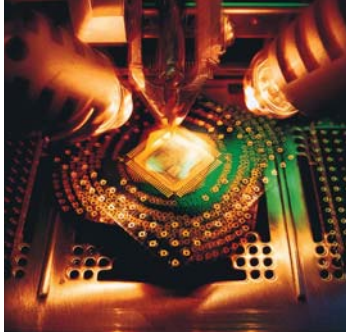

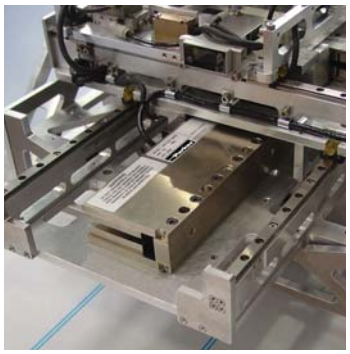

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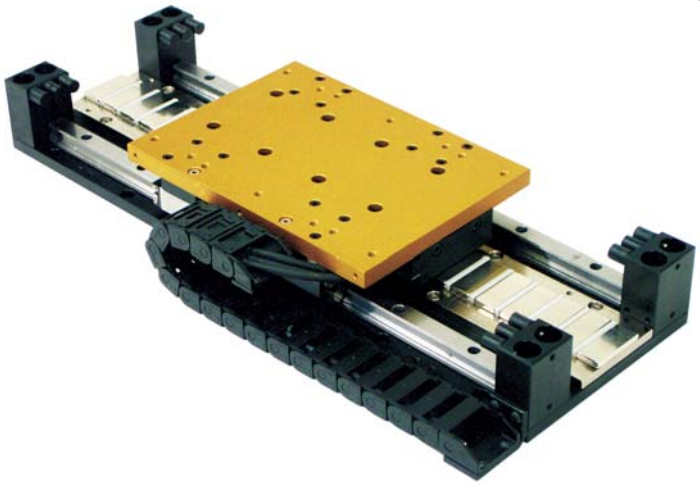
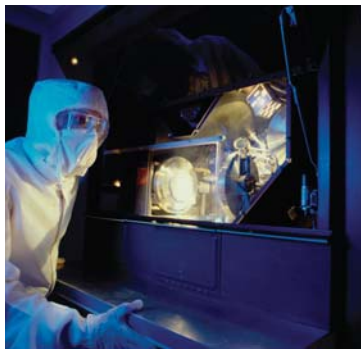


# Trilogy Linear Motor & Linear Motor Positioners



Parker

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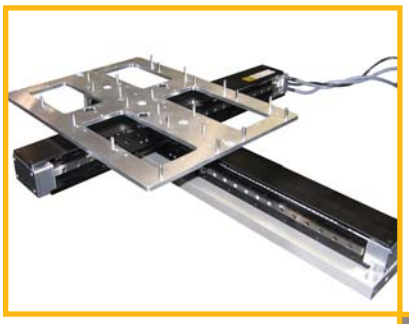
# PERFORMANCE



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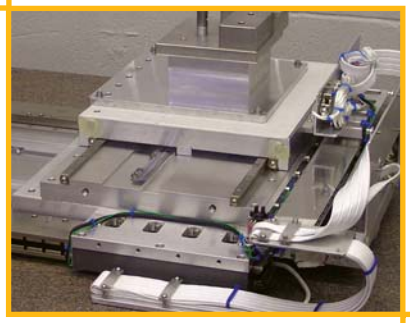

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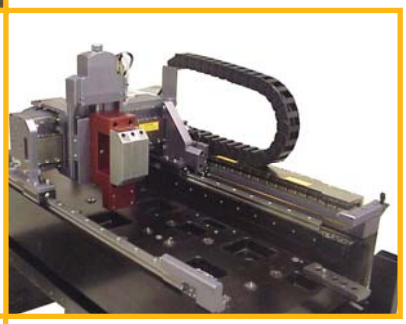

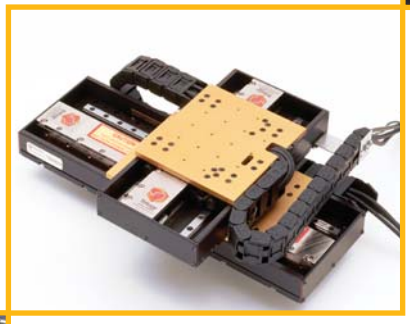

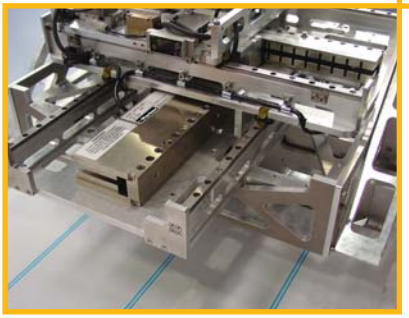

SPEED

Parker Hannifin has been providing innovative automation solutions for decades. This spirit of innovation continues within the exploding market of linear motor technology. In 2003, Parker acquired Trilogy Corporation, one of the most recognizable brands in linear motors. The powerful combination of Parker's and Trilogy's patented linear motor solutions gives automation and robotics customers distinct performance enhancements and cost of ownership benefits over competing technologies. With a full complement of linear motor components and fully engineered positioning systems, Parker has the right solution to increase productivity and to enhance the accuracy and dynamic performance of your machine.

**Linear Motor Advantages –**

- High Speeds
- High Accelerations
- Fast Response – 100 times that of a mechanical system
- Stiffness – spring rate better than a mechanical system
- Zero Backlash – direct drive technology
- Maintenance Free Operation – mechanical simplicity due to reduced component count
- Long Travels Without Performance Loss
- Suitable for Vacuum and Extreme Environments

**Applications –**

- Semiconductor and Electronics
- Flat Panel and Solar Panel Manufacturing
- Medical and Life Sciences
- Machine Tools
- Optics and Photonics
- Large Format Printing, Scanning and Digital Fabrication
- Packaging and Material Handling
- Automated Assembly

Parker has one of the broadest offerings in available linear motor technologies. From component or "kit" style motors, packaged positioning tables, to complete custom engineered systems, Parker can provide a solution for any linear motion requirement.

**Component Motors –**

- Ironless Motors – ultra high performance and zero cogging
- Ironcore Motors – highest power per package size
- Slotless Motors – good linear force, smooth translation, low cost

**Industrial Grade Positioners –**

- Pre-engineered, ready-to-run packages
- Drive / amplifier connectorization
- High dynamic velocity and accelerations
- High precision

**Precision Grade Positioners –**

- Pre-engineered, ready to run packages
- Drive / amplifier connectorization
- Extremely high precision
- Miniature positioners available

**Multi-axis Capability –**

- Standard transition brackets available
- Custom configurations
- Dowel pinning for superior orthogonality
- Cable Management

**Custom Engineered Systems –**

- Let Parker's extensive motion design experience, systematic project management process, and global infrastructure solve your most demanding motion problems.
- Collaborative development cycle aligns customer goals and rigorous performance specifications with a complete engineered solution.

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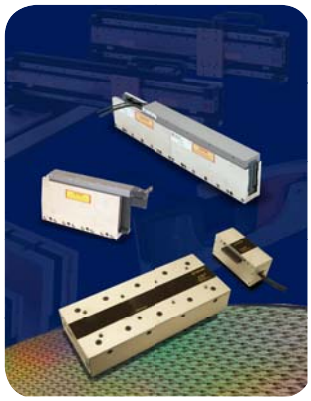


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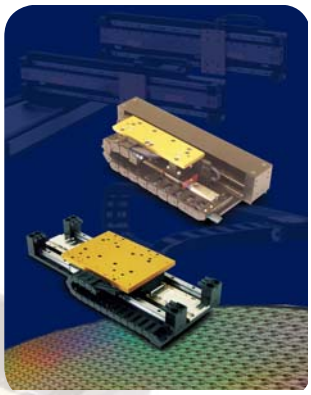


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# Linear Motor Engineering Reference Guide

## 1. Advantages of linear motors

### 1.1 What are linear motors?

Simply stated, a linear motor is the same as a rotary motor that has been "unwrapped." They operate exactly the same as rotary motors, where the same electromagnetic equations that describe how a rotary motor produces torque now describe how a linear motor produces a direct force.

In many applications, linear motors offer distinct advantages over conventional rotary drive systems. When using a linear motor, there is no need to couple the motor to the load by means of intermediate mechanical components such as gears, ballscrews, or belt drives. The load is directly connected to the motor. Therefore, there is no backlash or elasticity from the moving elements. Thus, the dynamic behavior of the servo control is improved and higher levels of accuracy are achieved.

The absence of a mechanical transmission component results in a drive system with low inertia and noise. In addition, mechanical wear only occurs in the guidance system. As a result, linear motors have better reliability and lower frictional losses than traditional rotary drive systems.

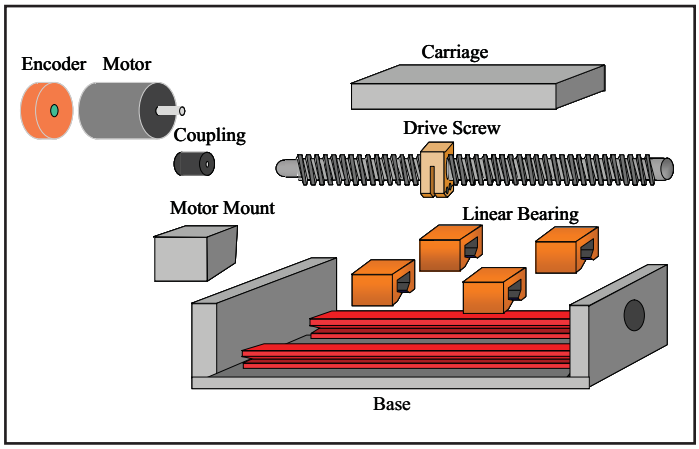



*Fig. 1: Precision table fitted with ballscrew drive*

### 1.2 Differences in construction

The differences in construction between a direct-drive linear motor and a conventional rotary drive system are shown in (Fig. 1 and Fig. 2,) using the examples of a linear motor drive and a ballscrew drive. Due to the absence of mechanical transmission elements converting rotary movement into linear movement, the axis fitted with a linear motor has a much simpler mechanical construction, resulting in a low-inertia drive for highly dynamic applications. Though not always required, the linear motor table is equipped with a linear encoder, which provides extremely accurate positional feedback.

