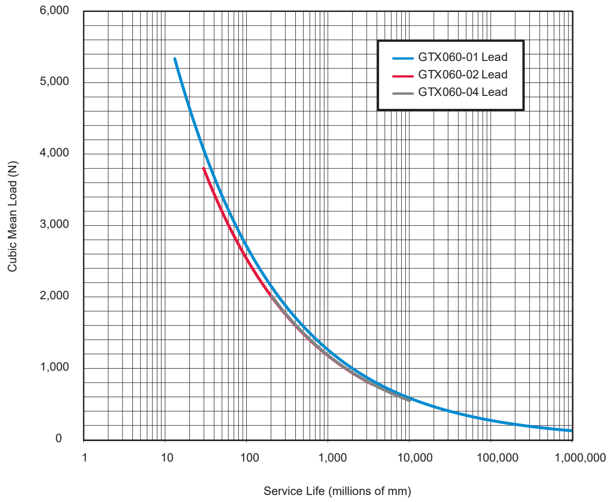
	Stroke Length mm (in)	Screw Lead mm (in)	Continuous Force Rating N (lbf)	Max Velocity mm/s (in/s)	Dynamic Load Rating N (lbf)	Armature Inertia kg-m^2 (in-lb-s^2)
			4 (VAC)	4 (VAC)		
GTX100-150-01	150 (5.9)	2.54 (0.1)	15,392 (3,460)	191 (7.5)	54,557 (12,266)	0.0014085 (0.012467)
GTX100-150-02		5.08 (0.2)	12,098 (2,720)	381 (15.0)	55,972 (12,584)	
GTX100-150-05		12.7 (0.5)	5,444 (1,224)	953 (37.5)	37,141 (8,350)	
GTX100-300-01	300 (11.8)	2.54 (0.1)	15,392 (3,460)	191 (7.5)	54,557 (12,266)	0.0017399 (0.015399)
GTX100-300-02		5.08 (0.2)	12,098 (2,720)	381 (15.0)	55,972 (12,584)	
GTX100-300-05		12.7 (0.5)	5,444 (1,224)	953 (37.5)	37,141 (8,350)	

Maximum velocities listed at maximum voltages
Configured stroke lengths available. Consult Exlar sales representative.

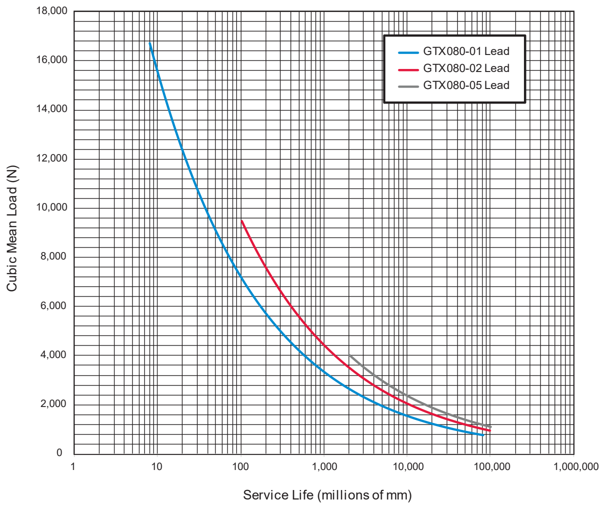
Do not exceed 2X the continuous force rating during operation
Continuous force rating based upon 25° C ambient conditions

Estimated Service Life

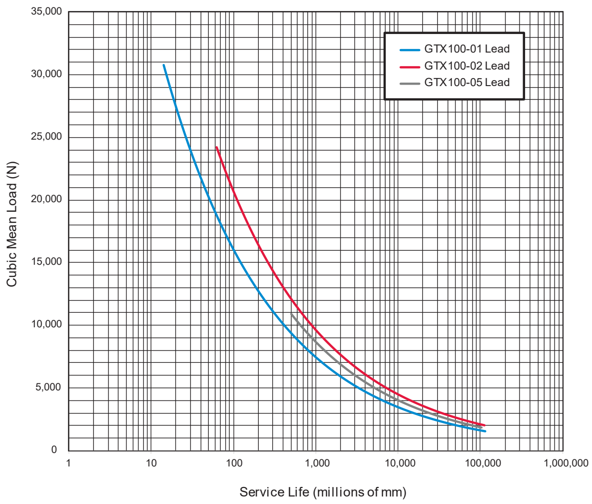
GTX060



GTX080



GTX100



Service Life Estimate Assumptions:

- Sufficient quality and quantity of lubrication is maintained throughout service life.
- No mechanical hard stops (external or internal) or impact loads
- No external side loads
- Does not apply to short stroke, high frequency applications such as fatigue testing or short stroke, high force applications such as pressing. If your application requires high force over a stroke length shorter than the length of the rollers/nut, please contact Exlar for additional details on calculating estimated service life. You may also download the article “Calculating Life Expectency” at www.cw-actuation.com.

The L_{10} expected life of a roller screw linear actuator is expressed as the linear travel distance that 90% of properly maintained roller screws manufactured are expected to meet or exceed. This is not a guarantee and these charts should be used for estimation purposes only.

The underlying formula that defines this value is:
Travel life in millions of inches, where:

C_a = Dynamic load rating (lbf)
F_{cml} = Cubic mean applied load (lbf)
ℓ = Roller screw lead (inches)

$$L_{10} = \left(\frac{C_a}{F_{cml}}\right)^3 \times \ell$$

For additional details on calculating estimated service life, please refer www.cw-actuation.com.

Electrical Specifications

GTX060

Motor Voltage		4 (AC)			D (DC)		
Max Bus Voltage	VAC	230/460 Vrms			24/48 VDC		
Speed @ Bus Voltage	RPM	5000/7500			2400/5000		
Actuator Lead	in	0.1	0.2	0.4	0.1	0.2	0.4
RMS Sinusoidal Commutation							
Continuous Motor Torque	Nm	1.35	1.81	1.81	1.35	1.53	1.53
	lbf-in	11.9	16.0	16.0	11.9	13.6	13.6
Continuous Current Rating	A	3.0	4.0	4.0	18.3	20.8	20.8
Peak Current Rating	A	6.0	8.0	8.0	36.7	41.7	41.7
Torque Constant (Kt) (+/– 10% @ 25˚C)	Nm/A	0.5			0.08		
	lbf-in/A	4.5			0.7		
Voltage Constant (Ke) (+/– 10% @ 25˚C)	V/kRPM	30.5			5.0		
0 - Peak Sinusoidal Commutation							
Continuous Motor Torque	Nm	1.8			1.5		
	lbf-in	16			13.6		
Continuous Current Rating	A	5.7			29.5		
Peak Current Rating	A	11.3			58.9		
Torque Constant (Kt) (+/– 10% @ 25˚C)	Nm/A	0.35			0.06		
	lbf-in/A	3.2			0.5		
Voltage Constant (Ke) (+/– 10% @ 25˚C)	V/kRPM	43.1			7.0		
Pole Configuration	Number of Poles	8			8		
Resistance (L-L) (+/– 5% @ 25˚C)	Ohms	2.8			0.1		
Inductance (L-L)(+/– 15%)	mH	13.8			0.3		
Electrical Time Constant	ms	4.9			3.1		
Insulation Class	460 VAC Max, 180°C (Class H)						

Specifications subject to change without notice
Test data derived using NEMA recommended aluminum heatsink 10" x 10" x 1/4" at 25°C ambient
VAC Class winding operational compatible with drive voltages up to 460 VAC
VDC Class winding operational compatible with drive voltages up to 48 VDC
Rotational speed approximately proportional to drive input voltage

GTX060 Weights	
Description	**kg (lb)**
GTX060-80	2.3 (5.1)
GTX060-150	2.8 (6.2)
GTX060-300	3.9 (8.6)
Brake Adder	0.7 (1.4)
Front Flange (1)	0.4 (0.9)
Tapped Face (3)	0.3 (0.5)
Rear Clevis (5)	0.2 (0.5)
Imperial Flange (F)	0.3 (0.7)
Imperial Clevis (C)	0.3 (0.7)
Anti Rotate (80 mm stroke)	0.3 (0.7)
Anti Rotate (150 mm stroke)	0.5 (1.1)
Anti Rotate (300 mm stroke)	0.6 (1.3)
Limit Switch Assembly w/Anti-Rotate (80 mm stroke)	0.4 (0.9)
Limit Switch Assembly w/Anti-Rotate (150 mm stroke)	0.6 (1.4)
Limit Switch Assembly w/Anti-Rotate (300 mm stroke)	0.9 (2.0)

Brake Specifications		
Brake Holding Torque (minimum)	Nm	2.5
	lbf-in	22
Brake Voltage	VDC	24 (-10%/+6%)
Nominal Brake Current at 24 VDC	A	0.46
Brake Engage/Disengage Time (typical)	ms	10/25

GTX080

Motor Voltage		4 (AC)	D (DC)
Max Bus Voltage	VAC	230/460 Vrms	24/48 VDC
Speed @ Bus Voltage	RPM	3000/6000	1000/2400
RMS Sinusoidal Commutation			
Continuous Motor Torque	Nm	4.51	3.83
	lbf-in	39.9	33.9
Continuous Current Rating	A	4.9	24.2
Peak Current Rating	A	9.9	48.5
Torque Constant (Kt) (+/– 10% @ 25˚C)	Nm/A	1.02	0.18
	lbf-in/A	9.0	1.6
Voltage Constant (Ke) (+/– 10% @ 25˚C)	V/kRPM	61.6	10.7
0 - Peak Sinusoidal Commutation			
Continuous Motor Torque	Nm	4.51	3.83
	lbf-in	39.9	33.9
Continuous Current Rating	A	6.6	34.6
Peak Current Rating	A	13.3	69.2
Torque Constant (Kt) (+/– 10% @ 25˚C)	Nm/A	0.72	0.13
	lbf-in/A	6.4	1.1
Voltage Constant (Ke) (+/– 10% @ 25˚C)	V/kRPM	87.1	15.1
Pole Configuration	Number of Poles	8	8
Resistance (L-L) (+/– 5% @ 25˚C)	Ohms	2.5	0.1
Inductance (L-L)(+/– 15%)	mH	17.3	0.46
Electrical Time Constant	ms	6.8	6.9
Insulation Class	460 VAC Max, 180°C (Class H)		

Specifications subject to change without notice
Test data derived using NEMA recommended aluminum heatsink 10" x 10" x 1/4" at 25°C ambient
VAC Class winding operational compatible with drive voltages up to 460 VAC
VDC Class winding operational compatible with drive voltages up to 48 VDC
Rotational speed approximately proportional to drive input voltage

GTX080 Weights	
Description	**kg (lb)**
GTX080-100	4.6 (10.0)
GTX080-150	5.2 (11.4)
GTX080-300	7.0 (15.4)
GTX080-450	8.9 (19.5)
Brake Adder	1.1 (2.5)
Front Flange (1)	1.0 (2.2)
Tapped Face (3)	0.6 (1.2)
Rear Clevis (5)	0.4 (0.8)
Imperial Flange (F)	0.8 (1.8)
Imperial Clevis (C)	0.8 (1.7)
Anti Rotate (100 mm stroke)	0.5 (1.1)
Anti Rotate (150 mm stroke)	0.6 (1.3)
Anti Rotate (300 mm stroke)	0.8 (1.8)
Anti Rotate (450 mm stroke)	1.1 (2.4)
Limit Switch Assembly w/Anti-Rotate (100 mm stroke)	0.9 (1.9)
Limit Switch Assembly w/Anti-Rotate (150 mm stroke)	1.0 (2.3)
Limit Switch Assembly w/Anti-Rotate (300 mm stroke)	1.6 (3.5)
Limit Switch Assembly w/Anti-Rotate (450 mm stroke)	2.1 (4.7)

Brake Specifications		
Brake Holding Torque (minimum)	Nm	4.5
	lbf-in	40
Brake Voltage	VDC	24 (-10%/+6%)
Nominal Brake Current at 24 VDC	A	0.5
Brake Engage/Disengage Time (typical)	ms	18/35

GTX100

Motor Voltage		4 (AC)
Max Bus Voltage	VAC	230/460 Vrms
Speed @ Bus Voltage	RPM	3000/4500
RMS Sinusoidal Commutation		
Continuous Motor Torque	Nm	12.23
	lbf-in	108.2
Continuous Current Rating*	A	12.3
Peak Current Rating*	A	24.7
Torque Constant (Kt) (+/– 10% @ 25˚C)	Nm/A	1.11
	lbf-in/A	9.8
Voltage Constant (Ke) (+/– 10% @ 25˚C)	V/kRPM	67.0
0 - Peak Sinusoidal Commutation		
Continuous Motor Torque	Nm	12.23
	lbf-in	108.2
Continuous Current Rating	A	17.4
Peak Current Rating	A	34.8
Torque Constant (Kt) (+/– 10% @ 25˚C)	Nm/A	0.78
	lbf-in/A	6.92
Voltage Constant (Ke) (+/– 10% @ 25˚C)	V/kRPM	94.8
Pole Configuration	Number of Poles	8
Resistance (L-L) (+/– 5% @ 25˚C)	Ohms	0.65
Inductance (L-L)(+/– 15%)	mH	4.9
Electrical Time Constant	ms	7.6
Insulation Class	460 VAC Max, 180°C (Class H)	

Specifications subject to change without notice
Test data derived using NEMA recommended aluminum heatsink 12" x 12" x 1/2" at 25°C ambient
VAC Class winding operational compatible with drive voltages up to 460 VAC
Rotational speed approximately proportional to drive input voltage

* For actuators with a 0.1” lead, the torque and current must be limited to 8.89 Nm/9.0 A not to exceed the continuous force rating specified in the mechanical specifications table on page 6. Peak torque and current values would be 2x the continuous values

GTX100 Weights	
Description	**kg (lb)**
GTX100-150	13.1 (28.8)
GTX100-300	16.0 (35.2)
Brake Adder	1.2 (2.7)
Front Flange (1)	2.2 (4.7)
Tapped Face (3)	1.1 (2.4)
Rear Clevis (5)	0.8 (1.8)
Imperial Flange (F)	1.9 (4.1)
Imperial Clevis (C)	1.1 (2.5)
Anti Rotate (150 mm stroke)	1.5 (3.2)
Anti Rotate (300 mm stroke)	2.0 (4.5)
Limit Switch Assembly w/Anti-Rotate (150 mm stroke)	2.0 (4.5)
Limit Switch Assembly w/Anti-Rotate (300 mm stroke)	2.8 (6.2)

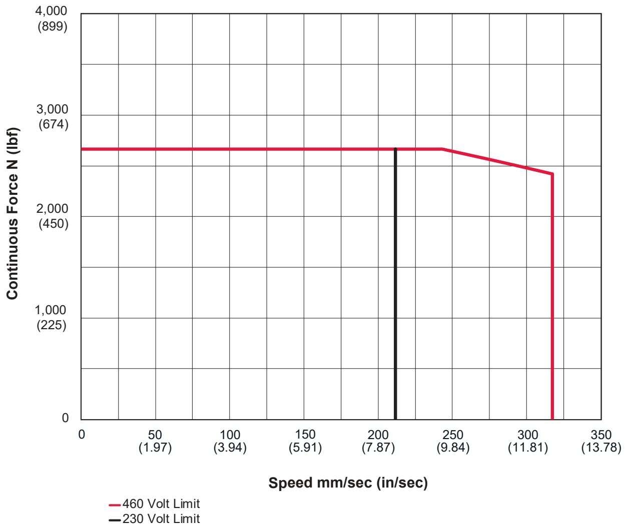
Brake Specifications		
Brake Holding Torque (minimum)	Nm	11
	lbf-in	97
Brake Voltage	VDC	24 (-10%/+6%)
Nominal Brake Current at 24 VDC	A	0.75
Brake Engage/Disengage Time (typical)	ms	25/40

Speed vs. Force Curves

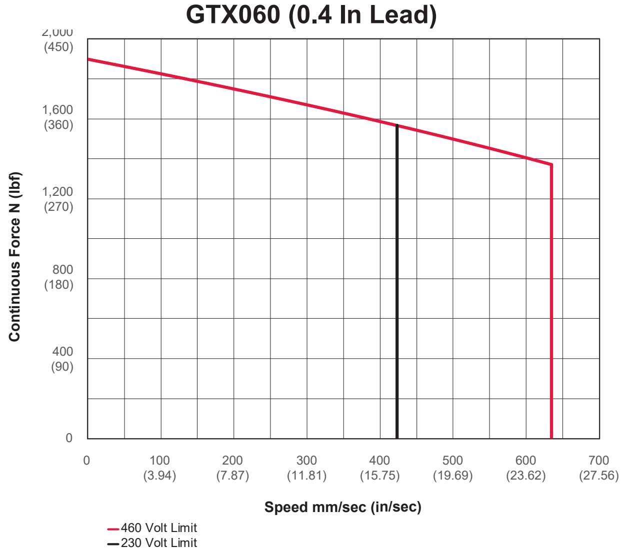
These charts represent typical linear speed versus linear force curves for the GTX actuators using common brushless motor amplifiers. The GTX Series are compatible with many different brushless motor amplifiers; any differences in the performance ratings of these amplifiers can alter the actuator's performance. Thus, the curves below should be used for estimation only. (Further information is available by contacting your local sales representative.)

AC Voltage Winding

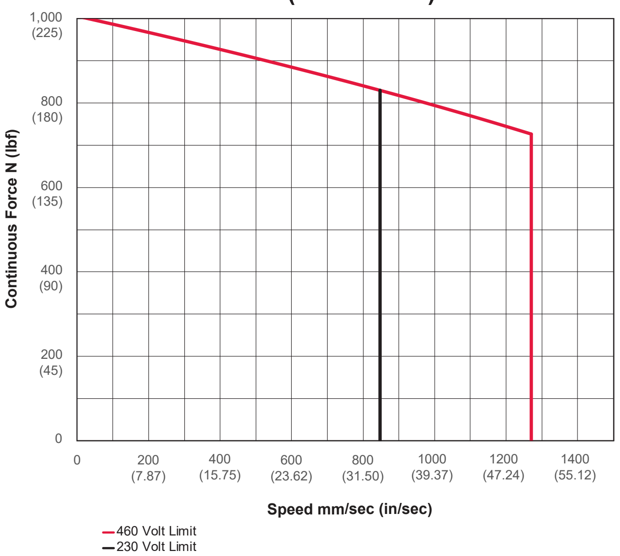
GTX060 (0.1 In Lead)



GTX060 (0.4 In Lead)



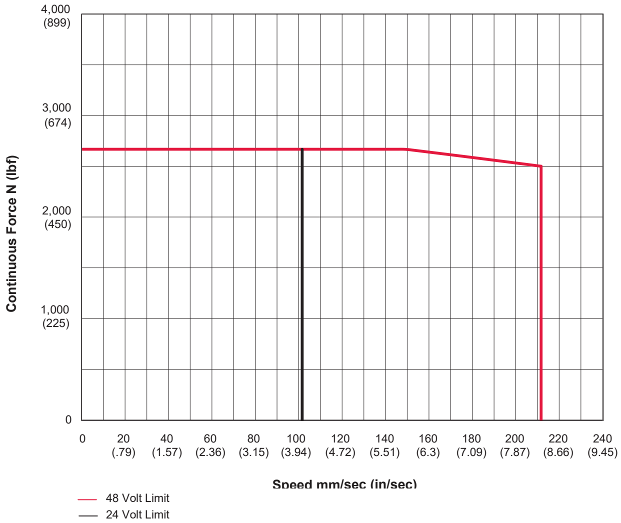
GTX060 (0.2 In Lead)



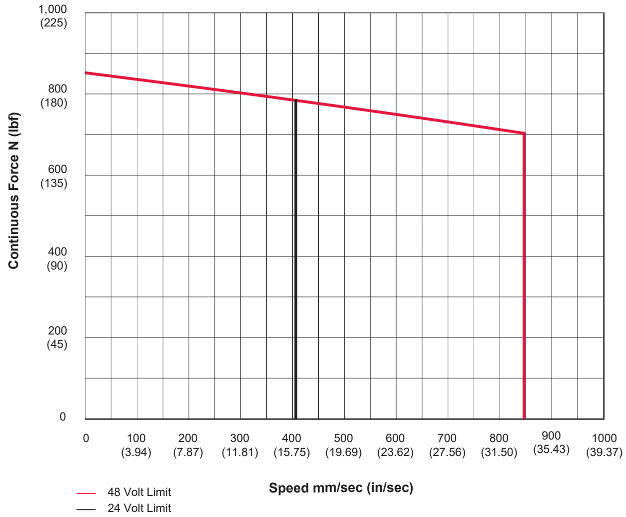
Test data derived using NEMA recommended aluminum heatsink 10" x 10" x 1/4" for GTX080.

DC Voltage Winding

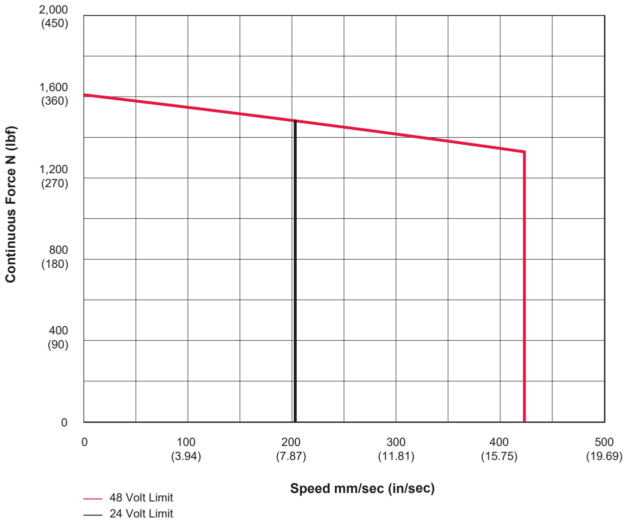
GTX060 (0.1 In Lead)



GTX060 (0.4 In Lead)

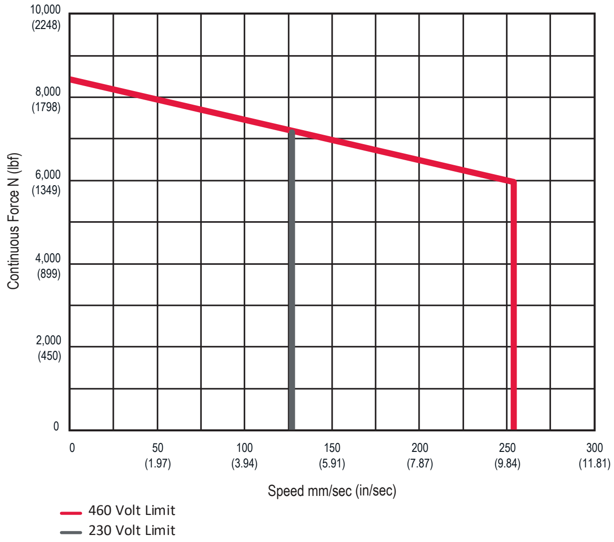


GTX060 (0.2 In Lead)

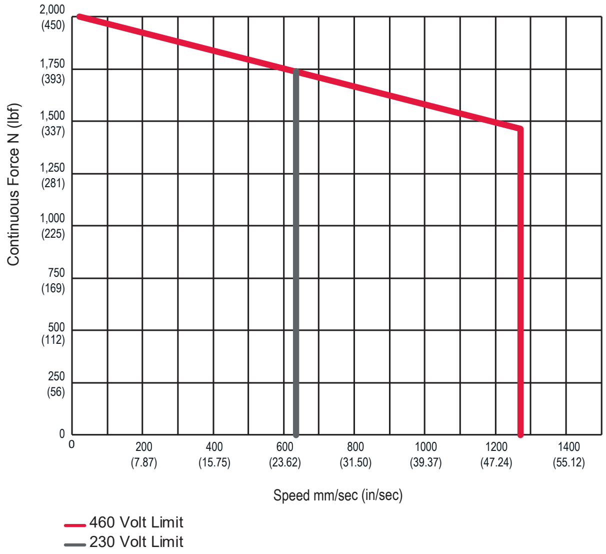


AC Voltage Winding

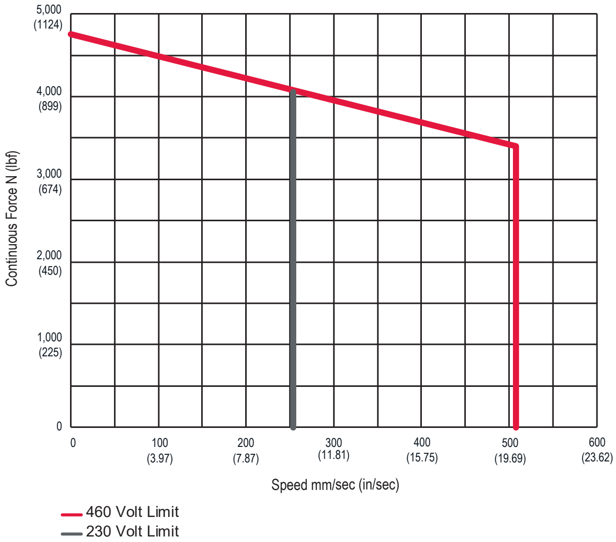
GTX080 (0.1 In Lead)



GTX080 (0.5 In Lead)

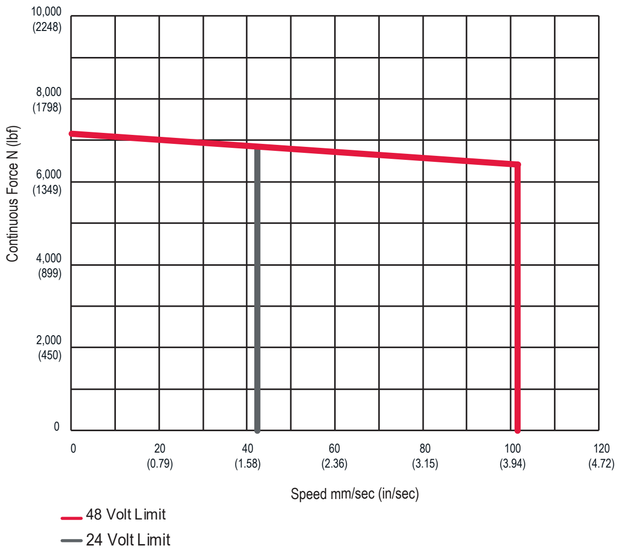


GTX080 (0.2 In Lead)

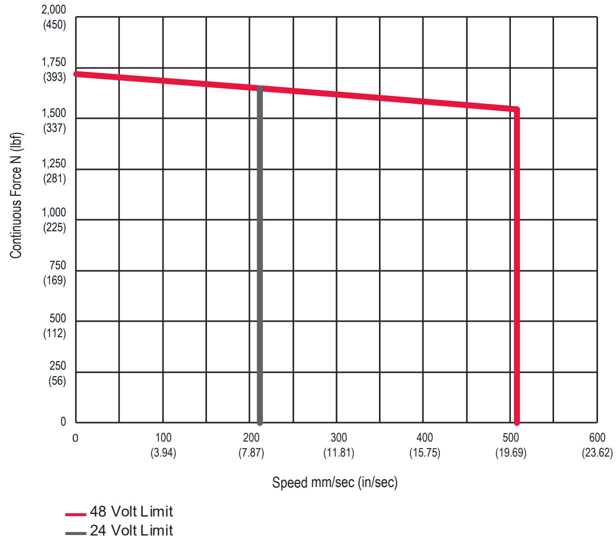


DC Voltage Winding

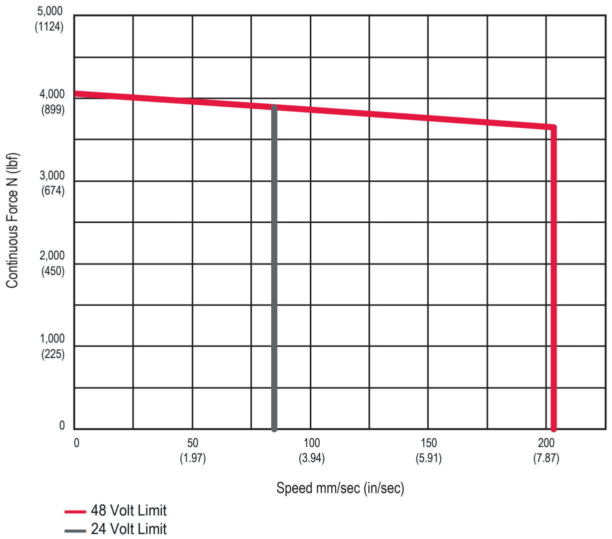
GTX080 (0.1 In Lead)



GTX080 (0.5 In Lead)



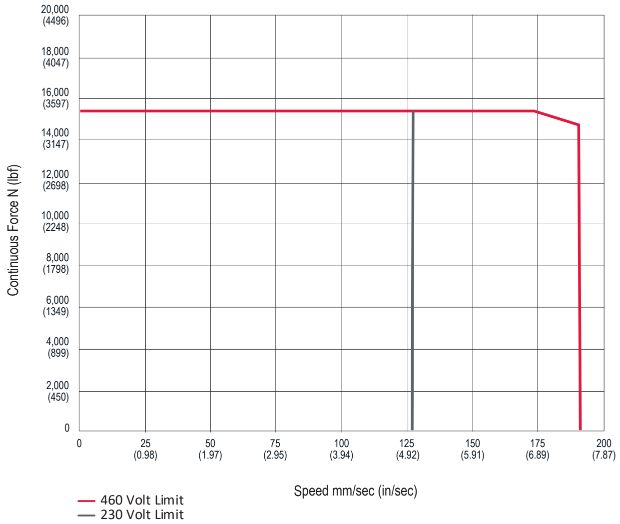
GTX080 (0.2 In Lead)



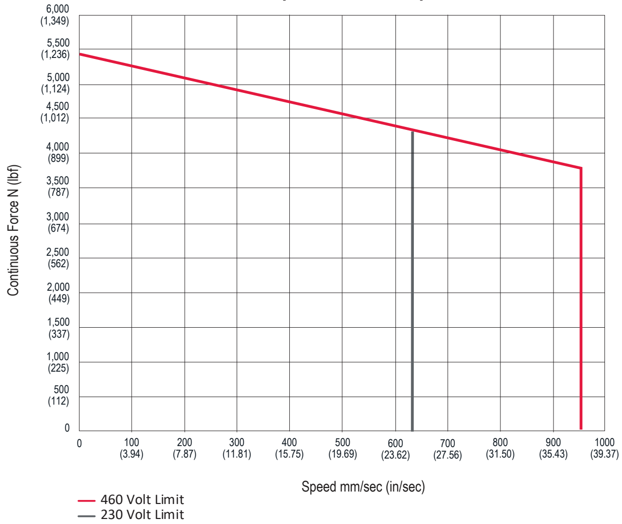
Test data derived using NEMA recommended aluminum heatsink 10" x 10" x 1/4" for GTX080.

AC Voltage Winding

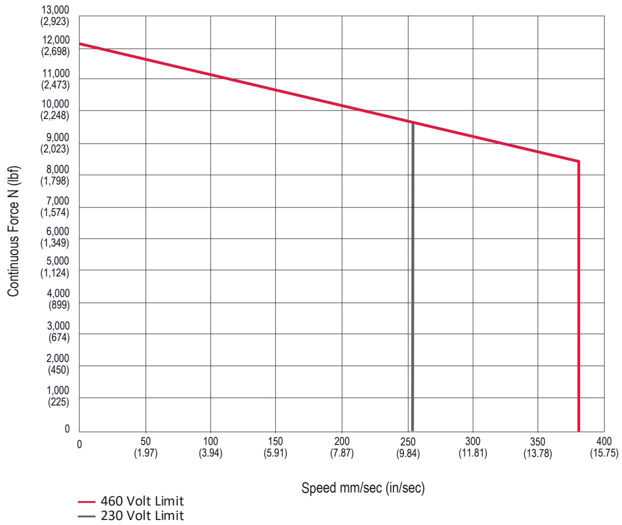
GTX100 (0.1 In Lead)



GTX100 (0.5 In Lead)



GTX100 (0.2 In Lead)



Test data derived using NEMA recommended aluminum heatsink 12" x 12" x 1/2" at 25°C ambient for GTX100.

Options

Motor Winding / Voltage

GTX actuators can be operated at a wide range of voltages (up to 460 VAC). For DC voltage applications, please refer to the order guide "D" callout. Refer to the mechanical/electrical specifications for motor torque and actuator rated force.

4	460 VAC Max
D	48 VDC Max

Internal Holding Brake

This option provides an internal holding brake for GTX Series actuators. The brake is a permanent magnet brake that is normally engaged. Power must be applied to the brake to disengage the brake.

Feedback Device Options:

Resolvers
Incremental Encoders
Absolute Encoders

Exlar GTX actuators are compatible with a variety of drive platforms available today. Exlar installs, aligns, and wires feedback devices to mimic a typical motor's wiring and cabling commonly used with the listed amplifier manufacturer (see wiring and alignment section for details). If your wiring and alignment is not listed, please consult Exlar.

External Anti-rotate Assembly

The unique design of the GTX Series of linear actuators permits the extending rod to rotate. This capability simplifies setup by allowing the user to rotate the rod in and out of the actuator for mechanical attachment or system testing.

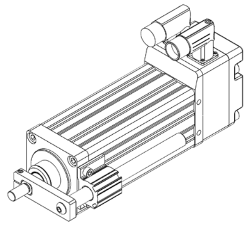
However, this feature also requires that once setup and testing are completed, the rod be kept from rotating so proper linear motion will be maintained. In most applications the actuator's load is coupled to linear bearings, or some other support device. In these cases the load cannot rotate, so an anti-rotation on the actuator is not needed.

Splined Rod Option

The splined rod is an internal anti-rotate option that will restrict rotation but still provide linear motion without the need for an external mechanism. It is not suitable for environments where contaminants may be able to penetrate the actuator. The option does NOT meet the IP66S rating as there is no sealing component where the driven rod extends and retracts. If the unit is installed vertically rod end down there is potential for grease to exit the unit in environments where overheating can occur.

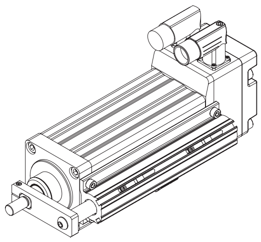
Mounting Options

Both as part of the actuator model code and sold as accessory kits. For applications in which the load is free to rotate, Exlar offers bolt-on anti-rotation systems.



External Limit Switch/ Anti-Rotate Assembly

This option allows external limit switches to be mounted to the GTX Series Actuator. These switches provide travel indication to the controller and are adjustable (Limit switches sold separately).



The external limit switch accessory for the GTX Series of linear actuators allows the user to externally mount adjustable switches for use as the end of travel limit switches or home position sensors.

(Limit switches sold separately from actuator)

NOTE: Accessory option "L" required in model mask to order

Switch Type	Exlar Part Number	Turck Part Number
Normally Closed Switch, PNP	43404	BIM-UNT-RP6X
Normally Open Switch, PNP	43403	BIM-UNT-AP6X
Normally Closed Switch, NPN	67635	BIM-UNT-RN6X
Normally Open Switch, NPN	67634	BIM-UNT-AN6X

Rod End Accessories

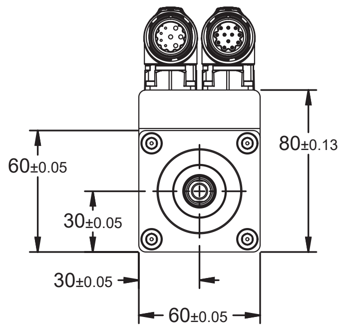
Spherical Rod Eye
Rod Clevis

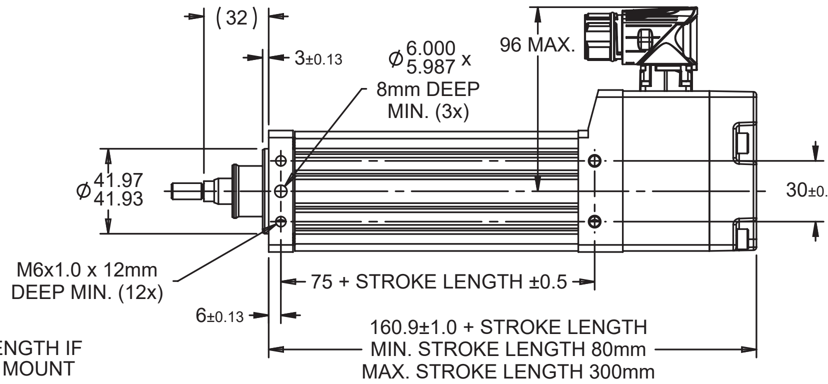
Rod end attachments sold separately from actuator.

Dimensions

GTX060 BASE ACTUATOR

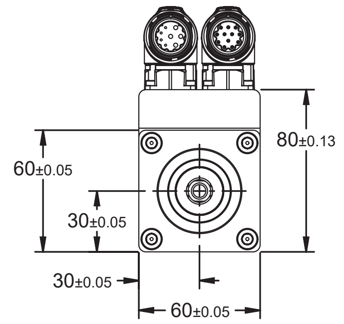
ALL DIMENSIONS ARE IN MILLIMETERS

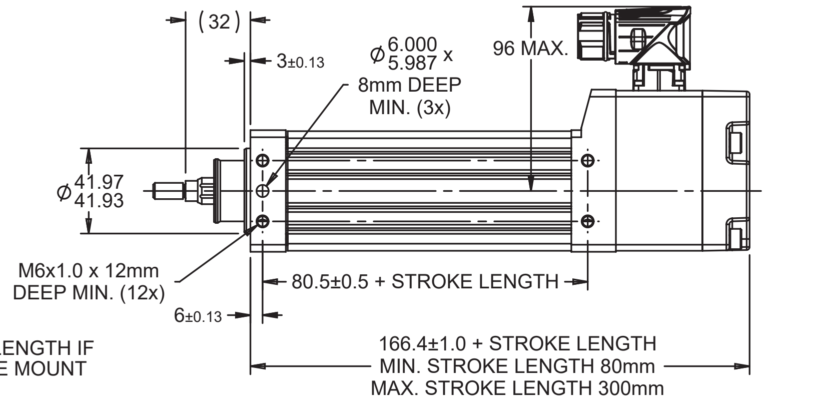




NOTE: ADD 50mm TO THE OVERALL LENGTH IF ORDERING A BRAKE. THE SIDE MOUNT DISTANCE IS NOT AFFECTED.

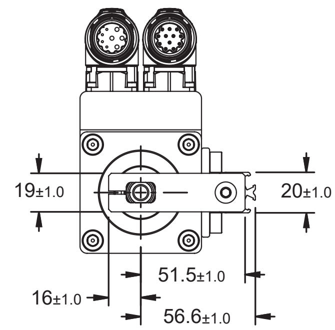
GTX060 WITH SPLINED MAIN ROD

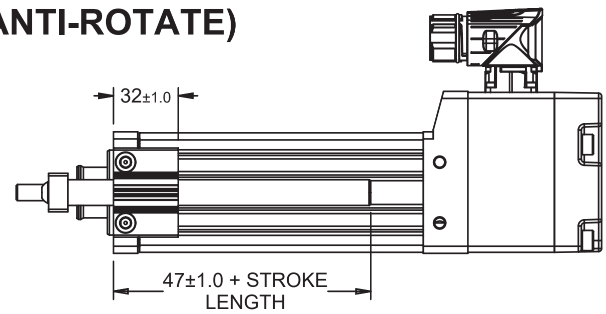




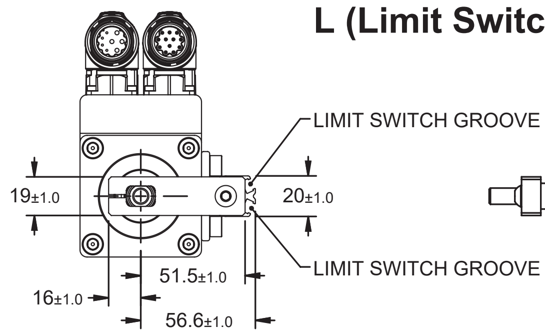
NOTE: ADD 50mm TO THE OVERALL LENGTH IF ORDERING A BRAKE. THE SIDE MOUNT DISTANCE IS NOT AFFECTED.

