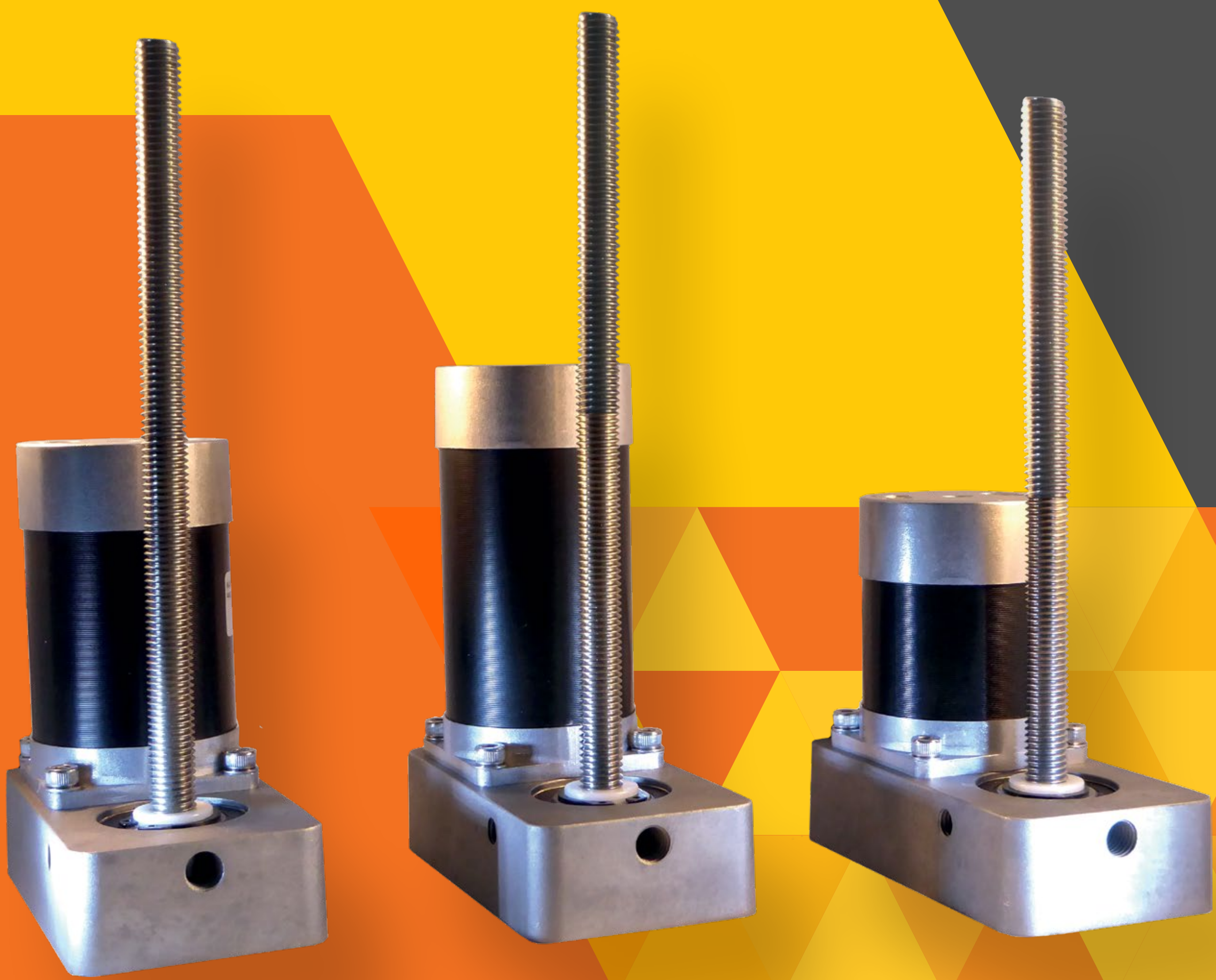
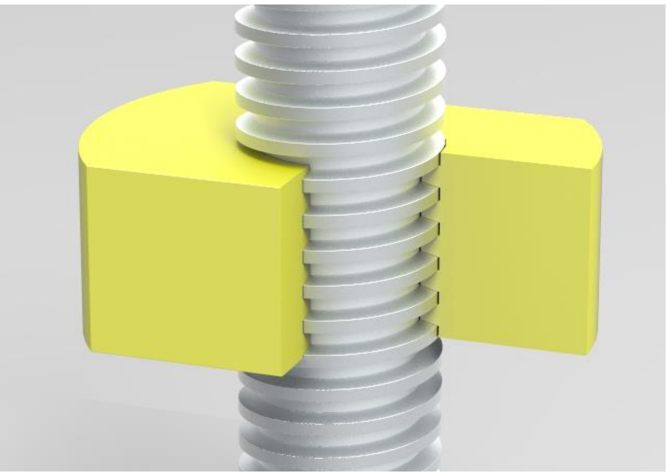
LEAD SCREW ACTUATORS