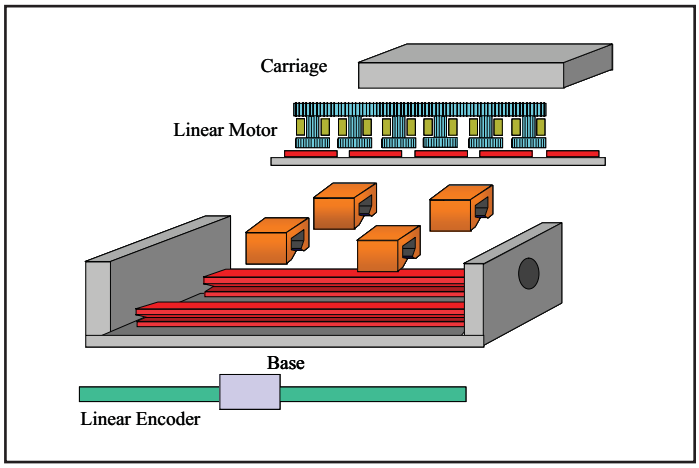



*Fig. 2: Precision table fitted with linear motor*

Though the linear encoder in (Fig. 2) can be considered a high-cost component, the selection of the feedback system can be optimally suited to the requirements of the application. For instance, Parker offers extremely high-resolution optical encoders for applications with demanding precision requirements. In addition, Parker offers lower-resolution, low-cost magnetic encoders for applications where overall system cost is a concern. Actually, it is not uncommon for a linear motor with an economical form of feedback to outperform and actually cost the same or even less than a rotary system using a precision ground ballscrew.

*Fig. 3: Linear motor components include a separate coil and magnet rail*

*Fig. 4: Linear motor positioning systems include a base, bearings, carriage, feedback and typically cable management*

## 2.0 Types of linear motors

There are many different types of linear motors. Each type exhibits its inherent advantages and benefits to the user. Parker manufactures 3 styles of linear motors – ironless, ironcore, and an interesting variant known as the "slotless" design.

Linear motors are either offered as individual components or complete systems. Components, or "kits" (Fig. 3), consist of a motor coil and separate magnet rail. The coil assembly is known as the "forcer" or sometimes as the "primary" element. The forcer generally consists of the motor coil and an attachment plate or mounting bar which allows the coil to connect to the carriage.

The motor cables typically exit from one side of the package. The magnet track is sometimes referred to as the "secondary" element. Depending on the type of linear motor used, the magnet track can either be a single row of magnets or a double-sided configuration offering balanced attraction forces.

A complete linear motor system (Fig. 4) is typically made up of the individual motor components, base, bearings, feedback elements, and cable management.

By selecting linear motor components, the user is given an economical solution and is allowed complete flexibility with respect to integration into the machine. However, this requires a high degree of specific knowledge on the part of the machine builder. The designing engineer must have an understanding of the motor characteristics, linear feedback technology, cooling methods, and the performance of the servo amplifier and control system.

By selecting integrated linear motor positioning systems, the design engineer is given a pre-engineered, robustly designed, fully tested package. This takes the worry out of designing and aligning bearings, encoders, heat sinks, cables, connectors, travel stops, and limit / home sensors. Parker linear motor tables provide all this and more in easily mounted and ready-to-run packages.

## 2.1 Ironcore motors

Ironcore motors consist of a forcer which rides over a single magnet rail (Fig. 5). The forcer is made of copper windings wrapped around iron laminations. The back iron provides an efficient path for the magnetic flux to circulate between the motor and the magnet rail. In addition, there is an efficient path for heat to escape the motor. This ironcore design allows for extremely high forces and efficient cooling. In fact, the ironcore design offers the highest force available per unit volume. Finally, the ironcore design is economically attractive because only one row of magnet material is required.

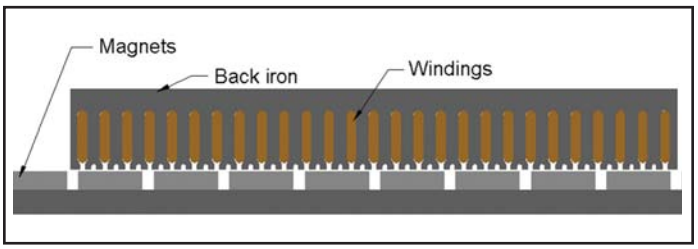



*Fig. 5: Ironcore linear motor*

One of the drawbacks of the ironcore design is that the motor has a high attractive force between the forcer and the magnet track. The attractive force can range from 5 – 13 times the rated force of the motor. This force must be supported by the bearing system of the motor. In addition, the high attractive force makes installation more challenging than other linear motor designs.

Another drawback of the ironcore design is the presence of cogging forces. Cogging occurs when the iron laminations exert a horizontal force on the motor in order to line up with their preferred positions over the magnets. Cogging limits the smoothness of motion systems because the force generated by the motor must change with position in order to maintain a constant velocity.

Parker Trilogy has developed a patent-pending Anti-Cog technology that virtually eliminates cogging and allows ironcore motors to be used in applications where only ironless motors were considered before. This offers the machine builder a powerful combination of extremely high force and smooth operation in an economical package.

*To summarize the advantages and disadvantages of ironcore motors:*

**Ironcore advantages:**

- **High Force per Size** - Uses laminations to concentrate the flux field.
- **Lower Cost** - Open face design only uses one row of magnets.
- **Good Heat Dissipation** - Because of laminations and large surface area, heat can be removed easily.

**Ironcore disadvantages:**

- **Normal attractive force** – 5 to 13 times greater than force generated.
- **Cogging** – Limits the smoothness of motion and creates velocity ripple. *This is counteracted by Parker Trilogy's patent pending Anti-Cog technology.*

Parker Trilogy offers ironcore motors both as components and as pre-engineered, fully integrated positioning systems. Please refer to the catalog for the **RIPPED Series** Ironcore Linear Motors and the **TR Series** Ironcore Linear Motor Positioners (Fig. 6 and Fig. 7).

*Fig. 6: Ripped Series Ironcore Linear Motor*

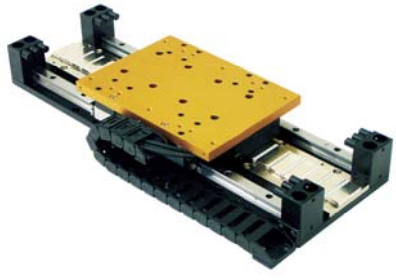


*Fig. 7: Parker Trilogy's TR Series Ironcore Linear Motor Positioner*

## 2.2 Ironless Motors

Ironless motors consist of a forcer which rides between dual magnet rails (Fig. 8). They are also known as “aircore” or “U-channel” motors. The forcer does not have any iron laminations in the coil – hence the name ironless. Instead, the copper windings are encapsulated and located in the air gap between the two rows of magnets. Because the motors are ironless, there are no attractive forces or cogging forces between the forcer and the magnet track.

In addition, the forcers have lower mass than their ironcore counterparts. What results is a motor design that allows for extremely high accelerations and overall dynamic performance. The ironless design has zero cogging and the lack of attractive force allows for extended bearing life and, in some applications, the ability to use smaller bearings.

While the high dynamic performance and zero cogging motion make the ironless motors a powerful design, they are not as thermally efficient as their ironcore counterparts. A small contacting surface area and a long thermal path from the winding base to the cooling plate makes the full-load power of these motors low. In addition, the dual row of magnets increases the overall cost of these motors in relation to the generated force and stroke length.

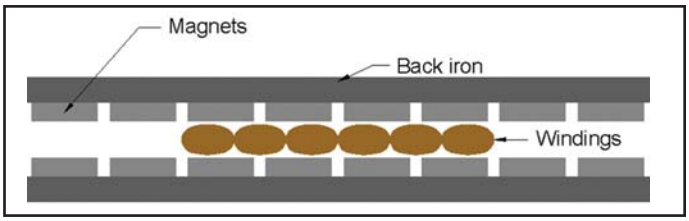



*Fig. 8: Ironless Linear Motor*

Parker Trilogy’s patented I-beam shape and overlapping winding design provides very high forces in a compact package. In addition, the design is more thermally efficient than tradition ironless motor designs.

By overlapping the windings (Fig. 9) instead of arranging them side-by-side, Parker Trilogy is able to provide a motor with a very high power density. The result is a package size considerably smaller than competitive motors with similar force capabilities.

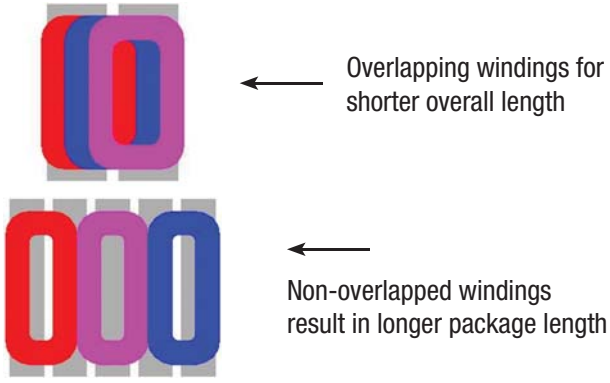



*Fig. 9: Overlapping Windings*

Parker Trilogy creates the I-beam shape by flaring out the end turns of the motor at a 90-degree angle. The end turns of a linear motor coil do not contribute to the horizontal force component of the motor. Instead of producing force, the end turns simply produce heat. Parker’s I-beam shaped design allows for better heat transfer between the motor coils and the heat sink by increasing the contacting surface area between components (Fig. 10). The combination of overlapped windings and the I-Beam shape creates a more thermally efficient motor than most traditional ironless motors. As a result, the payload will experience less thermal expansion due to heat from the motor. In high precision applications, thermal expansion can adversely affect the overall system accuracy. Parker Trilogy motors will help maintain system accuracy by running at lower operating temperatures than our competitors. In addition, there are added benefits of the I-beam shape by lowering the overall profile height and creating a stiffer mechanical structure.

*What results is a compact motor design with high force and extraordinary thermal characteristics.*

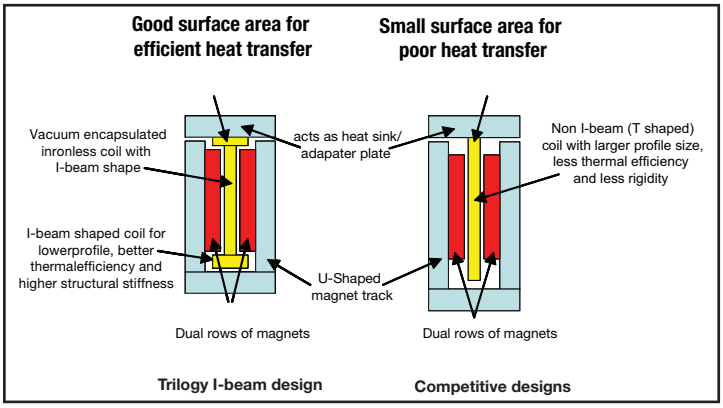



*Fig. 10: Parker Trilogy’s Patented I-Beam Design*

*To summarize the advantages and disadvantages of ironless motor designs:*

**Ironless advantages:**

- **No Attractive Force** - Balanced dual magnet track. Safe and easy to handle. No forces to deal with during assembly.
- **No Cogging** - Ironless forcer for zero cogging and ultimate smoothness.
- **Low Weight Forcer** - No iron means higher acceleration and deceleration rates, higher mechanical bandwidth.
- **Air Gap Forgiving** - easy to align and install.

**Ironless disadvantages:**

- **Heat dissipation** - Higher thermal resistance. Parker Trilogy's I-beam design helps mitigate this issue.
- **Power per package** - Lower RMS power when compared to ironcore designs.
- **Higher cost** - Uses twice as many magnets.