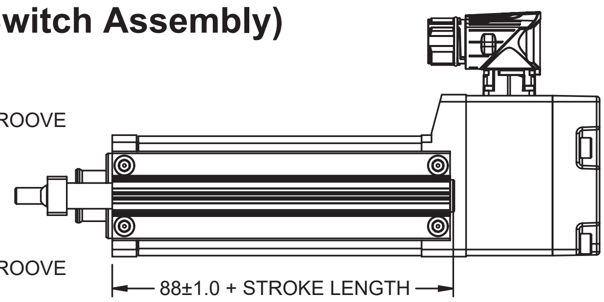
A (ANTI-ROTATE)





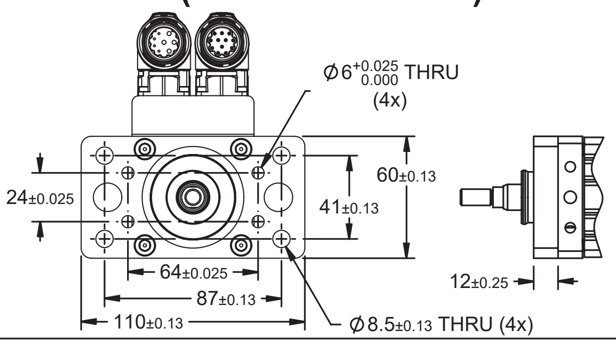
L (Limit Switch Assembly)



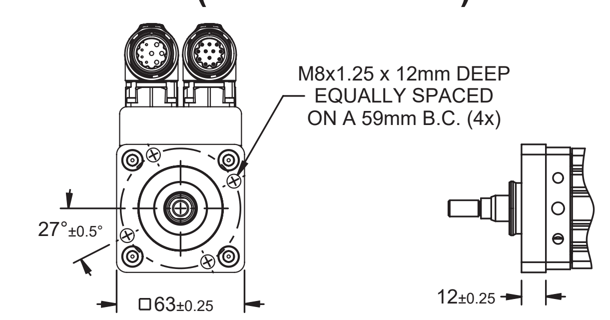


Pre-sale drawings and models are representative and are subject to change. Visit exlar.com to download a 3D model of your desired configuration.

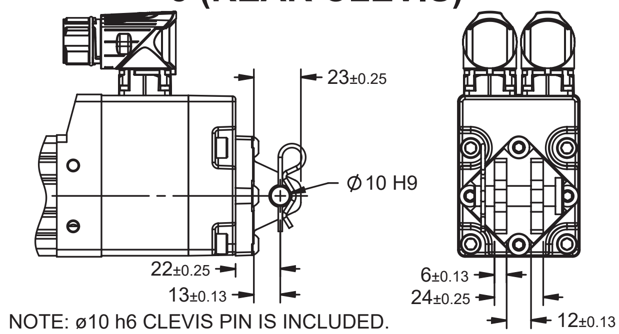
1 (FRONT FLANGE)



3 (TAPPED FACE)

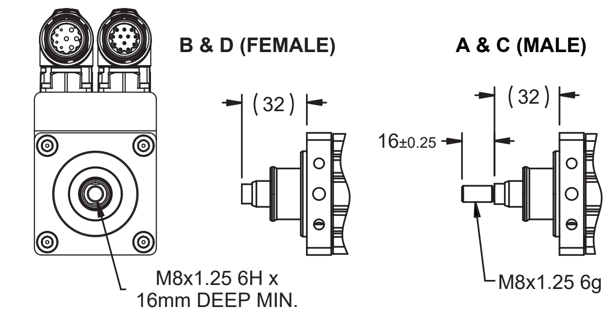


5 (REAR CLEVIS)



NOTE: ø10 h6 CLEVIS PIN IS INCLUDED.

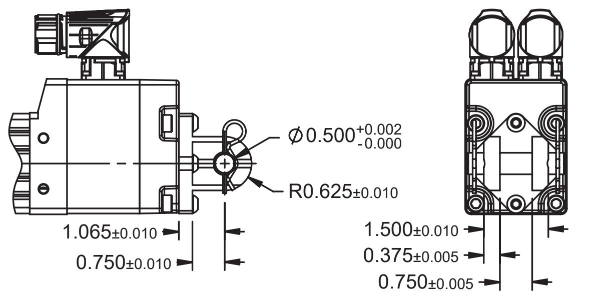
METRIC ROD ENDS



GTX060 IMPERIAL OPTIONS

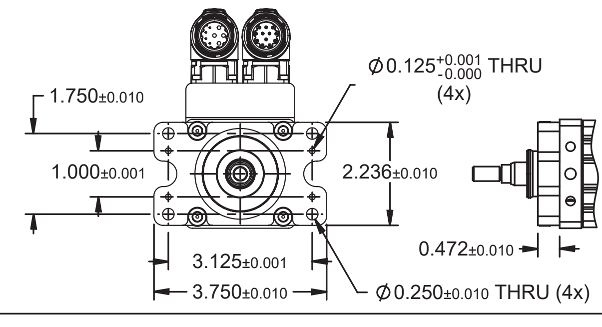
ALL DIMENSIONS ARE IN INCHES

C (GSX20 REAR CLEVIS)

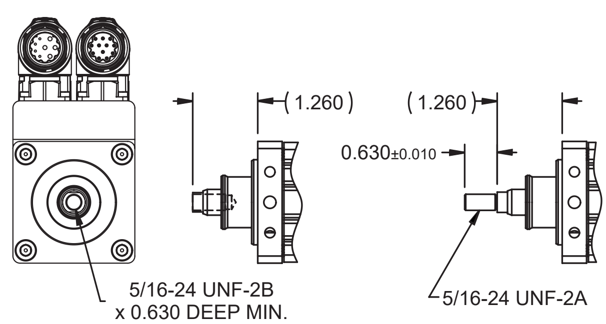


NOTE: ø0.499/ø0.498 CLEVIS PIN IS INCLUDED.

F (GSX20 FRONT FLANGE)

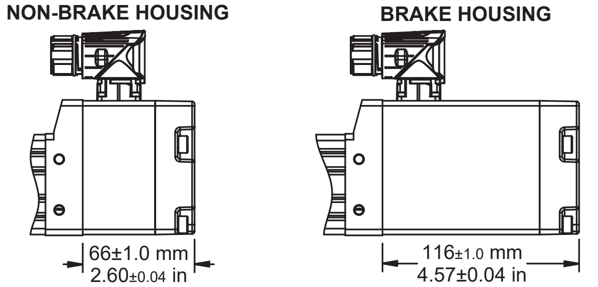


IMPERIAL ROD ENDS



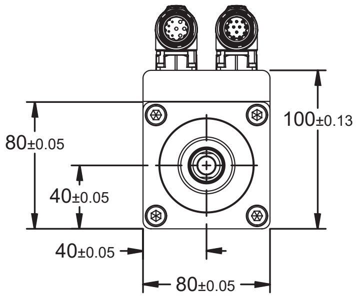
BRAKE ADDER LOCATION

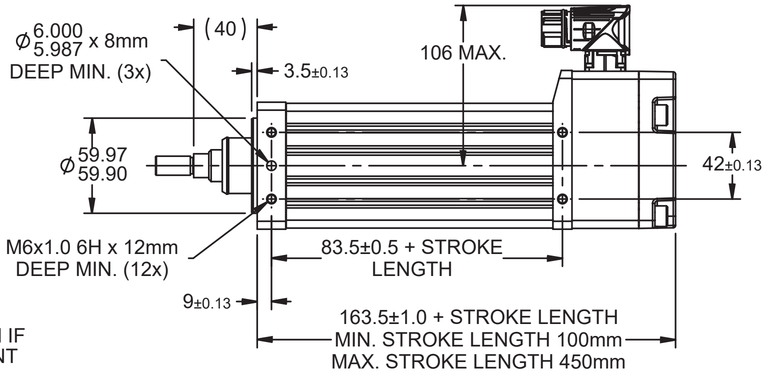
50mm (1.969 in) ADDER



GTX080 BASE ACTUATOR

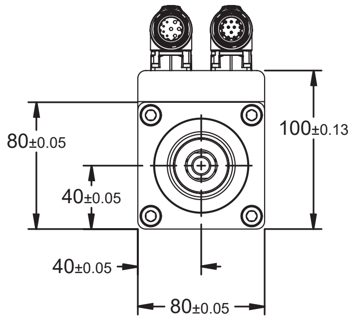
ALL DIMENSIONS ARE IN MILLIMETERS

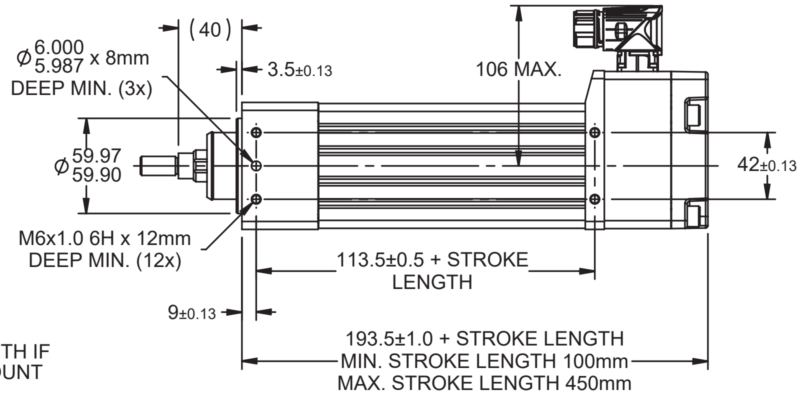




NOTE: ADD 40mm TO THE OVERALL LENGTH IF ORDERING A BRAKE. THE SIDE MOUNT DISTANCE IS NOT AFFECTED.

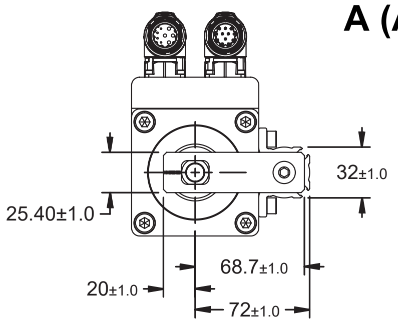
GTX080 WITH SPLINED MAIN ROD

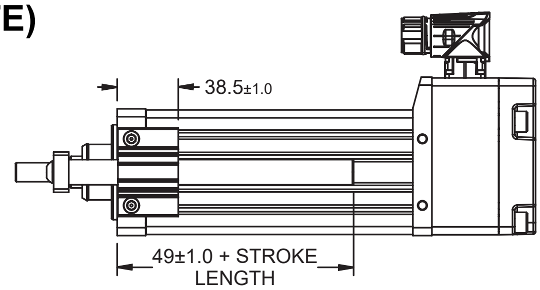




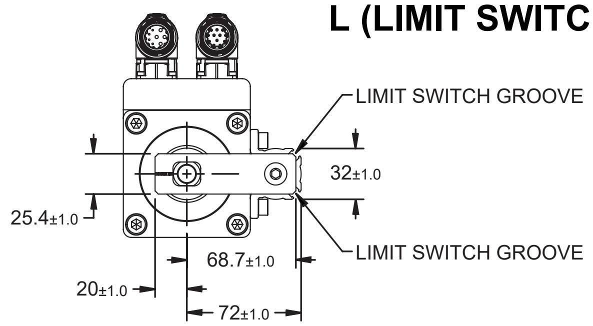
NOTE: ADD 40mm TO THE OVERALL LENGTH IF ORDERING A BRAKE. THE SIDE MOUNT DISTANCE IS NOT AFFECTED.

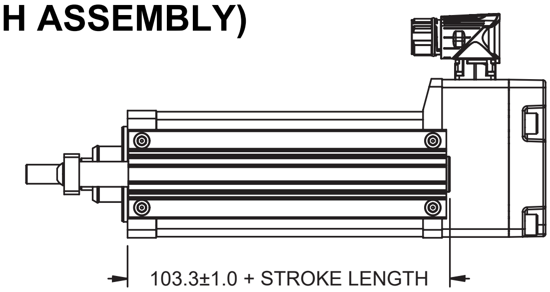
A (ANTI-ROTATE)



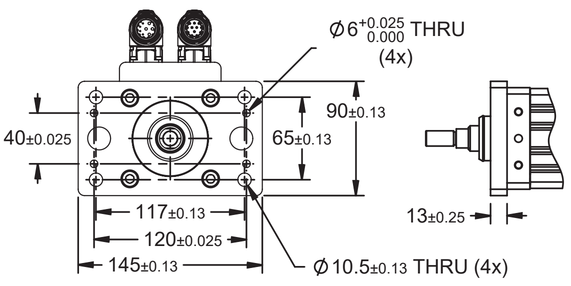


L (LIMIT SWITCH ASSEMBLY)

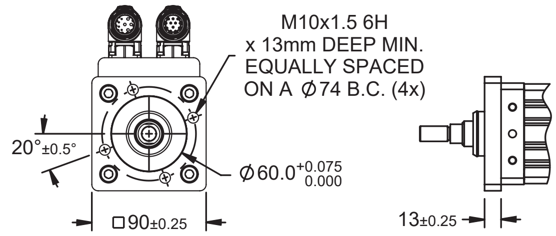




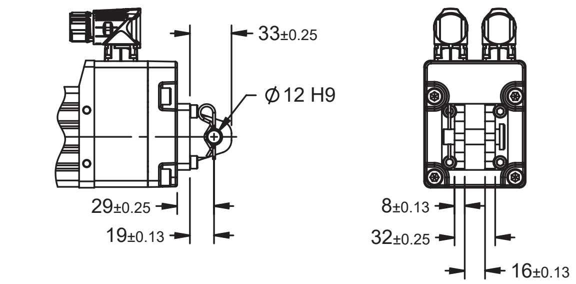
1 (FRONT FLANGE)



3 (TAPPED FACE)

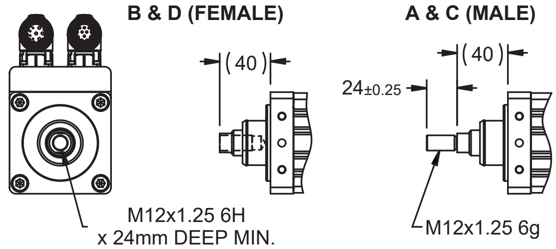


5 (REAR CLEVIS)



NOTE: ø12 h6 CLEVIS PIN IS INCLUDED.

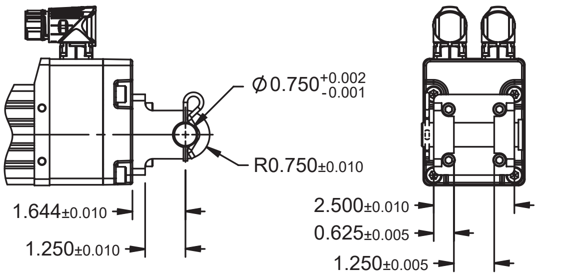
METRIC ROD ENDS



GTX080 IMPERIAL OPTIONS

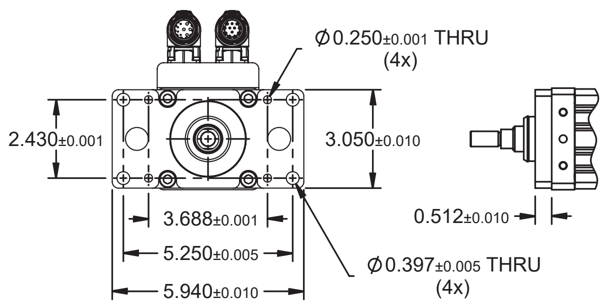
ALL DIMENSIONS ARE IN INCHES

C (GSX30 REAR CLEVIS)

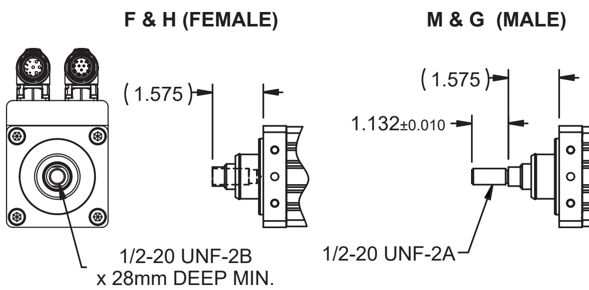


NOTE: ø0.746/ø0.741 CLEVIS PIN IS INCLUDED.

F (GSX30 FRONT FLANGE)

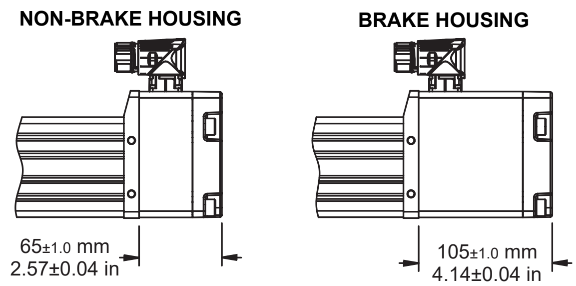


IMPERIAL ROD ENDS



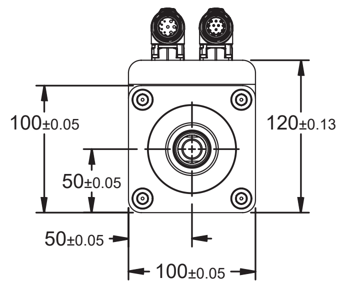
BRAKE ADDER LOCATION

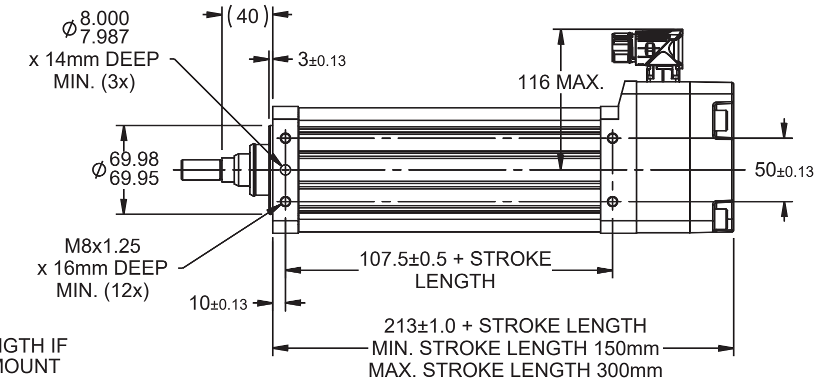
40mm (1.575 in) ADDER



GTX100 BASE ACTUATOR

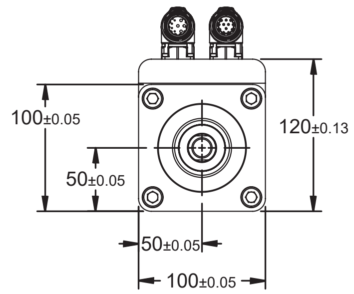
ALL DIMENSIONS ARE IN MILLIMETERS

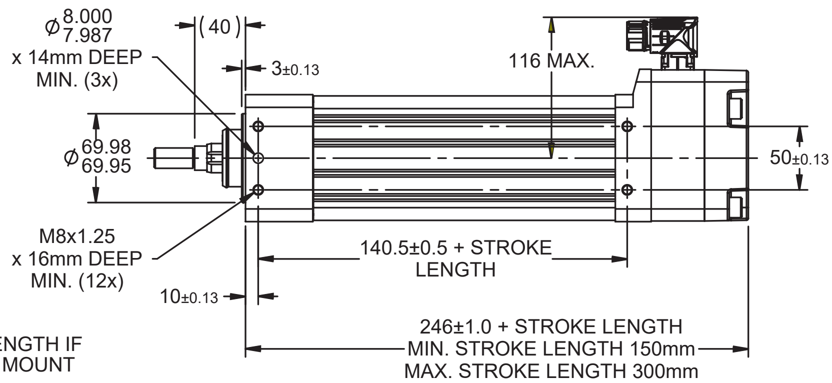




NOTE: ADD 40mm TO THE OVERALL LENGTH IF ORDERING A BRAKE. THE SIDE MOUNT DISTANCE IS NOT AFFECTED.

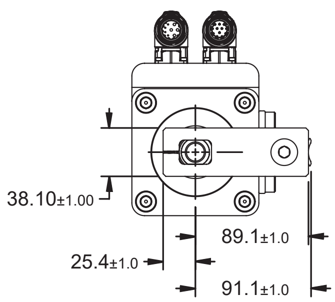
GTX100 WITH SPLINED MAIN ROD

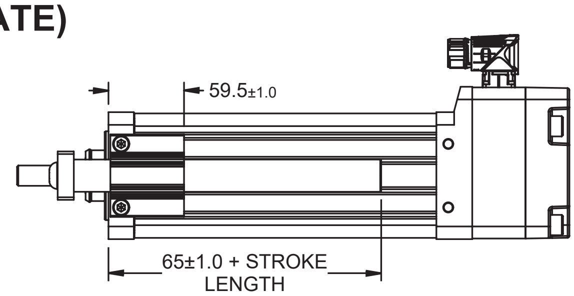




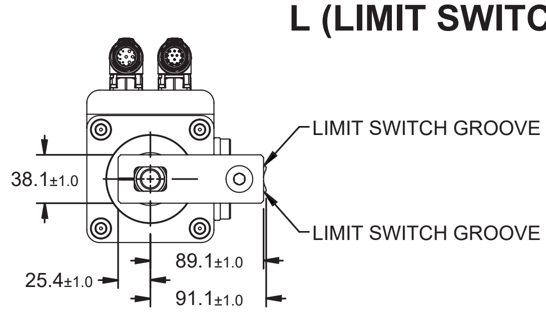
NOTE: ADD 40mm TO THE OVERALL LENGTH IF ORDERING A BRAKE. THE SIDE MOUNT DISTANCE IS NOT AFFECTED.

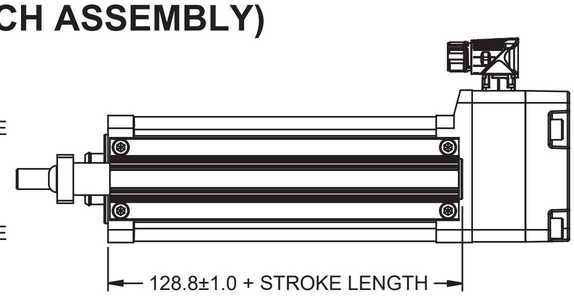
A (ANTI-ROTATE)



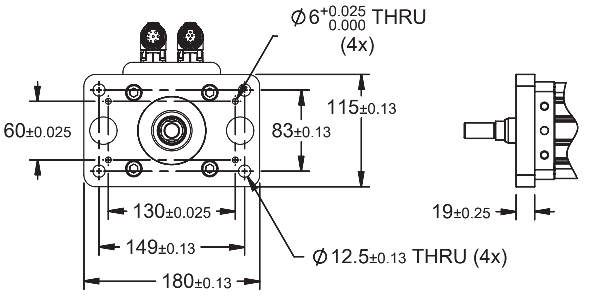


L (LIMIT SWITCH ASSEMBLY)

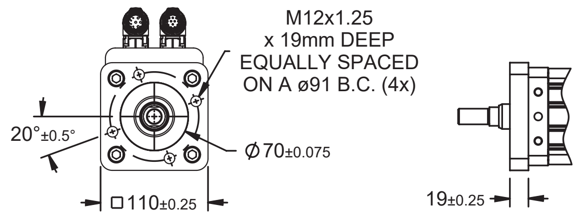




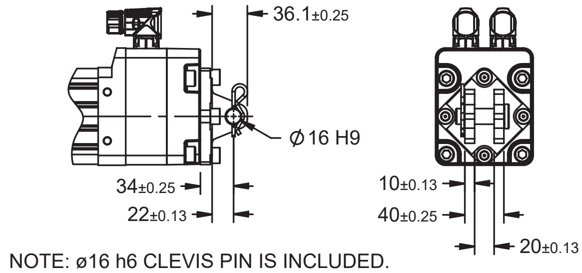
1 (FRONT FLANGE)



3 (TAPPED FACE)

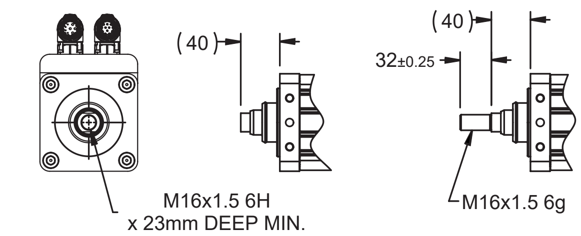


5 (REAR CLEVIS)



NOTE: ø16 h6 CLEVIS PIN IS INCLUDED.

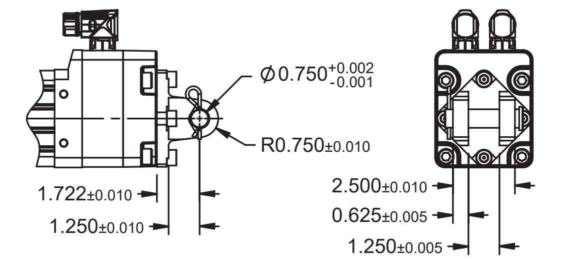
METRIC ROD ENDS



GTX100 IMPERIAL OPTIONS

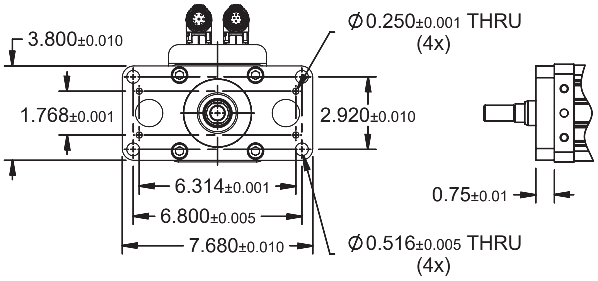
ALL DIMENSIONS ARE IN INCHES

C (GSX40 REAR CLEVIS)

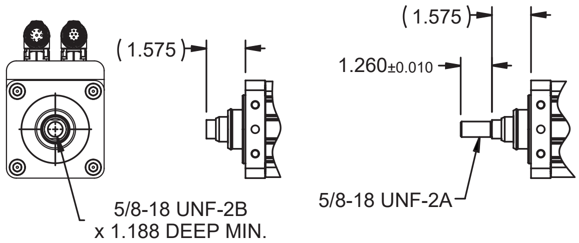


NOTE: ø0.746/ø0.741 CLEVIS PIN IS INCLUDED.

F (GSX40 FRONT FLANGE)

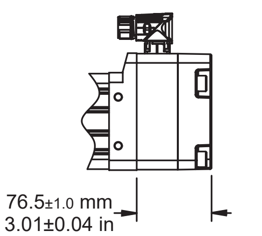


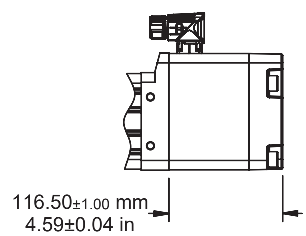
IMPERIAL ROD ENDS



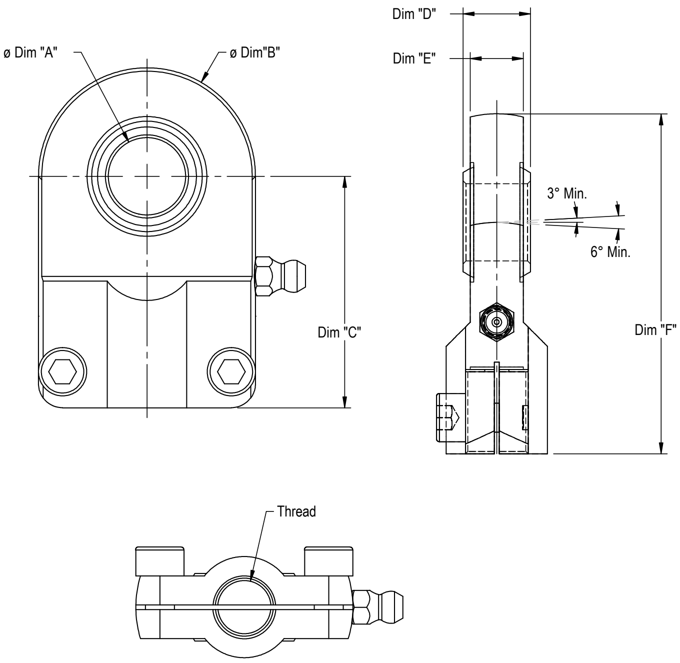
BRAKE ADDER LOCATION

40mm (1.575 in) ADDER





SPHERICAL ROD EYE

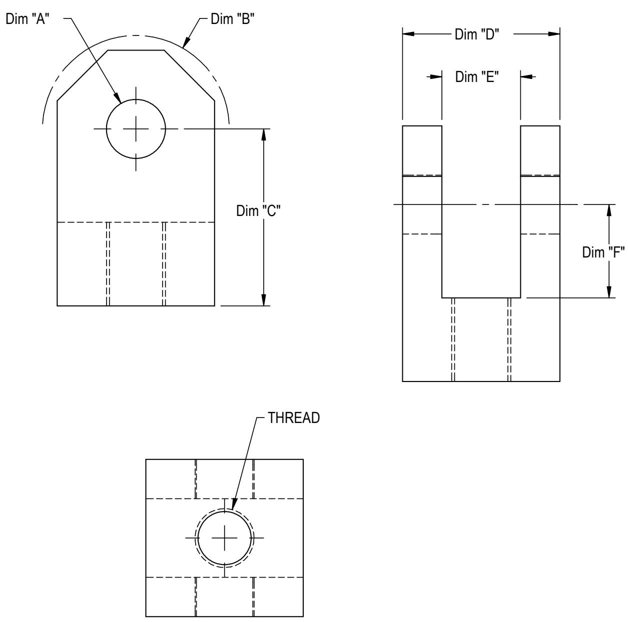


	Dimensional Specs		
	GTX060	GTX080	GTX100
ø Dim "A"	8.065 / 7.988	16.000 / 15.992	25.021 / 25.000
ø Dim "B"	22.25	45.0	65.0
Dim "C"	36.0	48.0	68.0
Dim "D"	12.0	14.0	20.0
Dim "E"	8.0	11.0	17.0
Dim "F"	47.1	70.5	100.5
Thread	M8x1.2	M12x1.25	M16x1.5
Weight (kg)	0.21	0.21	0.66

ROD END CODE "A" IS REQUIRED ON THE ACTUATOR

SPHERICAL ROD EYE ORDER CODE	
GTX060	GTX060-REI-KIT
GTX080	GTX080-REI-KIT
GTX100	GTX100-REI-KIT

ROD CLEVIS



	Dimensional Specs		
	GTX060	GTX080	GTX100
ø Dim "A"	8.065 / 7.988	12.043 / 12.000	20.052 / 20.000
ø Dim "B"	20.0	34.0	58.0
Dim "C"	32.0	36.0	54.0
Dim "D"	16.0	34.0	52.0
Dim "E"	8.0	16.0	30.0
Dim "F"	16.0	19.0	32.0
Thread	M8x1.25	M12x1.25	M16x1.5
Weight (kg)	0.25	0.25	1.0

ROD END CODE "A" IS REQUIRED ON THE ACTUATOR

SPHERICAL ROD EYE ORDER CODE	
GTX060	GTX060-RC1-KIT
GTX080	GTX080-RC1-KIT
GTX100	GTX100-RC1-KIT

Pre-sale drawings and models are representative and are subject to change. Visit exlar.com to download a 3D model of your desired configuration.

Feedback Types for GTX

Drive / Feedback Designator Callouts

Drive Manufacturers	Manufacturer Code	Resolver	Incremental Encoder	Stegmann Absolute Encoder	Stegmann Absolute DSL Encoder	Heidenhain Absolute Encoder
AMK	AK	R1A1				H1A1
B&R Automation	BR	R1A1				H1A2
Baldor	BD	R1A1				H1A1
Baumueller	BM	R1A1		S1A1		H1A2
Beckhoff	BE					H1A2
Control Technologies/Nidec	CT	R2B1	E1B2	S1B1		H1B2
Elau/Schneider	EU			S1A1		
Elmo Motion Control	EL	R1B1	E1B2			H1B2
Exlar	EX	R1A1	E1A2	S1A2		H1A2
Infranor	IF	R1B2		S1B2		
Indramat/Bosch-Rexroth	IN			S2D3		H1D3
Kollmorgen	KM	R2A1	E1A2			H1A2
LTI	LS	R2A1		S1A2		
Lenze	LZ	R1B1		S1B1		
Parker	PC	R1B1	E1B2			H1B2
Rockwell Automation	RA		E1C2	S1C2	S3C0	
Siemens	SM	R1B1				H1B2
Stober Drives	SB	R2A1				H1A1

Feedbacks
R1 – Standard Resolver – Size 15, 1024 line (2048 cts) per rev. two-pole resolver
R2 – Standard Resolver – Size 15, 1024 line (2048 cts) per rev. two-pole resolver
E1 – Standard Incremental Encoder – 2048 line (8192 cts) per rev. index pulse, Hall commutation, 5VDC
S1 – Hiperface Stegmann, SKM36 multi-turn absolute encoder
S2 – Hiperface Stegmann, SKM36 multi-turn absolute encoder
S3 – Hiperface DSL Stegmann, EKM36 multi-turn absolute encoder
H1 – EnDat Heidenhain, EQN 1125 multi-turn absolute encoder

Power Connectors	Feedback Connectors
A = 8 pin M23 Size 1, Right Angle Connector	0 = Feedback signal wired through power connector
B = 6 pin M23 Size 1, Right Angle Connector	1 = 12 pin M23 Size 1, P Type, Right Angle Connector
C = 9 pin M23 Size 1, Right Angle Connector	2 = 17 pin M23 Size 1, E Type, Right Angle Connector
D = 4+5 pin M23 size 1, Right Angle Connector	3 = 10 pin M23 Size 1, Right Angle Connector

Wiring and Alignment Options

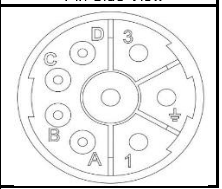
AMK-Resolver (AK-R1A1) -

Standard Resolver w/M23 connectors

Power Connector Pin-Out

19819 Connector	Drive Terminology
1	U
2	PE
3	W
4	V
A	TH
B	TH
C	BR +
D	BR 0V

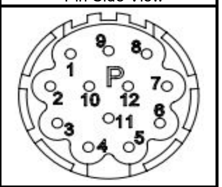
Pin Side View



Feedback Connector Pin-Out

19820 Connector	Drive Terminology
1	+ Sin
2	- Sin
3	+ Cos
4	- Cos
5	-
6	-
7	-
8	Shield
9	+ UREF
10	- UREF
11	-
12	-
Actuator Case	-

Pin Side View



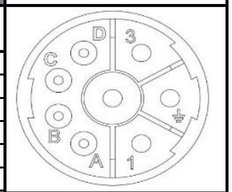
B & R Automation-Resolver (BR-R1A1) -

Standard Resolver w/M23 connectors

Power Connector Pin-Out

M23 Connector	Drive Terminology
1	U
2	PE
3	W
4	V
A	PT1000
B	PT1000
C	Brake+
D	Brake-

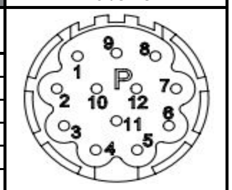
Pin Side View



Feedback Connector Pin-Out

M23 Connector	Drive Terminology
1	-
2	-
3	Cos+
4	Sin+
5	Ref+
6	-
7	Cos-
8	Sin-
9	Ref-
10	-
11	-
12	-
Actuator Case	-

Pin Side View



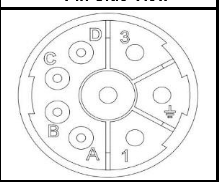
Mfg's Cable Part Number- 8CRXXX.12-1

AMK-Heidenhain (AK-H1A1) - EnDat Heidenhain EQN1125 multi-turn absolute encoder – ED/EK motor wiring w/M23 connectors

Power Connector Pin-Out

19819 Connector	Drive Terminology
1	U
2	PE
3	W
4	V
A	TH
B	TH
C	BR +
D	BR 0V

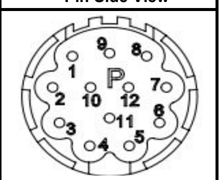
Pin Side View



Feedback Connector Pin-Out

19820 Connector	Drive Terminology
1	G2N
2	G2I
3	G1N
4	G1I
5	05P
6	GND
7	CLK+
8	CLK-
9	DAT+
10	DAT-
11	05P
12	GND
Actuator Case	-

Pin Side View



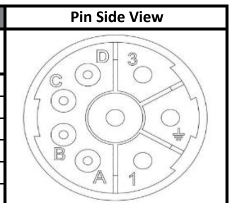
B & R Automation-Heidenhain (BR-H1A2) -

EnDat Heidenhain EQN1125 multi-turn absolute encoder – 8LS/8LM motor wiring w/M23 connectors

Power Connector Pin-Out

M23 Connector	Drive Terminology
1	U
2	PE
3	W
4	V
A	PT1000
B	PT1000
C	Brake+
D	Brake-

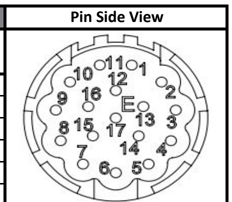
Pin Side View



Feedback Connector Pin-Out

M23 Connector	Drive Terminology
1	Up Sense
2	-
3	-
4	0V Sense
5	-
6	-
7	Up voltage supply
8	Clock
9	Clock-
10	0V voltage supply
11	-
12	B+
13	B-
14	Data
15	A+
16	A-
17	Data-
Actuator Case	-

Pin Side View

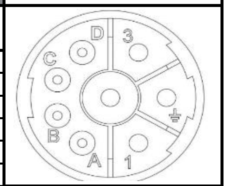


Mfg's Cable Part Number- 8CEXXX.12-1

Baldor-Resolver (BD-R1A1) -
Standard Resolver w/M23 connectors

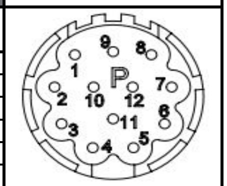
Power Connector Pin-Out	
19819 Connector	Drive Terminology
1	U
2	GND
3	W
4	V
A	Therm
B	Therm
C	Brake+
D	Brake-

Pin Side View



Feedback Connector Pin-Out	
19820 Connector	Drive Terminology
1	R1 Ref Hi
2	R2 Ref Lo
3	S1 Cos+
4	S3 Cos-
5	S2 Sin+
6	S4 Sin-
7	-
8	-
9	-
10	-
11	-
12	-
Actuator Case	Shield

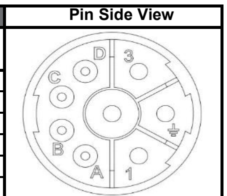
Pin Side View



Baldor-Heidenhain (BD-H1A1) - EnDat Heidenhain
EQN1125 multi-turn absolute encoder – ED/EK motor wiring w/M23 connectors

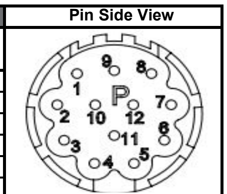
Power Connector Pin-Out	
19819 Connector	Drive Terminology
1	T1
2	Earth/Ground
3	T3
4	T2
A	Thermal Switch
B	Thermal Switch
C	Brake+
D	Brake-

Pin Side View



Feedback Connector Pin-Out	
19820 Connector	Drive Terminology
1	Data-
2	Sin+
3	0
4	Cos+
5	Clock-
6	-
7	Clock+
8	Cos-
9	5 volt
10	DGND
11	Sin-
12	Data+
Actuator Case	-

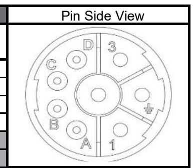
Pin Side View



Baumueller-Resolver (BM-R1A1) -
Standard Resolver w/M23 connectors

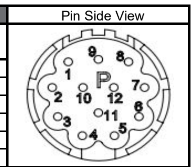
Power Connector Pin-Out	
19819 Connector	Drive Terminology
1	Phase U
2	PE
3	Phase W
4	Phase V
A	Brake+
B	Brake-
C	-
D	-

Pin Side View



Feedback Connector Pin-Out	
19820 Connector	Drive Terminology
1	Cos -
2	-
3	-
4	-
5	Sin -
6	Sin +
7	-
8	Cos +
9	-
10	Ref +
11	-
12	Ref -
Actuator Case	Shield