GEEPLUS Leadscrew Actuators

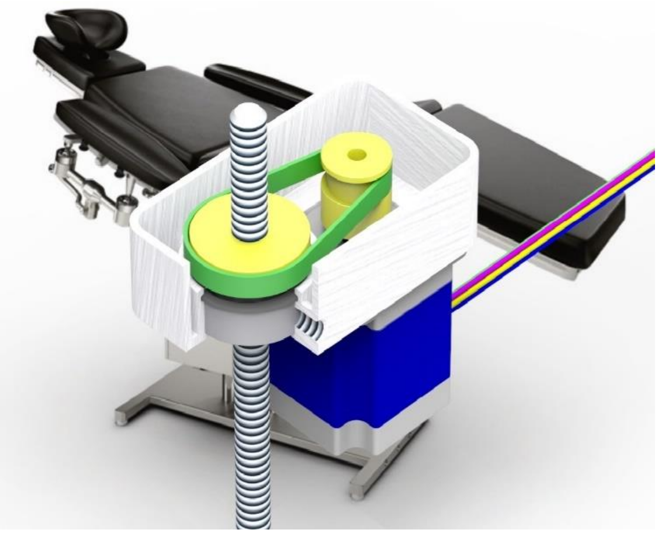
Leadscrew Actuators produce linear movement from the rotation of a rotary motor. They are used in applications including position adjustment of hospital beds and furniture, machine tool actuation, valve actuation, and others.

Options



The screw thread design, and materials and finish of the leadscrew and nut, can have a big impact on efficiency. A trapezoidal thread profile and rolled thread construction are desirable for good strength and efficiency. Low friction polymer material, or lubricated metal are desirable for the nut.

A small leadscrew diameter will reduce friction losses, but may result in higher pressure and faster wear between leadscrew and nut.



The rotating element of the actuator needs to be supported by a bearing having sufficient load capacity to support the axial load.

Different types of motor can be used. Stepping motors allow low-cost open-loop control, brushless DC motors produce less audible noise, and have higher rotational speed capability.

Where high linear forces are required, use of a timing belt reduction mechanism may be preferable to use of a small lead due to smaller friction losses. Timing belt drives are efficient and quiet.

Terminology & Design Considerations

Leadscrews and leadscrew behaviour may be described by the following terms.

Lead – the lead of a leadscrew is the linear distance moved by the non-rotating element when the other element is rotated through 1 complete revolution.

Starts – a leadscrew has one or more splines, a single-start leadscrew has one spline like a common machine screw, a twin-start or double start leadscrew has more. Larger leadscrews may have 3 or more starts. Multiple starts increase the surface area over which the load is distributed. A 3-start screw is pictured.

Thread root – for the leadscrew the thread root is the smallest diameter portion of the thread.

Thread crest – for the leadscrew the thread crest is the largest diameter portion of the thread.

Pitch – the pitch of a leadscrew is the linear distance between adjacent crests. For a single start leadscrew, this is equal to the lead. For a multiple start leadscrew with N starts, this is equal to 1/N x the lead.

Backdrive – When a force is applied to the moving element in a leadscrew system, it causes some torque to be developed which tries to turn the rotating element. In some leadscrew systems, this torque may be sufficient to overcome friction torque. A leadscrew system will be back-driven if the actuation torque is greater than the friction torque (T2 > T1). This may happen with the condition **L > π x μ x D** :

- Diameter of the leadscrew is small
- Friction co-efficient is small
- Lead is large

Theory of operation

Leadscrew actuators are based on a threaded rod and matching nut. One of these two elements is turned by a motor, either mounted directly to the motor shaft, or coupled by gears, belt, or other mechanisms. The other element is attached to the component to be moved and constrained so it cannot rotate. The relative rotation of the two elements causes a linear movement along the axis.

There are two components to the torque required to turn the rotating element of a leadscrew.

Friction torque – the load (F) applied along the axis is assumed to be applied to the outside diameter (D) of the leadscrew, acting at a radius of D/2. Where the friction co-efficient between the two elements is μ, a friction torque component (T1) is calculated as follows:

$$T1 = \mu \times F \times D/2$$

Actuation torque – the actuation torque component (T2) is calculated by equating mechanical work (assuming 100% efficiency) for 1 revolution.

The mechanical work carried out in one revolution is calculated by multiplying the load force (F) by the lead (L) of the screw elements (the displacement produced for 1 revolution).