Parker Trilogy offers ironless motors in both component kits and complete pre-engineered positioning systems. Please refer to the catalog for the "***I-Force***" and "***ML50***" ironless linear motors and the "***T Series***" linear motors positioners (Fig. 11 and 12).

*Fig. 11: ML50 Ironless Linear Motor*

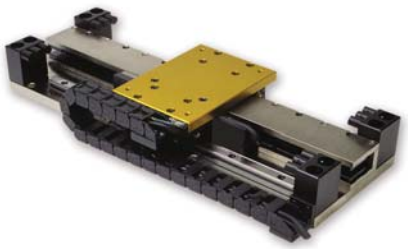


*Fig. 12: T2D Series Linear Motor Positioner*

## 2.3 Slotless Motors

Slotless motors are an interesting variant of linear motor which combines several of the design elements of ironcore and ironless motors. In a slotless motor (Fig. 13), the forcer has no iron toothed laminations. The coils are wound without iron and are located underneath a "back iron" plate. The forcer then operates along a single magnet row. The slotless motor design can be thought of as a sort of hybrid between ironcore and ironless linear motor designs.

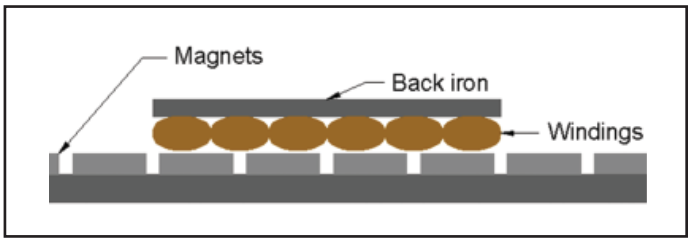



*Fig. 13: Slotless Linear Motor*

*What results is a motor with the following characteristics:*

**Slotless linear motor advantages:**

- Single-row magnet bar
- Lower cost (compared to ironless design)
- Better heat dissipation (compared to ironless design)
- More force per package size (compared to ironless design)
- Lighter weight and lower inertia forcer (compared to ironcore design)
- Lower attractive forces (compared to ironcore designs) – extended bearing life and smaller bearings in some applications
- Less cogging (compared to ironcore designs)

**Slotless linear motor disadvantages:**

- Some attractive force and cogging
- Air gap is critical
- Less efficient than both ironcore and ironless – more heat to do the same job

Parker offers slotless motors in both component kits and precision positioning systems. Please refer to this catalog under 400LXR Positioners or to the "SL Series" linear motor section on www.parkermotion.com (Fig. 14 and 15).

*Fig. 14: SL Series Slotless Linear Motors*

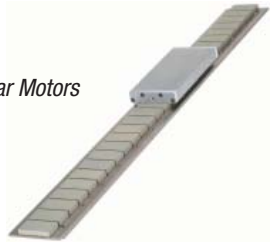


*Fig. 15: 404LXR Slotless Linear Motor Positioning System*

## 3.0 Guide Systems

Even though a linear motor system lacks the rotary transmission components of traditional positioning systems, the user is still required to provide some sort of linear guide / bearing. Typically, a linear bearing must be selected based on high speed and acceleration capability, long service life, high accuracy, low maintenance costs, high stiffness, and low noise. Other considerations may include, for example, the site space available, the mounting accuracy (flatness, parallelism, inclination), and the thermal expansion.

Different guide systems are available to fulfill these requirements:

- Slide bearings (dry running or hydrodynamic)
- Hydrostatic bearings
- Aerostatic bearings (air bearings)
- Track rollers (steel or plastic roller wheels)
- Rolling-contact bearings (square rail, cross roller, or round rail)
- Magnetic bearings

In practice, slide bearings, rolling-contact bearings, and air bearings are the most popular. For applications with low demands on precision and load-bearing capacity, dry-running slide bearings may be a suitable option. Guide systems based on rolling-contact like square rail and cross roller bearings exhibit good stiffness and excellent load-bearing capability. In addition, they offer excellent straightness and flatness over the length of travel. Air bearings offer the ultimate in performance. With practically no limits to max speed and acceleration and virtually no breakaway forces, air bearings are the best solution for ultra-high precision applications.

## 4.0 Servo Control and Feedback

Linear motors can offer the ultimate in high precision and motion dynamics. However, overall system performance is dependent on other components – particularly the servo controller and feedback mechanism used. In this section, we will examine how linear motors are commutated, how their position is sensed, and how it is important to have an adequate controller to optimize system performance.

Figure 16 shows the traditional cascaded structure of servo motor control. The same structure can be applied to linear motors. One advantage is that the position sensor can typically be located right at or closer to the load, thus improving the overall accuracy of the system.

One drawback is that the lack of a traditional mechanical transmission results in the effects of external forces being significantly greater. For this reason, the quality of the position signal (resolution and accuracy) and the performance of the servo controller (sampling time, trajectory update, and control algorithms used) are of prime importance in determining the degree of "positional stiffness" that can be achieved.

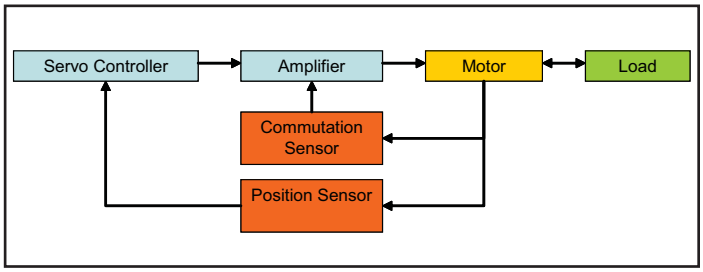



*Fig 16(a): Servo Motor Control (position sensor located at motor)*

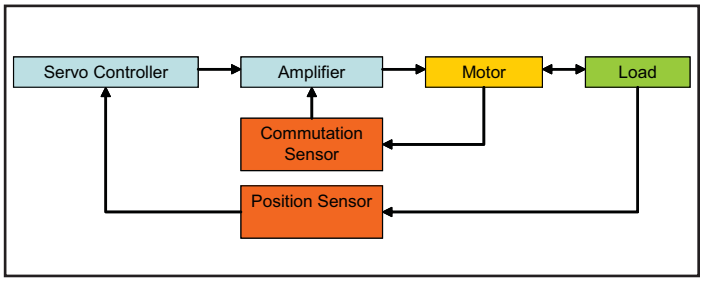



*Fig 16(b): Servo Motor Control (position sensor located at load)*

### 4.1 Commutation of the motor

In traditional rotary servo systems, it is important for the amplifier to know the position of the rotor. This way it can properly switch current through the motor phases in order to achieve the desired rotation of the shaft. Many times, three digital Hall effect sensors (spaced 60 degrees or 120 degrees apart) are used in order to provide positional information of the shaft within 6 states.

The same principle applies to linear motors. The amplifier must know the position of the forcer in relationship to the magnet rail in order to properly switch the windings. Rather than aligning the Hall effect devices (HEDs) within one complete revolution of the shaft, the Halls are matched to the magnetic pole pitch of the motor. The "pole pitch" is the linear distance traveled within one electrical cycle of the motor and is analogous to one revolution of a rotary motor.

Once the amplifier establishes the position of the forcer within the electrical cycle, it will then switch the motor phases whenever a transition occurs in the Hall states. This is known as *trapezoidal commutation.*

In most modern servo amplifiers, the position of the forcer need only be determined upon power up and enabling of the drive. Once the initial position is recognized, the drive can commutate off of the position sensor, which provides significantly higher resolution feedback than the digital HEDs. This allows the motor to be sinusoidally commutated. Sinusoidal commutation provides a smoother switching sequence resulting in less disturbances and less heat.

Another method of sinusoidal commutation is through the use of analog Hall effect devices. Analog Halls produce a sinusoidal signal as they pass over the magnetic poles of the magnet track. Analog Halls have also been used as an inexpensive method of providing positional feedback as well as commutation feedback. However, these devices are susceptible to picking up noise which can affect commutation – which in turn, affects smoothness of travel.

In some applications, HEDs are not desired – either from a cost savings standpoint, reduced wiring / component count, or other application specific standpoint. However, the servo drive must still be able to recognize the position of the motor forcer. In this case, **automatic commutation** can be achieved with a properly equipped servo drive. **Parker's Compax3** drive/control has an "auto-commutation with test movement" function that automatically establishes the commutation angle. In this system, the Compax3 applies a test signal which induces small movements in the motor upon power up. The physical size of these movements can be quite small – as small as 10 electrical degrees (less than 2 mm on many linear motors), so there is no need to worry about the motor "*jumping.*" In addition, the test signals are "softened" such that system jerk is minimized.

### 4.2 Positional Feedback

There are a variety of methods to provide linear positional feedback to the motion controller. There are analog transducers, rack-and-pinion style potentiometers, and laser interferometers, to name a few. Each has its own level of accuracy and cost. But far and away the most popular feedback device for linear motor positioning systems is the linear encoder.

Most linear encoders provide an incremental pulse train that provides discrete "counts" back to the motion controller as the encoder "read head" moves along a "linear scale." Typically, the read head is mounted close to the load and the linear scale is applied to the positioner base. There are two popular styles of linear encoders – optical and magnetic.

Optical encoders use reflected light scanning techniques to provide feedback with extremely high resolution and accuracy. Optical encoders are capable of providing feedback in the nanometer resolutions. Magnetic encoders use inductive scanning techniques to offer significantly more economical feedback, but have considerably lower accuracy and resolution. Magnetic encoders can typically offer resolutions down between the 1 to 5 micron range.

A third variation of linear encoder is the Sine encoder. The Sine encoder produces analog sine and cosine signals instead of discrete pulses. Many modern motion controllers have the ability to interpolate these analog signals into extremely fine resolutions. For example, the Compax3 controller can interpolate a 1 Vpp signal into 14 bits, i.e., the sine/cosine signal period is divided into 16,384 counts. A typical pitch period of a Sine encoder is 1mm, thus the resolution can be interpolated down to 62 nm in the controller.

All of these encoders provide incremental positioning information. Hence, it is necessary to establish a *home position* any time positional information is lost by the controller, i.e., power down. In some applications it is necessary to have *absolute feedback* where the actual position of the motor is known immediately and no homing sequence is required. Some encoder manufacturers are now making absolute linear encoders that transfer data using a synchronous serial interface (SSI). Parker's **Aries** family of servo drives support absolute feedback transmitted via SSI. Please contact your Parker representative for further details.

*Fig. 17: Parker ACR Controller and Aries Drives*

When using linear encoders it is critically important to have proper mounting of the scanner (read) head. Inadequate mounting may cause mechanical resonance effects and errors in the measured position caused by vibration of the sensor head. In this case, the achievable bandwidth of the control loop – and hence, the maximum positioning stiffness – is reduced considerably. In some cases, large gaps of positional information are lost entirely, rendering the system totally inaccurate.

If the linear scale is not aligned straight with the guide bearings, accuracy can be affected in the form of "cosine errors." (Fig. 18) shows a representation of how linear encoder scale misalignment can cause cosine errors.