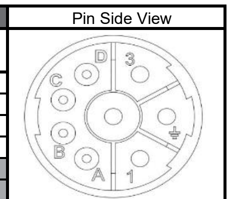
Pin Side View



Baumueller-Stegmann (BM-S1A1) - Hiperface
Stegmann SKM36 multi-turn absolute encoder – SH motor wiring w/M23 connectors

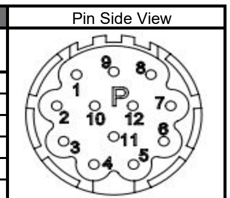
Power Connector Pin-Out	
19819 Connector	Drive Terminology
1	Phase U
2	PE
3	Phase V
4	Phase W
A	Brake+
B	Brake-
C	PT1000
D	PT1000

Pin Side View



Feedback Connector Pin-Out	
19820 Connector	Drive Terminology
1	Ref Cos
2	Daten +
3	-
4	-
5	Sin
6	Ref Sin
7	Daten -
8	Cos
9	-
10	GND
11	-
12	+V
Actuator Case	-

Pin Side View

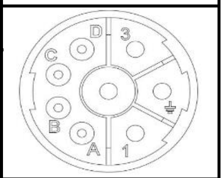


Baumueller-Heidenhain (BM-H1A2) -

EnDat Heidenhain EQN1125 multi-turn absolute encoder – 8LS/8LM motor wiring w/M23 connectors

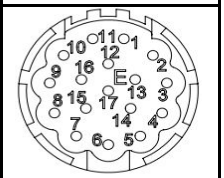
Power Connector Pin-Out	
19819 Connector	Drive Terminology
1	Phase U
2	PE
3	Phase V
4	Phase W
A	Brake+
B	Brake-
C	-
D	-

Pin Side View



Feedback Connector Pin-Out	
20494 Connector	Drive Terminology
1	Up Sense
2	-
3	-
4	0V Sense
5	PT1000
6	PT1000
7	Up voltage supply
8	Clock
9	Clock -
10	0V voltage supply
11	-
12	B+
13	B-
14	Data
15	A+
16	A-
17	Data -
Actuator Case	-

Pin Side View

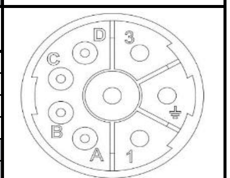


Beckhoff-Heidenhain (BE-H1A2) -

EnDat Heidenhain EQN1125 multi-turn absolute encoder – AM3XXXX motor wiring w/M23 connectors

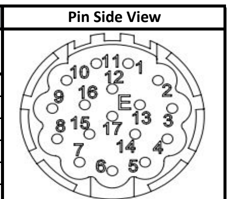
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	U
2	PE
3	W
4	V
A	Brake+
B	Brake-
C	PT1000
D	PT1000

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	B-
2	0V voltage supply
3	A-
4	Up voltage supply
5	Data
6	-
7	-
8	Clock
9	B+
10	0V Sense
11	A+
12	Up Sense
13	Data -
14	-
15	Clock -
16	-
17	-
Actuator Case	-

Pin Side View

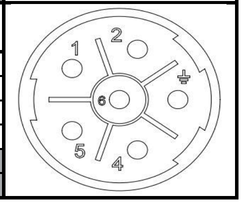


Control Technologies-Resolver (CT-R2B1) -

Standard Resolver – FM/UM/EZ motor wiring w/M23 connectors

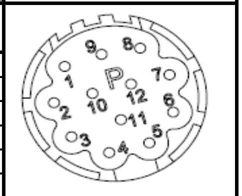
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	R
2	S
⏚	GND
4	T
5	Brake+
6	Brake-

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	Excitation High
2	Excitation Low
3	Cos High
4	Cos Low
5	Sin High
6	Sin Low
7	Therm Switch
8	Therm Switch
9	-
10	-
11	-
12	-
Actuator Case	Shield

Pin Side View



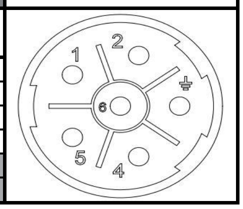
Mfg's Cable Part Number- SRBBBBXXXX / SRBBABXXXX

Control Technologies-Encoder (CT-E1B2) -

Standard Incremental Encoder – FM/UM/EZ motor wiring w/M23 connectors

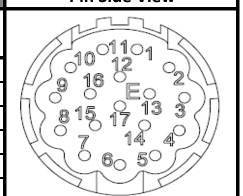
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	R
2	S
⏚	GND
4	T
5	Brake+
6	Brake-

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	Therm Switch
2	Therm Switch
3	-
4	U
5	U/
6	V
7	V/
8	W
9	W/
10	A
11	Z
12	Z/
13	A/
14	B
15	B/
16	+ 5 VDC
17	0V
Actuator Case	-

Pin Side View

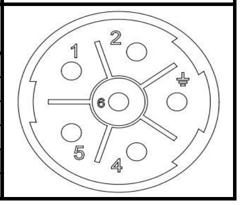


Mfg's Cable Part Number- S1BAAAXXXX

Control Tecchnologies-Stegmann (CT-S1B1)– Hiperface Stegmann SKM36 multi-turn absolute encoder – FM/UM/EZ motor wiring w/M23 connectors

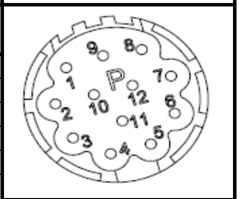
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	R
2	S
¥	GND
4	T
5	Brake+
6	Brake-

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	Ref Cos
2	Daten +
3	Daten -
4	Cos
5	Sin
6	Ref Sin
7	Therm Switch
8	Therm Switch
9	Screen
10	Com
11	-
12	+V
Actuator Case	-

Pin Side View

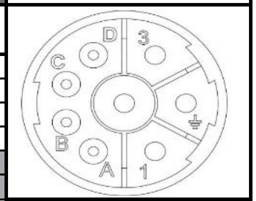


Mfg's Cable Part Number- SSBCABXXXX

Elau-Stegmann (EU-S1A1) - Hiperface Stegmann SKM36 multi-turn absolute encoder – SH motor wiring w/M23 connectors

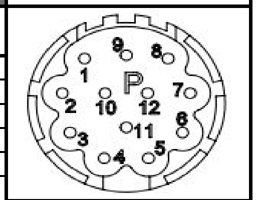
Power Connector Pin-Out	
19819 Connector	Drive Terminology
1	U (1)
2	PE
3	W (3)
4	V (2)
A	br+ (8)
B	br- (7)
C	PT1000
D	PT1000

Pin Side View



Feedback Connector Pin-Out	
19820 Connector	Drive Terminology
1	REFCOS
2	RS485+
3	-
4	-
5	SIN
6	REFSIN
7	RS485-
8	COS
9	-
10	GND
11	-
12	Us
Actuator Case	-

Pin Side View

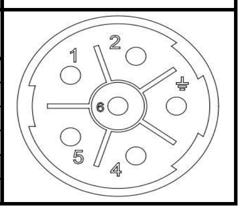


Mfg's Cable Part Number- SH Series Absolute Encoder Cable

Control Technologies-Heidenhain (CT-H1B2) - EnDat Heidenhain EQN1125 multi-turn absolute encoder unidrive SP w/M23 connectors

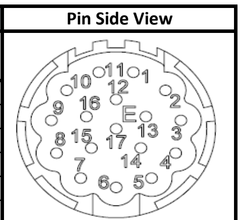
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	R
2	S
¥	GND
4	T
5	Brake+
6	Brake-

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	PT1000
2	PT1000
3	-
4	-
5	-
6	-
7	-
8	Clock +
9	Clock -
10	A+
11	Data +
12	Data -
13	A-
14	B+
15	B-
16	+ 5 VDC
17	COM
Actuator Case	Shield

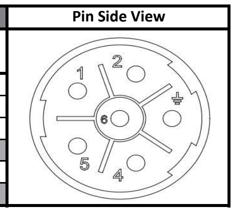
Pin Side View



Elmo-Resolver (EL-R1B1) - Standard Resolver w/M23 connectors

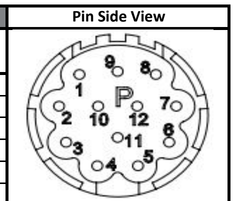
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	M1
2	M3
¥	PE
4	Brake-
5	M2
6	Brake+

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	-
2	-
3	Sin- S4
4	Cos- S3
5	Ref R2
6	-
7	Sin+ S2
8	Cos+ S1
9	Ref R1
10	-
11	-
12	-
Actuator Case	Shield

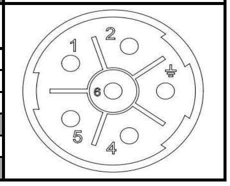
Pin Side View



Elmo-Encoder (EL-E1B2) - Standard Incremental Encoder w/M23 connectors

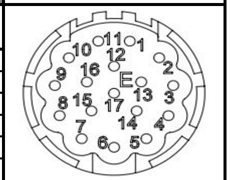
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	M1
2	M3
¥	PE
4	Brake-
5	M2
6	Brake+

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	Power Supply 5V
2	Therm Switch
3	Power Supply 0V
4	HC +
5	HC -
6	HA +
7	HA -
8	HB +
9	HB -
10	A +
11	A -
12	B +
13	B -
14	Z +
15	Z -
16	-
17	Therm Switch
Actuator Case	-

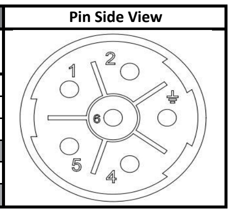
Pin Side View



Elmo-Heidenhain (EL-H1B2) - EnDat Heidenhain EQN1125 multi-turn absolute encoder w/M23 connectors

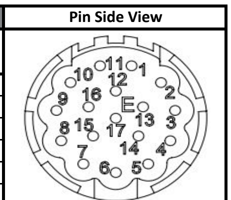
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	U
2	W
¥	PE
4	Brake-
5	V
6	Brake+

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	B-
2	0V voltage supply
3	A-
4	Up voltage supply
5	Data
6	-
7	Therm Switch
8	Clock
9	B+
10	0V Sense
11	A+
12	Up Sense
13	Data -
14	Therm Switch
15	Clock -
16	-
17	-
Actuator Case	-

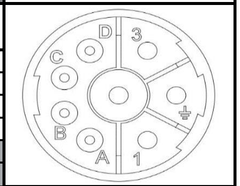
Pin Side View



Exlar-Resolver (EX-R1A1) - Standard Resolver w/M23 connectors

Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	R
2	GND
3	T
4	S
A	Brake+
B	Brake-
C	-
D	-

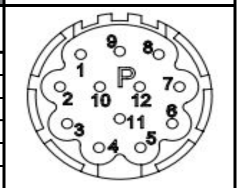
Pin Side View



CBL-PWRB1-SMI-XXX

Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	-
2	Therm Switch
3	- Cos
4	- Sin
5	- Exc
6	Therm Switch
7	+ Cos
8	+ Sin
9	+ Exc
10	-
11	-
12	-
Actuator Case	Shield

Pin Side View

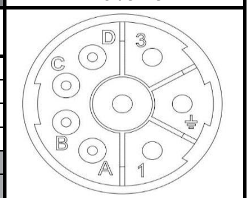


CBL-RESOL-SMI-XXX

Exlar-Encoder (EX-E1A2) -
Standard Incremental Encoder 2048 Line w/M23 connectors

Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	R
2	GND
3	T
4	S
A	Brake+
B	Brake-
C	-
D	-

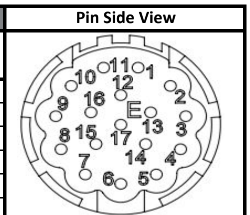
Pin Side View



CBL-PWRB1-SMI-XXX

Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	B-
2	B
3	A
4	A-
5	Z
6	Z-
7	GND
8	Therm Switch
9	Therm Switch
10	+5VDC
11	-
12	W-
13	V-
14	U-
15	W
16	V
17	U
Actuator Case	-

Pin Side View

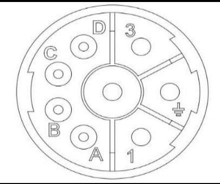


CBL-ENCOD-SMI-XXX

Exlar-Stegmann (EX-S1A2) - Hiperface Stegmann SKM36 multi-turn absolute encoder w/M23 connectors

Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	R
2	GND
3	T
4	S
A	Brake+
B	Brake-
C	-
D	-

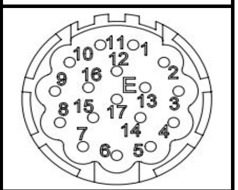
Pin Side View



CBL-PWRB1-SMI-XXX

Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	Sin +
2	Com
3	Cos +
4	+ 5V
5	Ref +
6	-
7	Therm Switch
8	-
9	Sin -
10	-
11	Cos -
12	-
13	Ref -
14	Therm Switch
15	-
16	-
17	-
Actuator Case	-

Pin Side View

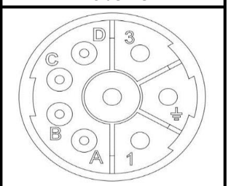


CBL-ENCOD-SMI-XXX

Exlar-Heidenhain (EX-H1A2) - EnDat Heidenhain EQN1125 multi-turn absolute encoder w/M23 connectors

Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	U
2	PE
3	W
4	V
A	Brake+
B	Brake-
C	-
D	-

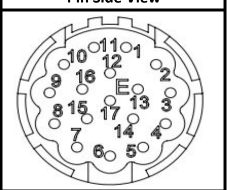
Pin Side View



CBL-ENCOD-SMI-XXX

Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	B-
2	0V voltage supply
3	A-
4	Up voltage supply
5	Data+
6	-
7	Therm Switch
8	Clock
9	B
10	0V Sense
11	A
12	Up Sense
13	Data -
14	Therm Switch
15	Clock -
16	-
17	-
Actuator Case	-

Pin Side View

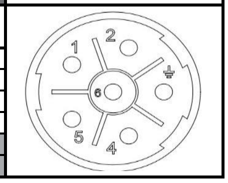


CBL-PWRB1-SMI-XXX

Infranor-Resolver (IF-R1B2) - Standard Resolver w/M23 connectors

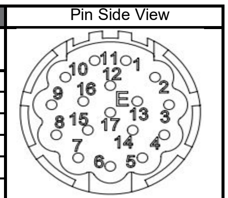
Power Connector Pin-Out	
20453 Connector	Drive Terminology
1	R
2	S
¥	GND
4	T
5	Brake+
6	Brake-

Pin Side View



Feedback Connector Pin-Out	
20494 Connector	Drive Terminology
1	S2
2	S4
3	S3
4	S1
5	R1
6	R2
7	-
8	-
9	-
10	-
11	-
12	Therm
13	Therm
14	-
15	-
16	-
17	-
Actuator Case	-

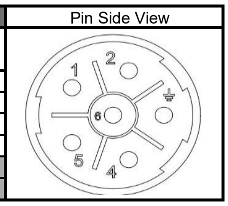
Pin Side View



Infranor-Stegmann (IF-S1B2) - Hiperface Stegmann SKM36 multi-turn absolute encoder w/M23 connectors

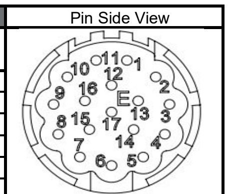
Power Connector Pin-Out	
20453 Connector	Drive Terminology
1	R
2	S
¥	GND
4	T
5	Brake+
6	Brake-

Pin Side View



Feedback Connector Pin-Out	
20494 Connector	Drive Terminology
1	Sin +
2	Sin -
3	Cos +
4	Cos -
5	Ref +
6	Ref -
7	-
8	-
9	-
10	Com
11	+ 5V
12	PT1000
13	PT1000
14	-
15	-
16	-
17	0
Actuator Case	-

Pin Side View

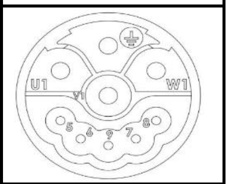


Indramat/Bosch-Rexroth-Stegmann (IN-S2D3)-

Hiperface Stegmann multi-turn absolute encoder –
MSK motor wiring w/M23 connectors

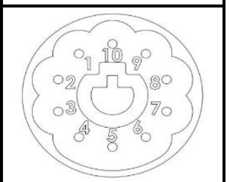
Power Connector Pin-Out	
M23 Connector	Drive Terminology
U1	Phase U
V1	Phase V
W1	Phase W
PE	Earth
5	PT1000
6	PT1000
7	Brake+
8	Brake-
9	-

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	Vcc_Encoder
2	GND_Encoder
3	A+
4	A-
5	B+
6	B-
7	EncData+
8	EncData-
9	-
10	-

Pin Side View



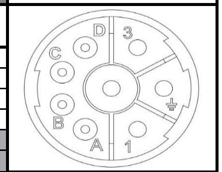
Mfg's Cable Part Number-
RKG4200

Kollmorgen-Resolver (KM-R2A1) - Standard Resolver

– AKM motor wiring w/M23 connectors

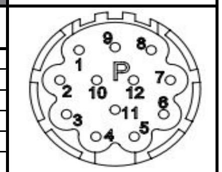
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	U
2	GND
3	W
4	V
A	Brake+
B	Brake-
C	-
D	-

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	-
2	Therm Switch
3	Cos Lo (S4)
4	Sin Lo (S3)
5	Ref Lo (R2)
6	Therm Switch
7	Cos Hi (S2)
8	Sin Hi (S1)
9	Ref Hi (R1)
10	-
11	-
12	-
Actuator Case	Shield

Pin Side View



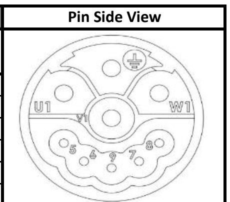
Mfg's Cable Part Number-
VF-RA2474N-XX

Indramat/Bosch-Rexroth-Heidenhain (IN-H1D3)-

EnDat Heidenhain EQN1125 multi-turn absolute Indradrive wiring w/M23 connectors

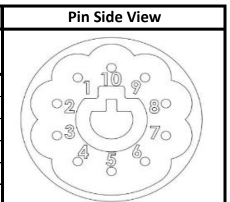
Power Connector Pin-Out	
M23 Connector	Drive Terminology
U1	Phase U
V1	Phase V
W1	Phase W
PE	Earth
5	PT1000
6	PT1000
7	Brake+
8	Brake-
9	-

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	Vcc_Encoder
2	GND_Encoder
3	A+
4	A-
5	B+
6	B-
7	Data +
8	Data -
9	Clock
10	Clock -

Pin Side View

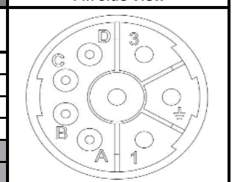


Kollmorgen-Encoder (KM-E1A2) -

Standard Incremental Encoder – AKM motor wiring w/ M23 connectors

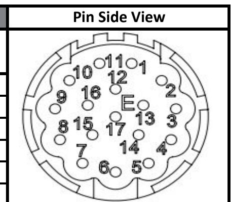
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	U
2	PE
3	W
4	V
A	Brake+
B	Brake-
C	-
D	-

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	B+
2	B-
3	A+
4	A-
5	Z
6	Z-
7	GND
8	Therm Switch
9	Therm Switch
10	Vcc
11	-
12	U-
13	V-
14	W-
15	U
16	V
17	W
Actuator Case	-

Pin Side View

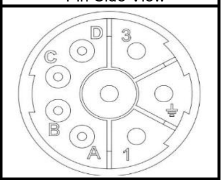


Mfg's Cable Part Number-
CF-CB7374N-XX

LTI-Resolver (LS-R2A1) - Standard Resolver – AKM motor wiring w/M23 connectors

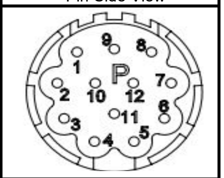
Power Connector Pin-Out	
19819 Connector	Drive Terminology
1	U
2	GND
3	W
4	V
A	Brake+
B	Brake-
C	-
D	-

Pin Side View



Feedback Connector Pin-Out	
19820 Connector	Drive Terminology
1	(S1) Cos +
2	(S3) Cos -
3	(S2) Sin +
4	(S4) Sin -
5	-
6	(R1) Ref +
7	(R2) Ref -
8	-
9	-
10	-
11	PT1000+
12	PT1000-
Actuator Case	-

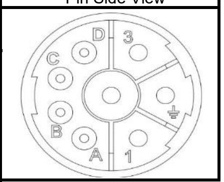
Pin Side View



LTI-Stegmann (LS-S1A2) - Hiperface Stegmann SKM36 multi-turn absolute encoder w/M23 connectors

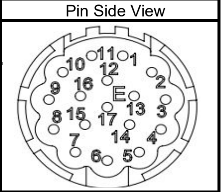
Power Connector Pin-Out	
19819 Connector	Drive Terminology
1	Phase U
2	Protective Earth
3	Phase W
4	Phase V
A	Brake+
B	Brake-
C	PT1000
D	PT1000

Pin Side View



Feedback Connector Pin-Out	
20494 Connector	Drive Terminology
1	COS+
2	REFCOS
3	SIN+
4	REFSIN
5	-
6	-
7	GND
8	-
9	Us 7-12v
10	Dataen+ RS485
11	Dataen- RS485
12	-
13	-
14	-
15	-
16	-
17	-
Actuator Case	-

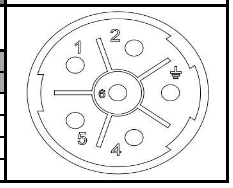
Pin Side View



Lenze-Resolver (LZ-R1B1) - Standard Resolver – MCS motor wiring w/M23 connectors

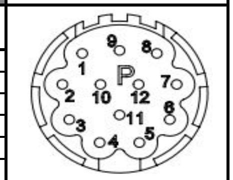
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	Y1 / BD1
2	Y2 / BD2
¥	PI
4	U
5	V
6	W

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	+ Ref
2	- Ref
3	-
4	+ Cos
5	- Cos
6	+ Sin
7	- Sin
8	-
9	-
10	-
11	PT1000
12	PT1000
Actuator Case	-

Pin Side View

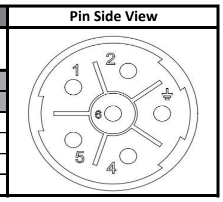


Mfg's Cable Part Number- MCS Series Resolver Cable

Lenze-Encoder (LZ-S1B1) - Hiperface Stegmann SKM36 multi-turn absolute encoder – FM/UM/EZ motor wiring w/M23 connectors

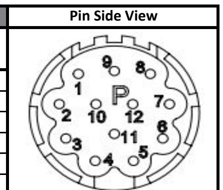
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	Y1 / BD1
2	Y2 / BD2
¥	PI
4	U
5	V
6	W

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	+ SIN
2	- COS
3	+ COS
4	+ 8 V
5	Mass
6	- RS485
7	+ RS485
8	-
9	- SIN
10	-
11	PT1000
12	PT1000
Actuator Case	-

Pin Side View

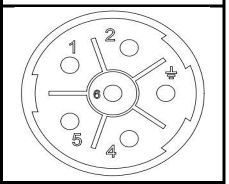


Mfg's Cable Part Number- MCS Series Absolute Encoder Cable

Parker-Resolver (PC-R1B1) - Standard Resolver – SMH motor wiring w/M23 connectors

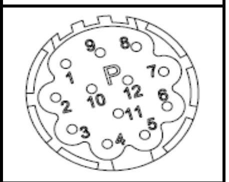
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	U
2	V
¥	PE
4	Brake+
5	Brake-
6	W

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	Sin -
2	Sin +
3	-
4	-
5	-
6	-
7	Ref -
8	PT1000
9	PT1000
10	Ref +
11	Cos +
12	Cos -
Actuator Case	Shield

Pin Side View

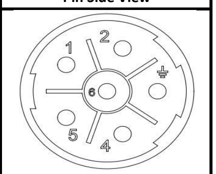


Mfg's Cable Part Number-
SMH Series Incremental
Encoder Cable

Parker-Encoder (PC-E1B2) - Standard Incremental Encoder – MPP series motor wiring w/M23 connectors

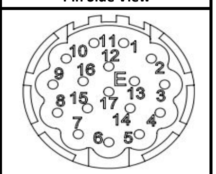
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	U
2	W
¥	PE
4	Brake+
5	Brake-
6	V

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	A-
2	A+
3	-
4	Hall 1
5	Hall 3
6	Hall 2
7	Ground
8	+5 vdc
9	Therm Switch
10	-
11	B
12	B -
13	Therm Switch
14	-
15	Z+
16	Z-
17	-
Actuator Case	-

Pin Side View



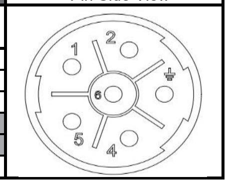
Mfg's Cable Part Number-
SMH Series Resolver Cable

Parker-Heidenhain (PC-H1B2) -

EnDat Heidenhain EQN1125 multi-turn absolute encoder unidrive SP w/M23 connectors

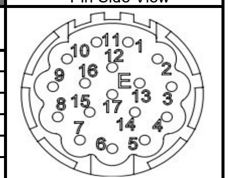
Power Connector Pin-Out	
20453 Connector	Drive Terminology
1	U
2	V
¥	GND
4	Brake+
5	Brake-
6	W

Pin Side View



Feedback Connector Pin-Out	
20494 Connector	Drive Terminology
1	CH A-
2	CH A+
3	-
4	CLK +
5	CLK -
6	-
7	Gound
8	Vcc
9	Therm
10	-
11	CH B+
12	CH B-
13	Therm
14	Up
15	Data +
16	Data -
17	-
Actuator Case	-

Pin Side View

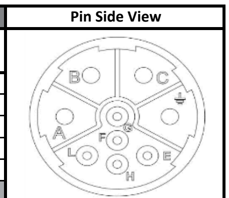


Rockwell Automation-Encoder (RA-E1C2) -

Standard Incremental Encoder - MPL Type M feedback w/M23 connectors

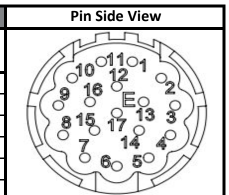
Power Connector Pin-Out	
M23 Connector	Drive Terminology
A	Phase U
B	Phase V
C	Phase W
D	Ground
E	-
F	Brake+
G	Brake-
H	-
L	-

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	A(+)
2	A(-)
3	B(+)
4	B(-)
5	I(+)
6	I(-)
7	-
8	-
9	EPWR_5V
10	Common
11	-
12	-
13	Therm Switch
14	Therm Switch
15	S1
16	S2
17	S3
Actuator Case	-

Pin Side View



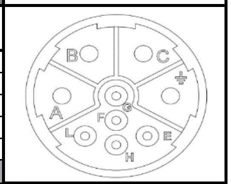
Mfg's Cable Part Number-
2090-CFBM7DF-CDAxyy

EXLAR®

RockwellAutomation-Stegmann (RA-S1C2) - Hiperface, SKM36 multi-turn absolute encoder. MPL Type V feedback (128 sin/cos) /M23 connectors[1]

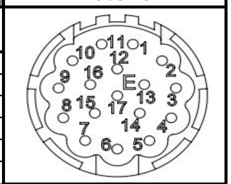
Power Connector Pin-Out	
M23 Connector	Drive Terminology
A	Phase U
B	Phase V
C	Phase W
D	Ground
E	-
F	Brake+
G	Brake-
H	-
L	-

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	Sine +
2	Sine -
3	Cos +
4	Cos -
5	Data +
6	Data -
7	-
8	-
9	-
10	ECOM
11	+ 9 vdc
12	-
13	Therm Switch
14	Therm Switch
15	-
16	-
17	-
Actuator Case	-

Pin Side View



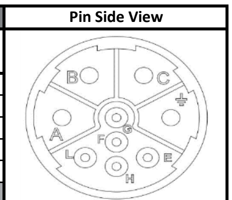
Mfg's Cable Part Number- 2090-CFBM7DF-CDAxyy

1. Not compatible with Kinetix 300 Drives.

RockwellAutomation-Stegmann Absolute DSL Encoder (RA-S3C0) - Hiperface, EKM36 multi-turn absolute encoder w/M23 connectors

Power Connector Pin-Out	
M23 Connector	Drive Terminology
A	Phase U
B	Phase V
C	Phase W
D	Ground
E	Data +
F	Brake+
G	Brake-
H	Data -
L	-

Pin Side View

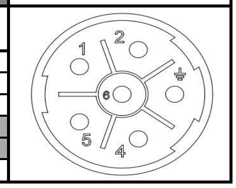


Mfg's Cable Part Number- 2090-CSBM1DE-14AA05

Siemens-Resolver (SM-R1B1) - Standard Resolver – 1FK7 motor wiring w/M23 connectors

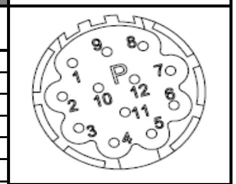
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	U
2	V
¥	GNYE
4	BD1+
5	BD2-
6	W

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	SIN
2	*SIN
3	-
4	-
5	-
6	Shield
7	-Vpp
8	PT1000
9	PT1000
10	+Vpp
11	COS
12	*COS
Actuator Case	Shield

Pin Side View

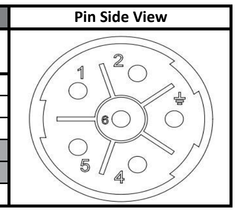


Mfg's Cable Part Number- 6FX5002-2CF02-...

Siemens-Heidenhain (SM-H1B2) - EnDat Heidenhain EQN1125 multi-turn absolute encoder – 1FK7 motor wiring w/M23 connectors

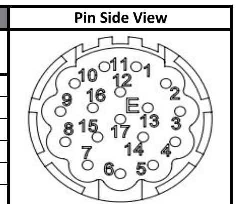
Power Connector Pin-Out	
M23 Connector	Drive Terminology
1	U
2	V
¥	GNYE
4	BD1+
5	BD2-
6	W

Pin Side View



Feedback Connector Pin-Out	
M23 Connector	Drive Terminology
1	A+
2	A-
3	+ data
4	-
5	+clock
6	-
7	M-Encoder
8	PT1000
9	PT1000
10	P-Encoder
11	B+
12	B-
13	- data
14	-clock
15	0 V Sense
16	5 V Sense
17	-
Actuator Case	-

Pin Side View

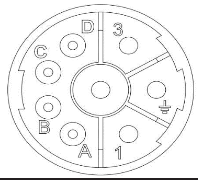


Mfg's Cable Part Number- 6FX5002-EQ10-...

Stober-Resolver (SB-R2A1) - Standard Resolver ED/EK motor wiring w/M23 connector

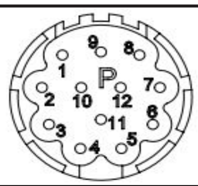
Power Connector Pin-Out	
19819 Connector	Drive Terminology
1	U
2	GND
3	V
4	W
A	Brake
B	Brake
C	Therm Switch
D	Therm Switch

Pin Side View



Feedback Connector Pin-Out	
19820 Connector	Drive Terminology
1	Sin + (S4)
2	Sin - (S2)
3	Cos + (S3)
4	Cos - (S1)
5	-
6	-
7	Erreg+ (R2)
8	Erreg- (R1)
9	-
10	-
11	-
12	-
Actuator Case	-

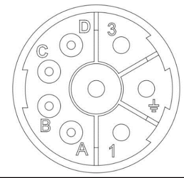
Pin Side View



Stober-Heidenhain (SB-H1A1) - EnDat Heidenhain EQN1125 multi-turn absolute encoder – ED/EK motor wiring w/M23 connectors

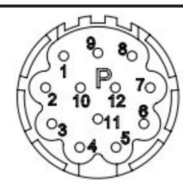
Power Connector Pin-Out	
19819 Connector	Drive Terminology
1	U
2	GND
3	S
4	T
A	Brake
B	Brake
C	Therm Switch
D	Therm Switch

Pin Side View

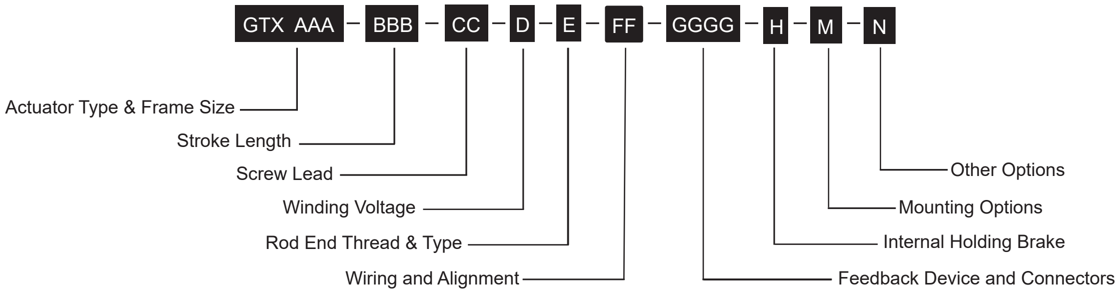


Feedback Connector Pin-Out	
19820 Connector	Drive Terminology
1	Clock +
2	Up Sense
3	-
4	-
5	Data -
6	Data
7	-
8	Clock -
9	-
10	0V
11	-
12	Up
Actuator Case	-

Pin Side View



Mfg's Cable Part Number- Stober Absolute Encoder Cable



AAA = GTX Integrated Motor / Actuator
060 = 60 mm (2.36 in)
080 = 80 mm (3.15 in)
100 = 100 mm (3.94)

BBB = Stroke Length
080 = 80 mm (GTX060)
100 = 100 mm (GTX060, GTX080)
150 = 150 mm
300 = 300 mm
450 = 450 mm (GTX080)

CC = Screw Lead
01 = 0.10 in (2.54 mm)
02 = 0.20 in (5.08 mm)
04 = 0.40 in (10.2 mm) GTX060
05 = 0.50 in (12.7 mm)

D = Winding Voltage
4 = 460 VAC Max
D = 48 VDC Max (GTX060, GTX080)

E = Rod End Thread & Type
A = Male, Metric
B = Female, Metric[2]
C = Male, Metric Splined[2]
D = Female, Metric Splined[2]
M = Male, English[2]
G = Male, English Splined[2]
F = Female, English[2]
H = Female, English Splined[2]

FF = Wiring and Alignment
AK = AMK
BR = B&R Automation
BD = Baldor
BE = Beckoff
BM = Baumueller
CT = Control Techniques/Nidec
EU = Elau/Schneider
EL = Elmo Motion Control
EX = Exlar
IF = Infranor
IN = Indramat/Bosch-Rexroth
KM = Kollmorgen/Danaher
LS = LTI
LZ = Lenze/AC Tech
PC = Parker Compumotor
RA = Rockwell Automation
SM = Siemens
SB = Stober Drives

GGGG = Feedback Device and Connectors
For more detailed descriptions of available feedback types see page 25
Resolver
- R1A1
- R1B1
- R1B2
- R2A1
- R2B1

Incremental Encoder
- E1A2
- E1B2
- E1C2

Absolute Encoder - Stegmann
- S1A1
- S1A2
- S1B1
- S1B2
- S1C2
- S2D3

Absolute DSL Encoder - Stegmann
- S3C0

Absolute Encoder - Heidenhain
- H1A1
- H1A2
- H1B2
- H1D3

H= Internal Holding Brake
N = No Brake
B = Internal Holding Brake, Electronically Released

M = Mounting Options
N = None
1 = Front Flange, Metric
3 = Tapped Face, Metric
5 = Rear Clevis, Metric
F = Front Flange, English
C = Rear Clevis, English

N = Other Options
N = None
A = Anti-Rotate Assembly, External
L = Limit Switch Housing/ Anti-Rotate Assembly[1]

[1]Switches sold separately
[2] Splined Rod (Internal Anti-Rotate) option reduces IP rating.

For options or specials not listed above or for extended temperature operation, please contact Exlar

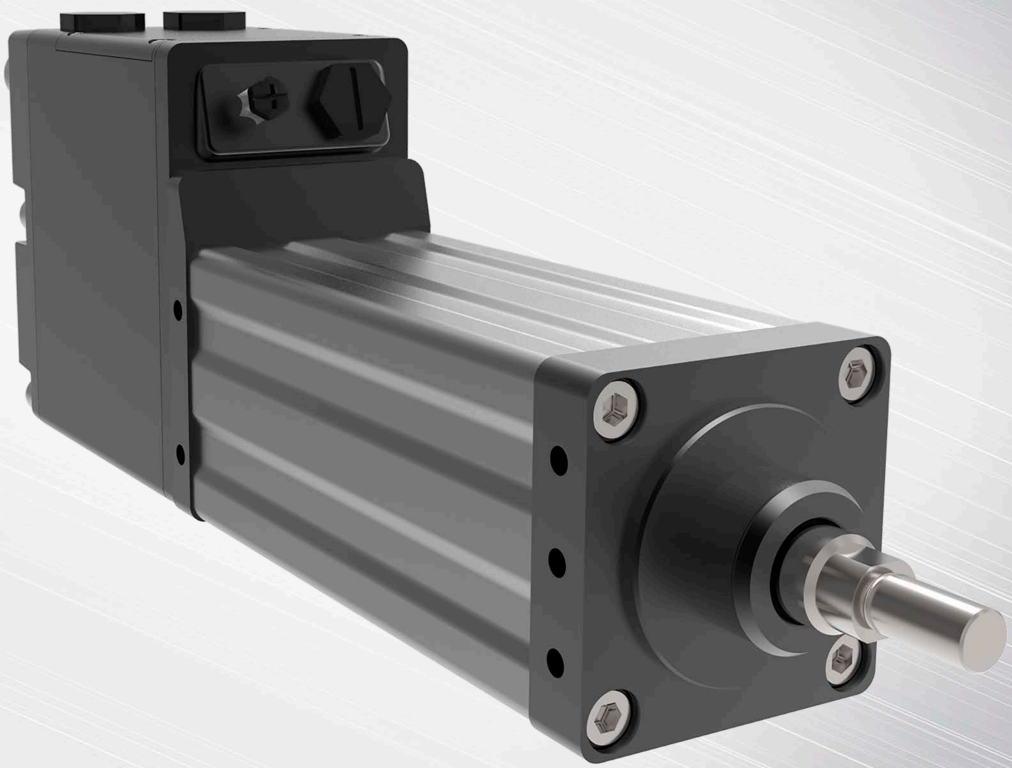
TTX Series

FULLY INTEGRATED SERVO DRIVE / MOTOR / ACTUATOR

Ideal for stand-alone applications

Multiple networking options

AC or DC powered models



TTX Series

Fully Integrated Drive/Motor/Actuator

By combining the latest electronic power technology with advanced thermal management modeling technology, Exlar® has set a new benchmark for electric actuator performance versus size. TTX Series actuators now integrate an AC or DC powered servo drive, digital position controller, brushless motor and linear actuator in one elegant, compact, sealed package. Now you can distribute motion control and resolve your application challenges with one integrated device. Simply connect power, I/O, communications and go!

Reduce Panel Space

TTX Series actuators are the highest power density, smallest footprint servo drive devices on the market. Finally, you can incorporate a fully electronic solution in the space of your existing hydraulic or pneumatic cylinder. You can also eliminate troublesome ball screw actuators; and the space previously consumed by panel mount servo drives and motion controllers is no longer needed. TTX Series actuators may also reduce the size of your machine design while significantly improving reliability.

Reduce Costs

Now you can eliminate the labor costs for mounting and wiring panels because the TTX Series houses the servo drive, digital positioner, and actuator in one convenient package. Cable costs are also significantly reduced by eliminating the need for expensive, high-maintenance specialty servo cables. All that is required is an economical standard AC or DC power cord, and standard communication cable for digital and analog I/O.

These actuators also eliminate the issues associated with power signals and feedback signals traveling long distances from servo drive to servo motor. With the TTX Series, the servo drive and motor are always integrated in the same housing.