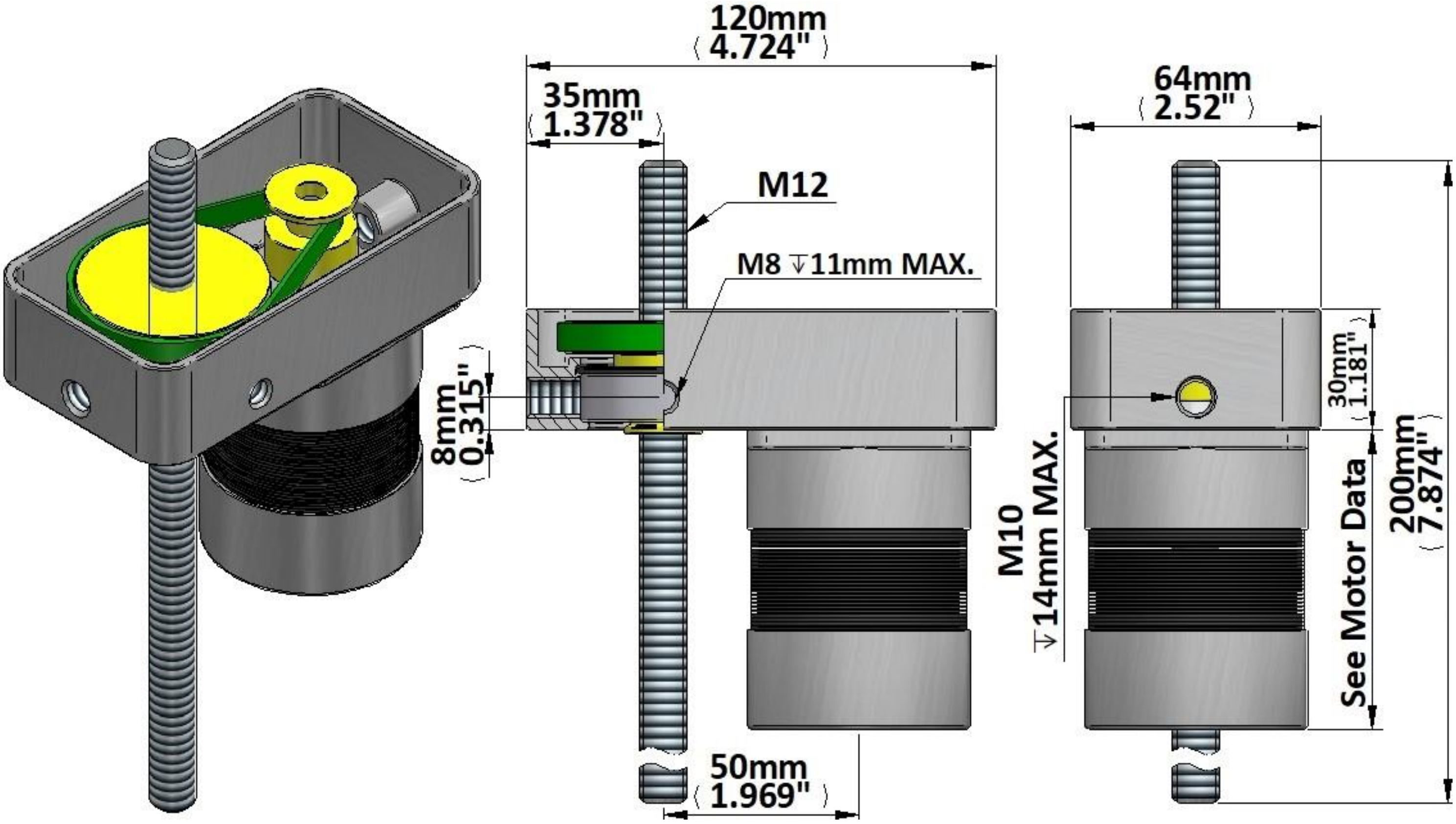
The rotary work is obtained by multiplying the actuation torque (T2) by the angle in radians (2 x π) translated in one revolution.

$$T2 = (F \times L)/(2 \times \pi)$$

So the total torque required to turn a leadscrew is given by:

$$T = 0.5 \times F \times ((\mu \times D)+(L/\pi))$$

This equation simplifies the losses due to friction, efficiency may be worse than assumed in this.



LA64120 Configuration Options

P/N	MOTOR	PULLEY RATIO	BEARING	SCREW	COMMENTS
LA64120-C10341	BLDC5775-01A	4:1	6004-2RS	M12	Standard M12 threaded rod for lowest cost
LA64120-C10342	BLDC5795-01A	4:1	6004-2RS	M12	Standard M12 threaded rod for lowest cost
LA64120-C10343	BLDC57115-01A	4:1	6004-2RS	M12	Standard M12 threaded rod for lowest cost
LA64120-C10343	BLDC57115-01A	4:1	6004-2RS	M12	Standard M12 threaded rod for lowest cost