The actual distance traveled will be L, where **L=Lenc(cosΘ)**. The size of the error will be **error = Lenc(1 – cosΘ)**. Thus, it is important to pay attention to the mounting of the read head as well as providing robust attachment and accurate alignment of the linear scale.

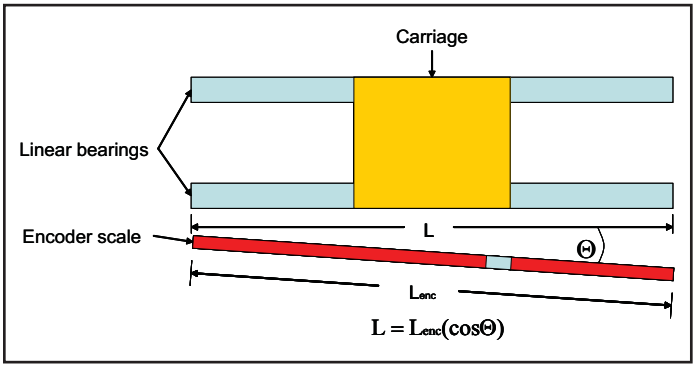



*Fig. 18: Cosine errors caused by encoder scale misalignment*

### 4.3 Servo Control –

Due to the direct drive nature of linear motors, there are no intermediate mechanical components or gear reductions to absorb external disturbances or shock loading. As a result, these disturbances have a significantly greater impact on the control loop than they would when using other technologies. For this reason, it is extremely important to have a controller with fast trajectory update rates. In addition, it is important to have a controller which allows you manipulate "feedforward" control of speed, acceleration, and jerk. These parameters allow the user to minimize tracking errors during acceleration, deceleration, and during external disturbances.

By defining parameters like jerk within your move profile, the tracking accuracy of highly dynamic moves can be improved, stresses on the mechanical system can be reduced, and excitation of mechanical resonances can be minimized. In addition, payloads that must be handled gently can still have optimized move profiles with the implementation of jerk-limited setpoint generation. Parker's **ACR** and **Compax3** families of controllers allow optimization of all feedforward parameters and provide extremely fast trajectory update rates for superior control of linear motors.

Another common control challenge of linear motor systems is the control of gantry robots. Unlike belt- and screw-driven gantries where the transmissions of parallel axes can be mechanically connected, linear motor gantries have no mechanical coupling whatsoever. If tight control is not provided between these axes, binding and mechanical damage can occur. Traditional "master – follower" control schemes do not work well with gantries because the follower axis can bind but the master axis will be unable to recognize it.

Parker's **ACR** series of controllers have a *gantry lock function* which provides skew compensation for gantry systems. By locking the feedback of each axis into the servo loop of the other, perfect coordination between axes is established to prevent binding and mechanical damage.

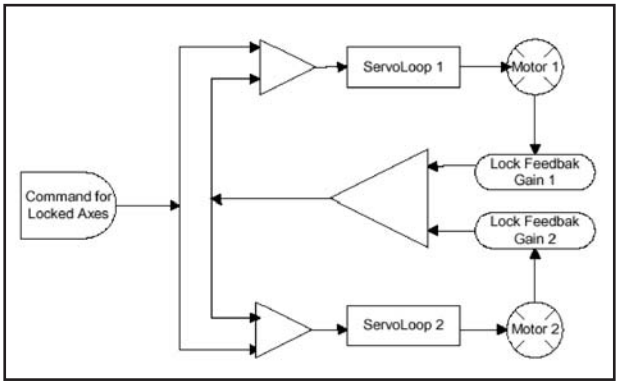


*Fig. 19: Parker's ACR Controller Gantry Lock Feature*

## 5.0 Packaged Linear Motor Positioners

As we have learned here, there are a lot of elements that affect precision in a linear motor system. Accuracy is affected by the bearing technology, structural stability, mounting and precision of the feedback system, and the capabilities of the controller. In addition, other variables such as mechanical stiffness and vibration can play a large part in the overall error budget of a machine.

As a result, it takes a reasonable amount of expertise to integrate all the components into a precision linear motor system. Many machine builders and laboratory equipment users tend to have expertise in their particular processes rather than in the integration of components. In addition, many systems integrators do not have the time to model, analyze, and implement linear motor designs.

For these reasons, several designers have chosen to purchase pre-packaged, pre-engineered linear motor positioners. By leaving the design and integration work to their vendors, they can deliver cost effective precision motion control solutions to their customers in an extremely short time to market. Components are performance matched for fast response, high acceleration, smooth translation, high velocity, and quick settling time. In addition, positioners can have a variety of flexible connectorization options, cable tracks, and mounting options – including multi-axis compatibility.

*Parker offers a variety of packaged linear motor positioners to fit most any application.*

- Industrial-grade positioners for high force, high motion dynamics, and high precision
- Precision-grade positioners for extremely high positional accuracy
- Miniature precision-grade positioners for lab automation, photonics, electronics and other applications requiring high accuracy in a small form factor

*Fig. 20: MX80L Miniature Linear Motor Stage*

## 6.0 Linear motors compared against other technologies

It has been well established that linear motors offer the ultimate in high dynamics and high precision. However, many machine builders have cost sensitive budgets and will often look to common rotary-to-linear technologies to solve their positioning needs. This section will take a hard look at these competing technologies and will show the long-term benefits switching to linear motors.

### 6.1 Belt Drives

Belts and pulleys are the workhorses of the automation world. They provide high speeds and reasonable positioning repeatability for an economical component cost. But there are inherent limitations to using belt drives. A belt drive system will typically consist of the following components:

- High tensile strength belt
- Pulleys
- Gearbox, for inertia matching
- Motor and coupling
- Carriage attached to belt
- Roller bearings or slider element

All the torsional windup, backlash, and belt stretching of these components contribute to inaccuracies in the system. Typical repeatability of a belt drive system is around ± 0.2 mm whereas repeatability for a common linear motor system can be ± 1µ. Even then, the belts must be optimally tensioned and the bearings preloaded. Also, the feedback is connected to the motor and not the load. This contributes to even further inaccuracies in the system.

Additionally, all of these components are “spring like” by nature and cause ringing and delays in settling time. So while belt drive systems can operate at high speeds, they can be difficult to tune for dampening and quick settling. This problem only gets worse at longer lengths, as belts tend to sag the longer they have to span. Eventually, the belt drives become limited in how long they can travel due to the unavoidable sag.

Finally, belt-driven systems can be maintenance intensive. Belts can lose tensioning over time and even skip teeth. Sliding bearings can break down. Couplings can slip or be misaligned. All of these problems force the user to shut down valuable production time in order to maintain the actuator.

Linear motors, by their direct-drive nature, are virtually maintenance free. As long as the bearings are properly lubricated, there is little else to do in order to maintain the positioner. Because all of the mechanical transmission components are gone, linear motor positioners do not suffer from torsional windup, backlash, belt stretch, or settling problems. They are extremely responsive and settle extraordinarily quick. They can match or exceed the acceleration and speed characteristics of a belt drive while positioning far more accurately. Finally, there are no limitations as to how long a linear motor travels. The dynamic performance stays exactly the same, no matter what the distance traversed.

### 6.2 Screw Drives

Screw driven positioning systems are very common for relatively high-precision positioning applications. They are cost-effective and offer varying degrees of precision depending on the needs of the application. A screw-driven system typically consists of the following components:

- Ballscrew or leadscrew that is precision ground or rolled
- Ball nut or sliding nut
- Motor
- Motor block and coupling
- Carriage
- Linear guide – typically square rail, cross roller, or round rail

Leadscrews are typically inefficient, less than 50% in most cases. While they are cost effective, the nut tends to wear due to friction. In addition, the accuracy and repeatability can suffer with leadscrews as most are not precision ground. Ballscrews, approaching 90% efficiency, come in precision ground or rolled packages. However, they still wear over time, suffer from torsional windup, and have a tendency to exhibit backlash. These problems factor into lost precision and slower settling times. In both cases, speeds are limited by the thread pitch and the length of the screw. As screws become longer, they tend to “whip” at higher speeds. Thus, they come nowhere near the speed and acceleration capabilities of linear motors. Eventually, there comes a point where screws become so long, they are difficult and unwieldy to manufacture.

Finally, like belt drives, screw-driven systems must be maintained. Eventually nuts wear, couplings slip, and screws need to be replaced - again, shutting down production and costing the user valuable time and money.

Since linear motor positioners have no intermediate mechanical transmissions, they do not suffer from the drawbacks of screw drives. In addition, they are not limited by length or by the dynamic performance related to length. One drawback to linear motors is that they are not inherently sufficient for vertical applications that require braking. Typically, this problem can be overcome by adding a pneumatic, spring-based, or weight-based counterbalance.

### 6.3 Comparing Costs

In most cases, the upfront cost of purchasing a linear motor system will be more expensive than belt- or screw-driven systems. However, in certain cases the cost can be similar or even less. Many machine builders requiring an extra degree of accuracy will buy a precision-ground ballscrew and add linear encoder feedback. Typically, the added cost of these components will drive the overall cost of the positioner to be higher than that of a linear motor system. In addition, improved manufacturing methods and increased volumes are driving down the cost of linear motors. Over time, users will see the price gap close dramatically. Finally, when comparing the overall cost of ownership (factoring in maintenance and down time), linear motors become considerably less expensive.

## 7.0 The Future of Linear Motors

The field of linear motors will develop dynamically in the future. As costs continue to fall and as innovations continue to rise, more and more industries will begin to adopt linear motor technology. Their high dynamics, high precision, and virtually maintenance-free operation will appeal to traditional users of rotary-to-linear transmissions.

In the early days of linear motors, only the high-tech industries like semiconductor and electronics adopted the technology. Eventually, industries like machine tool latched on to the inherent benefits of direct drives and now account for nearly 1/3rd of all linear motor sales. Now we are seeing new markets like material handling, packaging, medical, and food processing begin to switch out the belts, screws, and even pneumatics for linear motors. All of these new customers are beginning to push the technology to a critical mass and widespread acceptance. Indeed, it looks like linear motors will be making a breakthrough impact on the entire world of manufacturing.

# Linear Motors

# I-FORCE Ironless linear motors

Parker Trilogy's I-Force ironless linear motors offer high forces and rapid accelerations in a compact package. With forces ranging from 5.5 lbf (24.5 N) - 197.5 lbf (878.6 N) continuous up to 5.5 lbf (24.5 N) - (883 lbf (3928 N) peak, the I-Force family offers a superior combination of performance and size.

The I-Force patented I-beam shape with its overlapping windings allows for a higher power density in a smaller motor, improved heat removal, and added structural stiffness. In addition, the ironless (or air core) linear motor design has no attractive force toward the magnets. This allows for easy installation and zero cogging during motion.

Ultra high-flex cables come standard with I-Force motors. In addition, we offer modular magnet tracks for unrestricted travel length. Incredibly smooth motion, high precision and high force density make the I-Force linear motors an ideal solution for your demanding positioning requirements.