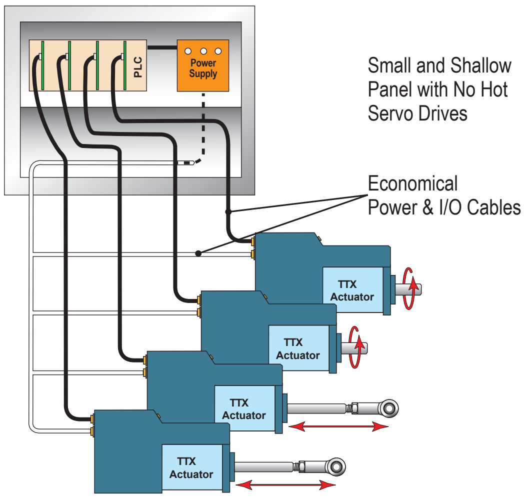
Flexible Communications

Digital and analog I/O, plus popular communication networks, such as Modbus TCP, Modbus RTU (standard), Ethernet/IP, and PROFINET IO, allow the TTX Series to become an integral part of your control architecture or machine control processes.

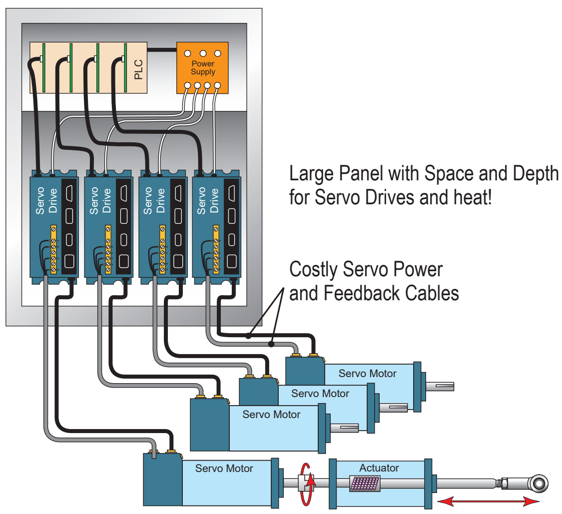
Improves Power, Performance, and Reliability

TTX Series actuators give you unrivaled power, performance, and reliability. No longer are you limited to trivial amounts of force or speeds so slow that many motion applications are not possible.

TTX System



Alternative Systems



Linear Applications

TTX Series linear actuators employ a superior inverted roller screw mechanism for converting rotary motion to highly robust and long-life linear motion. These characteristics enable the TTX Series actuator to solve applications that previously required pneumatic or hydraulic cylinders. No additional mechanisms (such as acme or ball screws) are necessary to convert the actuator's rotary power into linear motion in order to move the load.

Ideal for mobile and remote applications using DC power sources, the TTX Series DC actuators have the power needed to perform. The simple to configure, yet robust interface software allows either the AC or DC TTX Series actuators to perform nearly any motion control application. The TTX Series linear actuator can be programmed to follow an analog command signal, making it ideal for numerous factory automation applications

TTX Series Models

TTX Series AC and DC Models

- TTX Series high mechanical capacity actuator, 80 mm

Feedback Type

- Absolute Feedback (analog hall with multi-turn, battery backup)

Option Boards and I/O

Standard I/O:

8 - Digital Inputs
8 - Digital Outputs
1 - ±10V Analog Input
1 - 0-10V Analog Output

Ethernet / IP - Includes all standard I/O
Modbus TCP - Includes all standard I/O
Profinet I/O - Includes all standard I/O
4-20 mA - 4 digital inputs, 3 digital outputs, Isolated 4-20 mA input, Isolated 4-20 mA output

Standard Communications (All Models):

- 1 RS485 port, Modbus RTU, opto-isolated for programming, controlling and monitoring

TTX Series Option Boards

- Option boards offer adding functionality to the base TTX Series actuators
  - Terminal board for customer I/O
  - Isolated 4-20mA analog input and output
- Communication buses
  - EtherNet/IP
  - Modbus TCP
  - PROFINET IO

Connectivity

- Internal terminals accessible through removable cover
- M23 Power Connector (DC & AC Models differ)
- M23 I/O
- M8 connector for RS485 (may use internal connection instead)
- M12 connector for EtherNet options (may use internal connection instead)
- Power and I/O connectors may be removed by customer for M25 threaded port
- Power and I/O connectors may be replaced by customer with cable glands
- Power and I/O connectors may be replaced by customer with 1/2 inch NPT adaptors

TTX Series Operation

The TTX Series actuators can operate in one of five different motion-producing modes. These modes solve an endless variety of applications in industrial automation, medical equipment, fastening and joining, blow molding, injection molding, testing, food processing, and more.

Programmed functions are stored in the TTX Series non-volatile memory. A standard RS485 serial interface allows control, programming, and monitoring of all aspects of the motor or actuator as it performs your application. Optional communications protocols are available.

Operating Modes

1. *Move to a position (or switch)*
   The TTX Series actuators allow you to execute up to 16 programmed positions or distances. You may also use a limit switch or other input device as the end condition of a move. This combination of index flexibility provides a simple solution for point-to-point indexing.
2. *Move to a preset force*
   The TTX Series allows you to terminate your move upon the achievement of a programmed torque or force. This is an ideal mode for pressing and clamping applications.
3. *Position proportional to an analog signal*
   Ideal for process control solutions, the TTX Series provides the functionality to position a control valve by following an analog input signal. Therefore, it delivers precise valve control — which cannot be achieved by other electric, hydraulic, or pneumatic actuators.
4. *Velocity proportional to an analog signal*
   TTX Series actuators offer you the capability to control velocity with an analog signal.
5. *Force proportional to analog signal*
   Perfect for pressing applications, you can control force with an analog input while in force mode.

Selectable Input Functions

• Enable • Execute Move (0-15) • Dedicated Position • Jog+
• Jog- • Jog Fast • Home • Extend Switch • Retract Switch
• Home Switch • Teach Enable • Teach Move (1-16)
• Select Move • Stop • Hold • Reset Faults
• Alternate Mode (allows you to switch between 2 operating modes)

Selectable Output Functions

• Enabled • Homed • Ready (Enabled and Homed)
• Fault • Warning • Fault or Warning Active
• Move (0-15) in Progress • Homing • Jogging
• Jogging+ • Jogging- • Motion • In Position
• At Home Position • At Move (0-15) • Position
• Stopped • Holding • In Current Limit • In Current Fold Back
• Above Rated Current • Home

Expert User Interface

Expert, the TTX user interface software, provides you with a simple way to select all aspects of configuration and control required to set up and operate a TTX Series actuator. Easy-to-use tabbed pages provide access to input all of the parameters necessary to successfully configure your motion application. ‘Application’ files give you a convenient way to store and redistribute configurations amongst multiple computers, and ‘Drive’ files allow the same configuration to be distributed to multiple TTX Series actuators. Motion setup, homing, teach mode, tuning parameters, jogging, I/O configurations, and local control are all accomplished with ease using Expert software.

Protocol Options

The standard communication protocol for Tritex is an RS485 connection using Modbus RTU. The Modbus protocol provides a simple and robust method to connect industrial electronic devices on the same network. The Expert software acts as a Modbus Master and the TTX Series acts as the Slave device, only responding to requests commanded through the software. The Expert software allows full access to commissioning, configuring, monitoring, and controlling the TTX Series.

In addition, the following protocol options are available by selecting the communication option boards. Exlar requires initial commissioning of a TTX Series actuator to be performed with the Modbus protocol.

Modbus TCP

Modbus TCP couples Modbus communication structure from Modbus RTU with EtherNet connectivity. The Modbus TCP option is fully supported by the Expert software and offers seamless commissioning, configuring, monitoring and controlling the Tritex II. Communication protocol DSP 301 is supported as well as DSP 402 supporting Profile Torque, Profile Velocity, Profile Position and Homing. Setup on the system is most easily achieved with the Expert software using the RS485 port. A Modbus mapping table allows you to map all of the parameters you wish to read and modify into a register bank of up to 100 registers. This allows a PLC program to perform a single read operation and a single write operation to all the parameters.

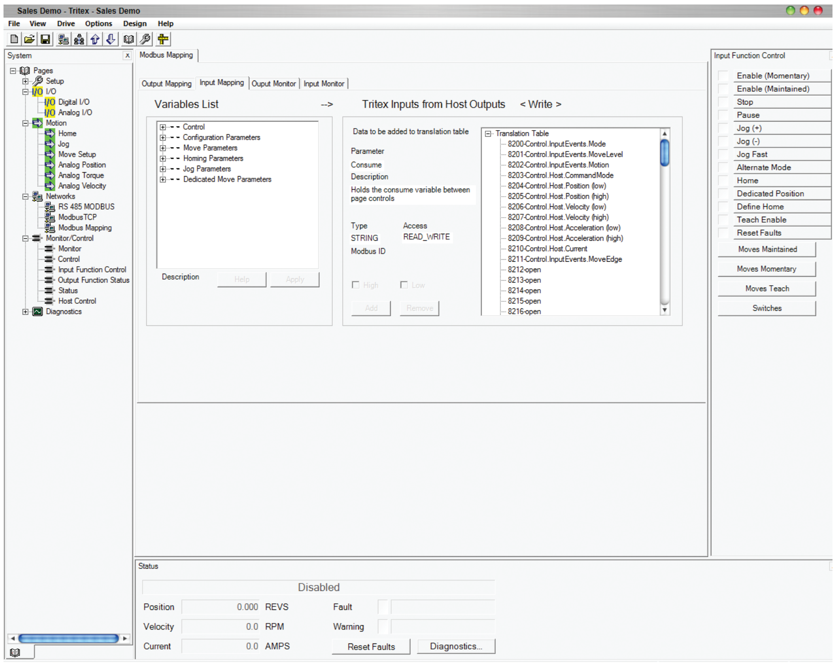
EtherNet/IP

EtherNet/IP allows you to change, monitor, and control the TTX through implicit or explicit messaging initiated from your Rockwell PLC. Tritex parameters are set up through the Expert software using a TTX Series parameter to EtherNet/IP parameter mapping table. Up to 100 input, and 100 output 16 bit registers can be mapped to TTX Series parameters.

PROFINET IO

PROFINET IO allows you to change, monitor and control the TTX Series from your Siemens PLC. Tritex parameters are set up through the Expert software using a TTX Series parameter to PROFINET IO parameter mapping table. Up to 100 input and 100 output, 16 bit registers can be mapped to TTX Series parameters.

Modbus Mapping Screen



EXLAR®

Motion Setup

Exlar configuration provides several templates for various applications. These can serve as your configuration, or as a starting point for your configuration. You can also begin by selecting configuration details specific to your application. At the click of a button, you can configure a move to position, move to switch, or move to force motion. TTX Series products offer absolute and incremental motion, as well as moves ending on a condition, such as a specific force or torque.

Control Page

The Expert control page gives you the ability to initiate all motion functions from one simple screen. This screen provides you with very easy system start-up and testing, without all the inconvenience of machine wiring.

The control page offers the capability to enable and disable the drive, and perform fast and slow jogs. This gives you the ability to verify motion, before needing any I/O wiring.

Monitoring and Diagnostics

All input functions can be monitored and activated from the Expert monitor page, and all output functions can be monitored. Critical fault and status data is available as a separate page, or as a fixed window on the bottom of each page of the software.

Configuring I/O

A drop down menu allows all I/O to be set up in a matter of minutes. Inputs can be configured to be maintained or momentary, depending on the application requirements. Input and output logic can be inverted with a single click.

Scope

The Expert Software includes a four-channel digital oscilloscope feature.

You can select up to four Tritex drive parameters to be monitored simultaneously.

For high speed requirements, the data can be captured in the drive's memory at an adjustable rate, down to 100 micro seconds, and then uploaded for plotting. The plots can be saved or printed, and the captured data can be saved as a comma separated file for further analysis with Excel.

Homing

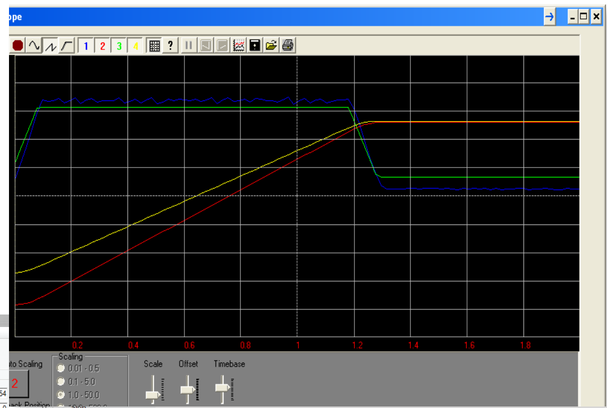
You can home to an input, by using a proximity or limit switch, or home to a specific force or torque.

Homing to a force or torque is ideal for setting up applications that require motion referenced to a hard stop, like the closed position of a valve, or the final position of a press.

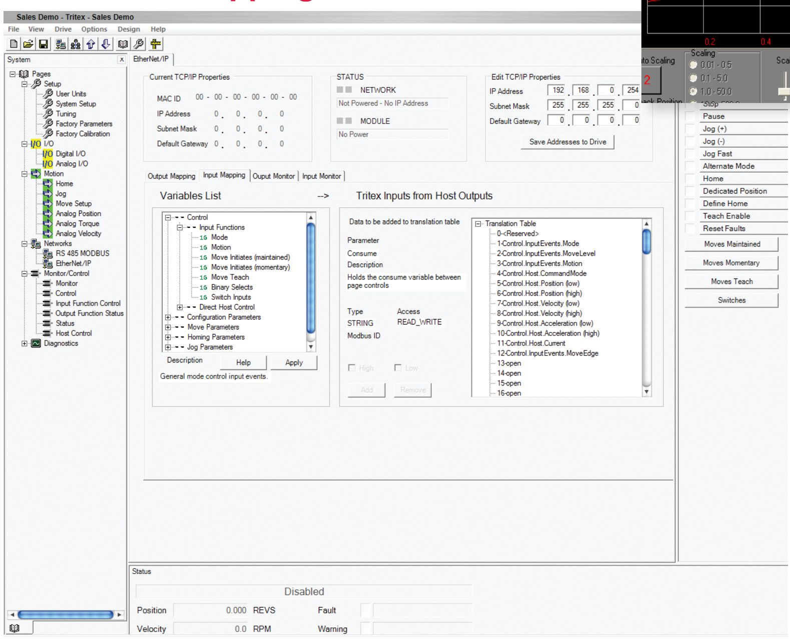
Teach Mode

In this mode, you can jog the actuator to the desired position, and activate an input. Alternatively, you can click a button in the Expert software and the current position of the actuator becomes the defined distance or absolute position associated with a particular move command.

Scope



EtherNet IP Mapping Screen



Process Control Functionality

Precise valve and damper control are perfect applications for TTX Series actuators. They outperform other electric, hydraulic and pneumatic actuators by providing small hysteresis and dead band, quick response to small signal changes, and stable dynamic responses. Fully programmable to follow an analog or digital signal representing either position or force, the TTX Series linear actuator is well suited for control valve applications with thrust requirements up to 4404 N.

Additionally, TTX Series actuators can be mounted on any valve from any manufacturer giving you maximum flexibility.

Benefits for Process Control Applications

Extreme Accuracy

The Exlar actuators stroke the valve based on position, not air or oil pressure. Accuracy and repeatability are better than 0 .1%.

100% Duty Cycle

A roller screw provides a unique way of converting rotary motor motion to a linear force, and offers full modulation capability. Life is measured in hundreds of million strokes vs. thousands like typical electric actuators.

Built in Positioner

TTX Series actuators include a built in positioner with a 4-20 mA or digital signal to tell you the exact stroke position. An analog output is also available.

Flexibility

These actuators include digital I/O and analog control. This provides the user with options for additional control such as emergency stop, +/- jog, or various diagnostic conditions.

Low Power Consumption

The TTX Series actuator only uses the current needed for a given force. This extreme efficiency makes it suitable for use with solar panels and batteries.

Fast Response and Stroke Speeds

Most other electric actuators are known for being slow—a major disadvantage. TTX Series response rate is measured in milliseconds. Stoke speeds can be up to 762 mm/sec.

Hydraulic Replacement

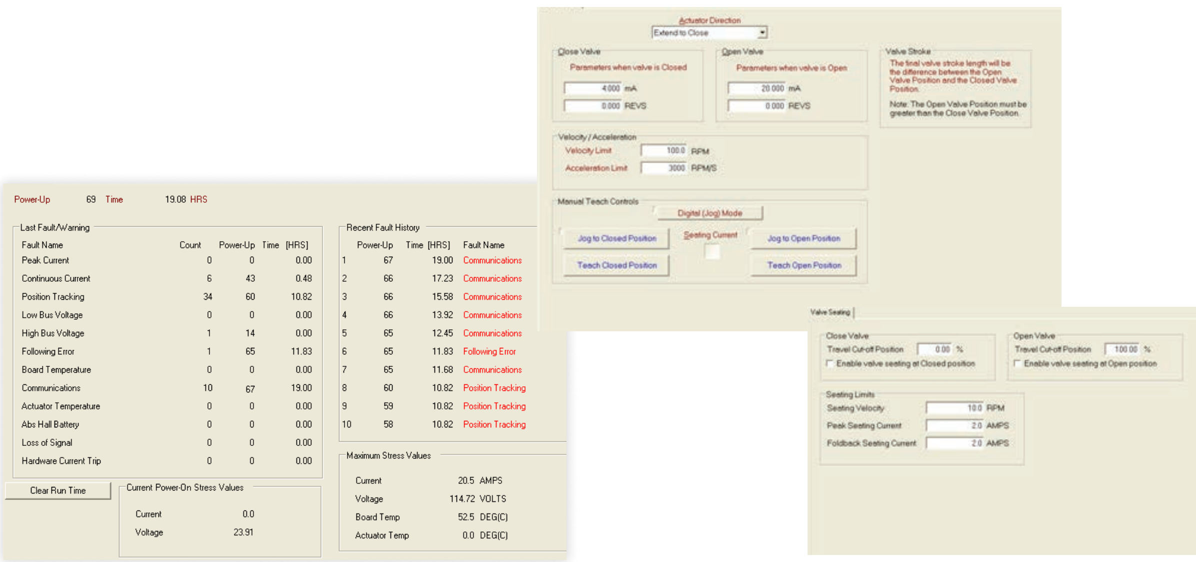
Tritex actuators have the same capabilities as a hydraulic equivalent, but without the cost or maintenance issues. High force, fast speeds and precise movements make it a superior substitute for hydraulic applications.

Absolute Feedback

The absolute feedback option gives the actuator memory after teaching the valve limits. So upon power loss, the battery backup will maintain the valve limits.

Diagnostics

All inputs and outputs can be monitored including position, temperature, current, and many more. An oscilloscope feature allows you to select up to four parameters to be monitored simultaneously. The data can be captured in the drive's memory at an adjustable rate, down to 100 micro sec, and then uploaded for plotting.



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TTX Series Agency Approval

Shown below are additional agency approvals applied to TTX Series Actuators.

Agency Standards & Approvals			
		TTX-AC Models	TTX-DC Models
UL		UL 1004-1	N/A
		UL 1004-3	
		UL 1004-6	
		UL 508C (TTX080 PCB)	
		UL 61800-5-1 (TTX100 PCB)	
CSA		CSA C22.2 NO. 77	N/A
		CSA C22.2 NO. 100	
		CSA C22.2 NO. 274 (PCB)	
CE	EMC	EN 61800-3	EN 61800-3
	Safety	EN 61800-5-1	N/A
	RoHS	RoHS 2011/65/EU	RoHS 2011/65/EU
Vibration	Qual. Test Only	2.5 grms; 5 to 500 Hz	5.0 grms; 5 to 500 Hz
ODVA		Ethernet IP	Ethernet IP
PROFINET			Profinet IO

TTX Series (AC Power)

No Compromising on Power, Performance or Reliability

With forces up to almost 6,000 N (1,350 lbf) continuous and and speeds to 635 mm/sec (25 in/sec), the AC TTX Series linear actuators also offer a benefit that no other integrated product offers: POWER! No longer are you limited to trivial amounts of force, or speeds so slow that many motion applications are not possible. The TTX Series with AC power electronics operates with maximum reliability over a broad range of ambient temperatures: O˚C to +65˚C. The AC powered TTX Series actuators contain a 1.5 kW servo amplifier and a very capable motion controller. With standard features such as analog following for position, compound moves, move chaining, and individual force/torque control for each move, the TTX Series is the ideal solution for most motion applications.

TTX Series Models

- TTX Series high mechanical capacity actuator, 80 mm

Power Requirements

- AC Power 100V - 230V, +/- 10%, single phase
- Built-in AC line filter
- Connections for external braking resistor

Feedback

- Absolute Feedback (analog hall with multi-turn, battery backup)

Connectivity

- Internal terminals acessible through removable cover
- M23 connectors
- M8 connector for RS485
- M12 connector for Ethernet options

TTX Linear
AC Actuator

TTX Series (DC Power)

Linear Actuators

No Compromising on Power, Performance or Reliability
With forces up to approximately 3879 N (872 lbf) continuous and speeds up to 508 mm/sec (20 in/sec). The DC TTX Series linear actuators also offer a benefit that no other integrated product offers: POWER! No longer are you limited to trivial amounts of force, or speeds so slow that many motion applications are not possible. The new TTX Series with DC power electronics operates with maximum reliability over a large temperature range: 0˚C to +65˚C. The DC powered TTX Series actuators contain a 750 W servo amplifier and a very capable motion controller. With standard features such as analog following for position, compound moves, move chaining, and individual force/torque control for each move, the TTX Series is the ideal solution for most motion applications.

TTX Series Models

- TTX Series high mechanical capacity actuator, 80 mm

Power Requirements

- DC Power 12-48 VDC nominal
- Connections for external braking resistor

Feedback

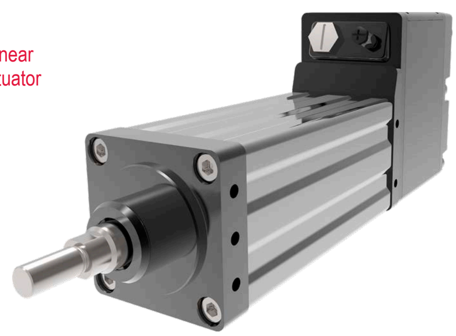
- Absolute Feedback (analog hall with multi-turn, battery backup)

Connectivity

- Internal terminals accessible through removable cover
- M23 connectors
- M8 connector for RS485
- M12 connector for EtherNet options

Operating Conditions and Usage for AC and DC Units		
Accuracy:		
Screw Lead Error	μm / 300 mm	25
	in/ft	0.001
Screw Travel Variation	μm / 300 mm	30
	in/ft	0.0012
Standard Ambient Temperature*	°C	0 to 65
	°F	32 to 149
IP Rating		IP66S
Friction Torque (typical)	Frame Size	080
	(Nm)	0.23

TTX Linear
DC Actuator



Communications & I/O

All models include digital IO and an isolated RS485 communication port. Digital I/O is isolated from other channels as a group, with all channels referenced to the negative side of the I/O supply.

The IO count and type vary with the actuator model and option module selected.

TTX AC and DC I/O

	SIO, EIP, PIO, TCP	IA4
Digital inputs	8	4
Digital outputs	4	3
Analog input, voltage	1	0
Analog output, voltage	1	0
Analog input 4-20mA	0	1
Analog output 4-20mA	0	1

Digital Inputs:
10 to 30 VDC Opto-isolated but common return

Digital Outputs:
30 VDC maximum
Opto-isolated but common supply & return
100 mA continuous output Isolated

SIO
Analog Input (Voltage):
+/-10 Vdc Range
13 bit resolution over full range
May be assigned to control Position, Velocity, Torque, or Velocity Override.

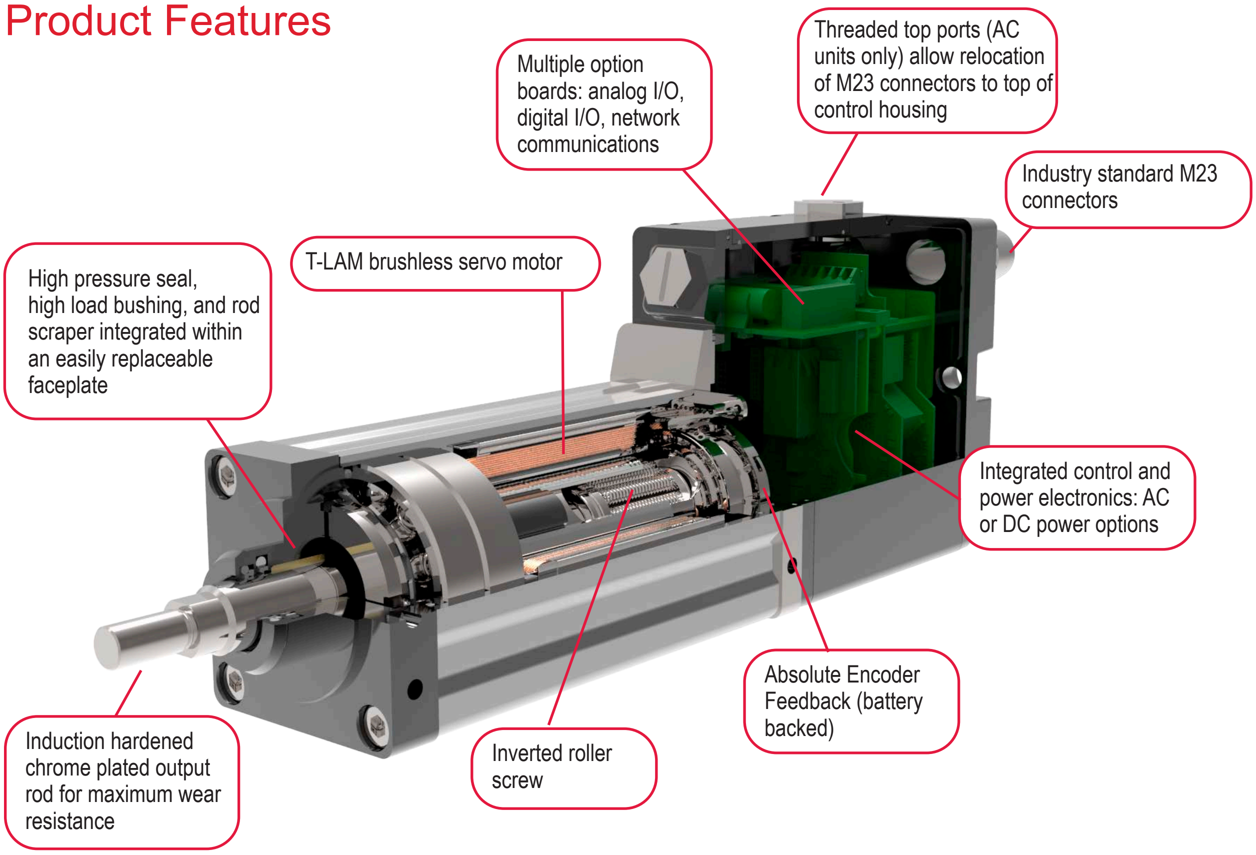
Analog Output (Voltage):
0 -10 Vdc Range
11 bit resolution over full range
May be assigned to monitor one of many internal parametes.

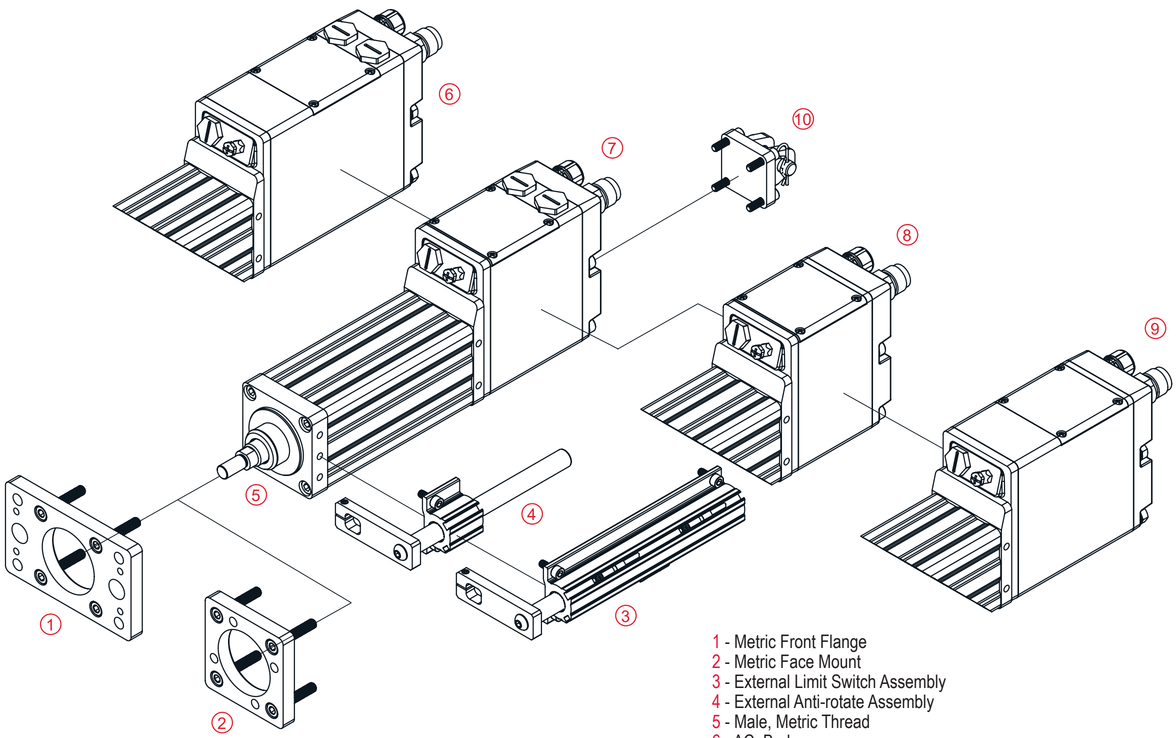
IA4
Analog Input (4-20 mA):
16 bit resolution Isolated
Assignable to Position, Velocity, or Torque command

Analog Output (4-20 mA):
12 bit resolution
Assignable to Position, Velocity, Current, Temperature, etc

Standard Communications:
1 RS485 port opto-isolated, for programming, controlling and monitoring. Uses Modbus RTU protocol

Product Features





1 - Metric Front Flange
2 - Metric Face Mount
3 - External Limit Switch Assembly
4 - External Anti-rotate Assembly
5 - Male, Metric Thread
6 - AC, Brake
7 - AC, No Brake
8 - DC, No Brake
9 - DC, Brake
10 - Metric Rear Clevis

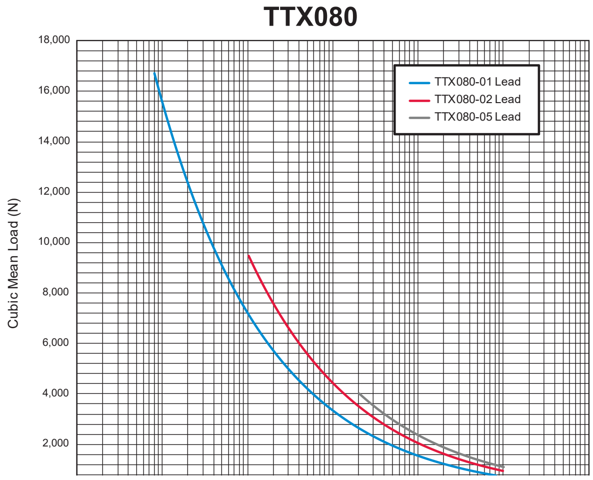
Mechanical Specifications

TTX080

	Stroke mm (in)	Screw Lead mm (in)	Continuous Force Rating N (lbf)		Peak Force Rating N (lbf)		Max Velocity mm/s (in/s)		Dynamic Load Rating N (lbf)	Armature Inertia kg-m^2 (in-lb-s^2)	Maximum Continuous Input Current	
			4 (VAC)	D (VDC)	4 (VAC)	D (VDC)	4 (VAC)	D (VDC)			4 (VAC) (A-RMS)	D (VDC) (A-DC)
TTX080-100-01	100 (3.9)	2.54 (0.1)	5,897 (1,326)	4,970 (1,117)	11,794 (2,651)	8,946 (2,011)	127 (5.0)	102 (4.0)	24,535 (5,516)	0.000340 (0.003013)	4.1	18.0
TTX080-100-02		5.08 (0.2)	3,342 (751)	2,816 (633)	6,683 (1,502)	5,069 (1,140)	254 (10.0)	203 (8.0)	25,798 (5,800)			
TTX080-100-05		12.7 (0.5)	1,415 (318)	1,193 (268)	2,830 (636)	2,147 (483)	635 (25.0)	508 (20.0)	21,795 (4,900)			
TTX080-150-01	150 (5.9)	2.54 (0.1)	5,897 (1,326)	4,970 (1,117)	11,794 (2,651)	8,946 (2,011)	127 (5.0)	102 (4.0)	24,535 (5,516)	0.000369 (0.003267)		
TTX080-150-02		5.08 (0.2)	3,342 (751)	2,816 (633)	6,683 (1,502)	5,069 (1,140)	254 (10.0)	203 (8.0)	25,798 (5,800)			
TTX080-150-05		12.7 (0.5)	1,415 (318)	1,193 (268)	2,830 (636)	2,147 (483)	635 (25.0)	508 (20.0)	21,795 (4,900)			
TTX080-300-01	300 (11.8)	2.54 (0.1)	5,897 (1,326)	4,970 (1,117)	11,794 (2,651)	8,946 (2,011)	127 (5.0)	102 (4.0)	24,535 (5,516)	0.000455 (0.004029)		
TTX080-300-02		5.08 (0.2)	3,342 (751)	2,816 (633)	6,683 (1,502)	5,069 (1,140)	254 (10.0)	203 (8.0)	25,798 (5,800)			
TTX080-300-05		12.7 (0.5)	1,415 (318)	1,193 (268)	2,830 (636)	2,147 (483)	635 (25.0)	508 (20.0)	21,795 (4,900)			
TTX080-450-01	450 (17.7)	2.54 (0.1)	5,897 (1,326)	4,970 (1,117)	11,794 (2,651)	8,946 (2,011)	127 (5.0)	102 (4.0)	24,535 (5,516)	0.000541 (0.004790)		
TTX080-450-02		5.08 (0.2)	3,342 (751)	2,816 (633)	6,683 (1,502)	5,069 (1,140)	254 (10.0)	203 (8.0)	25,798 (5,800)			
TTX080-450-05		12.7 (0.5)	1,415 (318)	1,193 (268)	2,830 (636)	2,147 (483)	635 (25.0)	508 (20.0)	21,795 (4,900)			

Specifications subject to change without notice.
Test data derived using NEMA recommended aluminum heatsink 10" x 10" x 3/8" at 25°C ambient.
Maximum velocities listed at maximum voltages

Estimated Service Life



Service Life Estimate Assumptions:

- Sufficient quality and quantity of lubrication is maintained throughout service life (please refer to the engineering reference section for lubrication interval estimates.)
- Bearing and screw temperature between 20° C and 40° C
- No mechanical hard stops (external or internal) or impact loads
- No external side loads
- Does not apply to short stroke, high frequency applications such as fatigue testing or short stroke, high force applications such as pressing. (For information on calculating estimating life for unique applications please refer to the engineering reference section.)

The L_{10} expected life of a roller screw linear actuator is expressed as the linear travel distance that 90% of properly maintained roller screws are expected to meet or exceed. For higher than 90% reliability, the result should be multiplied by the following factors: 95% x 0.62; 96% x 0.53; 97% x 0.44; 98% x 0.33; 99% x 0.21. This is not a guarantee; these charts should be used for estimation purposes only.

The underlying formula that defines this value is:
Travel life in millions of inches, where:

C_a = Dynamic load rating (lbf)
F_{cml} = Cubic mean applied load (lbf)
ℓ = Roller screw lead (inches)

$$L_{10} = \left(\frac{C_a}{F_{cml}}\right)^3 \times \ell$$

For additional details on calculating estimated service life, please refer www.exlar.com.

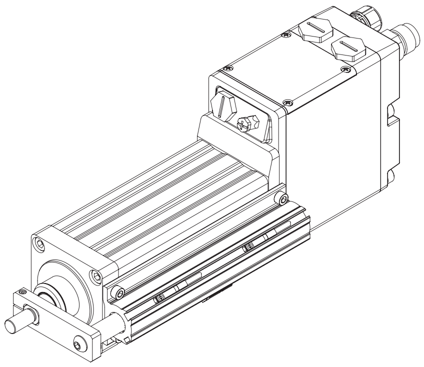
Accessories

Internal Holding Brake

This option provides an internal holding brake. The brake is spring activated and electrically released.

External Anti-rotate Assembly

This option provides a rod and bushing to restrict the actuator rod from rotating when the load is not held by another method. Shorter actuators have single sided anti-rotation attachments. Longer lengths require attachments on both sides for proper operation.



Description	Weight kg (lb)
TTX080-100	5.5 (12.2)
TTX080-150	6.2 (13.5)
TTX080-300	8.0 (17.6)
TTX080-450	9.8 (21.6)
Brake Adder	1.1 (2.5)
Front Flange (1)	1.0 (2.2)
Tapped Face (3)	0.6 (1.2)
Rear Clevis (5)	0.4 (0.8)
Imperial Flange (F)	0.8 (1.8)
Imperial Clevis (C)	0.8 (1.7)
Anti Rotate (100 mm stroke)	0.5 (1.1)
Anti Rotate (150 mm stroke)	0.6 (1.3)
Anti Rotate (300 mm stroke)	0.8 (1.8)
Anti Rotate (450 mm stroke)	1.1 (2.4)
Limit Switch Assembly (100 mm stroke)	0.9 (1.9)
Limit Switch Assembly (150 mm stroke)	1.0 (2.3)
Limit Switch Assembly (300 mm stroke)	1.6 (3.5)
Limit Switch Assembly (450 mm stroke)	2.1 (4.7)

TTX Brake Speccifications		
Brake Holding Torque (minimum)	Nm	4.5
	lbf-in	40
Brake Voltage	VDC	24 (-10%/+6%)
Nominal Brake Current at 24 VDC	A	0.5
Brake Engage/Disengage Time (typical)	ms	18/35

Speed vs. Force Curves

Temperature Derating

The speed/torque curves are based on 25° C ambient conditions. The actuators may be operated at ambient temperatures up to 85° C.