**Overlapping Windings:**
- Increased force density
- Improved heat dissipation
- Lower temperature rise
- Smaller, less expensive motor

**No attractive force toward the magnets:**
- Easier/Safer assembly and handling, smoother travel (no cogging)

**Uses thermally conductive epoxy together with the windings (Patented RE34674):**
- Better heat dissipation

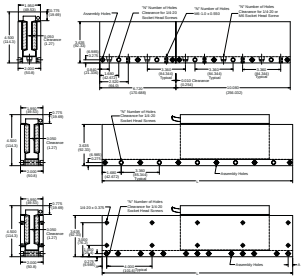
**Vacuum encapsulation process:**
- Allows motors to be used in high-vacuum environments (Rated at 10^-6 torr, currently used in 10^-7 torr applications)

**Modular magnet track:**
- Unrestricted travel length

**Embedded overtemp thermostat or optional thermistor:**
- Protects windings against overheating

**Ultra high-flex cables:**
- Longer cable life, good for millions of cycles

# 110 Specifications



I FORCE

- Ironless motor, patented, RE34674
- Cross-section: 2.05”H (50mm) x 0.82”W (21mm)
- Peak forces in two sizes to 45lbs (200N), continuous forces to 10lbs (44N)
- Precision ground 3-piece track (110 model)
- Two lengths of modular magnet tracks allow unlimited length of travel
- Single-piece magnet tracks to 36” length
- Prealigned imbedded digital Hall effect devices
- Internal thermal cutout switch protects coil

## PERFORMANCE

| MOTOR MODEL | | 110-1 | 110-2 |
|---|---|---|---|
| Peak Force | N | 108.5 | 202.5 |
| | lb | 24.4 | 45.5 |
| Continuous Force | N | 24.5 | 45.4 |
| | lb | 5.5 | 10.2 |
| Peak Power | W | 938 | 1641 |
| Continuous Power | W | 47 | 82 |

## ELECTRICAL

| MOTOR MODEL | | 110-1 | | | 110-2 | | |
|---|---|---|---|---|---|---|---|
| WIRING TYPE | UNITS | S-Series | P-Parallel | T-Triple | S-Series | P-Parallel | T-Triple |
| Peak Current | A pk sine | 15.9 | 31.8 | 47.7 | 14.8 | 29.6 | 44.4 |
| | (RMS) | 11.2 | 22.5 | 33.7 | 10.4 | 20.9 | 31.4 |
| Continuous Current | A pk sine | 3.6 | 7.2 | 10.8 | 3.3 | 6.6 | 9.9 |
| | (RMS) | 2.5 | 5.1 | 7.6 | 2.3 | 4.7 | 7.0 |
| Force Constant | N/A peak | 6.8 | 3.4 | 2.3 | 13.7 | 6.8 | 4.6 |
| | lb/A peak | 1.5 | 0.8 | 0.5 | 3.1 | 1.5 | 1.0 |
| Back EMF | V/m/s | 7.9 | 3.9 | 2.6 | 15.7 | 7.9 | 5.2 |
| | V/in/s | 0.20 | 0.10 | 0.07 | 0.40 | 0.20 | 0.13 |
| Resistance 25°C, phase to phase | ohms | 3.8 | 1.0 | 0.4 | 7.6 | 1.9 | 1.0 |
| Inductance, phase to phase | mH | 1.0 | 0.3 | 0.1 | 2.0 | 0.5 | 0.2 |
| Electrical Time Constant | ms | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Motor Constant | N/W | 3.56 | 3.56 | 3.56 | 5.02 | 5.02 | 5.02 |
| | lb/W | 0.80 | 0.80 | 0.80 | 1.13 | 1.13 | 1.13 |
| Max Terminal Voltage | VDC | 330 | 330 | 330 | 330 | 330 | 330 |

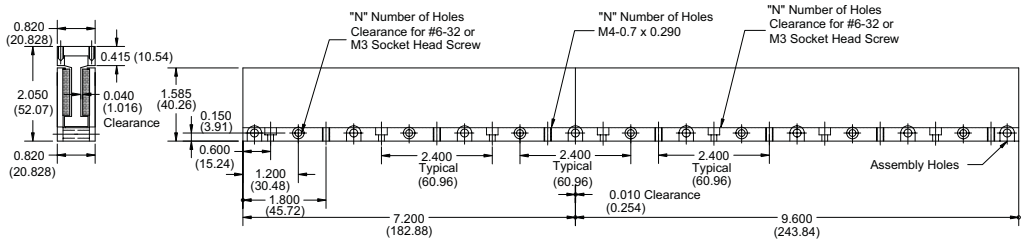
## THERMAL

| MOTOR MODEL | | 110-1 | 110-2 |
|---|---|---|---|
| Thermal Resistance Wind-Amb | degC / W | 1.59 | 0.92 |
| Thermal Time Constant | min | 3.2 | 3.2 |
| Maximum Winding Temperature | °C | 100 | 100 |

## MECHANICAL

| MOTOR MODEL | | 110-1 | 110-2 |
|---|---|---|---|
| Coil Weight | kg | 0.12 | 0.22 |
| | lb | 0.27 | 0.48 |
| Coil Length | mm | 81.3 | 142.2 |
| | in | 3.20 | 5.60 |
| Attractive Force | N | 0 | 0 |
| | lbf | 0 | 0 |
| Electrical Cycle Length | mm | 60.96 | 60.96 |
| | in | 2.40 | 2.40 |

## MODULAR 11007M 11009M



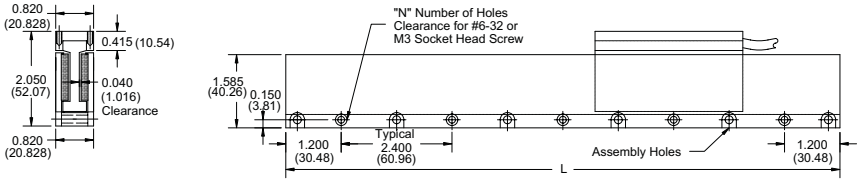

**Incremental Length:**
2.4in/60.96mm

**Minimum Length:**
2.4in/60.96mm

**Maximum Length:**
**(For Single Piece)**
36in/914.40mm

**Weight/Foot:**
2.66lbs/ft

## MODULAR 110xxM1



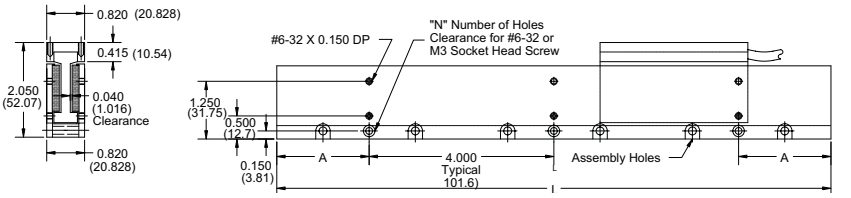

**Incremental Length:**
2.4in/60.96mm

**Minimum Length:**
2.4in/60.96mm

**Maximum Length:**
**(For Single Piece)**
36in/914.90mm

**Weight/Foot:**
2.66lbs/ft

## SINGLE PIECE 110xxS



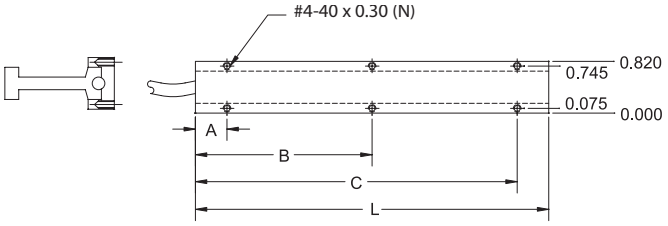

**Incremental Length:**
1.2in/30.48mm

**Minimum Length:**
8.4in/213.4mm

**Maximum Length:**
**(For Single Piece)**
36in/914.90mm

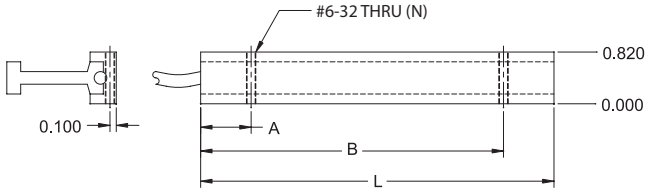
**Weight/Foot:**
2.66lbs/ft

### (A) ENGLISH TOP MOUNTING



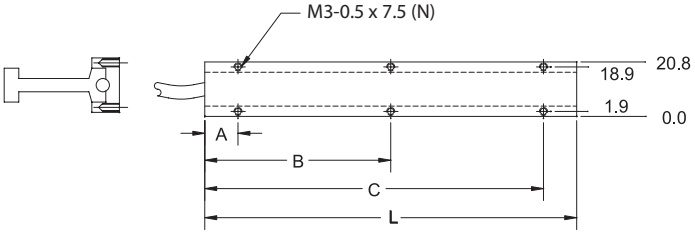

| COIL SIZE (inches) | L | N | A | B | C |
|---|---|---|---|---|---|
| 110-1A | 3.20 | 4 | 0.50 | 2.70 | --- |
| 110-2A | 5.60 | 6 | 0.50 | 2.80 | 5.10 |

### (B) ENGLISH SIDE MOUNTING



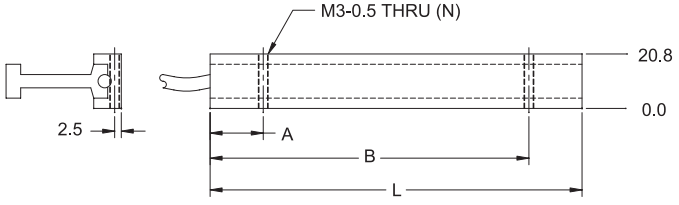

| COIL SIZE (inches) | L | N | A | B |
|---|---|---|---|---|
| 110-1B | 3.20 | 2 | 0.80 | 2.40 |
| 110-2B | 5.60 | 2 | 0.80 | 4.80 |

### (M) METRIC TOP MOUNTING




| COIL SIZE (mm) | L | N | A | B | C |
|---|---|---|---|---|---|
| 110-1M | 81.3 | 4 | 12.7 | 68.6 | --- |
| 110-2M | 142.2 | 6 | 12.7 | 71.1 | 129.5 |

### (N) METRIC SIDE MOUNTING




| COIL SIZE (mm) | L | N | A | B |
|---|---|---|---|---|
| 110-1N | 81.3 | 2 | 20.3 | 60.9 |
| 110-2N | 142.2 | 2 | 20.3 | 121.9 |

| MODULAR TRACK COMBINATIONS | | | |
|---|---|---|---|
| LENGTH In Inches | LENGTH In mm | QUANTITY 11007M | QUANTITY 11009M |
| 7.2 | 182.9 | 1 | 0 |
| 9.6 | 243.8 | 0 | 1 |
| 12.0 | 304.8 | 0 | 0 |
| 14.4 | 365.8 | 2 | 0 |
| 16.8 | 426.7 | 1 | 1 |
| 19.2 | 487.7 | 0 | 2 |
| 21.6 | 548.6 | 3 | 0 |
| 24.0 | 609.6 | 2 | 1 |
| 26.4 | 670.6 | 1 | 2 |
| 28.8 | 731.5 | 0 | 3 |
| 31.2 | 792.5 | 3 | 1 |
| 33.6 | 853.4 | 2 | 2 |
| 36.0 | 914.4 | 1 | 3 |
| 38.4 | 975.4 | 0 | 4 |
| 40.8 | 1036.3 | 3 | 2 |
| 43.2 | 1097.3 | 2 | 3 |
| 45.6 | 1158.2 | 1 | 4 |
| 48.0 | 1219.2 | 0 | 5 |
| 50.4 | 1280.2 | 3 | 3 |
| 52.8 | 1341.1 | 2 | 4 |
| 55.2 | 1402.1 | 1 | 5 |
| 57.6 | 1463.0 | 0 | 6 |
| 60.0 | 1524.0 | 3 | 4 |
| 62.4 | 1585.0 | 2 | 5 |
| 64.8 | 1645.9 | 1 | 6 |
| 67.2 | 1706.9 | 0 | 7 |
| 69.6 | 1767.8 | 3 | 5 |
| 72.0 | 1828.8 | 2 | 6 |