Elevated Ambient Temp Factor (%) =

$$100\% \times \sqrt{\frac{\text{Max Rated Temp [~130° C] - Environment Temp [in °C]}}{\text{Max Rated Temp [~130° C] - Rated Ambient [~25° C]}}} =$$

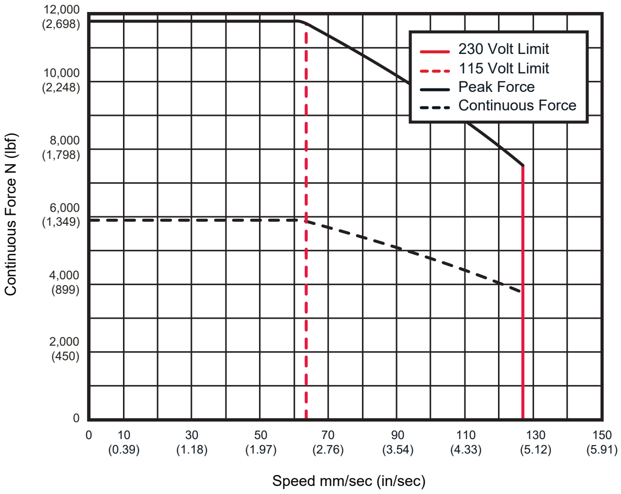
$$100\% \times \sqrt{\frac{\text{130° C - Environment Temp}}{\text{105° C}}}$$

= % of published continuous @ 25° C

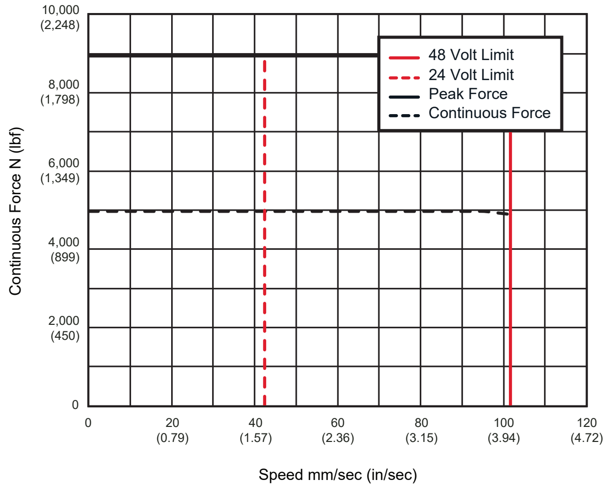
AC Voltage

DC Voltage

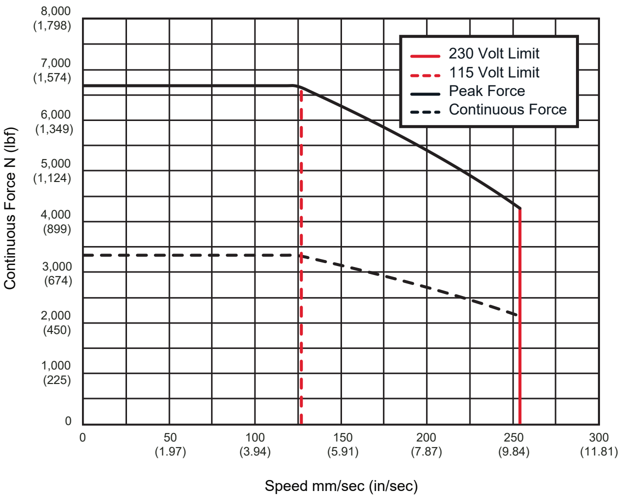
TTX080 (0.1 In Lead) — AC Voltage



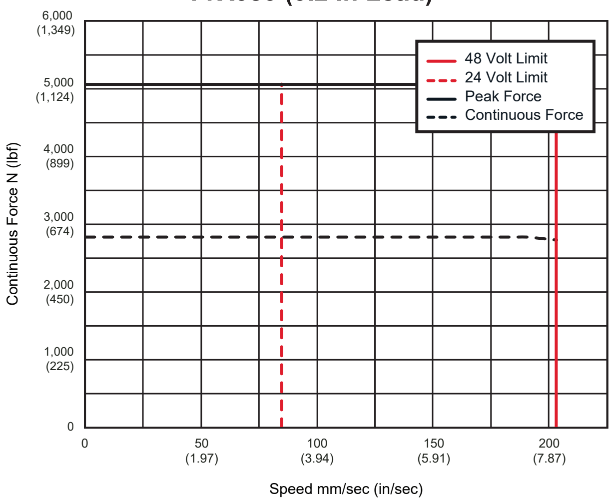
TTX080 (0.1 In Lead) — DC Voltage



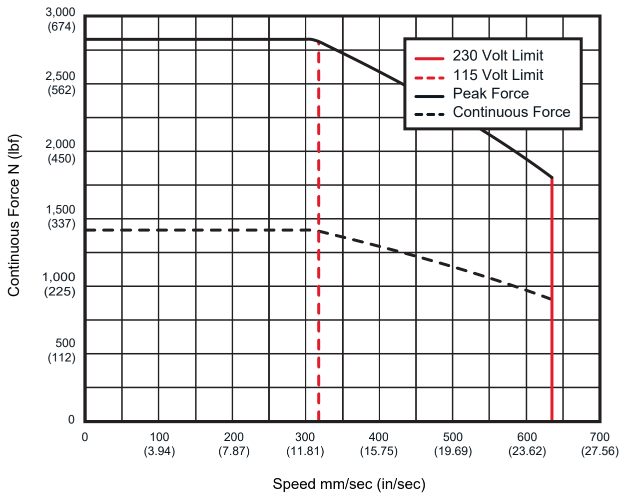
TTX080 (0.2 In Lead) — AC Voltage



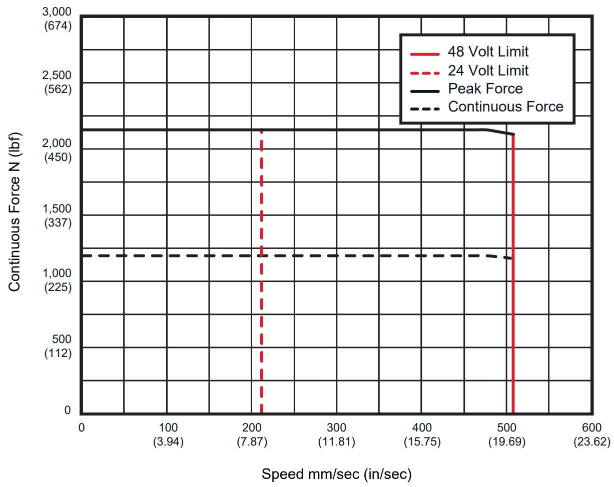
TTX080 (0.2 In Lead) — DC Voltage



TTX080 (0.5 In Lead) — AC Voltage



TTX080 (0.5 In Lead) — DC Voltage

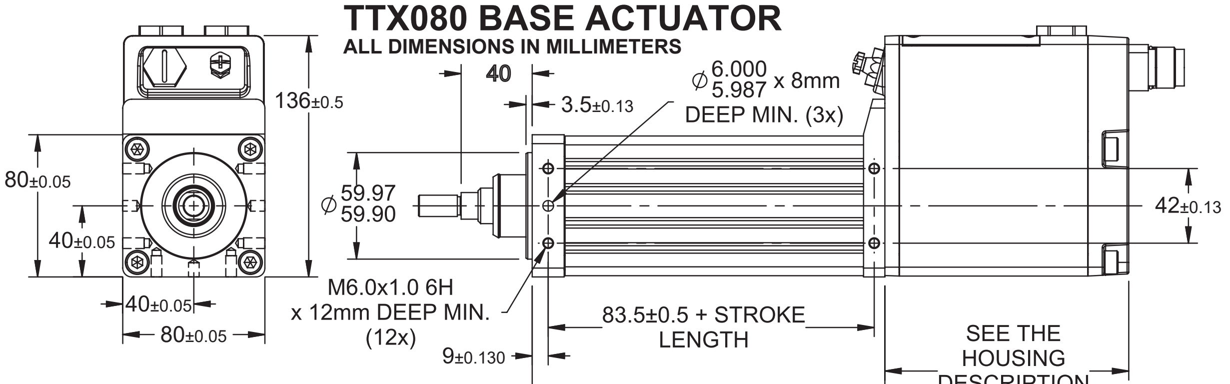


*Test data derived using NEMA recommended aluminum heatsink 10" x 10" x 3/8" at 25°C ambient.

Dimensions

AC and DC Base Actuator

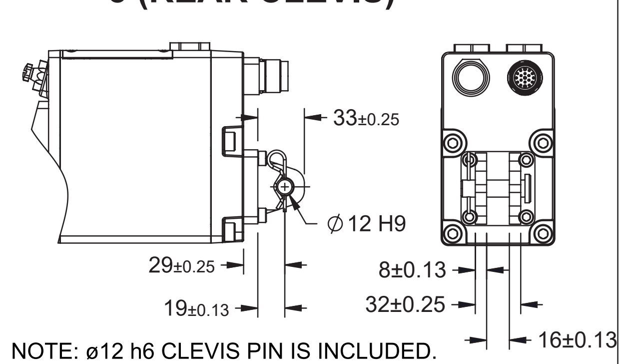
TTX080 BASE ACTUATOR



HOUSING DESCRIPTION	LENGTH
AC HOUSING	137.3 ±0.5
AC HOUSING WITH BRAKE	185 ±0.5
DC HOUSING	116.5 ±0.5
DC HOUSING WITH BRAKE	164.3 ±0.5

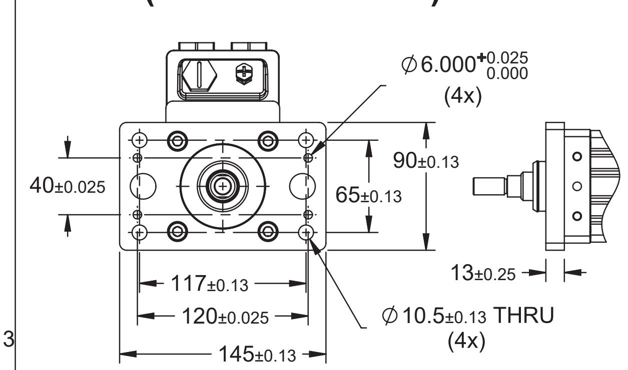
NOTE: ADD 40mm TO THE OVERALL LENGTH IF ORDERING A BRAKE. THE SIDE MOUNT DISTANCE IS NOT AFFECTED.

5 (REAR CLEVIS)

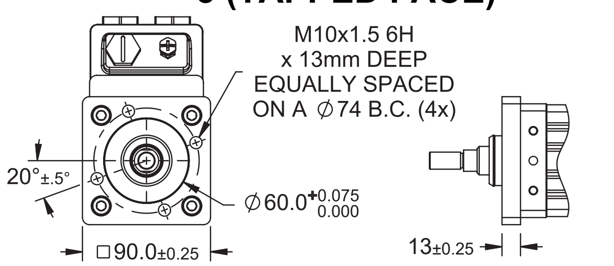


NOTE: ø12 h6 CLEVIS PIN IS INCLUDED.

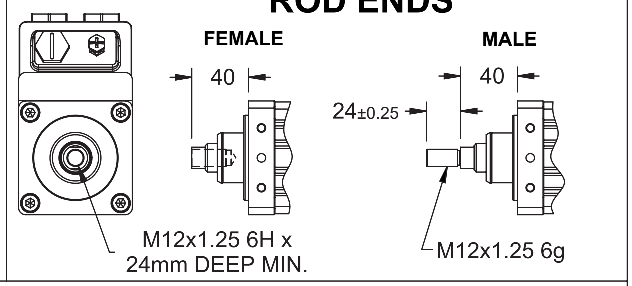
1 (FRONT FLANGE)



3 (TAPPED FACE)

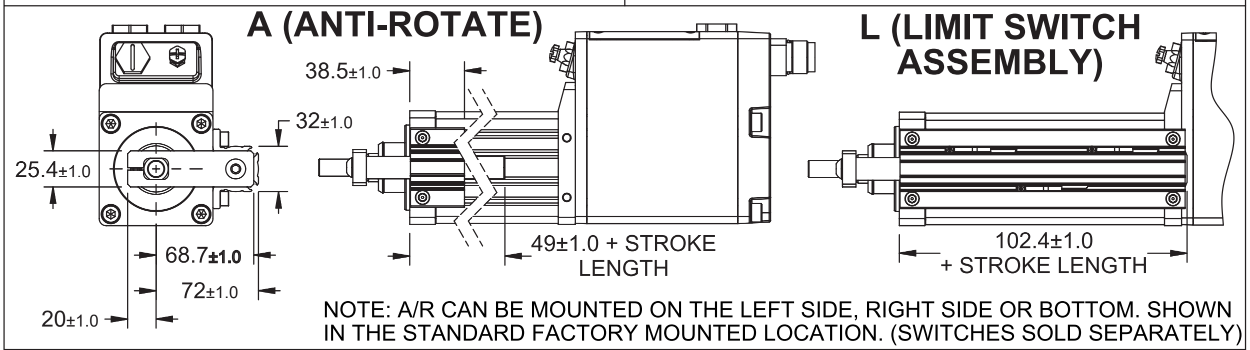


ROD ENDS



A (ANTI-ROTATE)

L (LIMIT SWITCH ASSEMBLY)



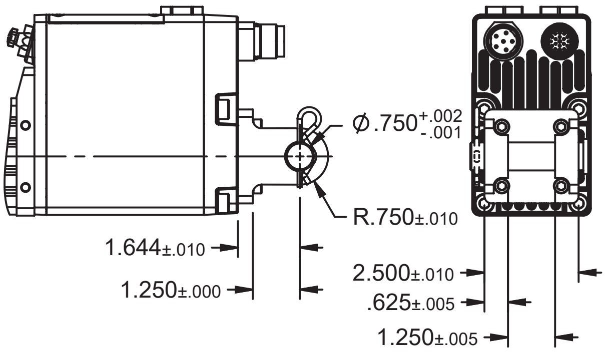
NOTE: A/R CAN BE MOUNTED ON THE LEFT SIDE, RIGHT SIDE OR BOTTOM. SHOWN IN THE STANDARD FACTORY MOUNTED LOCATION. (SWITCHES SOLD SEPARATELY)

Pre-sale drawings and models are representative and are subject to change. Visit exlar.com to download a 3D model of your desired configuration.

TTX080 IMPERIAL OPTIONS

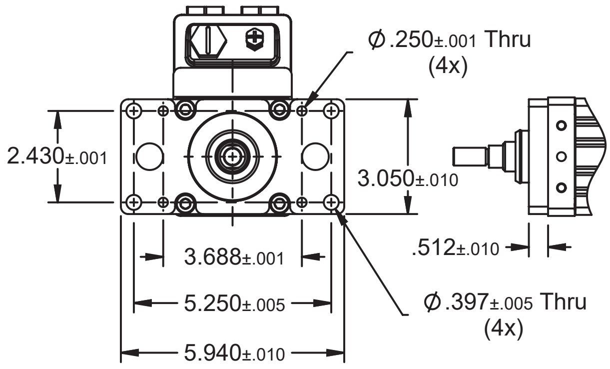
ALL DIMENSIONS IN INCHES

C (GSX30 REAR CLEVIS)

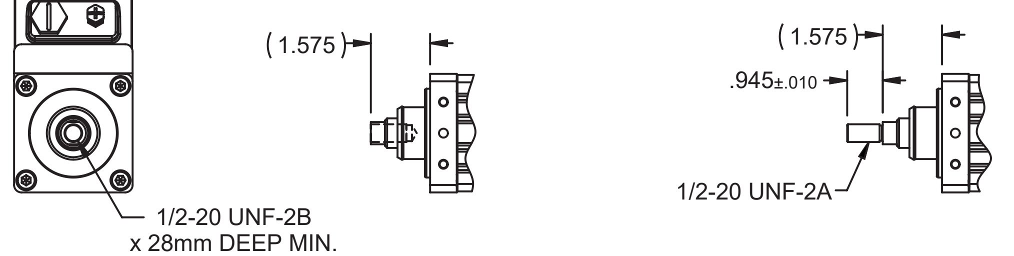


NOTE: ø0.746/ø0.741 CLEVIS PIN IS INCLUDED.

F (GSX30 FRONT FLANGE)

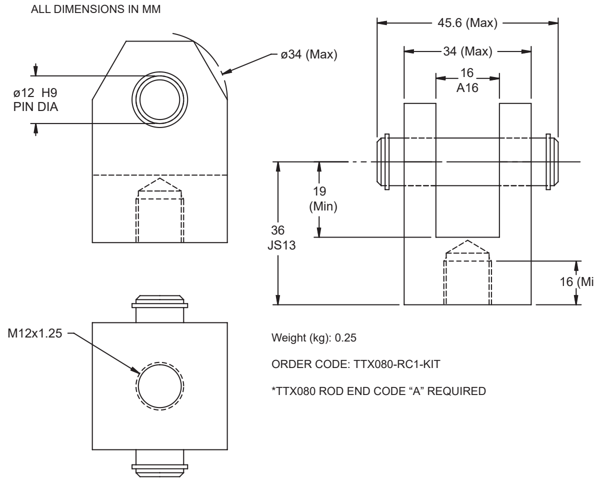


ROD ENDS



ROD CLEVIS

ALL DIMENSIONS IN MM



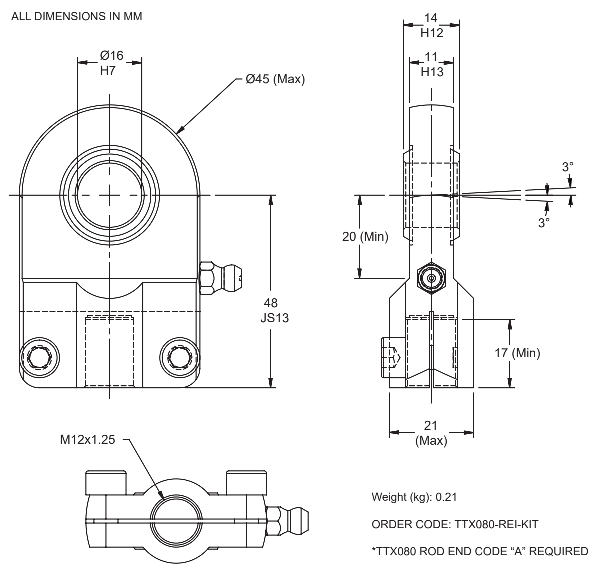
Weight (kg): 0.25

ORDER CODE: TTX080-RC1-KIT

*TTX080 ROD END CODE "A" REQUIRED

SPHERICAL ROD EYE

ALL DIMENSIONS IN MM



Weight (kg): 0.21

ORDER CODE: TTX080-REI-KIT

*TTX080 ROD END CODE "A" REQUIRED

Cables and Accessories

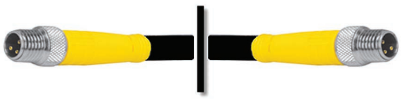
TTX Series Cables & Accessories	Part No.
"I" Connection	
Power cables, molded M23 style connector, 8 pin, xxx = length in feet. Standard lengths 15, 25, 50 feet (DC Stator)	CBL-TTIPC-SMI-xxx
Power cable with M23 6 pin xxx = Length in feet, std lengths 15, 25, 50, 75, 100 (AC Stator)	CBL-T2IPC-SMI-xxx
I/O cables, molded M23 style connector, 19 pin, xx = length in feet. Standard lengths 15, 25, 50 feet	CBL-TTIOC-SMI-xxx
Communications Accessories - RECOMMENDED PC COMMUNCIATIONS CABLE	
PC to TTX Communications cable-USB/RS485 to M8 connector, 6 feet	CBL-T2USB485-M8-006
PC to TTX Communications cable-USB/RS485 to M8 connector, 15 feet	CBL-T2USB485-M8-015
Multi-Drop RS485 Accessories	
RS485 splitter - M8 Pin plug to double M8 Socket receptacle	TT485SP
Multidrop Communications Cable for use with TT485SP, 6 feet	CBL-TTDAS-006
Multidrop Communications Cable for use with TT485SP, 15 feet	CBL-TTDAS-015
Multi-Purpose Communications Accessories	
Communication cable, PICO type connector, 4 pin, xxx = length in meters, Standard lengths 4.572, 7.62, 15.24 meters	CBL-TTCOM-xxx

CBL-T2USB485-M8-006 or 015
Our recommended communications cable.
No special drivers or setup required for use with MS Windows™.

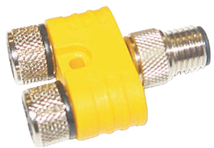
CBL-TTIOC-SMI-xxx

CBL-TTIPC-SMI-xxx / CBL-T2IPC-SMI-xxx

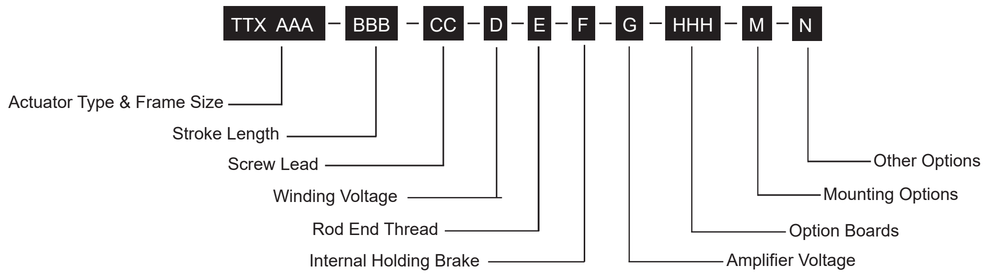
CBL-TTCOM-xxx
Use with CBL-T2USB485-xxx for long cable runs.



CBL-TTDAS-006 or 015
For use with TT485SP for multi-drop applications.



TT485SP
RS485 communications splitter.
Use to daisy-chainmultiple TTX actuators.



Actuator Type
TTX = Integrated Drive / Motor / Actuator

AAA = Actuator Frame Size
080 = 80 mm (3.15 in)

BBB = Stroke Length
100 = 100 mm
150 = 150 mm
300 = 300 mm
450 = 450 mm

CC =Screw Lead
01 = 0.10 in (2.54 mm)
02 = 0.20 in (5.08 mm)
05 = 0.50 in (12.7 mm)

D = Winding Voltage
4 = 230 VAC Max
D = 48 VDC Max

E = Rod End Thread
A = Male Metric
B = Female Metric[2]
M = Male, English)[2]
F = Female, English[2]

F = Internal Holding Brake
N = No Brake
B = Internal Holding Brake, Electrically Released

G = Amplifier Voltage
A = 200 VAC Class
D = 48 VDC Class

HHH = Option Boards
SIO = Standard I/O Interconnect
IA4 = 4-20 mA Analog I/O
EIP = SIO plus Ethernet/IP w/M12 connector
PIO = SIO plus Profinet IO w/M12 connector
TCP = SIO plus Modbus TCP w/M12 connector

M = Mounting Options
N = None
1 = Front Flange, Metric
3 = Tapped Face, Metric
5 = Rear Clevis, Metric
F = Front Flange, English[2]
C = Rear Clevis, English[2]

N = Accessory Options
N = None
A = Anti-Rotate Assembly
L = Limit Switch Housing / Anti-Rotate Assembly[1]

[1]Switches sold separately
[2]Available option. May add lead time.

For options or specials not listed above or for extended temperature operation, please contact Exlar

FTX Series

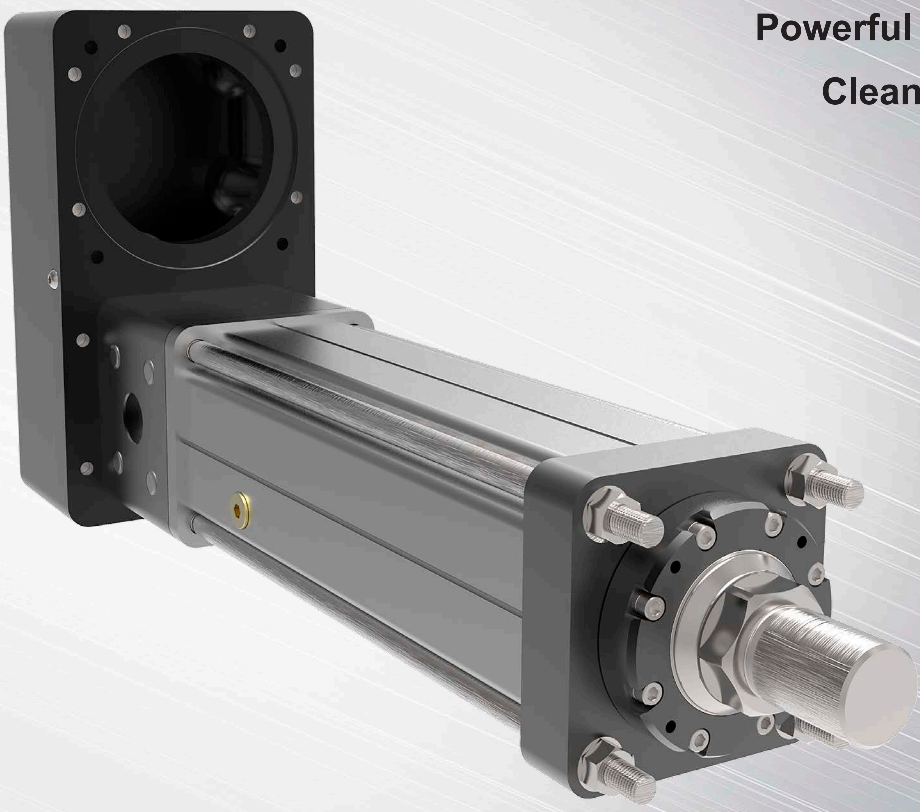
HIGH FORCE ACTUATOR

Hydraulic cylinder replacement

Rugged and reliable

Powerful and compact

Clean and efficient



FTX Series

High Force Actuators

Hydraulic Cylinder Replacement

Hydraulic cylinders provide long life and high force in a small package size. The FTX Series high force electric actuators were designed specifically to allow migration from traditional hydraulic actuation to electric. Based on planetary roller screw technology, the FTX offers life and force density not attainable with more common ball screw based electric actuators. With up to 15X the life and 2X the force density, the roller screw based FTX is the right choice when migrating from hydraulic to electric actuation.

Rugged and Reliable

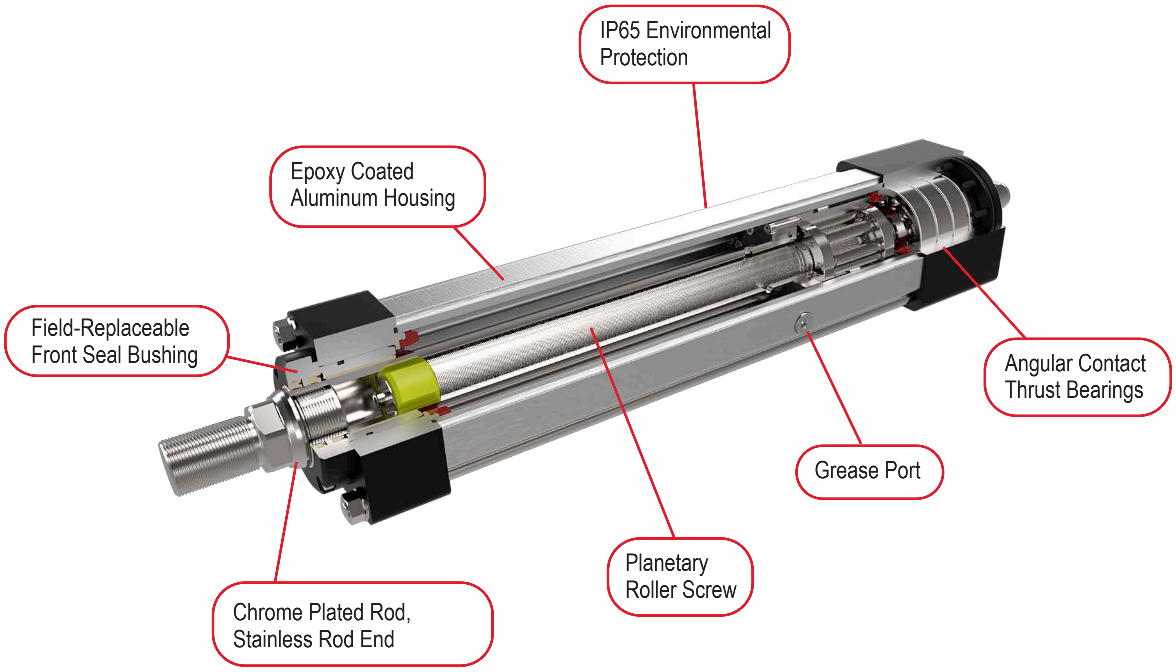
Hydraulic cylinders are commonly installed in harsh industrial settings. Therefore all FTX Series models are environmentally sealed to IP65. In addition, its planetary roller screw mechanism withstands significantly higher shock loads than weaker ball screw alternatives. Migrate to electric with confidence knowing the FTX Series is every bit as rugged and reliable as the hydraulics they are designed to replace.

Minimal Maintenance

More and more machine builders are looking to eliminate the mess and downtime associated with hydraulic fluid leaks. Electric actuation not only eliminates the problems associated with fluid leaks, it offers significantly higher levels of performance and flexibility than is possible even with servo-hydraulic solutions. FTX Series roller screw actuators allow machine builders to meet the ever-increasing performance demands of their customers while minimizing or eliminating the maintenance issues associated with traditional hydraulic solutions.

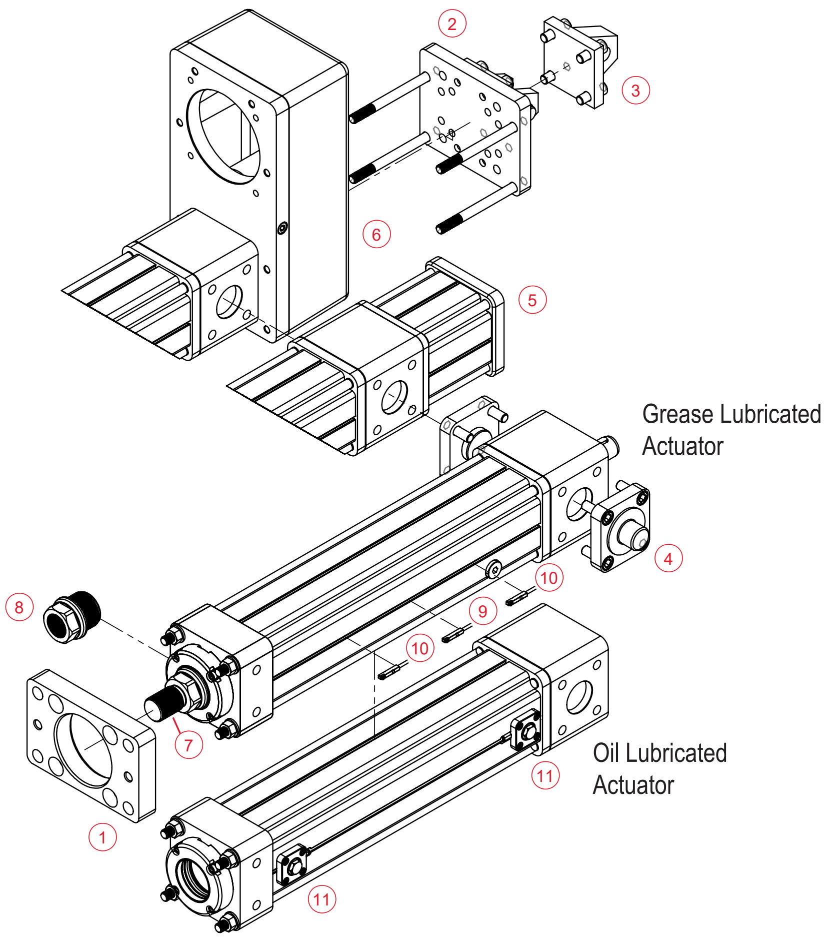
Operating Conditions and Usage		
Accuracy:		
Screw Travel Variation	mm (in)	0.030 (0.0012)
Screw Lead Error	mm/300 mm (in/ft)	0.025 (0.001)
Screw Lead Backlash	mm (in)	0.06 (0.002)
Ambient Conditions:		
Standard Ambient Temperature	°C	0° to 85°
IP Rating		IP65S

Product Features



1 - Front flange
2 - Rear clevis
3 - Rear eye
4 - Rear trunnion
5 - Inline direct drive
6 - Parallel, 1:1 belt reduction
Parallel, 2:1 belt reduction
7 - Male, metric thread
8 - Female, metric thread
9 - External limit switch - N.O., PNP or NPN*
10 - External limit switch - N.C., PNP or NPN*
11 - Oil ports

*Ordered Separately



Mechanical Specifications

FTX095

		05	10	20
Screw Lead	mm	5	10	20
	in	0.197	0.394	0.787
Maximum Force	kN	22.2	22.2	22.2
	lbf	5,000	5,000	5,000
Life at Maximum Force	km	392	626	1440
	in x 10^6	15.4	24.6	56.7
C_a (Dynamic Load Rating)	kN	95.2	88.3	92.5
	lbf	21,400	19,850	20,800
Maximum Input Torque	Nm	22.1	44.3	88.5
	lbf-in	196	392	783
Max Rated RPM @ Input Shaft	RPM	4,500	4,500	4,500
Maximum Linear Speed @ Maximum Rated RPM	mm/sec	373	750	1,500
	in/sec	14.7	29.5	59.3
Friction Torque (Typical)	Nm	1.12	1.12	1.12
	lbf-in	10	10	10

Weights kg (lbs)

Base Actuator Weight (Zero Stroke)	kg	10
	lb	21
Actuator Weight Adder (Per 25 mm of stroke)	kg	0.39
	lb	0.87
Adder for Inline (excluding motor)	kg	2.9
	lb	6.5
Adder for Parallel Drive (excluding motor)	kg	13.1
	lb	28.9
Adder for Front Flange	kg	1.9
	lb	4.2
Adder for Rear Clevis	kg	5.3
	lb	11.7
Adder for Rear Eye	kg	5.1
	lb	11.3
Adder for Rear Trunnion	kg	1.9
	lb	4.3

Base Unit Inertia		Zero Stroke [kg-m² (lbf-in-sec²)]	Add per 25 mm [kg-m² (lbf-in-sec²)]
5 mm Lead		8.27×10^{-4} (7.32×10^{-3})	2.19×10^{-6} (1.94×10^{-5})
10 mm Lead		8.33×10^{-4} (7.37×10^{-3})	2.42×10^{-6} (2.14×10^{-5})
20 mm Lead		8.57×10^{-4} (7.58×10^{-3})	3.31×10^{-6} (2.93×10^{-5})
Inline Drive Inertia	**Inline Unit - w/Motor Coupling**	**Inline Unit - w/Motor Coupling For Gearbox Mount**	**Add per 25 mm**
5 mm Lead	9.27×10^{-4} (8.20×10^{-3})	1.09×10^{-3} (9.62×10^{-3})	2.19×10^{-6} (1.94×10^{-5})
10 mm Lead	9.33×10^{-4} (8.26×10^{-3})	1.09×10^{-3} (9.67×10^{-3})	2.42×10^{-6} (2.14×10^{-5})
20 mm Lead	9.57×10^{-4} (8.47×10^{-3})	1.12×10^{-3} (9.89×10^{-3})	3.31×10^{-6} (2.93×10^{-5})
Parallel Drive Inertia		**1:1 Reduction**	**2:1 Reduction**
5 mm Lead (zero stroke)		4.90×10^{-3} (4.34×10^{-2})	2.22×10^{-3} (1.97×10^{-2})
Add per 25 mm stroke		2.19×10^{-6} (1.94×10^{-5})	5.48×10^{-7} (4.85×10^{-6})
10 mm Lead (zero stroke)		4.91×10^{-3} (4.34×10^{-2})	2.23×10^{-3} (1.97×10^{-2})
Add per 25 mm stroke		2.42×10^{-6} (2.14×10^{-5})	6.04×10^{-7} (5.34×10^{-6})
20 mm Lead (zero stroke)		4.93×10^{-3} (4.37×10^{-2})	2.23×10^{-3} (1.98×10^{-2})
Add per 25 mm stroke		3.31×10^{-6} (2.93×10^{-5})	8.28×10^{-7} (7.33×10^{-6})

FTX125

		05	10
Screw Lead	mm	5	10
	in	0.197	0.394
Maximum Force	kN	44.5	44.5
	lbf	10,000	10,000
Life at Maximum Force	km	249.2	486.3
	in x 10^6	9.81	19.14
C_a (Dynamic Load Rating)	kN	163.7	162.4
	lbf	36,800	36,500
Maximum Input Torque	Nm	46.5	82.3
	lbf-in	412	728
Max Rated RPM @ Input Shaft	RPM	3,500	3,500
Maximum Linear Speed @ Maximum Rated RPM	mm/sec	292	583
	in/sec	11.5	23
Friction Torque (Typical)	Nm	2.23	2.23
	lbf-in	20	20

Weights kg (lbs)

Base Actuator Weight (Zero Stroke)	kg	21
	lb	47
Actuator Weight Adder (Per 25 mm of stroke)	kg	0.84
	lb	1.85
Adder for Inline (excluding motor)	kg	6.8
	lb	15.0
Adder for Parallel Drive (excluding motor)	kg	25.6
	lb	56.5
Adder for Front Flange	kg	3.6
	lb	7.9
Adder for Rear Clevis	kg	6.5
	lb	14.3
Adder for Rear Eye	kg	6.3
	lb	13.8
Adder for Rear Trunnion	kg	3.1
	lb	6.8

Base Unit Inertia		**Zero Stroke [kg-m² (lbf-in-sec²)]**	**Add per 25 mm [kg-m² (lbf-in-sec²)]**
5 mm Lead		2.55×10^{-3} (2.26×10^{-2})	4.62×10^{-5} (4.09×10^{-4})
10 mm Lead		2.56×10^{-3} (2.27×10^{-2})	4.65×10^{-5} (4.12×10^{-4})
Inline Drive Inertia	**<32 mm Motor Shaft Diameter**	**>32 mm Motor Shaft Diameter**	**Add per 25 mm**
5 mm Lead	2.81×10^{-3} (2.49×10^{-2})	3.35×10^{-3} (2.97×10^{-2})	4.62×10^{-5} (4.09×10^{-4})
10 mm Lead	2.82×10^{-3} (2.50×10^{-2})	3.36×10^{-3} (2.98×10^{-2})	4.65×10^{-5} (4.12×10^{-4})
Parallel Drive Inertia		**1:1 Reduction**	**2:1 Reduction**
5 mm Lead (zero stroke)		9.43×10^{-3} (8.34×10^{-2})	4.66×10^{-3} (4.12×10^{-2})
Add per 25 mm stroke		4.62×10^{-5} (4.09×10^{-4})	1.15×10^{-5} (1.02×10^{-4})
10 mm Lead (zero stroke)		9.44×10^{-3} (8.35×10^{-2})	4.66×10^{-3} (4.13×10^{-2})
Add per 25 mm stroke		4.65×10^{-5} (4.12×10^{-4})	1.16×10^{-5} (1.03×10^{-4})

FTX160

		06	12	30
Screw Lead	mm	6	12	30
	in	0.236	0.472	1.181
Maximum Force	kN	89.0	89.0	89.0
	lbf	20,000	20,000	20,000
Life at Maximum Force	km	154.9	416.6	358.9
	in x 10^6	6.1	16.4	21.2
C_a (Dynamic Load Rating)	kN	263.7	290.0	233.0
	lbf	59,275	65,200	52,400
Maximum Input Torque	Nm	106	212	531
	lbf-in	940	1,880	4,699
Max Rated RPM @ Input Shaft	RPM	2,000	2,000	2,000
Maximum Linear Speed @ Maximum Rated RPM	mm/sec	201	401	1000
	in/sec	7.9	15.8	39.0
Friction Torque (Typical)	Nm	4.54	4.54	4.54
	lbf-in	40	40	40

Weights kg (lbs)

Base Actuator Weight (Zero Stroke)	kg	49
	lb	108
Actuator Weight Adder (Per 25 mm of stroke)	kg	1.62
	lb	3.6
Adder for Inline (excluding motor)	kg	14.2
	lb	31.5
Adder for Parallel Drive (excluding motor)	kg	53.1
	lb	117.8
Adder for Front Flange	kg	7.4
	lb	16.4
Adder for Rear Clevis	kg	21.2
	lb	48.8
Adder for Rear Eye	kg	22.4
	lb	49.7
Adder for Rear Trunnion	kg	10.9
	lb	24.2

Base Unit Inertia		Zero Stroke [kg-m^2 (lbf-in-sec^2)]	Add per 25 mm [kg-m^2 (lbf-in-sec^2)]
6 mm Lead		1.35×10^{-2} (1.19×10^{-1})	2.57×10^{-4} (2.27×10^{-3})
12 mm Lead		1.35×10^{-2} (1.20×10^{-1})	2.58×10^{-4} (2.28×10^{-3})
30 mm Lead		1.38×10^{-2} (1.22×10^{-1})	2.66×10^{-4} (2.36×10^{-3})
Inline Drive Inertia	**<32 mm Motor Shaft Diameter**	**>32 mm Motor Shaft Diameter**	**Add per 25 mm**
6 mm Lead	1.47×10^{-2} (1.30×10^{-1})	1.67×10^{-2} (1.48×10^{-1})	2.57×10^{-4} (2.27×10^{-3})
12 mm Lead	1.47×10^{-2} (1.30×10^{-1})	1.68×10^{-2} (1.49×10^{-1})	2.58×10^{-4} (2.28×10^{-3})
30 mm Lead	1.50×10^{-2} (1.33×10^{-1})	1.71×10^{-2} (1.51×10^{-1})	2.66×10^{-4} (2.36×10^{-3})
Parallel Drive Inertia		**1:1 Reduction**	**2:1 Reduction**
6 mm Lead (zero stroke)		5.27×10^{-2} (4.67×10^{-1})	2.30×10^{-2} (2.04×10^{-1})
Add per 25 mm stroke		2.57×10^{-4} (2.27×10^{-3})	6.42×10^{-5} (5.68×10^{-4})
12 mm Lead (zero stroke)		5.28×10^{-2} (4.67×10^{-1})	2.30×10^{-2} (2.04×10^{-1})
Add per 25 mm stroke		2.58×10^{-4} (2.28×10^{-3})	6.45×10^{-5} (5.71×10^{-4})
30 mm Lead (zero stroke)		5.30×10^{-2} (4.69×10^{-1})	2.31×10^{-2} (2.05×10^{-1})
Add per 25 mm stroke		2.66×10^{-4} (2.36×10^{-3})	6.66×10^{-5} (5.89×10^{-4})