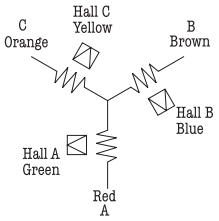
*Please note that 72.0 inches is NOT the maximum length for modular tracks.

| 110xxS SINGLE PIECE | | | | | | |
|---|---|---|---|---|---|---|
| P/N 110xx | S | L (in) | L (mm) | A | mm | N |
| 11008 | S | 8.4 | 205.8 | 0.20 | 5.08 | 3 |
| 11009 | S | 9.6 | 235.2 | 0.80 | 20.32 | 3 |
| 11010 | S | 10.8 | 264.6 | 1.40 | 35.56 | 3 |
| 11012 | S | 12.0 | 294.0 | 2.00 | 50.80 | 3 |
| 11013 | S | 13.2 | 323.4 | 2.60 | 66.04 | 3 |
| 11014 | S | 14.4 | 352.8 | 3.20 | 81.28 | 3 |
| 11015 | S | 15.6 | 382.2 | 3.80 | 96.52 | 3 |
| 11016 | S | 16.8 | 411.6 | 0.40 | 10.16 | 5 |
| 11018 | S | 18.0 | 441.0 | 1.00 | 25.40 | 5 |
| 11019 | S | 19.2 | 470.4 | 1.60 | 40.64 | 5 |
| 11020 | S | 20.4 | 499.8 | 2.20 | 55.88 | 5 |
| 11021 | S | 21.6 | 529.2 | 2.80 | 71.12 | 5 |
| 11022 | S | 22.8 | 558.6 | 3.40 | 86.36 | 5 |
| 11024 | S | 24.0 | 588.0 | 4.00 | 101.60 | 5 |
| 11025 | S | 25.2 | 617.4 | 0.60 | 15.24 | 7 |
| 11026 | S | 26.4 | 646.8 | 1.20 | 30.48 | 7 |
| 11027 | S | 27.6 | 676.2 | 1.80 | 45.72 | 7 |
| 11028 | S | 28.8 | 705.6 | 2.40 | 60.96 | 7 |
| 11030 | S | 30.0 | 735.0 | 3.00 | 76.20 | 7 |
| 11031 | S | 31.2 | 764.4 | 3.60 | 91.44 | 7 |
| 11032 | S | 32.4 | 793.8 | 0.20 | 5.08 | 9 |
| 11033 | S | 33.6 | 823.2 | 0.80 | 20.32 | 9 |
| 11034 | S | 34.8 | 852.6 | 1.40 | 35.56 | 9 |
| 11036 | S | 36.0 | 882.0 | 2.00 | 50.80 | 9 |

| 110xxM and 110xxM1 MODULAR | | | | |
|---|---|---|---|---|
| P/N 110xx | M/M1 | L (in) | L (mm) | N |
| 11002 | M/M1 | 2.4 | 60.96 | 1 |
| 11004 | M/M1 | 4.8 | 121.92 | 2 |
| 11007 | M/M1 | 7.2 | 182.88 | 3 |
| 11009 | M/M1 | 9.6 | 243.84 | 4 |
| 11012 | M/M1 | 12.0 | 304.80 | 5 |
| 11014 | M/M1 | 14.4 | 365.76 | 6 |
| 11016 | M/M1 | 16.8 | 426.72 | 7 |
| 11019 | M/M1 | 19.2 | 487.68 | 8 |
| 11021 | M/M1 | 21.6 | 548.64 | 9 |
| 11024 | M/M1 | 24.0 | 609.60 | 10 |
| 11026 | M/M1 | 26.4 | 670.56 | 11 |
| 11028 | M/M1 | 28.8 | 731.52 | 12 |
| 11031 | M/M1 | 31.2 | 792.48 | 13 |
| 11033 | M/M1 | 33.6 | 853.44 | 14 |
| 11036 | M/M1 | 36.0 | 914.40 | 15 |

## WD0

WYE wound with Thermostat
Digital Hall Effect Devices
Single Cable: THF10



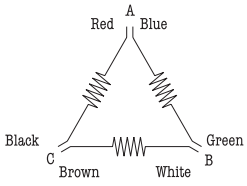

HED Power
Black(+)
White(gnd)

Hall Effect Devices
Symmetrical Response
4.5V to 18 V Operation
Open Collector Output
$I_{OUT}$ Continuous 15 mA

Thermostat(NC)
Opens at 90ºC
Grey(+)
Violet(-)

## WD1

Delta wound with Thermistor
Single Cable: THF08



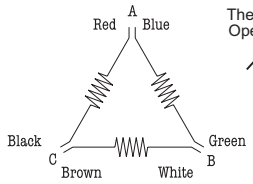

Orange
Thermistor Omega 44004
2.2 kOhms Resistance @ 25ºC
Yellow

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = ºKelvin; R = Resistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_{E}$-8

## WD2

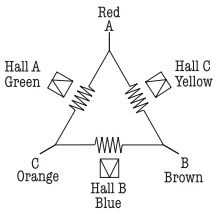
Delta wound with Thermostat
Single Cable: THF08




Thermostat(NC)
Opens at 90ºC
Yellow(+)
Orange(-)

## WD3

Delta wound with Thermostat
Digital Hall Effect Devices
Single Cable: THF10



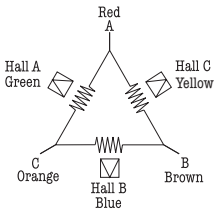

HED Power
Black(+)
White(gnd)

Hall Effect Devices
Symmetrical Response
4.5V to 18 V Operation
Open Collector Output
$I_{OUT}$ Continuous 15 mA

Thermostat(NC)
Opens at 90ºC
Grey(+)
Violet(-)

## WD4

Delta wound with Thermistor
Digital Hall Effect Devices
Single Cable: THF10




HED Power
Black(+)
White(gnd)

Hall Effect Devices
Symmetrical Response
4.5V to 18 V Operation
Open Collector Output
$I_{OUT}$ Continuous 15 mA

Grey
Thermistor Omega 44004
2.2 kOhms Resistance @ 25ºC
Violet

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = ºKelvin; R = Reistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_{E}$-8

## NOTES

1. Peak force and current based on 5% duty cycle and one second duration.
2. Continuous force and current based on coil winding temperature maintained at 100ºC.
3. Force constant is peak of resistive force produced by 1.0 amp thru one motor lead and 0.5 amps thru other two leads. Also, Back EMF (V/in/sec) * 7.665 = Force constant (lb/amp).
4. Motor resistance measured between any two motor leads with motor connected in Delta winding at 25ºC. For temperature at 100ºC, multiply resistance by 1.295 (75ºC rise * 0.393%/ºC)
5. Back EMF measured between any two motor leads while moving at constant velocity. Value is amplitude or 0-Peak of sine wave produced.
6. Motor inductance measured using 1Kz with the motor in the magnetic field.
7. Electrical Time Constant is time it takes for motor value to reach 63% of its final current after a step change in voltage.
8. Thermal Time Constant is time it takes for motor temperature to reach 63% of its final value after a step change in power.
9. Thermal Resistance is the number of degrees (Celsius) of temperature rise in the winding per watt of power dissipated. Determined experimentally.
10. Motor Constant is a measure of efficiency. Calculated by dividing the force constant by the square root of the motor resistance at maximum operating temperature.
11. Electrical Cycle Length is distance coil must travel to complete 360º electrical cycle.
12. Use TIPS sizing software for the most accurate estimate of coil temperature for a particular motion profile.
13. Motors available with nickel plating or black epoxy coating on magnets. Track part number modified with -N or -B at end. Must be specified at time of order.
14. Electrical motor specifications are for delta wound motors. Consult factory for wye-wound motor specifications.

# 210 Specifications

**I FORCE**

- Ironless motor, patented, RE34674
- Cross-section: 2.25"H (57.1mm) x 1.25"W (31.7mm)
- Peak forces in four sizes to 110lbs (494), continuous forces to 24.8lb (104.5N)
- Precision ground 3-piece track (210 model)
- Two lengths of modular magnet tracks allow unlimited length of travel
- Prealigned imbedded digital HEDs, also available in separate cable from motor leads
- Internal air cooling manifold standard
- Internal thermal cutout switch protects coil

## PERFORMANCE

| MOTOR MODEL | | 210-1 | 210-2 | 210-3 | 210-4 |
|---|---|---|---|---|---|
| Peak Force | N | 137.0 | 255.8 | 375.0 | 494.2 |
| | lb | 30.8 | 57.5 | 84.3 | 111.1 |
| Continuous Force | N | 30.7 | 57.4 | 84.1 | 110.3 |
| | lb | 6.9 | 12.9 | 18.9 | 24.8 |
| Peak Power | W | 905 | 1583 | 2261 | 2940 |
| Continuous Power | W | 45 | 79 | 113 | 147 |