FTX215

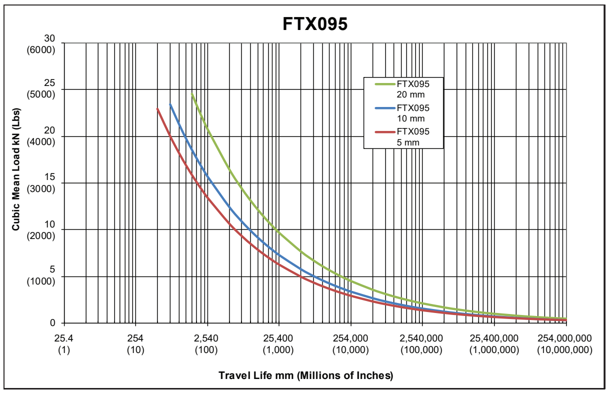
		06	12	30
Screw Lead	mm	6	12	30
	in	0.236	0.472	1.181
Maximum Force	kN	177.9	177.9	177.9
	lbf	40,000	40,000	40,000
Life at Maximum Force	km	78.7	161.8	414.3
	in x 10^6	3.1	6.4	16.3
C_a (Dynamic Load Rating)	kN	398	423	376
	lbf	89,500	95,200	84,700
Maximum Input Torque	Nm	243	425	976
	lbf-in	2,148	3,760	8,642
Max Rated RPM @ Input Shaft	RPM	1,750	1,750	1,750
Maximum Linear Speed @ Maximum Rated RPM	mm/sec	175	351	875
	in/sec	6.9	13.8	34.4
Friction Torque (Typical)	Nm	5.65	5.65	5.65
	lbf-in	50	50	50

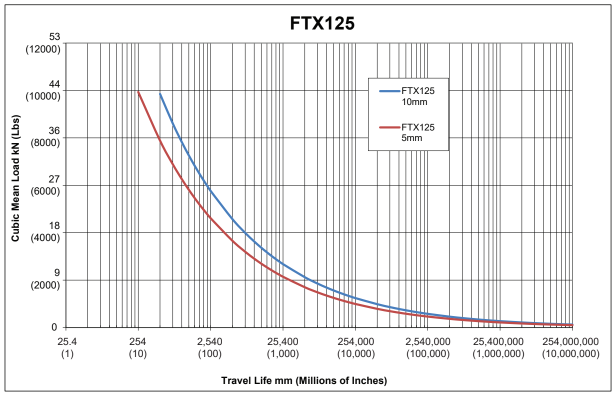
Weights kg (lbs)

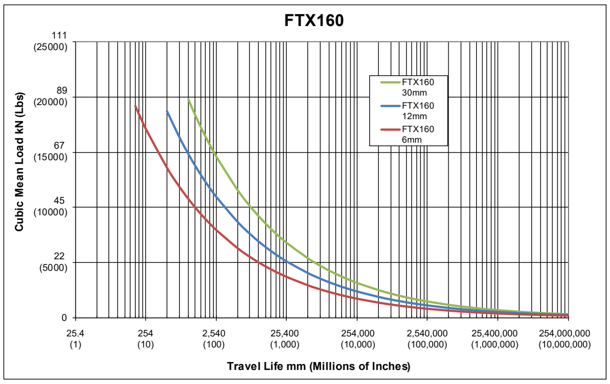
Base Actuator Weight (Zero Stroke)	kg	103
	lb	227
Actuator Weight Adder (Per 25 mm of stroke)	kg	2.70
	lb	5.96
Adder for Inline (excluding motor)	kg	38.6
	lb	85.1
Adder for Parallel Drive (excluding motor)	kg	62.3
	lb	137.3
Adder for Front Flange	kg	26.7
	lb	58.8
Adder for Rear Clevis	kg	32.5
	lb	71.6
Adder for Rear Eye	kg	32.5
	lb	71.6
Adder for Rear Trunnion	kg	9.6
	lb	21.2

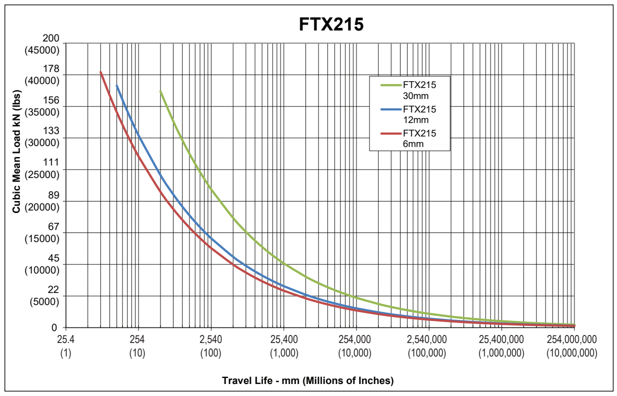
Base Unit Inertia		**Zero Stroke [kg-m² (lbf-in-sec²)]**	**Add per 25 mm [kg-m² (lbf-in-sec²)]**
6 mm Lead		4.25×10^{-2} (3.76×10^{-1})	8.00×10^{-4} (7.08×10^{-3})
12 mm Lead		4.26×10^{-2} (3.77×10^{-1})	8.02×10^{-4} (7.10×10^{-3})
30 mm Lead		4.31×10^{-2} (3.82×10^{-1})	8.15×10^{-4} (7.21×10^{-3})
Inline Drive Inertia	**<55 mm Motor Shaft Diameter**	**>55 mm Motor Shaft Diameter**	**Add per 25 mm**
6 mm Lead	4.43×10^{-2} (3.92×10^{-1})	6.15×10^{-2} (5.44×10^{-1})	8.00×10^{-4} (7.08×10^{-3})
12 mm Lead	4.44×10^{-2} (3.93×10^{-1})	6.16×10^{-2} (5.45×10^{-1})	8.02×10^{-4} (7.10×10^{-3})
30 mm Lead	4.49×10^{-2} (3.98×10^{-1})	6.21×10^{-2} (5.50×10^{-1})	8.15×10^{-4} (7.21×10^{-3})
Parallel Drive Inertia		**1:1 Reduction**	**2:1 Reduction**
6 mm Lead (zero stroke)		9.42×10^{-2} (8.34×10^{-1})	3.50×10^{-2} (3.10×10^{-1})
Add per 25 mm stroke		8.00×10^{-4} (7.08×10^{-3})	2.00×10^{-4} (1.77×10^{-3})
12 mm Lead (zero stroke)		9.43×10^{-2} (8.34×10^{-1})	3.50×10^{-2} (3.10×10^{-1})
Add per 25 mm stroke		8.02×10^{-4} (7.10×10^{-3})	2.01×10^{-4} (1.78×10^{-3})
30 mm Lead (zero stroke)		9.48×10^{-2} (8.39×10^{-1})	3.52×10^{-2} (3.11×10^{-1})
Add per 25 mm stroke		8.15×10^{-4} (7.21×10^{-3})	2.04×10^{-4} (1.80×10^{-3})

Estimated Service Life









The L_{10} expected life of a roller screw linear actuator is expressed as the linear travel distance that 90% of properly maintained roller screws manufactured are expected to meet or exceed. This is not a guarantee and these charts should be used for estimation purposes only.

The underlying formula that defines this value is:
Travel life in millions of inches, where:

C_a = Dynamic load rating (lbf)
F_{cml} = Cubic mean applied load (lbf)
ℓ = Roller screw lead (inches)

$$L_{10} = \left(\frac{C_a}{F_{cml}}\right)^3 \times \ell$$

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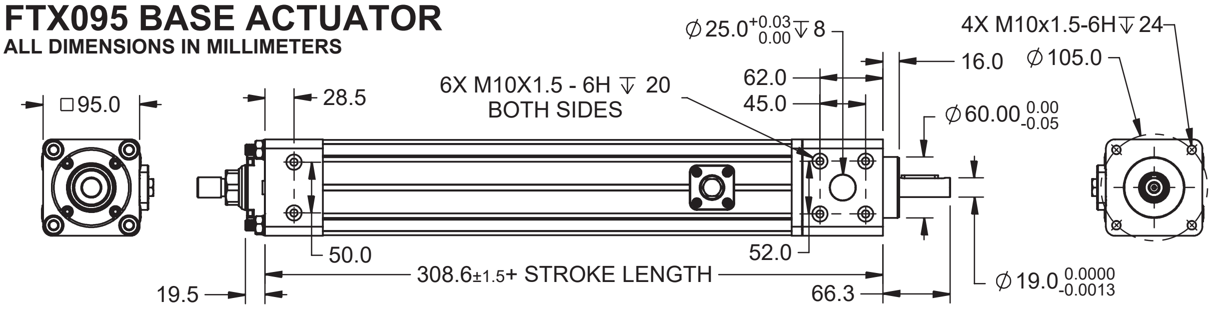
Service Life Estimate Assumptions:

- Sufficient quality and quantity of lubrication is maintained throughout service life
- Bearing and screw temperature between 20° C and 40° C
- No mechanical hard stops (external or internal) or impact loads
- No external side loads
- Does not apply to short stroke, high frequency applications such as fatigue testing or short stroke, high force applications such as pressing.

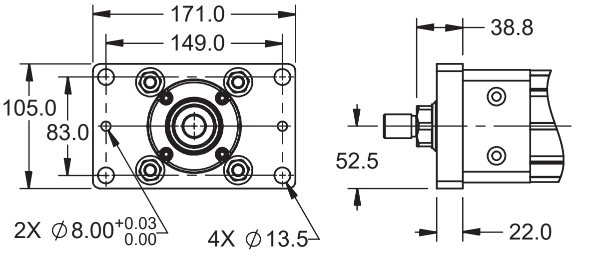
Dimensions

FTX095 BASE ACTUATOR

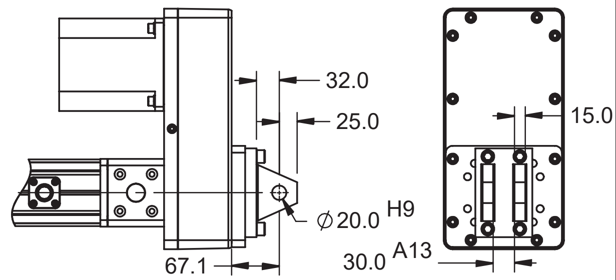
ALL DIMENSIONS IN MILLIMETERS



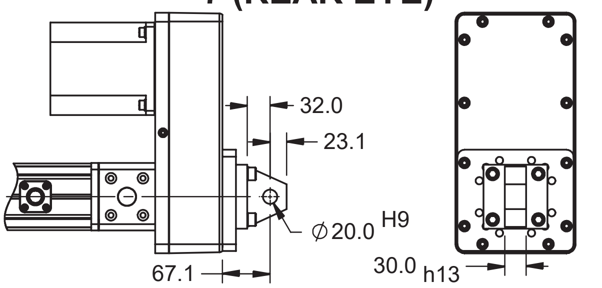
1 (FRONT FLANGE)



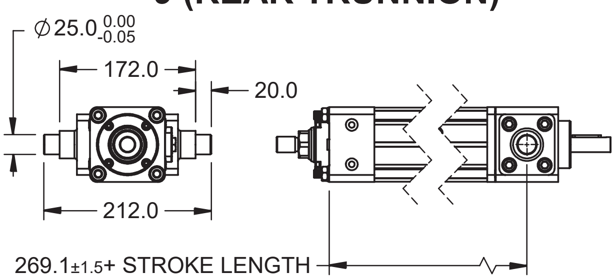
5 (REAR CLEVIS)



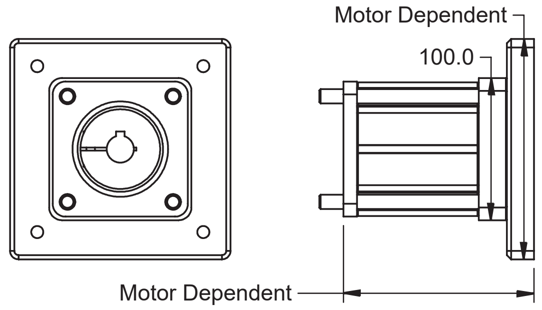
7 (REAR EYE)



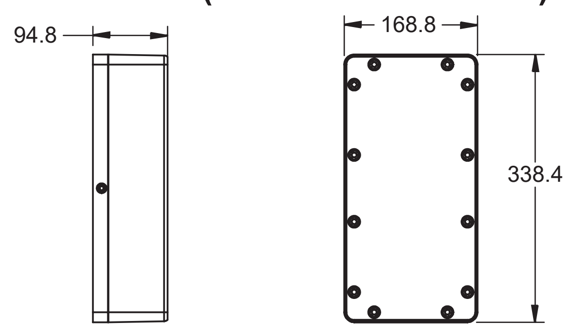
9 (REAR TRUNNION)



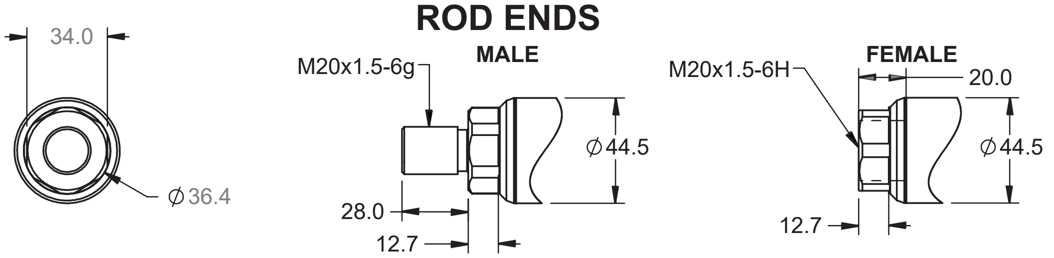
N10 (INLINE MOUNT)



P10/P20 (PARALLEL MOUNT)



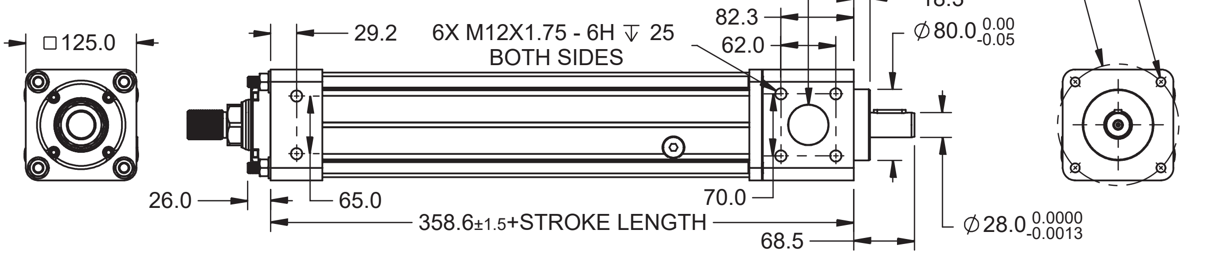
ROD ENDS



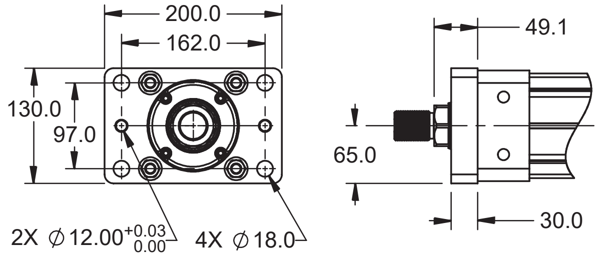
Pre-sale drawings and models are representative and are subject to change.

FTX125 BASE ACTUATOR

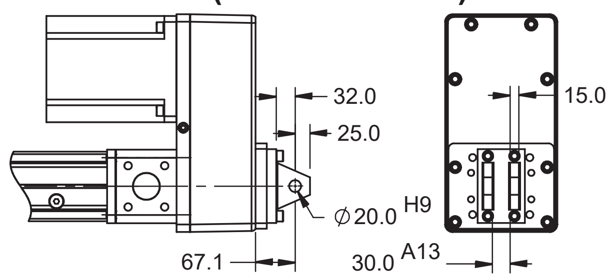
ALL DIMENSIONS IN MILLIMETERS



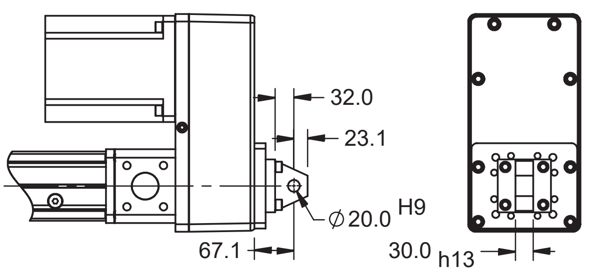
1 (FRONT FLANGE)



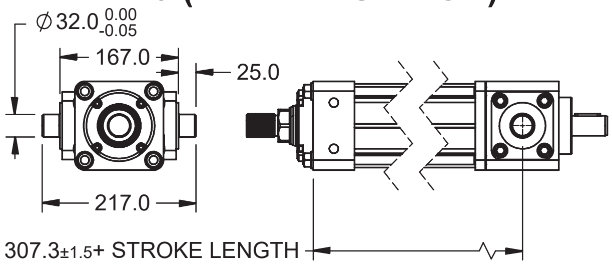
5 (REAR CLEVIS)



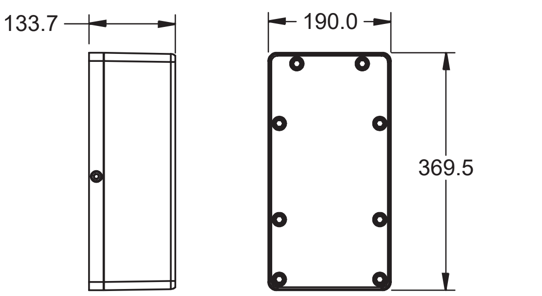
7 (REAR EYE)



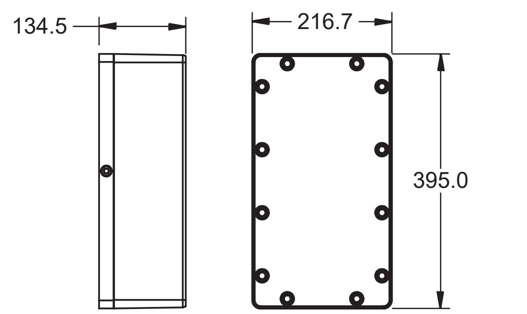
9 (REAR TRUNNION)



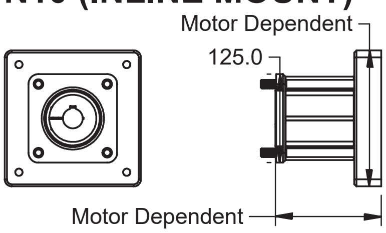
P10 (PARALLEL MOUNT)



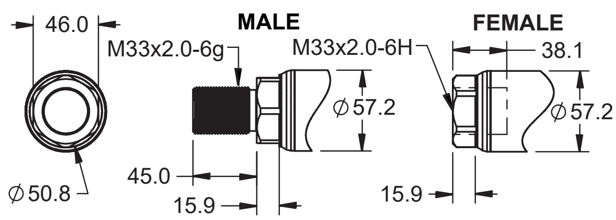
P20 (PARALLEL MOUNT)



N10 (INLINE MOUNT)



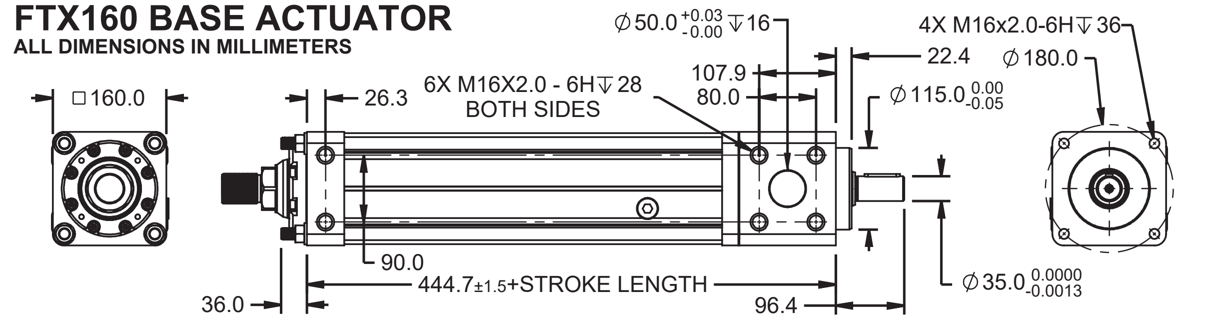
ROD ENDS



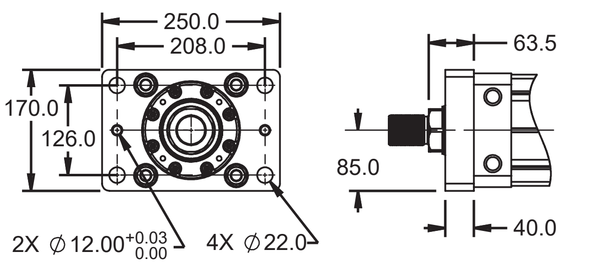
Pre-sale drawings and models are representative and are subject to change.

FTX160 BASE ACTUATOR

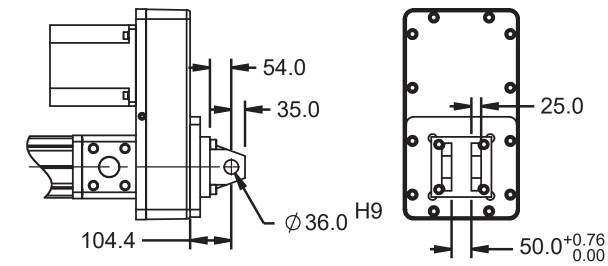
ALL DIMENSIONS IN MILLIMETERS



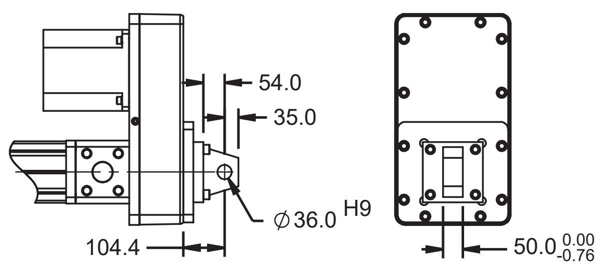
1 (FRONT FLANGE)



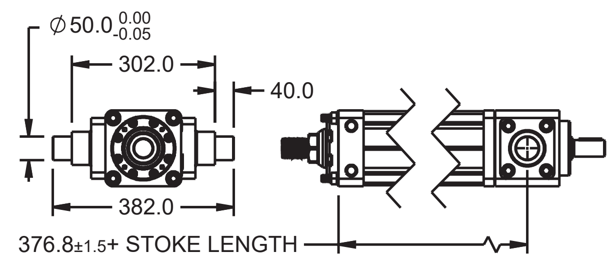
5 (REAR CLEVIS)



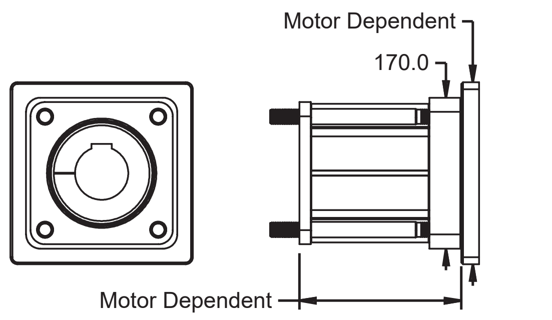
7 (REAR EYE)



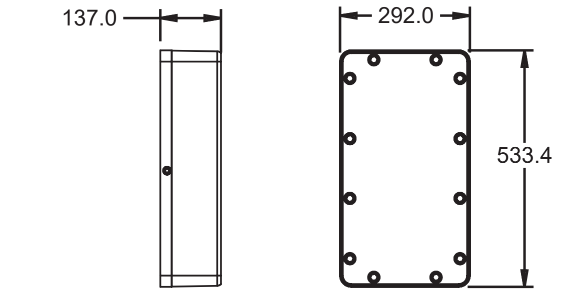
9 (REAR TRUNNION)



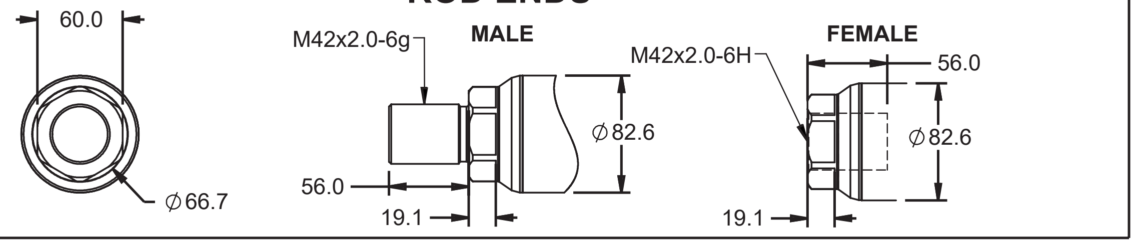
N10 (INLINE MOUNT)



P10/P20 (PARALLEL MOUNT)



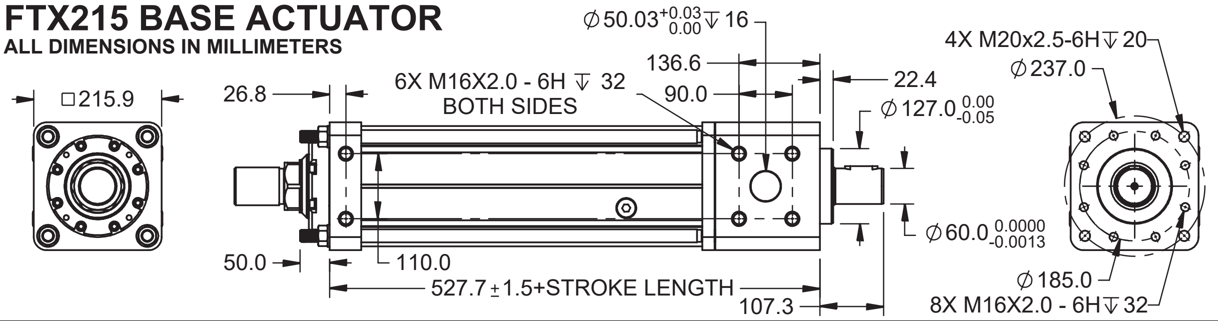
ROD ENDS



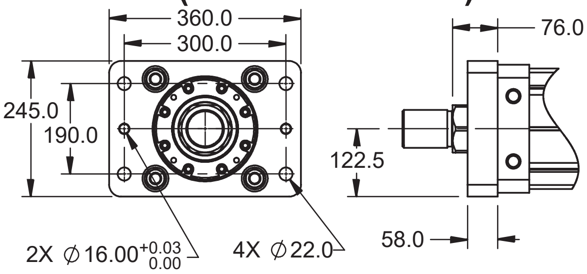
Pre-sale drawings and models are representative and are subject to change.

FTX215 BASE ACTUATOR

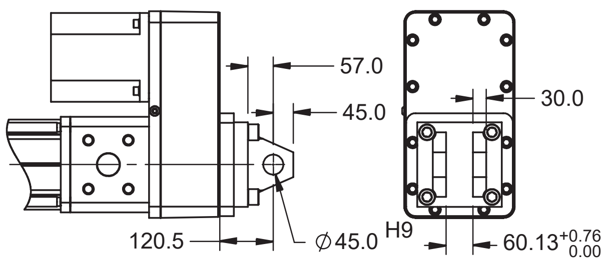
ALL DIMENSIONS IN MILLIMETERS



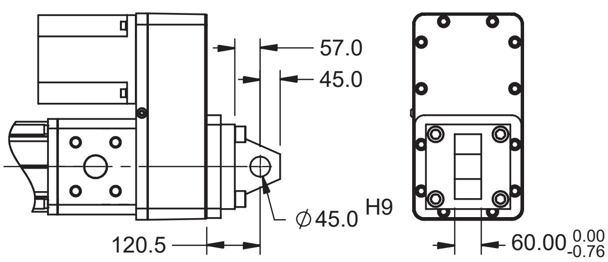
1 (FRONT FLANGE)



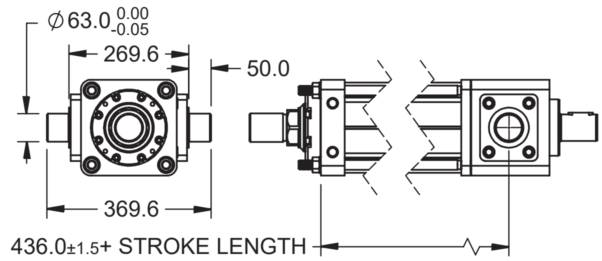
5 (REAR CLEVIS)



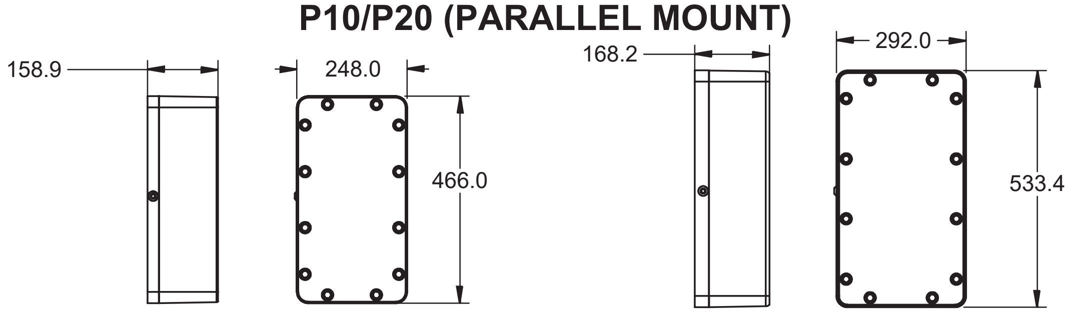
7 (REAR EYE)



9 (REAR TRUNNION)

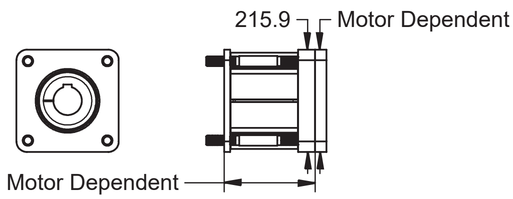


P10/P20 (PARALLEL MOUNT)

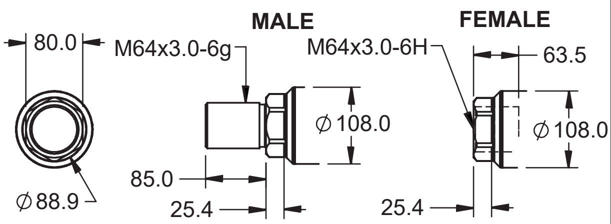


NOTE: 248mm WIDE HOUSING USED FOR MOTORS WITH 215mm MOUNTING B.C AND SMALLER, 1:1
292mm WIDE HOUSING USED FOR ALL 2:1 DRIVE MOTORS

N10 (INLINE MOUNT)

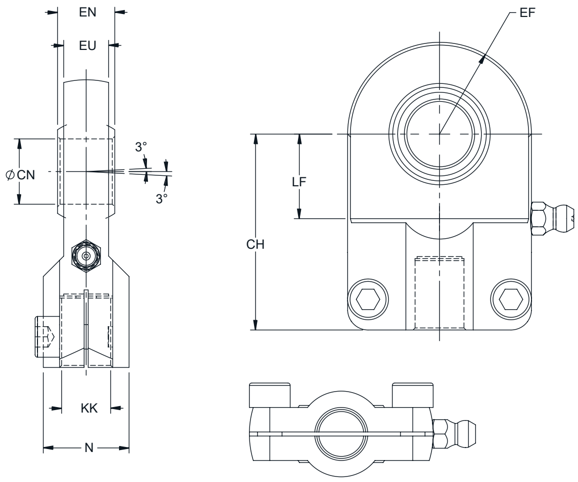


ROD ENDS



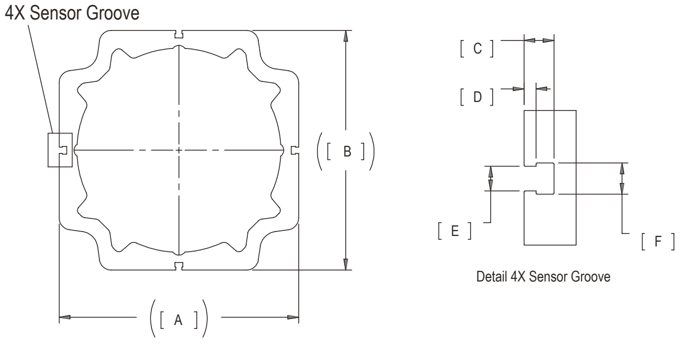
Pre-sale drawings and models are representative and are subject to change.

Rod Eye, Spherical



		FTX095	FTX125	FTX160	FTX215
AV	mm	29.0	46.0	55.0	86.0
	in	1.14	1.81	2.17	3.39
CH	mm	85.0	130.0	150.0	240.0
	in	3.35	5.12	5.91	9.45
CN	mm	30.0	50.0	60.0	100.0
	in	1.18	1.97	2.36	3.94
EF (max)	mm	41.0	61.0	80.0	120.0
	in	1.61	2.40	3.15	4.72
EN	mm	22.0	35.0	44.0	70.0
	in	0.87	1.38	1.73	2.76
EU (max)	mm	20.0	31.0	39.0	57.0
	in	0.79	1.22	1.54	2.24
KK		M20X1.5 6H	M33X2.0 6H	M42X2.0 6H	M64X3.0 6H
LF (min)	mm	35.0	58.0	68.0	116.0
	in	1.38	2.28	2.68	4.57
N (max)	mm	37.0	57.0	69.0	110.0
	in	1.46	2.24	2.72	4.33

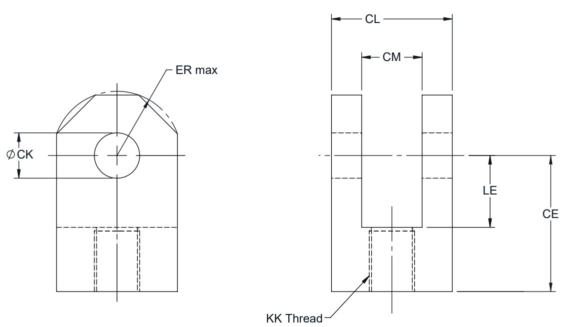
Case Dimensions



Detail 4X Sensor Groove

		FTX095	FTX125	FTX160	FTX215
A	mm	94	118	156	203
	in	3.7	4.6	6.1	8.0
B	mm	94	118	156	203
	in	3.7	4.6	6.1	8.0
C	mm	4.9	5.6	5.5	6.4
	in	0.19	0.22	0.22	0.25
D	mm	1.1	1.8	1.7	2.5
	in	0.4	0.07	0.07	0.10
E	mm	5.2	5.2	5.3	5.2
	in	0.21	0.21	0.21	0.21
F	mm	6.6	6.6	6.6	6.6
	in	0.26	0.26	0.26	0.26

Rod Clevis



		FTX095	FTX125	FTX160	FTX215
CE	mm	60.0	99.0	113.0	168.0
	in	2.36	3.90	4.45	6.61
Ø CK	mm	20.0 h9	36.0 h9	45.0 h9	70.0 h9
	in	0.79	1.42	1.77	2.76
CL	mm	62.0	103.0	123.0	163.0
	in	2.44	4.06	4.84	6.42
CM	mm	30.0	50.0	60.0	80.0
	in	1.18	1.97	2.36	3.15
Ø ER (max)	mm	29.0	50.0	53.0	78.0
	in	1.14	1.97	2.09	3.07
LE (min)	mm	32.0	54.0	57.0	83.0
	in	1.26	2.13	2.24	3.27
KK		M20X1.5 6H	M33X2.0 6H	M42X2.0 6H	M64X3.0 6H

Standard Motor/Gearbox Mount Codes for the FTX

FTX095 Motor / Gearbox Mounts															
None		Inline				Parallel 1:1				Parallel 2:1					
				Dimension in mm				Dimension in mm				Dimension in mm			
Motor Flange Code		Motor Flange Code		Bolt Circle	Pilot Diam.	Motor Flange Code		Bolt Circle	Pilot Diam.	Motor Flange Code		Bolt Circle	Pilot Diam.		
NMT-	00	N10-	02	68	60	P10-	02	68	60	P20-	02	68	60		
		N10-	04	75	60	P10-	04	75	60	P20-	04	75	60		
		N10-	05	85	70	P10-	05	85	70	P20-	05	85	70		
		N10-	10	100	80	P10-	10	100	80	P20-	10	100	80		
		N10-	11	115	95	P10-	11	115	95	P20-	11	115	95		
		N10-	12	130	110	P10-	12	130	110	P20-	12	130	110		
		N10-	13	130	95	P10-	13	130	95	P20-	13	130	95		
		N10-	14	145	110	P10-	14	145	110	P20-	14	145	110		
		N10-	19	165	130	P10-	19	165	130	P20-	19	165	130		

Motor Shaft Code	Motor Shaft Code	Shaft Diam.	Key Width	Motor Shaft Code	Shaft Diam.	Key Width	Motor Shaft Code	Shaft Diam.	Key Width
00	AA	24	8	AA	24	8	AA	24	8
	BA	22	6	BA	22	6	BA	22	6
	CA	22	8	CA	22	8	CA	22	8
	DA	20	6	DA	20	6	DA	20	6
	EA	19	6	EA	19	6	EA	19	6
	FA	16	5	FA	16	5	FA	16	5
	GA	14	5	GA	14	5	GA	14	5
	LA	28	8	LA	28	8	LA	28	8
	MA	32	10	MA	32	10			

Shaft Length	Shaft Length		Shaft Length		Shaft Length	
000	030, 032, 040, 048, 050, 055, 058, 060, 063, 065, 070, 080	* Pick closest shaft length within 2mm if your exact length is not listed	038-084	* Allowable shaft length range in 1 mm increments	038-084	* Allowable shaft length range in 1 mm increments

FTX125 Motor / Gearbox Mounts

None		Inline				Parallel 1:1				Parallel 2:1			
				Dimension in mm				Dimension in mm				Dimension in mm	
Motor Flange Code		**Motor Flange Code**		Bolt Circle	Pilot Diam.	**Motor Flange Code**		Bolt Circle	Pilot Diam.	**Motor Flange Code**		Bolt Circle	Pilot Diam.
NMT-	00	N10-	05	85	70	P10-	05	85	70	P20-	05	85	70
		N10-	10	100	80	P10-	10	100	80	P20-	10	100	80
		N10-	12	130	110	P10-	12	130	110	P20-	12	130	110
		N10-	14	145	110	P10-	14	145	110	P20-	14	145	110
		N10-	18	120	90	P10-	18	120	90	P20-	19	165	130
		N10-	19	165	130	P10-	19	165	130	P20-	20	200	114.3
		N10-	20	200	114.3	P10-	20	200	114.3	P20-	21	215	130
		N10-	21	215	130	P10-	21	215	130	P20-	23	215	180
		N10-	23	215	180	P10-	23	215	180				

Motor Shaft	**Motor Shaft Code**	Shaft Diam.	Key Width	**Motor Shaft code**	Shaft Diam.	Key Width	**Motor Shaft Code**	Shaft Diam.	Key Width
00	AA	24	8	AA	24	8	AA	24	8
	AB	28	10	AB	28	10	AB	28	10
	BA	22	6	BA	22	6	BA	22	6
	DA	20	6	DA	20	6	DA	20	6
	EA	19	6	EA	19	6	EA	19	6
	LA	28	8	LA	28	8	LA	28	8
	MA	32	10	MA	32	10	MA	32	10
	NA	35	10	NA	35	10	NA	35	10
	PA	38	10	PA	38	10	YA	24	10
	RA	42	12	RA	42	12			
	SA	42	10	SA	42	10			
	YA	24	10	YA	24	10			

Shaft Length	**Shaft Length**		**Shaft Length**		**Shaft Length**	
000	040, 046, 049, 050, 055, 058, 060, 063, 065, 068, 072, 080, 082, 088, 097, 100, 102, 105, 112, 113	* Pick closest shaft length within 2mm if your exact length is not listed	048-099	* Allowable shaft length range in 1 mm increments	048-099	* Allowable shaft length range in 1 mm increments

FTX160 Motor / Gearbox Mounts

None		Inline				Parallel 1:1				Parallel 2:1			
				Dimension in mm				Dimension in mm				Dimension in mm	
Motor Flange Code		**Motor Flange Code**		Bolt Circle	Pilot Diam.	**Motor Flange Code**		Bolt Circle	Pilot Diam.	**Motor Flange Code**		Bolt Circle	Pilot Diam.
NMT-	00	N10-	10	100	80	P10-	10	100	80	P20-	10	100	80
		N10-	12	130	110	P10-	12	130	110	P20-	12	130	110
		N10-	18	120	90	P10-	18	120	90	P20-	18	120	90
		N10-	19	165	130	P10-	19	165	130	P20-	19	165	130
		N10-	20	200	114.3	P10-	20	200	114.3	P20-	20	200	114.3
		N10-	21	215	130	P10-	21	215	130	P20-	21	215	130
		N10-	22	215	160	P10-	22	215	160	P20-	23	215	180
		N10-	23	215	180	P10-	23	215	180	P20-	24	235	200
		N10-	24	235	200	P10-	24	235	200	P20-	25	265	230
		N10-	25	265	230	P10-	25	265	230				

Motor Shaft Code	**Motor Shaft Code**	Shaft Diam.	Key Width	**Motor Shaft Code**	Shaft Diam.	Key Width	**Motor Shaft Code**	Shaft Diam.	Key Width
00	AA	24	8	AA	24	8	AA	24	8
	BA	22	6	BA	22	6	BA	22	6
	LA	28	8	LA	28	8	LA	28	8
	MA	32	10	MA	32	10	MA	32	10
	NA	35	10	NA	35	10	NA	35	10
	PA	38	10	PA	38	10	PA	38	10
	QA	40	12	QA	40	12	QA	40	12
	RA	42	12	RA	42	12	RA	42	12
	SA	42	10	SA	42	10	SA	42	10
	UA	55	16	UA	55	16	ZA	25	8
	ZA	25	8	ZA	25	8			

Shaft Length	**Shaft Length**		**Shaft Length**		**Shaft Length**	
000	040, 048, 050, 055, 058, 060, 070, 072, 080, 082, 085, 088, 097, 100, 105, 110, 112, 113, 116	* Pick closest shaft length within 2mm if your exact length is not listed	060-124	* Allowable shaft length range in 1 mm increments	060-124	* Allowable shaft length range in 1 mm increments

FTX215 Motor / Gearbox Mounts

None		Inline				Parallel 1:1				Parallel 2:1			
				Dimension in mm				Dimension in mm				Dimension in mm	
Motor Flange Code		Motor Flange Code		Bolt Circle	Pilot Diam.	Motor Flange Code		Bolt Circle	Pilot Diam.	Motor Flange Code		Bolt Circle	Pilot Diam.
NMT-	00	N10-	19	165	130	P10-	19	165	130	P20-	19	165	130
		N10-	22	215	160	P10-	22	215	160	P20-	23	215	180
		N10-	23	215	180	P10-	23	215	180	P20-	25	265	230
		N10-	24	235	200	P10-	24	235	200	P20-	26	300	250
		N10-	25	265	230	P10-	25	265	230				
		N10-	26	300	250	P10-	26	300	250				

Motor Shaft Code	Motor Shaft Code	Shaft Diam.	Key Width	Motor Shaft Code	Shaft Diam.	Key Width	Motor Shaft Code	Shaft Diam.	Key Width
00	PA	38	10	PA	38	10	PA	38	10
	QA	40	12	QA	40	12	QA	40	12
	RA	42	12	RA	42	12	RA	42	12
	TA	48	14	TA	48	14	TA	48	14
	UA	55	16	UA	55	16			
	VA	60	18	VA	60	18			
	WA	65	18	WA	65	18			

Shaft Length	Shaft Length		Shaft Length		Shaft Length	
000	080, 082, 085, 097, 100, 102, 105, 110, 112, 116, 140	* Pick closest shaft length within 2mm if your exact length is not listed	070-155	*Aallowable shaft length range in 1 mm increments	070-155	* Allowable shaft length range in 1 mm increments

FTX AAA – BBBB – CC – D – E – FFF – GG – HH – III – M – N

- FTX AAA: Actuator Type & Frame Size
- BBBB: Stroke Length
- CC: Screw Lead
- D: Lubrication Type
- E: Rod End Thread
- FFF: Motor Mounting Configurations
- GG: Motor Flange Code
- HH: Motor Shaft Code
- III: Shaft Length
- M: Mounting Options
- N: Other Options

AAA = Frame Size
095 = 95 mm
125 = 125 mm
160 = 160 mm
215 = 215 mm

BBBB = Stroke Length
0150 = 150 mm
0300 = 300 mm
0600 = 600 mm
0900 = 900 mm (FTX095, FTX125, FTX160)

CC = Screw Lead
05 = 5 mm (FTX095, FTX125)
06 = 6 mm (FTX160, FTX215)
10 = 10 mm (FTX095, FTX125)
12 = 12 mm (FTX160, FTX215)
20 = 20 mm (FTX095)
30 = 30 mm (FTX160, FTX215)

D = Lubrication Type
1 = Grease
2 = Oil

E = Rod End Thread
A = Male, Metric
B = Female, Metric
M = Male, English[3]
F = Female, English[3]

FFF = Motor Mounting Configurations[1]
NMT = None, base unit only
N10 = Inline, includes shaft coupling
P10 = Parallel, 1:1 belt reduction
P20 = Parallel, 2:1 belt reduction

GG = Motor/Gearbox Flange Code
See standard motor/gearbox mounting code dimension sheet

HH = Motor Shaft Code
See standard motor/gearbox mounting code dimension sheet

III = Shaft Length
See standard motor/gearbox mounting code dimension sheet

M = Mounting Options
N = None
1 = Front Flange, Metric
5 = Rear Clevis, Metric[2]
7 = Rear Eye, Metric[2]
9 = Rear Trunnion, Metric
F = Front Flange, English[3]
C = Rear Clevis, English[3] (Not available on FTX215)
G = Rear Clevis, Metric[3] (Not available on FTX125 or FTX215)

N = Other Options
N = None
L = Limit Switches*

*Ordered Separately

For options or specials not listed above, please contact Exlar

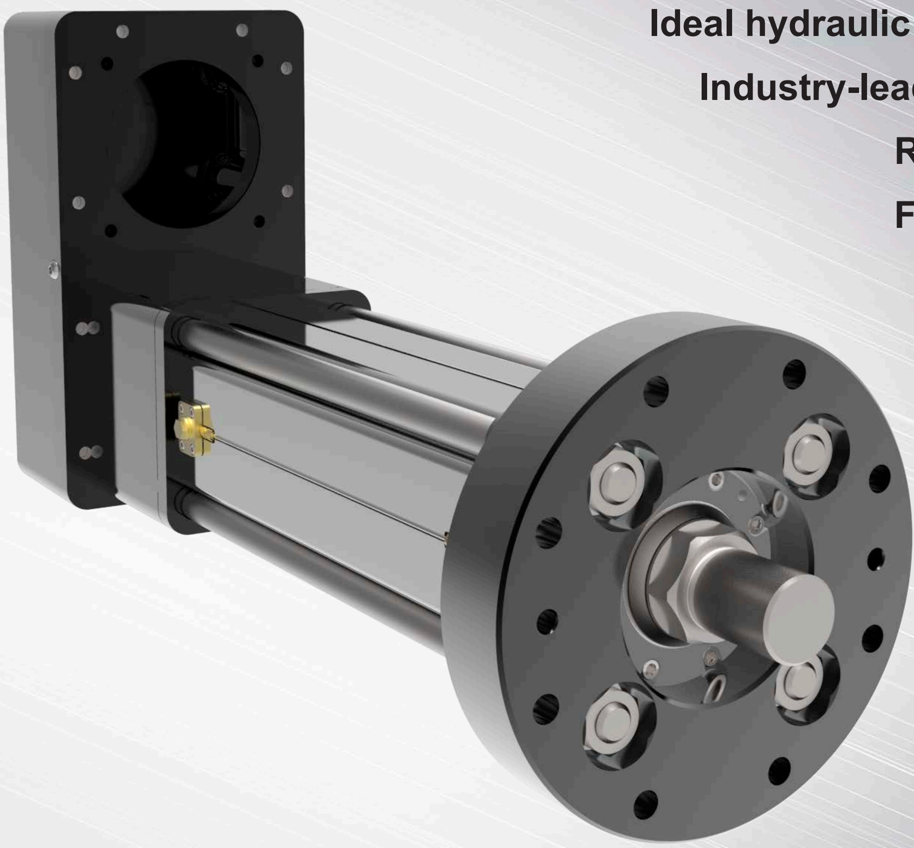
NOTES:
1. Always discuss your motor selection with your local sales representative.
2. Not available with inline or NMT motor mount, contact your local sales representative.
3. Available option. May add lead time

FTX Series Accessories

Exlar Part Number	Switches Type
43403	Normally Open PNP Limit Switch (10-30 VDC, 1m. 3 wire embedded cable)
43404	Normally Closed PNP Limit Switch (10-30 VDC, 1m. 3 wire embedded cable)
67634	Normally Open NPN Limit Switch (10-30 VDC, 1m. 3 wire embedded cable)
67635	Normally Closed NPN Limit Switch (10-30 VDC, 1m. 3 wire embedded cable)

FTP Series

HIGH FORCE ELECTRIC PRESS ACTUATOR



Ideal hydraulic press replacement

Industry-leading power density

Rugged and reliable

Flexible and precise

FTP Series

High Force Electric Press Actuators

Hydraulic Press Replacement

Based on planetary rollers screw technology, the FTP Series high force electric press actuators were designed to provide very high force in a small package size making them an ideal alternative to hydraulic cylinders in pressing applications. The FTP offers force density not attainable with more common ball screw based electric actuators, up to 15X the life and 2X the force density in most cases.

Programmable and Accurate

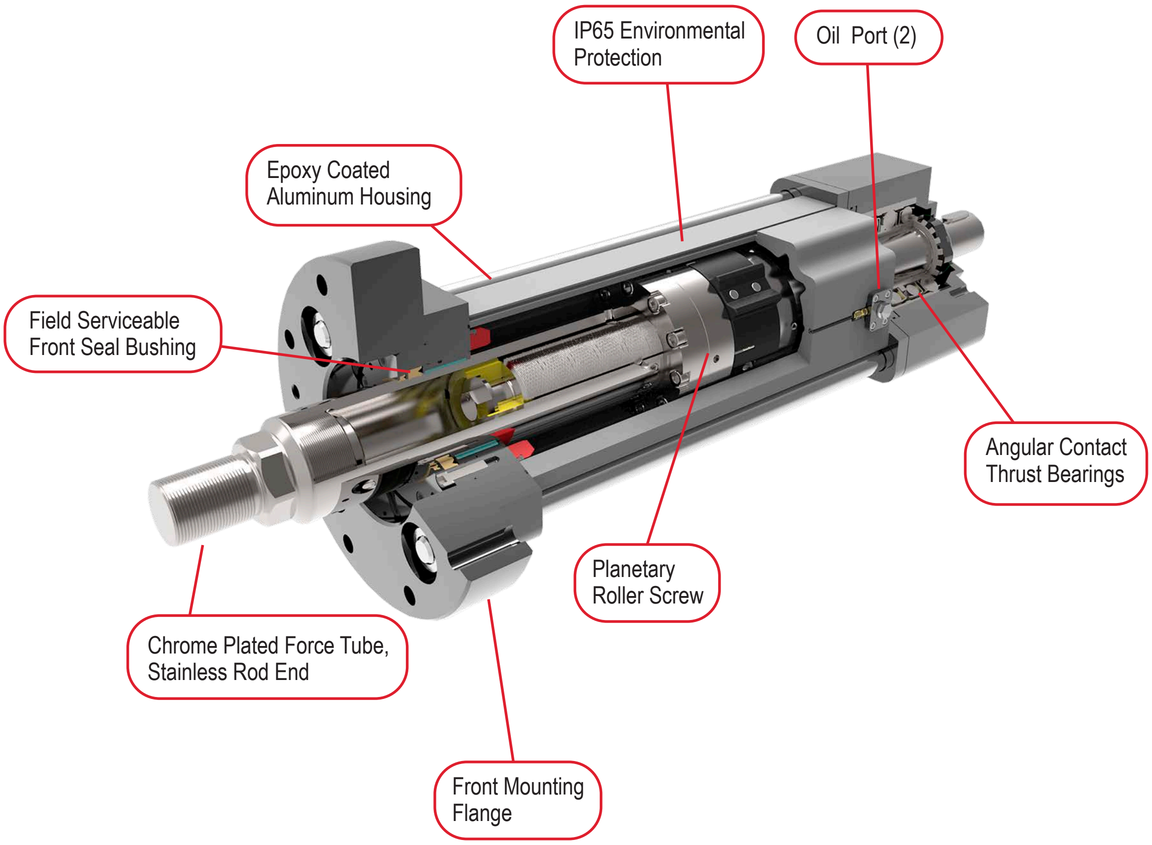
Attaining any kind of accuracy with a traditional hydraulic solution requires complicated servo valves that are difficult to set up and need frequent adjustment for optimum performance. Once set, changeover to a different part or mode of operation is equally as troublesome. The all-electric FTP Series utilizes commonly understood servo motor technology, offering accuracy, control and flexibility not available with hydraulics.

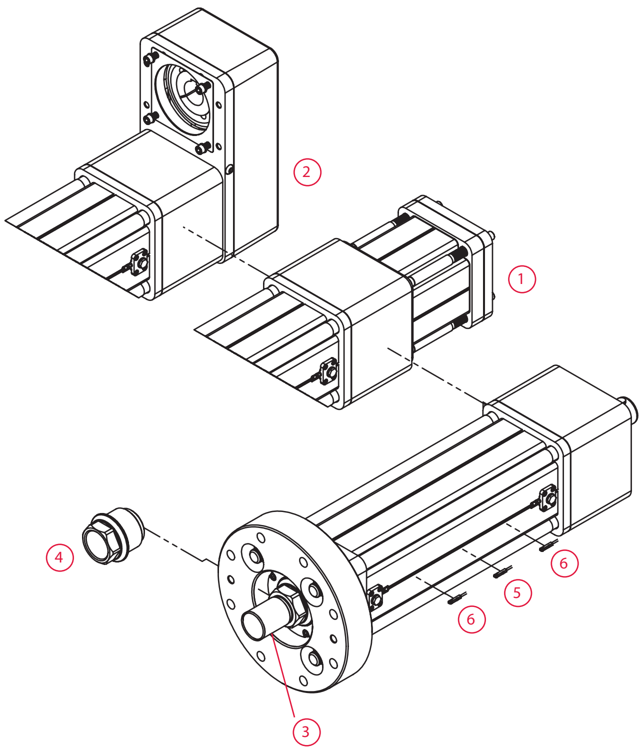
Reliable and Efficient

The FTP Series high force electric press actuators allow machine builders to meet the ever-increasing performance demands of their customers while minimizing or eliminating the maintenance issues and downtime associated with traditional hydraulic solutions. Their programmability and flexibility significantly reduces changeover time between production runs enabling smaller batch sizes, and they typically consume 25% less energy than a typical hydraulic solution. Increase your operational efficiency today by switching to the FTP Series.

Operating Conditions and Usage		
Accuracy:		
Screw Travel Variation	mm (in)	0.030 (0.0012)
Screw Lead Error	mm/300 mm (in/ft)	0.025 (0.001)
Screw Lead Backlash	mm (in)	0.06 (0.002)
Ambient Conditions:		
Standard Ambient Temperature	°C	0° to 85°
IP Rating		IP65S

Product Features





1 - Inline direct drive
2 - Parallel, 1:1 belt reduction
3 - Male, metric thread
4 - Female, metric thread
5 - External limit switch - N.O., PNP or NPN*
6 - External limit switch - N.C., PNP or NPN*

*Ordered Separately

Mechanical Specifications

FTP160

		12
Screw Lead	mm	12
	in	0.472
Maximum Force (Extension)	kN	200.0
	lbf	45,000
Maximum Force (Retraction)	kN	89.0
	lbf	20,000
Life at Maximum Force (Minimum)	Press Cycles	3 Million
Maximum Full Load Press Stroke	mm	12
	in	0.47
C_a (Dynamic Load Rating)	kN	290.0
	lbf	65,200
Maximum Input Torque	Nm	472
	lbf-in	4,225
Max Rated RPM @ Input Shaft	RPM	2,000
Maximum Linear Speed @ Maximum Rated RPM	mm/sec	401
	in/sec	15.8
Friction Torque (Typical)	Nm	4.54
	lbf-in	40

Weights kg (lbs)

Base Actuator Weight (Zero Stroke)	kg	56
	lb	124
Actuator Weight Adder (Per 25 mm of stroke)	kg	1.73
	lb	3.8
Adder for Inline (excluding motor)	kg	14.2
	lb	30.7
Adder for Parallel Drive (excluding motor)	kg	53.1
	lb	117.8
Adder for Front Flange	kg	19.0
	lb	41.7

Base Unit Inertia		Zero Stroke [kg-m² (lbf-in-sec²)]	Add per 25 mm [kg-m² (lbf-in-sec²)]
12 mm Lead		1.35×10^{-2} (1.20×10^{-1})	2.58×10^{-4} (2.28×10^{-3})
Inline Drive Inertia	**Inline Unit - w/Motor Coupling**	**Inline Unit - w/Motor Coupling For Gearbox Mount**	**Add per 25 mm**
12 mm Lead	1.47×10^{-2} (1.30×10^{-1})	1.68×10^{-2} (1.49×10^{-1})	2.58×10^{-4} (2.28×10^{-3})
Parallel Drive Inertia		**1:1 Reduction**	**Add per 25 mm**
12 mm Lead (zero stroke)		5.28×10^{-2} (4.67×10^{-1})	2.58×10^{-4} (2.28×10^{-3})

EXLAR®

FTP215

		12
Screw Lead	mm	12
	in	0.472
Maximum Force (Extension)	kN	355.8
	lbf	80,000
Maximum Force (Retraction)	kN	177.9
	lbf	40,000
Life at Maximum Force (Minimum)	Press Cycles	1.6 Million
Maximum Full Load Press Stroke	mm	12
	in	0.47
C_a (Dynamic Load Rating)	kN	423.5
	lbf	95,200
Maximum Input Torque	Nm	850
	lbf-in	7,520
Max Rated RPM @ Input Shaft	RPM	1,750
Maximum Linear Speed @ Maximum Rated RPM	mm/sec	351
	in/sec	13.8
Friction Torque (Typical)	Nm	5.65
	lbf-in	50

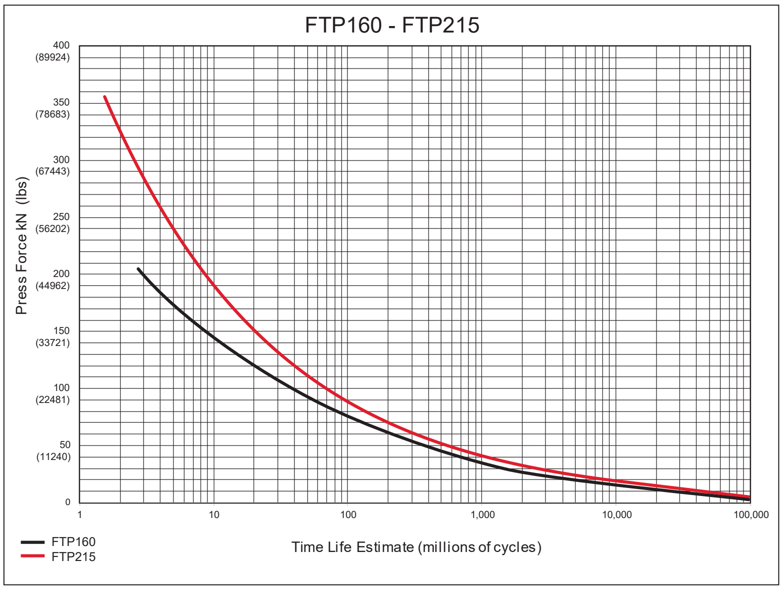
Weights kg (lbs)

Base Actuator Weight (Zero Stroke)	kg	127
	lb	280
Actuator Weight Adder (Per 25 mm of stroke)	kg	2.7
	lb	5.96
Adder for Inline (excluding motor)	kg	38.6
	lb	85.1
Adder for Parallel Drive (excluding motor)	kg	62.3
	lb	137.35
Adder for Front Flange	kg	46.5
	lb	102.5

Base Unit Inertia		Zero Stroke [kg-m² (lbf-in-sec²)]	Add per 25 mm [kg-m² (lbf-in-sec²)]
12 mm Lead		4.26×10^{-2} (3.77×10^{-1})	8.02×10^{-4} (7.10×10^{-3})
Inline Drive Inertia	**Inline Unit - w/Motor Coupling**	**Inline Unit - w/Motor Coupling For Gearbox Mount**	**Add per 25 mm**
12 mm Lead	4.44×10^{-2} (3.93×10^{-1})	6.16×10^{-2} (5.45×10^{-1})	8.02×10^{-4} (7.10×10^{-3})
Parallel Drive Inertia		**1:1 Reduction**	**Add per 25 mm**
12 mm Lead (zero stroke)		9.43×10^{-2} (8.34×10^{-1})	8.02×10^{-4} (7.10×10^{-3})

Data Curves

Estimated Service Life



The underlying formula that defines this value is:

L_{10} = Lifetime estimate in millions of cycles, where:

C_a = Dynamic load rating (lbf)

F_{press} = Press force (press distance ≤ 12mm)

$$L_{10} = \left(\frac{C_a}{F_{press}}\right)^3$$

Service Life Estimate Assumptions:

- Sufficient quality and quantity of lubrication is maintained throughout service life
- Bearing and screw temperature between 20° C and 40° C
- No mechanical hard stops (external or internal) or impact loads
- No external side loads

FTP Press Sizing Guide

Exlar's FTP series actuators meet the most demanding pressing applications in the market. Successful applications include bearing press, stamping, and leak testing. Due to design considerations for the FTP series, the extreme forces are only achievable when extending the main rod. See manufacturer's specifications on page 70 for maximum force ratings for each actuator in the FTP series.

For any press force less than the maximum rating, calculate the estimated L_{10} life by using the calculation method listed. The press distance must not exceed the maximum rated press distance listed.

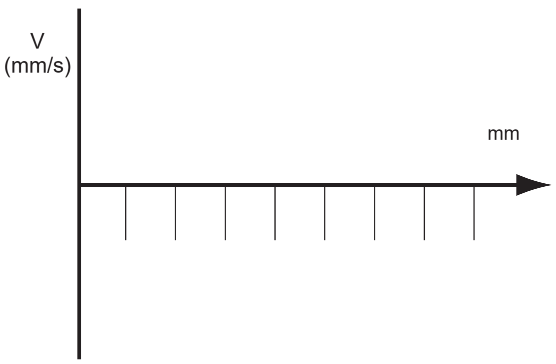
If your application is outside the specifications, please fill in the following table and chart. Send the completed document to cha_applications@curtisswright.com. Exlar's sales engineering team will review the application to determine if Exlar has a solution to meet the requirements.

Required Data for Press Applications Outside Listed Specifications

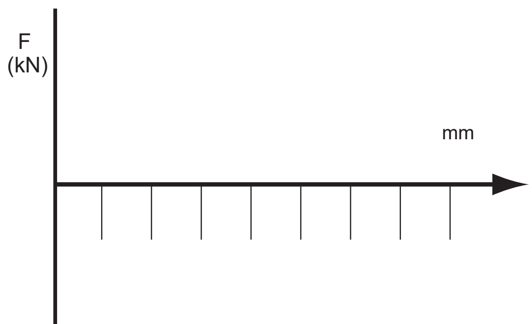
Application Data		
Typical Press Force	kN	
Typical Press Stroke	mm	
Maximum Press Force	kN	
Maximum Press Stroke	mm	
Cycle Rate	Cycles/min	
Dwell Time After Each Cycle	s	
Life Expectancy	Months	

Sketch Profile of Typical Cycle

Velocity vs. Position



Force vs. Position

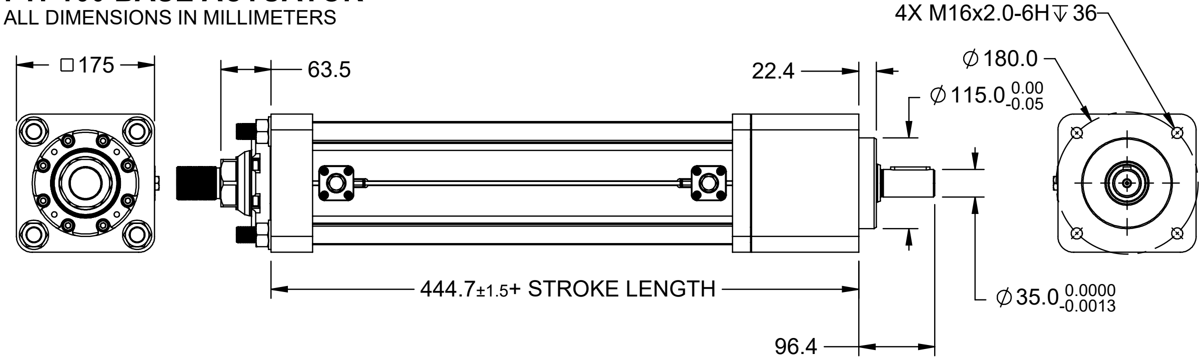


Note any system compliance in sketch

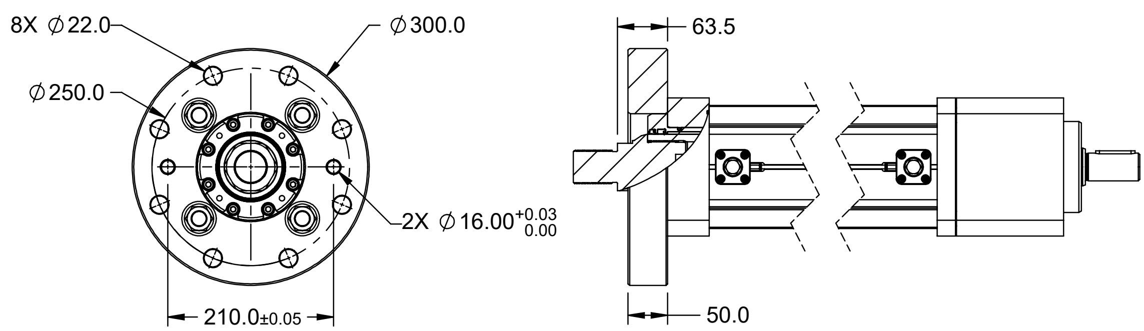
Dimensions

FTP160 BASE ACTUATOR

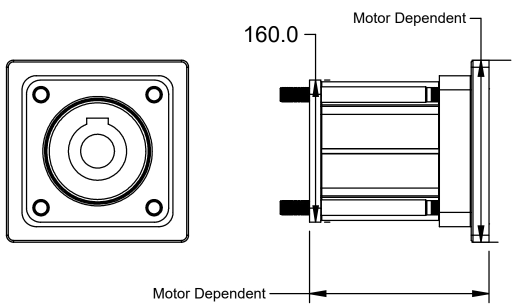
ALL DIMENSIONS IN MILLIMETERS



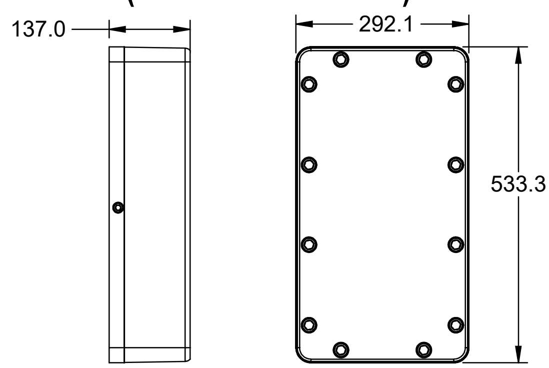
1 (FRONT FLANGE)



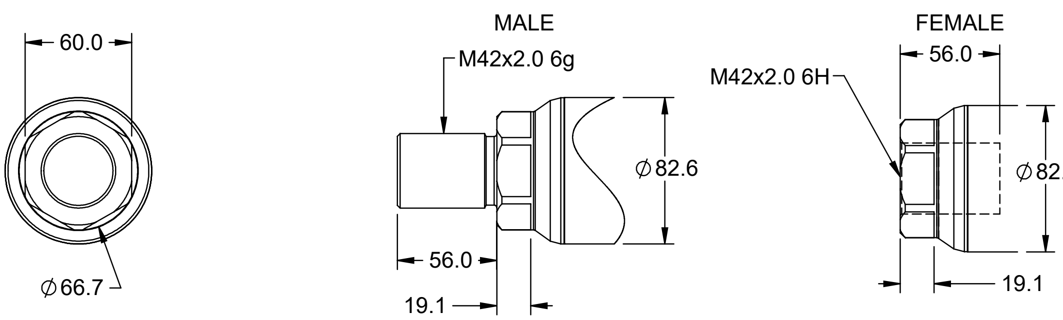
N10 (INLINE MOUNT)



P10 (PARALLEL MOUNT)

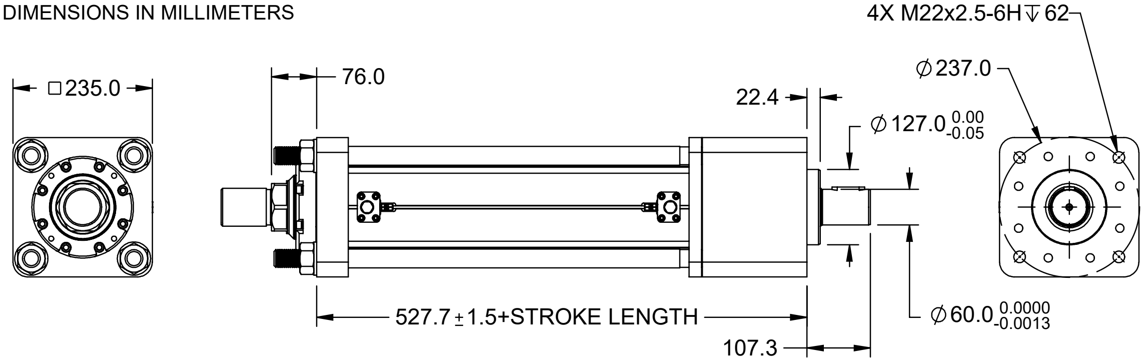


ROD ENDS

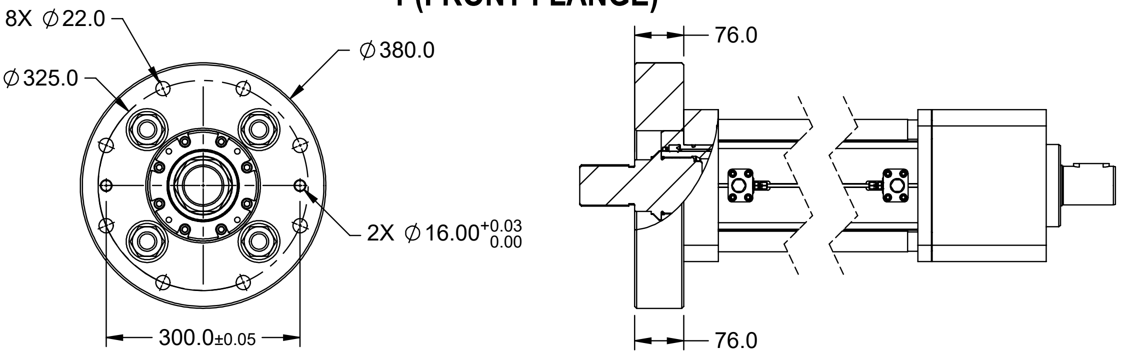


FTP215 BASE ACTUATOR

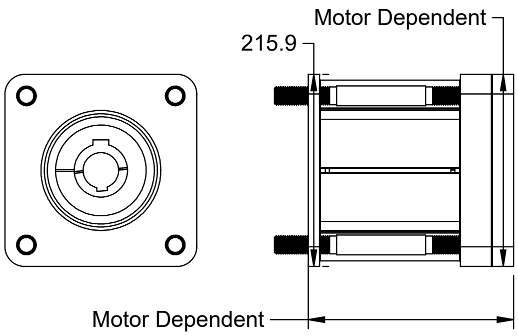
ALL DIMENSIONS IN MILLIMETERS



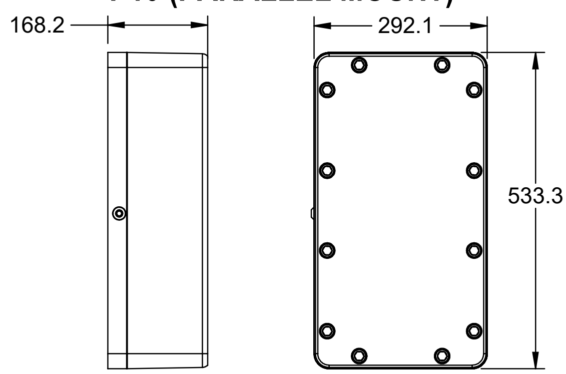
1 (FRONT FLANGE)



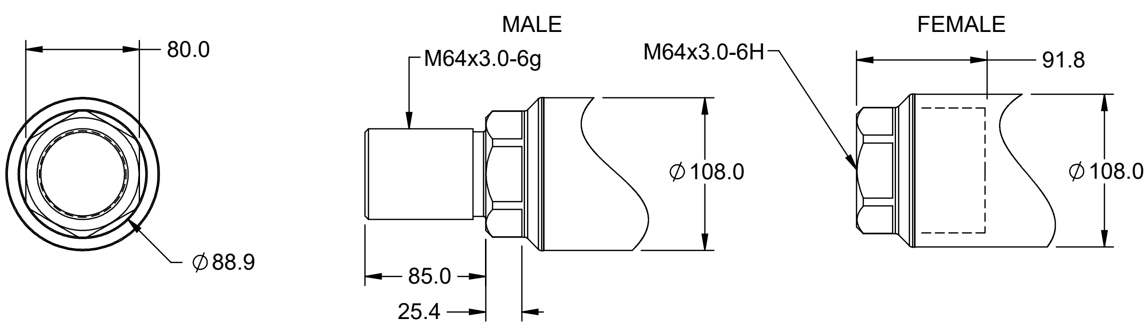
N10 (INLINE MOUNT)



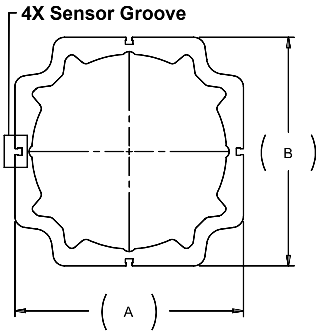
P10 (PARALLEL MOUNT)

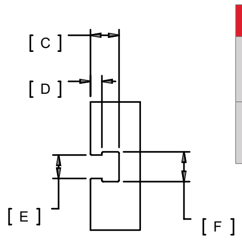


ROD ENDS



Case Dimensions





Detail 4X Sensor Groove

		A	B	C	D	E	F
FTP160	mm	156	156	5.5	1.7	5.3	6.6
	in	6.1	6.1	0.22	0.07	0.21	0.26
FTP215	mm	203	203	6.4	2.5	5.2	6.6
	in	8.0	8.0	0.25	0.10	0.21	0.26

Standard Gearbox Mount Codes for the FTP

FTP160 Gearbox Mounts

None		Inline				Parallel 1:1			
				Dimension in mm				Dimension in mm	
Motor Flange Code		**Motor Flange Code**		Bolt Circle	Pilot Diam.	**Motor Flange Code**		Bolt Circle	Pilot Diam.
NMT-	00	N10-	19	165	130	P10-	19	165	130
		N10-	22	215	160	P10-	22	215	160
Motor Shaft Code		**Motor Shaft Code**		Shaft Diam.	Key Width	**Motor Shaft Code**		Shaft Diam.	Key Width
00		QA		40	12	QA		40	12
		UA		55	16	UA		55	16
Shaft Length		**Shaft Length**				**Shaft Length**			
000		080, 082, 085, 088, 097, 100, 105, 110, 112, 113, 116		* Pick closest shaft length within 2mm if your exact length is not listed		060-124		* Allowable shaft length range in 1 mm increments	

FTP215 Gearbox Mounts

None		Inline				Parallel 1:1			
				Dimension in mm				Dimension in mm	
Motor Flange Code		**Motor Flange Code**		Bolt Circle	Pilot Diam.	**Motor Flange Code**		Bolt Circle	Pilot Diam.
NMT-	00	N10-	19	165	130	P10-	19	165	130
		N10-	22	215	160	P10-	22	215	160
		N10-	27	250	180	P10-	27	250	180
Motor Shaft Code		**Motor Shaft Code**		Shaft Diam.	Key Width	**Motor Shaft Code**		Shaft Diam.	Key Width
00		QA		40	12	QA		40	12
		UA		55	16	UA		55	16
		XA		75	20	XA		75	20
Shaft Length		**Shaft Length**				**Shaft Length**			
000		080, 082, 085, 097, 100, 102, 105, 110, 112, 116, 140		* Pick closest shaft length within 2mm if your exact length is not listed		070-155		* Allowable shaft length range in 1 mm increments	

FTP AAA – BBBB – CC – D – E – FFF – GG – HH – III – M – N

Actuator Type & Frame Size
Stroke Length
Screw Lead
Lubrication Type
Rod End Thread
Gearbox Mounting Configurations
Gearbox Flange Code
Gearbox Shaft Code
Shaft Length
Mounting Options
Other Options

AAA = Frame Size
160 = 160 mm
215 = 215 mm

BBBB = Stroke Length
0150 = 150 mm
0300 = 300 mm
0600 = 600 mm
0900 = 900 mm (FTP160 only)

CC = Screw Lead
12 = 12 mm

D = Lubrication Type
2 = Oil

E = Rod End Thread
A = Male, Metric
B = Female, Metric

FFF = Motor Mounting Configurations[1]
NMT = None, base unit only
N10 = Inline, includes shaft coupling
P10 = Parallel, 1:1 belt reduction

GG = Motor/Gearbox Flange Code
See standard gearbox mounting code dimension sheet

HH = Motor Shaft Code
See standard gearbox mounting code dimension sheet

III = Shaft Length
See standard gearbox mounting code dimension sheet

M = Mounting Option
1 = Front Flange, Metric (Required)

N = Other Options
N = None

NOTES:
1. Always discuss your motor selection with your local sales representative.

FTP Series Accessories

Limit Switches	
Part Number	**Description**
43403	Normally Open PNP Limit Switch (10-30 VDC, 1m. 3 wire embedded cable)
43404	Normally Closed PNP Limit Switch (10-30 VDC, 1m. 3 wire embedded cable)
67634	Normally Open NPN Limit Switch (10-30 VDC, 1m. 3 wire embedded cable)
67635	Normally Closed NPN Limit Switch (10-30 VDC, 1m. 3 wire embedded cable)

For options or specials not listed above, please contact Exlar

Sizing and Selection of Exlar Linear and Rotary Actuators

Move Profiles

The first step in analyzing a motion control application and selecting an actuator is to determine the required move profile. This move profile is based on the distance to be traveled and the amount of time available in which to make that move. The calculations below can help you determine your move profile.

Each motion device will have a maximum speed that it can achieve for each specific load capacity. This maximum speed will determine which type of motion profile can be used to complete the move. Two common types of move profiles are trapezoidal and triangular. If the average velocity of the profile, is less than half the maximum velocity of the actuator, then triangular profiles can be used. Triangular Profiles result in the lowest possible acceleration and deceleration. Otherwise a trapezoidal profile can be used. The trapezoidal profile below with 3 equal divisions will result in 25% lower maximum speed and 12.5% higher acceleration and deceleration. This is commonly called a 1/3 trapezoidal profile.

The following pages give the required formulas that allow you to select the proper Exlar linear or rotary actuator for your application. The first calculation explanation is for determining the required thrust in a linear application.