## ELECTRICAL

| MOTOR MODEL | | 210-1 | | | 210-2 | | | 210-3 | | | 210-4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WIRING TYPE | UNITS | S-Series | P-Parallel | T-Triple | S-Series | P-Parallel | T-Triple | S-Series | P-Parallel | T-Triple | S-Series | P-Parallel | T-Triple |
| Peak Current | A pk sine | 12.6 | 25.2 | 37.8 | 11.8 | 23.6 | 35.4 | 11.5 | 23 | 34.5 | 11.3 | 22.6 | 33.9 |
| | (RMS) | 8.9 | 17.8 | 26.7 | 8.3 | 16.7 | 25.0 | 8.1 | 16.3 | 24.4 | 8.0 | 16.0 | 23.9 |
| Continuous Current | A pk sine | 2.8 | 5.6 | 8.4 | 2.6 | 5.2 | 7.8 | 2.6 | 5.2 | 7.8 | 2.5 | 5.0 | 7.5 |
| | (RMS) | 1.9 | 3.9 | 5.9 | 1.8 | 3.7 | 5.5 | 1.8 | 3.7 | 5.5 | 1.8 | 3.5 | 5.3 |
| Force Constant | N/A peak | 10.9 | 5.4 | 3.6 | 21.8 | 10.9 | 7.3 | 32.7 | 16.4 | 10.9 | 43.6 | 21.8 | 14.5 |
| | lb/A peak | 2.5 | 1.2 | 0.8 | 4.9 | 2.5 | 1.6 | 7.4 | 3.7 | 2.5 | 9.8 | 4.9 | 3.3 |
| Back EMF | V/m/s | 12.6 | 6.3 | 4.2 | 25.2 | 12.6 | 8.4 | 37.8 | 18.9 | 12.6 | 50.4 | 25.2 | 16.8 |
| | V/in/s | 0.32 | 0.16 | 0.11 | 0.64 | 0.32 | 0.21 | 0.96 | 0.48 | 0.32 | 1.28 | 0.64 | 0.43 |
| Resistance 25°C, phase to phase | ohms | 5.9 | 1.5 | 0.7 | 11.8 | 3.0 | 1.3 | 17.7 | 4.4 | 2.0 | 23.6 | 5.9 | 2.6 |
| Inductance, phase to phase | mH | 2.4 | 0.6 | 0.3 | 4.8 | 1.2 | 0.5 | 7.2 | 1.8 | 0.8 | 9.6 | 2.4 | 1.1 |
| Electrical Time Constant | ms | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Motor Constant | N/W | 4.54 | 4.54 | 4.54 | 6.45 | 6.45 | 6.45 | 7.87 | 7.87 | 7.87 | 9.12 | 9.12 | 9.12 |
| | lb/W | 1.02 | 1.02 | 1.02 | 1.45 | 1.45 | 1.45 | 1.77 | 1.77 | 1.77 | 2.05 | 2.05 | 2.05 |
| Max Terminal Voltage | VDC | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 |

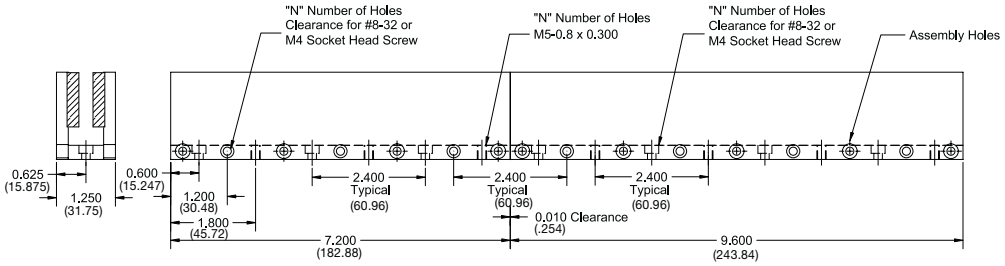
## THERMAL

| MOTOR MODEL | | 210-1 | 210-2 | 210-3 | 210-4 |
|---|---|---|---|---|---|
| Thermal Resistance Wind-Amb | degC / W | 1.67 | 0.94 | 0.66 | 0.51 |
| Thermal Time Constant | min | 4.3 | 4.3 | 4.3 | 4.3 |
| Maximum Winding Temperature | °C | 100 | 100 | 100 | 100 |

## MECHANICAL

| MOTOR MODEL | | 210-1 | 210-2 | 210-3 | 210-4 |
|---|---|---|---|---|---|
| Coil Weight | kg | 0.16 | 0.27 | 0.39 | 0.51 |
| | lb | 0.35 | 0.60 | 0.86 | 1.12 |
| Coil Length | mm | 81.3 | 142.2 | 203.2 | 264.2 |
| | in | 3.2 | 5.6 | 8.0 | 10.4 |
| Attractive Force | N | 0 | 0 | 0 | 0 |
| | lbf | 0 | 0 | 0 | 0 |
| Electrical Cycle Length | mm | 60.96 | 60.96 | 60.96 | 60.96 |
| | in | 2.4 | 2.4 | 2.4 | 2.4 |

## MODULAR 21007M 21009M



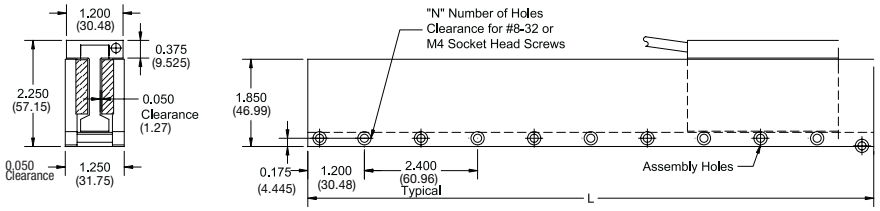

**Incremental Length:**
2.4in/60.96mm

**Minimum Length:**
2.4in/60.96mm

**Maximum Length:**
**(For Single Piece)**
48in/1219.2mm

**Weight/Foot:**
5.50lbs/ft

## MODULAR 210xxM1



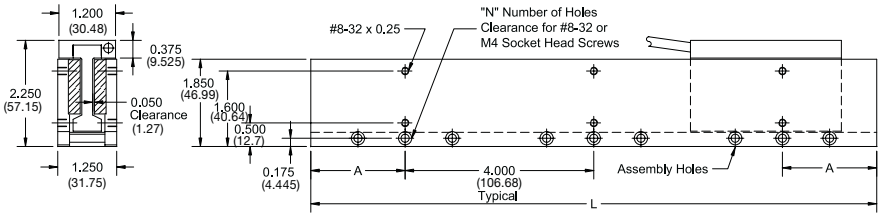

**Incremental Length:**
2.4in/60.96mm

**Minimum Length:**
2.4in/60.96mm

**Maximum Length:**
48in/1219.2mm

**Weight/Foot:**
5.50lbs/ft

## SINGLE PIECE 210xxS



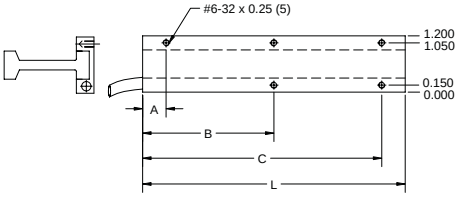

**Incremental Length:**
1.2in/30.48mm

**Minimum Length:**
8.4in/213.4mm

**Maximum Length:**
48in/1219.2mm

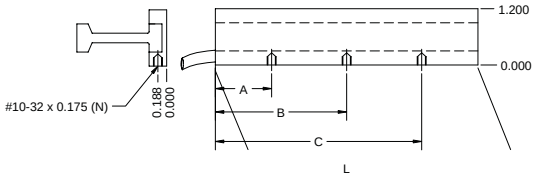
**Weight/Foot:**
5.50lbs/ft

## (A) ENGLISH TOP MOUNTING



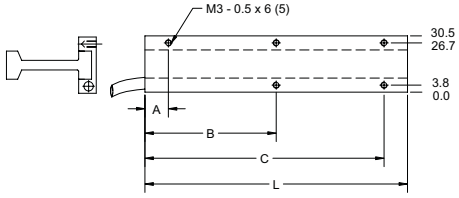

| COIL SIZE (inches) | L | N | A | B | C |
|---|---|---|---|---|---|
| 210-1A | 3.20 | 5 | 0.50 | 1.60 | 2.70 |
| 210-2A | 5.60 | 5 | 0.50 | 2.80 | 5.10 |
| 210-3A | 8.00 | 5 | 0.50 | 4.00 | 7.50 |
| 210-4A | 10.40 | 5 | 0.50 | 5.20 | 9.90 |

## (B) ENGLISH SIDE MOUNTING



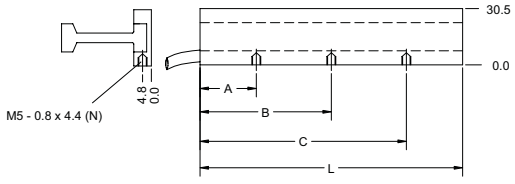

| COIL SIZE (inches) | L | N | A | B | C |
|---|---|---|---|---|---|
| 210-1B | 3.20 | 2 | 1.950 | 2.950 | --- |
| 210-2B | 5.60 | 2 | 1.625 | 3.975 | --- |
| 210-3B | 8.00 | 3 | 2.438 | 4.000 | 5.562 |
| 210-4B | 10.40 | 3 | 2.600 | 5.200 | 7.800 |

## (M) METRIC TOP MOUNTING




| COIL SIZE (mm) | L | N | A | B | C |
|---|---|---|---|---|---|
| 210-1M | 81.3 | 5 | 12.7 | 40.6 | 68.6 |
| 210-2M | 142.2 | 5 | 12.7 | 71.1 | 129.5 |
| 210-3M | 203.2 | 5 | 12.7 | 101.6 | 190.5 |
| 210-4M | 264.2 | 5 | 12.7 | 132.1 | 251.5 |

## (N) METRIC SIDE MOUNTING




| COIL SIZE (mm) | L | N | A | B | C |
|---|---|---|---|---|---|
| 210-1N | 81.3 | 2 | 49.5 | 74.9 | --- |
| 210-2N | 142.2 | 2 | 41.3 | 101.0 | --- |
| 210-3N | 203.2 | 3 | 61.9 | 101.6 | 141.3 |
| 210-4N | 264.2 | 3 | 66.0 | 132.1 | 198.1 |

## MODULAR TRACK COMBINATIONS

| LENGTH In Inches | LENGTH In mm | QUANTITY 21007M | QUANTITY 21009M |
|---|---|---|---|
| 7.2 | 182.9 | 1 | 0 |
| 9.6 | 243.8 | 0 | 1 |
| 12.0 | 304.8 | 0 | 0 |
| 14.4 | 365.8 | 2 | 0 |
| 16.8 | 426.7 | 1 | 1 |
| 19.2 | 487.7 | 0 | 2 |
| 21.6 | 548.6 | 3 | 0 |
| 24.0 | 609.6 | 2 | 1 |
| 26.4 | 670.6 | 1 | 2 |
| 28.8 | 731.5 | 0 | 3 |
| 31.2 | 792.5 | 3 | 1 |
| 33.6 | 853.4 | 2 | 2 |
| 36.0 | 914.4 | 1 | 3 |
| 38.4 | 975.4 | 0 | 4 |
| 40.8 | 1036.3 | 3 | 2 |
| 43.2 | 1097.3 | 2 | 3 |
| 45.6 | 1158.3 | 1 | 4 |
| 48.0 | 1219.2 | 0 | 5 |
| 50.4 | 1280.2 | 3 | 3 |
| 52.8 | 1341.1 | 2 | 4 |
| 55.2 | 1402.1 | 1 | 5 |
| 57.6 | 1463.0 | 0 | 6 |
| 60.0 | 1524.0 | 3 | 4 |
| 62.4 | 1585.0 | 2 | 5 |
| 64.8 | 1645.9 | 1 | 6 |
| 67.2 | 1706.9 | 0 | 7 |
| 69.6 | 1767.8 | 3 | 5 |
| 72.0 | 1828.8 | 2 | 6 |

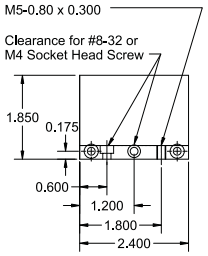
*Please note that 72.0 inches is NOT the maximum length for modular tracks.