The second provides the necessary equations for determining the torque required from a linear or rotary application. For rotary applications this includes the use of reductions through belts or gears, and for linear applications, through screws.

Pages are included to allow you to enter your data and easily perform the required calculations. You can also describe your application graphically and send to Exlar for sizing. Reference tables for common unit conversions and motion system constants are included at the end of the section.

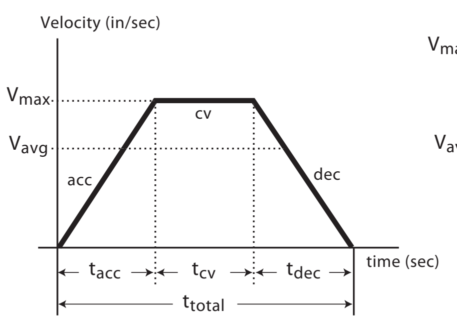
Linear Move Profile Calculations

Vmax = max.velocity-in/sec (m/sec)
Vavg = avg. velocity-in/sec (m/sec)
tacc = acceleration time (sec)
tdec = deceleration time (sec)
tcv = constant velocity (sec)
ttotal = total move time (sec)
acc = accel-in/sec^2 (m/sec^2)
dec = decel-in/sec^2 (m/sec^2)
cv = constant vel.-in/sec (m/sec)
D = total move distance-in (m) or revolutions (rotary)

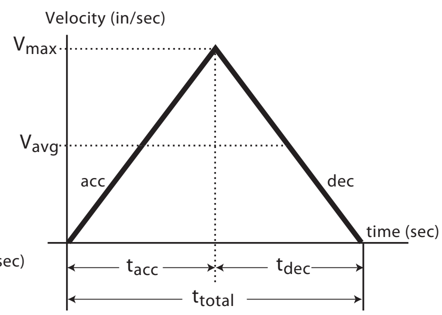
Standard Equations

Vavg = **D** / ttotal
If tacc = **t**dec **Then: V**max = (**t**total/(**t**total-tacc)(**V**avg)
and
D = Area under profile curve
D = (1⁄2(**t**acc+**t**dec)+**t**cv)(**V**max)

Trapezoidal Move Profile



Triangular Move Profile



Trapezoidal Equations

If tacc = **t**cv = **t**dec **Then:**

Vmax = 1.5 (**V**avg)

D = (2⁄3) (**t**total) (**V**max)

acc = dec = $\frac{V_{max}}{t_{acc}}$

Triangular Equations

If tacc = **t**total/2 **Then:**

Vmax = 2.0 (**V**avg)

D = (1⁄2) (**t**total) (**V**max)

acc = dec = $\frac{V_{max}}{t_{acc}}$

Terms and (units)

THRUST = Total linear force-lbf (N)

Ø = Angle of inclination (deg)

Ffriction = Force from friction-lbf (N)

tacc = Acceleration time (sec)

Facc = Acceleration force-lbf (N)

v = Change in velocity-in/sec (m/s)

Fgravity = Force due to gravity-lbf (N)

µ = Coefficient of sliding friction

Fapplied = Applied forces-lbf (N)

(refer to table on page 136 for different materials)

WL = Weight of Load-lbf (N)

g = 386.4: Acceleration of gravity - in/sec^2 (9.8 m/sec^2)

Thrust Calculation Equations

THRUST = **F**friction + [**F**acceleration] + **F**gravity + **F**applied

THRUST = **W**Lµcosø + [(**W**L /386.4) (**v**/tacc)] + **W**Lsinø + **F**applied

Sample Calculations: Calculate the thrust required to accelerate a 200 pound mass to 8 inches per second in an acceleration time of 0.2 seconds. Calculate this thrust at inclination angles(ø) of 0˚, 90˚ and 30˚. Assume that there is a 25 pound spring force that is applied against the acceleration.

WL = 200 lbm, v = 8.0 in/sec., **t**a = 0.2 sec., **F**app. = 25 lbf, µ = 0.15

ø = 0˚

THRUST = **W**Lµcosø + [(**W**L /386.4) (**v**/tacc)] + **W**Lsinø + **F**applied
= (200)(0.15)(1) + [(200/386.4)(8.0/0.2)] + (200)(0) + 25

= 30 lbs + 20.73 lbs + 0 lbs + 25 lbs = **75.73 lbs force**

ø = 90˚

THRUST = **W**Lµcosø + [(**W**L /386.4) (**v**/tacc)] + **W**Lsinø + **F**applied
= (200)(0.15)(0) + [(200/386.4)(8.0/0.2)] + (200)(1) + 25

= 0 lbs + 20.73 lbs + 200 lbs + 25 lbs = **245.73 lbs force**

ø = 30˚

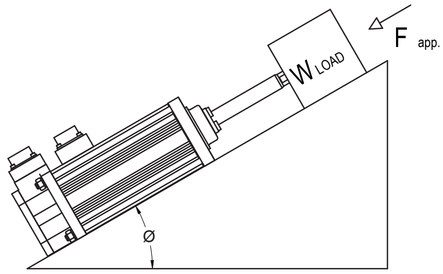
THRUST = **W**Lµcosø + [(**W**L /386.4) (**v**/tacc)] + **W**Lsinø + **F**applied
= (200)(0.15)(0.866) + [(200/386.4)(8.0/0.2)] + (200)(0.5) + 25

= 26 lbs + 20.73 lbs + 100 + 25 = **171.73 lbs force**

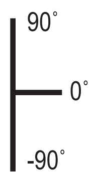
Thrust Calculations

Definition of thrust:

The thrust necessary to perform a specific move profile is equal to the sum of four components of force. These are the force due to acceleration of the mass, gravity, friction and applied forces such as cutting and pressing forces and overcoming spring forces.



Angle of Inclination



Note: at ø = 0˚
cosø = 1; sinø = 0
at ø = 90˚
cosø = 0; sinø = 1

It is necessary to calculate the required thrust for an application during each portion of the move profile, and determine the worst case criteria. The linear actuator should then be selected based on those values. The calculations at the right show calculations during acceleration which is often the most demanding segment of a profile.

Motor Torque Calculations

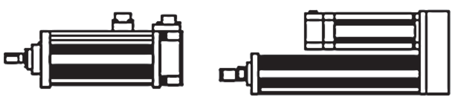
When selecting an actuator system it is necessary to determine the required motor torque to perform the given application. These calculations can then be compared to the torque ratings of the given amplifier and motor combination that will be used to control the actuator's velocity and position.

When the system uses a separate motor and screw, like the FTX actuator, the ratings for that motor and amplifier are consulted. In the case of the GTX Series actuators with their integral brushless motors, the required torque divided by the torque constant of the motor (Kt) must be less than the current rating of the GTX or SLM motor.

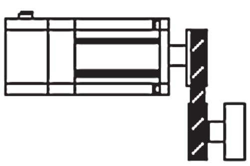
Inertia values and torque ratings can be found in the GTX, FTX, and SLM/SLG Series product specifications.

For the GTX Series the screw and motor inertia are combined.

Motor with screw (GTX, FTX)



Motor with belt and pulley



Terms and (units)

λ	=	Required motor torque, lbf-in (N-m)
λa	=	Required motor acceleration torque, lbf-in (N-m)
F	=	Applied force load, non inertial, lbf (kN)
ℓ	=	Screw lead, in (mm)
R	=	Belt or reducer ratio
TL	=	Torque at driven load lbf-in (N-m)
vL	=	Linear velocity of load in/sec (m/sec)
ωL	=	Angular velocity of load rad/sec
ωm	=	Angular velocity of motor rad/sec
η	=	Screw or ratio efficiency
g	=	Gravitational constant, 386.4 in/s^2 (9.75 m/s^2)
α	=	Angular acceleration of motor, rad/s^2
m	=	Mass of the applied load, lb (N)
JL	=	Reflected Inertia due to load, lbf-in-s^2 (N-m-s^2)
Jr	=	Reflected Inertia due to ratio, lbf-in-s^2 (N-m-s^2)
Js	=	Reflected Inertia due to external screw, lbf-in-s^2 (N-m-s^2)
Jm	=	Motor armature inertia, lbf-in-s^2 (N-m-s^2)
L	=	Length of screw, in (m)
ρ	=	Density of screw material, lb/in^3 (kg/m^3)
r	=	Radius of screw, in (m)
π	=	pi (3.14159)
C_a	=	Dynamic load rating, lbf (N)

Velocity Equations

Screw drive: $V_L = \omega m * S / 2\pi$ in/sec (m/sec)

Belt or gear drive: $\omega m = \omega_L * R$ rad/sec

Torque Equations

Torque Under Load

Screw drive (GS, FT or separate screw): $\lambda = \dfrac{S \cdot F}{2 \cdot \pi \cdot \eta}$ lbf-in (N-**m**)

Belt and Pulley drive: $\lambda = T_L / R\,\eta$ lbf-in (N-**m**)

Gear or gear reducer drive: $\lambda = T_L / R\,\eta$ lbf - in (N-**m**)

Torque Under Acceleration

$\lambda a = (J_m + J_R + (J_s + J_L)/R^2)\alpha$ lbf-in

α = angular acceleration = ((RPM / 60) x 2π) / t_{acc}, rad/sec^2.

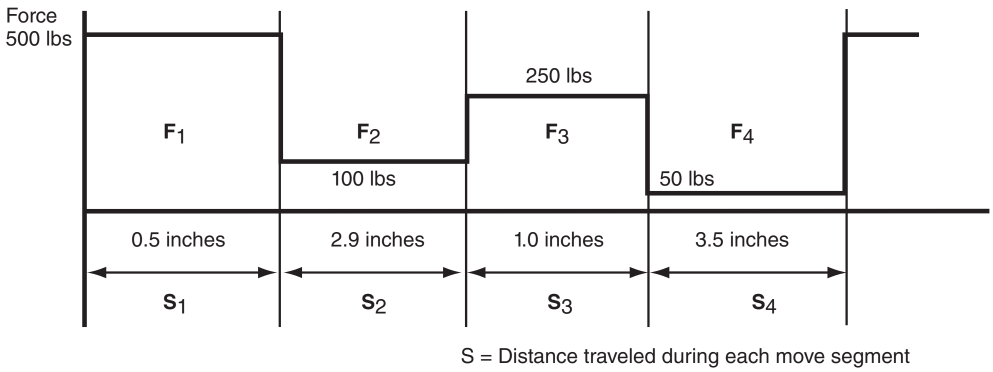
$J_S = \dfrac{\pi \cdot L \cdot \rho \times r^4}{2 \cdot g}$ lb - in - s^2 (N - **m** - s^2)

Total Torque per move segment

$\lambda T = \lambda a + \lambda$ lbf-in (N-m)

Mean Load Calculations

For accurate lifetime calculations of a roller screw in a linear application, the cubic mean load should be used. Following is a graph showing the values for force and distance as well as the calculation for cubic mean load. Forces are shown for example purposes. Negative forces are shown as positive for calculation.



Cubic Mean Load Equation

$$F_{cml} = \sqrt[3]{\frac{F_1^3 S_1 + F_2^3 S_2 + F_3^3 S_3 + F_4^3 S_4}{S_1 + S_2 + S_3 + S_4}}$$

Value from example numbers is 217 lbs.

Lifetime Calculations

The expected $\mathbf{L}_{10}$ life of a roller screw is expressed as the linear travel distance that 90% of the screws are expected to meet or exceed before experiencing metal fatigue. The mathematical formula that defines this value is below. The life is in millions of inches (mm). This standard $\mathbf{L}_{10}$ life calculation is what is expected of 90% of roller screws manufactured and is not a guarantee. Travel life estimate is based on a properly maintained screw that is free of contaminants and properly lubricated. Higher than 90% requires de-rating according to the following factors:

95% x 0.62	96% x 0.53
97% x 0.44	98% x 0.33
99% x 0.21	

Single (non-preloaded) nut:

$$L_{10} = \left(\frac{C_a}{F_{cml}}\right)^3 \times \ell$$

Short Stroke Lifetime Calculations

If your application requires high force over a stroke length shorter than the length of the rollers/nut, please contact Exlar for derated life calculations. You may also download the article “Calculating Life Expectency” at www.exlar.com.

Note: The dynamic load rating of zero backlash, preloaded screws is 63% of the dynamic load rating of the standard non-preloaded screws. The calculated travel life of a preloaded screw will be 25% of the calculated travel life of the same size and lead of a non-preloaded screw for the same application.

Elevated Ambient Temperature Operation

The speed/torque curves are based on 25° C ambient conditions. The actuators may be operated at ambient temperatures up to 85° C.

Elevated Ambient Temp Factor (%) =

$$100\% \text{ X } \sqrt{\frac{\text{Max Rated Temp [~130° C] - Environment Temp [in °C]}}{\text{Max Rated Temp [~130° C] - Rated Ambient [~25° C]}}} =$$

$$100\% \text{ X } \sqrt{\frac{\text{130° C - Environment Temp}}{\text{105° C}}}$$ = % of published continuous @ 25° C

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Total Thrust Calculations

Terms and (units)

THRUST = Total linear force-lbf (N)

$\mathbf{F}_{friction}$ = Force from friction-lbf (N)

$\mathbf{F}_{acc}$ = Acceleration force-lbf (N)

$\mathbf{F}_{gravity}$ = Force due to gravity-lbf (N)

$\mathbf{F}_{applied}$ = Applied forces-lbf (N)

386.4 = Acceleration of gravity - in/sec^2 (9.8 m/sec^2)

Variables

Ø = Angle of inclination - deg...................... = _______

tacc = Acceleration time - sec......................... = _______

v = Change in velocity - in/sec (m/s)........... = _______

µ = Coefficient of sliding friction .... = _______

$\mathbf{W}_L$ = Weight of Load-lbm (kg)....................... = _______

$\mathbf{F}_{applied}$ = Applied forces-lbf (N) .... = _______

Thrust Calculation Equations

$$\mathbf{THRUST} = [\ \mathbf{F}_{friction}\ ] + [\ \mathbf{F}_{acceleration}\ ] + \mathbf{F}_{gravity} + \mathbf{F}_{applied}$$

$$\mathbf{THRUST} = [\ \mathbf{W}_L \times \mu \times \cos ø\ ] + [(\ \mathbf{W}_L / 386.4) \times (\mathbf{v} / \mathbf{t}_{acc})] + \mathbf{W}_L \sin ø + \mathbf{F}_{applied}$$

THRUST = [( )x( )x( )] + [(/386.4) x (/)] + [( ) ( )] + ( )

THRUST = [ ] + [( ) x ( )] + [ ] + ( )

= ________________ lbf.

Calculate the thrust for each segment of the move profile. Use those values in calculations below.
Use the units from the above definitions.

Cubic Mean Load Calculations

$$\sqrt[3]{\frac{\mathbf{F}_1^3\,\mathbf{S}_1 + \mathbf{F}_2^3\,\mathbf{S}^2 + \mathbf{F}_3^3\,\mathbf{S}_3 + \mathbf{F}_4^3\,\mathbf{S}_4}{\mathbf{S}_1 + \mathbf{S}_2 + \mathbf{S}_3 + \mathbf{S}_4}}$$

$\mathbf{F}_1$= __________	$\mathbf{S}_1$= __________	$\mathbf{F}_1^3\,\mathbf{S}_1$ = __________
$\mathbf{F}_2$= __________	$\mathbf{S}_2$= __________	$\mathbf{F}_2^3\,\mathbf{S}_2$ = __________
$\mathbf{F}_3$= __________	$\mathbf{S}_3$= __________	$\mathbf{F}_3^3\,\mathbf{S}_3$ = __________
$\mathbf{F}_4$= __________	$\mathbf{S}_4$= __________	$\mathbf{F}_4^3\,\mathbf{S}_4$ = __________

Move Profiles may have more or less than four components. Adjust your calculations accordingly.

Torque Calculations

Terms and (units)

λ	= Torque, lb-in (N-m)	= ----------------------
F	= Applied Load, non inertial, lbf (N)	= ----------------------
S	= Screw lead, in (m)	= ----------------------
η	= Screw or ratio efficiency (~85% for roller screws)	= ----------------------
g	= Gravitational constant, 386 in/s2 (9.8 m/s2)	= ----------------------
α	= Acceleration of motor, rad/s2	= ----------------------
R	= Belt or reducer ratio	= ----------------------
$\mathbf{T}_L$	= Torque at driven load, lbf-in (N-m)	= ----------------------
$\mathbf{V}_L$	= Linear velocity of load, in/sec (m/sec)	= ----------------------
ω_L	= Angular velocity of load, rad/sec	= ----------------------
ω_m	= Angular velocity of motor, rad/sec	= ----------------------
m	= Mass of the applied load, lbm (kg)	= ----------------------
$\mathbf{J}_R$	= Reflected Inertia due to ratio, lb-in-s2 (N-m-s2)	= ----------------------
$\mathbf{J}_S$	= Reflected Inertia due to screw, lb-in-s2 (N-m-s2)	= ----------------------
$\mathbf{J}_L$	= Reflected Inertia due to load, lb-in-s2(N-m-s2)	= ----------------------
$\mathbf{J}_M$	= Motor armature inertia, lb-in-s2 (N-m-s2)	= ----------------------
π	= pi	= 3.14159
$\mathbf{K}_t$	= Motor Torque constant, lb-in/amp (N-m/amp)	= ----------------------

* For the GS Series J_S and J_M are one value from the GS Specifications.

Torque Equations

Torque From Calculated Thrust.

$\lambda = \frac{SF}{2 \cdot \pi \cdot \eta}$ lb - in (N - m) = ( ) x ( )/2π (0.85) = ( ) x ( )/5.34 = ------------------------------

Torque Due To Load, Rotary.

Belt and pulley drive: $\lambda = T_L / R\,\eta$ lbf-in (N-m)

Gear or gear reducer drive: $\lambda = T_L / R\eta$ lbf-in (N-m)

Torque During Acceleration due to screw, motor, load and reduction, linear or rotary.

$I = (\mathbf{J}_m + (\mathbf{J}_S + \mathbf{J}_L) / \mathbf{R}^2)\,\alpha$ lb-in (N-**m**) = [( ) + (+) / ( )] ( ) = ------------------------

Total Torque = Torque from calculated Thrust + Torque due to motor, screw and load

( ) + ( ) + ( ) = ________________

Motor Current = $\lambda / \mathbf{K}_t$ = ( ) / ( ) = ___________________

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Exlar Application Worksheet

Send to:
Exlar Automation
Email: cha_applications@curtisswright.com
Fax: (952) 368-4877
Attn: Applications Engineering

Date: ______________________________ Company Name: ____

Address: ____

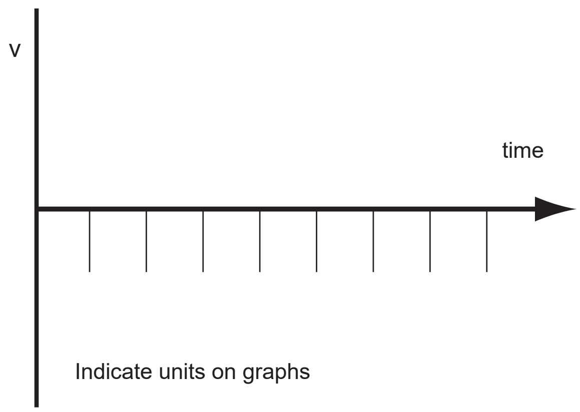
City: ____ State: ______________________ Zip Code: __________

Phone: ____ Fax: ____

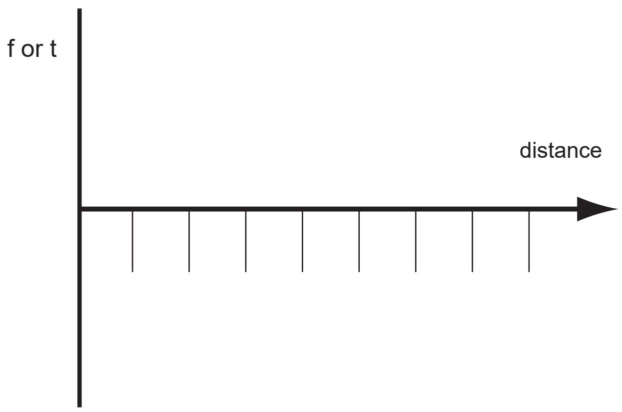
Contact: ____ Title: ____

Sketch/Describe Application

Velocity vs. Time



Force or Torque vs. Distance



Exlar Application Worksheet

Date: ____________________ Contact: ___________________________ Company: __________________________

Stroke & Speed Requirements

Maximum Stroke Needed .... __________________ inches (mm), revs

Index Stroke Length .... __________________ inches (mm), revs

Index Time .... __________________ sec

Max Speed Requirements .... __________________ in/sec (mm/sec), revs/sec

Min Speed Requirements .... __________________ in/sec (mm/sec), revs/sec

Required Positional Accuracy .... __________________ inches (mm), arc min

Load & Life Requirements

Gravitational Load .... _________________ lb (N)

External Applied Load .... _________________ lbf (N)

Inertial Load .... _________________ lbf (N)

Friction Load .... _________________ lbf (N)

Rotary Inertial Load .... _________________ lbf-in-sec^2 (Kg-m^2)

or rotary mass, radius of gyr. .... lb (kg) ________________ in (mm)

Side Load (rot. or lin. actuator) .... ________________ lb (N)

Force Direction _____ Extend _____ Retract _____ Both

Actuator Orientation _____ Vertical Up _____ Vertical Down _____ Horizontal

_____ Fixed Angle _____ Degrees from Horizontal

_____ Changing Angle _____ to _____

Cycling Rate .... ___________________ Cycles/min/hr/day

Operating Hours per Day .... ___________________ Hours

Life Requirement .... ___________________ Cycles/hr/inches/mm

---

Configuration

Mounting: _____ Side _____ Flange _____ Ext Tie Rod _____ Clevis _____ Trunnion

Rod End: _____ Male _____ Female _____ Sph Rod Eye _____ Rod Eye _____ Clevis

Rod Rotation Limiting: _____ Appl Inherent _____ External Required

Holding Brake Required: _____ Yes _____ No

Cable Length: _________ ft (m)

Rotary Inertia
To obtain a conversion from A to B, multiply by the value in the table.

B	Kg-m^2	Kg-cm^2	g-cm^2	kgf-m-s^2	kgf-cm-s^2	gf-cm-s^2	oz-in^2	ozf-in-s^2	lb-in^2	lbf-in-s^2	lb-ft^2	lbf-ft-s^2
A												
Kg-m^2	1	10^{4}	10^{7}	0.10192	10.1972	$1.01972x10^{4}$	$5.46745x10^{4}$	$1.41612x10^{2}$	$3.41716x10^{3}$	8.850732	23.73025	0.73756
Kg-cm^2	10^{-4}	1	10^{3}	$1.01972x10^{5}$	$1.01972x10^{3}$	1.01972	5.46745	$1.41612x10^{-2}$	0.341716	$8.85073x10^{-4}$	$2.37303x10^{-3}$	$7.37561x10^{-5}$
g-cm^2	10^{-7}	10^{-3}	1	$1.01972x10^{-8}$	$1.01972x10^{-6}$	$1.01972x10^{-3}$	$5.46745x10^{-3}$	$1.41612x10^{-5}$	$3.41716x10^{-4}$	$8.85073x10^{-7}$	$2.37303x10^{-6}$	$7.37561x10^{-8}$
kgf-m-s^2	9.80665	$9.80665x10^{4}$	$9.80665x10^{7}$	1	10^{2}	10^{5}	$5.36174x10^{5}$	$1.388674x10^{3}$	$3.35109x10^{4}$	86.79606	$2.32714x10^{2}$	7.23300
kgf-cm-s^2	$9.80665x10^{-2}$	$9.80665x10^{2}$	$9.80665x10^{5}$	10^{-2}	1	10^{5}	$5.36174 x10^{3}$	13.8874	$3.35109x10^{-2}$	0.86796	2.32714	$7.23300x10^{-2}$
gf-cm-s^2	9.80665x10-5	0.980665	$9.80665x10^{2}$	10^{-5}	10^{-3}	1	5.36174	$1.38874 x10^{-2}$	0.335109	$8.67961x10^{-4}$	$2.32714x10^{-3}$	$7.23300x10^{-5}$
oz-in^2	$1.82901x10^{-5}$	0.182901	$1.82901x10^{2}$	$1.86505x10^{-6}$	$1.86505x10^{-4}$	0.186506	1	$2.59008 x10^{-3}$	$6.25 x10^{-2}$	$1.61880x10^{-4}$	$4.34028x10^{-4}$	$1.34900x10^{-3}$
oz-in-s^2	$7.06154x10^{-3}$	70.6154	$7.06154x10^{4}$	$7.20077x10^{4}$	$7.20077x10^{-2}$	72.0077	$3.86089x10^{2}$	1	24.13045	$6.25 x10^{-2}$	0.167573	$5.20833x10^{-4}$
lb-in^2	$2.92641x10^{-4}$	2.92641	$2.92641x10^{3}$	$2.98411x10^{5}$	$2.98411x10^{3}$	2.98411	16	$4.14414 x10^{2}$	1	$2.59008x10^{-3}$	$6.94444x10^{-3}$	$2.15840x10^{-4}$
lbf-in-s^2	0.112985	$1.129x10^{3}$	$1.12985x10^{6}$	$1.15213x10^{2}$	1.15213	$1.51213 x10^{3}$	$6.1774 x10^{3}$	16	$3.86088x10^{2}$	1	2681175	$8.3333x10^{-2}$
lbf-ft^2	$4.21403x10^{-2}$	$4.21403x10^{2}$	$4.21403x10^{5}$	$4.29711x10^{3}$	0.429711	4.297114	$2.304 x10^{3}$	5.96755	144	0.372971	1	$3.10809x10^{-2}$
lbf-ft-s^2	1.35583	$1.35582x10^{4}$	$1.35582x10^{7}$	0.138255	13.82551	$1.38255x10^{4}$	$7.41289x10^{4}$	192	$4.63306x10^{3}$	12	32.17400	1

Torque
To obtain a conversion from A to B, multiply A by the value in the table.

B	N-m	N-cm	dyn-cm	Kg-m	Kg-cm	g-cm	oz-in	ft-lb	in-lb
A									
N-m	1	10^{-2}	10^{7}	0.109716	10.19716	$1.019716 x10^{4}$	141.6199	0.737562	8.85074
N-cm	102	1	10^{5}	$1.019716 x10^{3}$	0.1019716	$1.019716 x10^{2}$	1.41612	$7.37562 x10^{-3}$	$8.85074 x10^{-2}$
dyn-cm	10-7	10^{-5}	1	$1.019716 x10^{-8}$	$1.019716 x10^{-6}$	$1.019716 x10^{-3}$	$1.41612 x10^{-5}$	$7.2562 x10^{-8}$	$8.85074 x10^{-7}$
Kg-m	9.80665	$980665x10^{2}$	$9.80665 x10^{7}$	1	10^{2}	10^{5}	$1.38874 x10^{3}$	7.23301	86.79624
Kg-cm	9.80665x10-2	9.80665	$9.80665 x10^{5}$	10^{-2}	1	10^{3}	13.8874	$7.23301 x10^{-2}$	0.86792
g-cm	9.80665x10-5	$9.80665x10^{-3}$	$9.80665 x10^{2}$	10^{-5}	10^{-3}	1	$1.38874 x10^{-2}$	$7.23301 x10^{-5}$	$8.679624 x10^{-4}$
oz-in	7.06155x10-3	0.706155	$7.06155 x10^{4}$	$7.20077 x10^{-4}$	$7.20077 x10^{-2}$	72,077	1	$5.20833 x10^{-3}$	$6.250 x10^{-2}$
ft-lb	1.35582	$1.35582x10^{2}$	$1.35582 x10^{7}$	0.1382548	13.82548	$1.382548 x10^{4}$	192	1	12
in-lb	0.113	11.2985	$1.12985 x10^{6}$	$1.15212 x10^{-2}$	1.15212	$1.15212 x10^{3}$	16	$8.33333 x10^{-2}$	1

Common Material Densities

Material	oz/in^3	gm/cm^3
Aluminum (cast or hard drawn)	1.54	2.66
Brass (cast or rolled)	4.80	8.30
Bronze (cast)	4.72	8.17
Copper (cast or hard drawn)	5.15	8.91
Plastic	0.64	1.11
Steel (hot or cold rolled)	4.48	7.75
Wood (hard)	0.46	0.80
Wood (soft)	0.28	0.58

Coefficients of Sliding Friction

Materials in contact	μ
Steel on Steel (dry)	0.58
Steel on Steel (lubricated)	0.15
Aluminum on Steel	0.45
Copper on Steel	0.36
Brass on Steel	0.44
Plastic on Steel	0.20
Linear Bearings	0.001

Standard Ratings for Exlar Actuators

The standard IP rating for Exlar Actuators is IP54S or IP65S. Ingress protection is divided into two categories: solids and liquids.

For example, in IP65S the three digits following "IP" represent different forms of environmental influence:

- The first digit represents protection against ingress of solid objects.
- The second digit represents protection against ingress of liquids.
- The suffix digit represents the state of motion during operation.

Digit 1 - Ingress of Solid Objects

The IP rating system provides for 6 levels of protection against solids.

1	Protected against solid objects over 50 mm e.g. hands, large tools.
2	Protected against solid objects over 12.5 mm e.g. hands, large tools.
3	Protected against solid objects over 2.5 mm e.g. large gauge wire, small tools.
4	Protected against solid objects over 1.0 mm e.g. small gauge wire.
5	Limited protection against dust ingress.
6	Totally protected against dust ingress.

Digit 2 - Ingress of Liquids

The IP rating system provides for 9 levels of protection against liquids.

1	Protected against vertically falling drops of water or condensation.
2	Protected against falling drops of water, if the case is positioned up to 15 degrees from vertical.
3	Protected against sprays of water from any direction, even if the case is positioned up to 60 degrees from vertical.
4	Protected against splash water from any direction.
5	Protected against low pressure water jets from any direction. Limited ingress permitted.
6	Protected against high pressure water jets from any direction. Limited ingress permitted.
7	Protected against short periods (30 minutes or less) of immersion in water of 1m or less.
8	Protected against long durations of immersion in water.
9	Protected against high-pressure, high-temperature wash-downs.

Suffix

S	Device standing still during operation	M	Device moving during operation

Notes

1. OFFER AND ACCEPTANCE: These terms and conditions constitute Seller's offer to Buyer and acceptance by Buyer and any resulting sale is expressly limited to and conditioned upon Seller's terms and conditions as set forth below. If Buyer objects to any of Seller's terms and conditions, such objections must be expressly stated and brought to the attention of Seller in a written document which is separate from any purchase order or other printed form of Buyer. Such objections, or the incorporation of any additional or different terms or conditions by Buyer into a resulting order shall constitute non-acceptance of these Terms and Conditions, releasing Seller from any obligation or liability hereunder and a proposal for different terms and conditions which shall be objected to by Seller unless expressly accepted in writing by an authorized representative of Seller. Acknowledgment copy, if any, shall not constitute acceptance by Seller of any additional or different terms or conditions, nor shall Seller's commencement of effort, in itself, be construed as acceptance of an order containing additional or different terms and conditions.

2. PRICES: Published prices and discount schedules are subject to change without notice. They are prepared for the purpose of furnishing general information and are not quotations or offers to sell on the part of the company.

3. TRADE TERMS: Shipment terms are FCA, shipping point (Exlar, Chanhassen, MN). FCA (Free Carrier) per Incoterms 2010 means the Seller delivers the goods, cleared for export into the custody of the first carrier named by the buyer at the named place, above. This term is suitable for all modes of transport, including carriage by air, rail, road, and containerized/multi-modal transport. Title of the merchandise transfers from Exlar Corporation to the Buyer when it is received from Exlar by the carrier. Where allowable, Exlar will arrange the transportation via the carrier specified by the Buyer. The Buyer is responsible for all costs associated with the shipment.

4. PAYMENT TERMS: Subject to approval of Buyer's credit, the full net amount of each invoice is due and payable in cash within thirty (30) days of shipment. No payment discounts are offered, and minor inadvertent administrative errors contained in an invoice are subject to correction and shall not constitute reason for untimely payment. If, in the judgment of the Seller, the financial credit of Buyer at any time does not justify continuance of production or shipment of any product(s) on the payment terms herein specified, Seller may require full or partial payment prior to completion of production or shipment, or may terminate any order, or any part thereof, then outstanding. Custom products and blanket orders are subject to payment terms: 30% due at time of order, 70% due net 30 days from shipment.

5. MINIMUM BILLING: Minimum billing will be $50.00.

6. DELAYS: Exlar shall not be liable for any defaults, damages or delays in fulfilling any order caused by conditions beyond Seller's control, including but not limited to acts of God, strike, lockout, boycott, or other labor troubles, war, riot, flood, government regulations, or delays from Seller's subcontractors or suppliers in furnishing materials or supplies due to one or more of the foregoing clauses.

7. CANCELLATIONS: All cancelled orders for standard products are subject to order cancellation charges. The minimum cancellation charge will be 20% of the order total. Standard products, if unused may be returned in accordance with the current return policy. All returns are subject to prior approval by Exlar, and return charges may apply. No return credit for any product will be issued or authorized prior to evaluation of the product by Exlar. Custom product is not returnable. Orders for custom product are not cancelable.

8. QUANTITY PRICING AND BLANKET ORDER PRICING TERMS: Blanket order quantity pricing requires a complete delivery schedule for the volume being ordered, with all units scheduled to deliver within a 15 month period from the placement of the purchase order to the final scheduled shipment. Any requests to change the delivery schedule of a blanket order must be received in writing 60 days prior to the requested change. Failure to take delivery of the entire ordered volume will result in back charges equal to the difference in quantity price between the volume ordered and the volume received times the number of units received. A cancellation charge in accordance with the cancellation policy (item 7) will apply to any reduction in delivered volume from the original ordered quantity.

For orders receiving quantity discounts, but not as scheduled blanket orders, the same quantity pricing rules apply. Failure to take delivery of the entire quantity ordered will result in back charges equal to the difference in quantity price between the volume ordered and the volume received times the number of units received. Cancellation charges in accordance with the cancellation policy (item 7) will apply to any reduction in delivered volume from the original ordered quantity. For either blanket orders or quantity orders, in addition to any applicable cancellation charges, the customer is responsible for the value of any additional inventory allocated specifically to their order. Charges for this inventory will be invoiced in addition to cancellation charges, along with any back charges for quantity variance.

9. DESTINATION CONTROL STATEMENT: Exlar products, technology or software are exported from the United States in accordance with the Export Administration Regulations (EAR) or International Traffic in Arms Regulations (ITAR) as applicable. Diversion, transfer, transshipment or disposal contrary to U.S. law is prohibited.

10. EXPORT CONTROL AND SHIPMENT REGULATIONS: Purchaser agrees at all times to comply with all United States laws and regulations as well as International Trade Laws, as they may exist from time to time, regarding export licenses or the control or regulation of exportation or re-exportation of products or technical data sold or supplied to Distributor. Seller may terminate or suspend this order, without remedy, should the Purchaser become an entity identified on any US export denial listing. Products ordered may require authorization and/or validated export license from a U.S. government agency. Seller may terminate or suspend this order, without remedy, should a government agency approval be denied.

11. GOVERNING LAW AND VENUE: This order shall be governed by, and construed in accordance with the laws of the State of Minnesota, U.S.A. All disputes shall be resolved by a court of competent jurisdiction in the trial courts of Carver County, in the State of Minnesota.

12. ATTORNEY FEES: Reasonable attorney's fees and other expenses of litigation must be awarded to the prevailing party in an action in which a remedy is sought under this order.

13. NON-WAIVER: The failure by the Seller to require performance of any provision shall not affect the Seller's right to require performance at any time thereafter, nor shall a waiver of any breach or default of this Order constitute a waiver of any subsequent breach or default or a waiver of the provision itself.

14. MERGER AND INTEGRATION: These Terms and Conditions contain the entire agreement of the parties with respect to the subject matter of this order, and supersede all prior negotiations, agreements and understandings with respect thereto. Purchase orders may only be amended by a written document duly executed by buyer and seller.

15. INDEMNITY: Buyer agrees to indemnify, defend and hold harmless Exlar from any claims, loss or damages arising out of or related to Seller's compliance with Buyer's designs, specifications or instructions in the furnishing of products to Buyer, whether based on infringement of patents, copyrights, trademark or other right of others, breach of warranty, negligence, or strict liability or other tort.

WARRANTY AND LIMITATION OF LIABILITY: Products are warranted for two years from date of manufacture as determined by the serial number on the product label. Labels are generated and applied to the product at the time of shipment. The first and second digits are the year and the third and fourth digits represent the manufacturing week. Product repairs are warranted for 90 days from the date of the repair. The date of repair is recorded within the Exlar database and tracked by individual product serial number.

Exlar Corporation warrants its product(s) to the original purchaser and in the case of original equipment manufacturers, to their original customer to be free from defects in material and workmanship and to be made only in accordance with Exlar standard published catalog specifications for the product(s) as published at the time of purchase. Warranty or performance to any other specifications is not covered by this warranty unless otherwise agreed to in writing by Exlar and documented as part of any and all contracts, including but not limited to purchase orders, sales orders, order confirmations, purchase contracts and purchase agreements. In no event shall Exlar be liable or have any responsibility under such warranty if the product(s) has been improperly stored, installed, used or maintained, or if Buyer has permitted any unauthorized modifications, adjustments and/or repairs to such product(s). Seller's obligation hereunder is limited solely to repairing or replacing (at its opinion), at the factory any product(s), or parts thereof, which prove to Seller's satisfaction to be defective as a result of defective materials, or workmanship and within the period of time, in accordance with the Seller's stated product warranty (see Terms and Conditions above), provided, however, that written notice of claimed defects shall have been given to Exlar within thirty (30) days from the date of any such defect is first discovered. The product(s) claimed to be defective must be returned to Exlar, transportation prepaid by Buyer, with written specification of the claimed defect. Evidence acceptable to Exlar must be furnished that the claimed defects were not caused by misuse, abuse, or neglect by anyone other than Exlar.

Components such as seals, wipers, bearings, brakes, bushings, gears, splines, and roller screw parts are considered wear parts and must be inspected and serviced on a regular basis. Any damage caused by failure to properly lubricate Exlar products and/or to replace wear parts at appropriate times, is not covered by this warranty. Any damage due to excessive loading is not covered by this warranty.

The use of products or components under load such that they reach the end of their expected life is a normal characteristic of the application of mechanical products. Reaching the end of a product's expected life does not indicate any defect in material or workmanship and is not covered by this warranty.

Costs for shipment of units returned to the factory for warranty repairs are the responsibility of the owner of the product. Exlar will return ship all warranty repairs or replacements via UPS Ground at no cost to the customer.

For international customers, Exlar will return ship warranty repairs or replacements via UPS Expedited Service and cover the associated shipping costs. Any VAT or local country taxes are the responsibility of the owner of the product.

The foregoing warranty is in lieu of all other warranties (except as Title), whether expressed or implied, including without limitation, any warranty of merchantability, or of fitness for any particular purpose, other than as expressly set forth and to the extent specified herein, and is in lieu of all other obligations or liabilities on the part of Exlar.

Seller's maximum liability with respect to these terms and conditions and any resulting sale, arising from any cause whatsoever, including without limitation, breach of contract or negligence, shall not exceed the price specified of the product(s) giving rise to the claim, and in no event shall Exlar be liable under this warranty otherwise for special, incidental or consequential damages, whether similar or dissimilar, of any nature arising or resulting from the purchase, installation, removal, repair, operation, use or breakdown of the product(s) or any other cause whatsoever, including negligence.

The foregoing warranty shall also apply to products or parts which have been repaired or replaced pursuant to such warranty, and within the period of time, in accordance with Seller's stated warranty.

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USA & CANADA
Exlar Automation
18400 West 77th Street
Chanhassen, MN 55317
Phone: 855-620-6200 (US & Canada)
Fax: 952-368-4877

EUROPE
Exlar Europe GmbH
Schleißheimer Str., 91a
Garching bei München D-85748
Germany
Phone: +49 6184 994730

ASIA
Exlar Asia Pacific
1007 Pine City Hotel
8 Dong An Road, Xuhui District
Shanghai 200032 China
Phone: +86 021-6495-7868

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