## 210xxS SINGLE PIECE

| P/N | 210xx | S | L (in) | L (mm) | A | mm | N |
|---|---|---|---|---|---|---|---|
| | 21008 | S | 8.4 | 205.8 | 0.20 | 5.08 | 3 |
| | 21009 | S | 9.6 | 235.2 | 0.80 | 20.32 | 3 |
| | 21010 | S | 10.8 | 264.6 | 1.40 | 35.56 | 3 |
| | 21012 | S | 12.0 | 294.0 | 2.00 | 50.80 | 3 |
| | 21013 | S | 13.2 | 323.4 | 2.60 | 66.04 | 3 |
| | 21014 | S | 14.4 | 352.8 | 3.20 | 81.28 | 3 |
| | 21015 | S | 15.6 | 382.2 | 3.80 | 96.52 | 3 |
| | 21016 | S | 16.8 | 411.6 | 0.40 | 10.16 | 5 |
| | 21018 | S | 18.0 | 441.0 | 1.00 | 25.40 | 5 |
| | 21019 | S | 19.2 | 470.4 | 1.60 | 40.64 | 5 |
| | 21020 | S | 20.4 | 499.8 | 2.20 | 55.88 | 5 |
| | 21021 | S | 21.6 | 529.2 | 2.80 | 71.12 | 5 |
| | 21022 | S | 22.8 | 558.6 | 3.40 | 86.36 | 5 |
| | 21024 | S | 24.0 | 588.0 | 4.00 | 101.60 | 5 |
| | 21025 | S | 25.2 | 614.4 | 0.60 | 15.24 | 7 |
| | 21026 | S | 26.4 | 646.8 | 1.20 | 30.48 | 7 |
| | 21027 | S | 27.6 | 676.2 | 1.80 | 45.72 | 7 |
| | 21028 | S | 28.8 | 705.6 | 2.40 | 60.96 | 7 |
| | 21030 | S | 30.0 | 735.0 | 3.00 | 76.20 | 7 |
| | 21031 | S | 31.2 | 764.4 | 3.60 | 91.44 | 7 |
| | 21032 | S | 32.4 | 793.8 | 0.20 | 5.08 | 9 |
| | 21033 | S | 33.6 | 823.2 | 0.80 | 20.32 | 9 |
| | 21034 | S | 34.8 | 842.6 | 1.40 | 35.56 | 9 |
| | 21036 | S | 36.0 | 882.0 | 2.00 | 50.80 | 9 |
| | 21037 | S | 37.2 | 911.4 | 2.60 | 66.04 | 9 |
| | 21038 | S | 38.4 | 940.8 | 3.20 | 81.28 | 9 |
| | 21039 | S | 39.6 | 970.2 | 3.80 | 96.52 | 9 |
| | 21040 | S | 40.8 | 999.6 | 0.40 | 10.16 | 11 |
| | 21042 | S | 42.0 | 1029.0 | 1.00 | 25.40 | 11 |
| | 21043 | S | 43.2 | 1058.4 | 1.60 | 40.64 | 11 |
| | 21044 | S | 44.4 | 1127.8 | 2.20 | 55.88 | 11 |
| | 21045 | S | 45.6 | 1158.2 | 2.80 | 71.12 | 11 |
| | 21046 | S | 46.8 | 1188.7 | 3.40 | 86.36 | 11 |
| | 21048 | S | 48.0 | 1219.2 | 4.00 | 101.6 | 11 |

## 210xxM AND 210xxM1 MODULAR

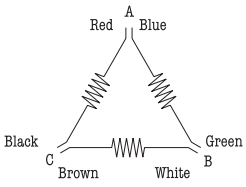
| P/N | 210xx | M/M1 | L (in) | L (mm) | N |
|---|---|---|---|---|---|
| | 21002 | M/M1 | 2.4 | 60.96 | 1 |
| | 21004 | M/M1 | 4.8 | 121.62 | 2 |
| | 21007 | M/M1 | 7.2 | 182.88 | 3 |
| | 21009 | M/M1 | 9.6 | 243.84 | 4 |
| | 21012 | M/M1 | 12.0 | 304.80 | 5 |
| | 21014 | M/M1 | 14.4 | 365.76 | 6 |
| | 21016 | M/M1 | 16.8 | 426.72 | 7 |
| | 21019 | M/M1 | 19.2 | 487.68 | 8 |
| | 21021 | M/M1 | 21.6 | 548.64 | 9 |
| | 21024 | M/M1 | 24.0 | 609.60 | 10 |
| | 21026 | M/M1 | 26.4 | 670.56 | 11 |
| | 21028 | M/M1 | 28.8 | 731.52 | 12 |
| | 21031 | M/M1 | 31.2 | 792.48 | 13 |
| | 21033 | M/M1 | 33.6 | 853.44 | 14 |
| | 21036 | M/M1 | 36.0 | 914.40 | 15 |
| | 21038 | M/M1 | 38.4 | 975.36 | 16 |
| | 21040 | M/M1 | 40.8 | 1036.32 | 17 |
| | 21043 | M/M1 | 43.2 | 1097.28 | 18 |
| | 21045 | M/M1 | 45.6 | 1158.24 | 19 |
| | 21048 | M/M1 | 48.0 | 1219.20 | 20 |



P/N 21002 M

## WD1

Delta wound with Thermistor
Single Cable: THF08



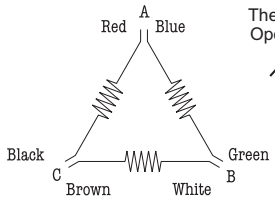

Orange
Thermistor Omega 44004
2.2 kOhms Resistance @ 25°C
Yellow

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = °Kelvin; R = Resistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_E$-8

## WD2

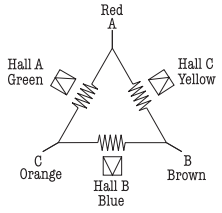
Delta wound with Thermostat
Single Cable: THF08




Thermostat(NC)
Opens at 90°C
Yellow(+)
Orange(-)

## WD3

Delta wound with Thermostat
Digital Hall Effect Devices
Single Cable: THF10



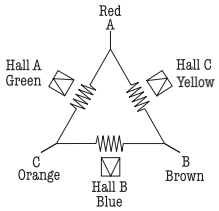

HED Power
Black(+)
White(gnd)

| Hall Effect Devices |
|---|
| Symmetrical Response |
| 4.5V to 18 V Operation |
| Open Collector Output |
| $I_{OUT}$ Continuous 15 mA |

Thermostat(NC)
Opens at 90°C
Grey(+)
Violet(-)

## WD4

Delta wound with Thermistor
Digital Hall Effect Devices
Single Cable: THF10




HED Power
Black(+)
White(gnd)

| Hall Effect Devices |
|---|
| Symmetrical Response |
| 4.5V to 18 V Operation |
| Open Collector Output |
| $I_{OUT}$ Continuous 15 mA |

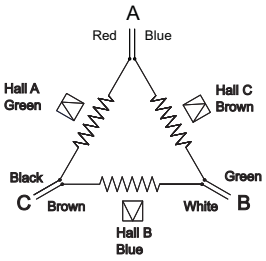
Grey
Thermistor Omega 44004
2.2 kOhms Resistance @ 25°C
Violet

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = °Kelvin; R = Reistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_E$-8

## WD7*

Delta wound with Thermostat
Digital Hall Effect Devices
Dual Cables: THF06 and THF08




Thermostat
(Normally Closed)
Opens at 90C
Orange (+)
Yellow (-)

HED Power
Black (+)
White (Gnd)

HALL EFFECT DEVICES
Symmetrical Response
4.5 to 18 Vdc power
Open Collector Output
15ma continuous

*Preferred Configuration with Parker Drives

## NOTES

1. Peak force and current based on 5% duty cycle and one second duration.
2. Continuous force and current based on coil winding temperature maintained at 100°C.
3. Force constant is peak of resistive force produced by 1.0 amp thru one motor lead and 0.5 amps thru other two leads. Also, Back EMF (V/in/sec) * 7.665 = Force constant (lb/amp).
4. Motor resistance measured between any two motor leads with motor connected in Delta winding at 25°C. For temperature at 100°C, multiply resistance by 1.295 (75°C rise * 0.393%/°C).
5. Back EMF measured between any two motor leads while moving at constant velocity. Value is amplitude or 0-Peak of sine wave produced.
6. Motor inductance measured using 1Kz with the motor in the magnetic field.
7. Electrical Time Constant is time it takes for motor value to reach 63% of its final current after a step change in voltage.
8. Thermal Time Constant is time it takes for motor temperature to reach 63% of its final value after a step change in power.
9. Thermal Resistance is the number of degrees (Celsius) of temperature rise in the winding per watt of power dissipated. Determined experimentally.
10. Motor Constant is a measure of efficiency. Calculated by dividing the force constant by the square root of the motor resistance at maximum operating temperature.
11. Electrical Cycle Length is distance coil must travel to complete 360° electrical cycle.
12. Use TIPS sizing software for the most accurate estimate of coil temperature for a particular motion profile.
13. Motors available with nickel plating or black epoxy coating on magnets. Track part number modified with -N or -B at end. Must be specified at time of order.
14. Electrical motor specifications are for delta wound motors. Consult factory for wye-wound motor specifications.

# 310 Specifications

I FORCE

- Ironless motor, patented, RE34674
- Cross-section: 3.40”H (86.4mm) x 1.35”W (34.3mm)
- Peak forces in two sizes to 263lbs (1170N), continuous forces to 58lbs (262N)
- Precision ground 3-piece track (310 model)
- Two lengths of modular magnet tracks allow unlimited length of travel
- Single-piece magnet tracks to 66” length
- Prealigned embedded digital HEDs, also available in separate cable from motor leads
- Internal air or liquid cooling available
- Internal thermal cutout switch protects coil

## PERFORMANCE

| MOTOR MODEL | | 310-1 | 310-2 | 310-3 | 310-4 | 310-5 | 310-6 |
|---|---|---|---|---|---|---|---|
| Peak Force | N | 218.9 | 409.3 | 600.0 | 790.0 | 980.0 | 1170.0 |
| | lb | 49.2 | 92.0 | 135.1 | 177.2 | 220.3 | 263.2 |
| Continuous Force | N | 49.0 | 91.6 | 133.9 | 176.2 | 219.3 | 262.0 |
| | lb | 11.0 | 20.6 | 30.1 | 39.6 | 49.3 | 58.9 |
| Peak Power | W | 1077 | 1885 | 2693 | 3500 | 4308 | 5116 |
| Continuous Power | W | 54 | 94 | 135 | 179 | 215 | 256 |

## ELECTRICAL

| MOTOR MODEL | | 310-1 | | | 310-2 | | | 310-3 | | | 310-4 | | | 310-5 | | | 310-6 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WIRING TYPE | UNITS | S | P | T | S | P | T | S | P | T | S | P | T | S | P | T | S | P | T |
| Peak Current | A pk sine | 16.1 | 32.2 | 48.3 | 15.0 | 30.0 | 45.0 | 14.7 | 29.4 | 44.1 | 14.5 | 29.0 | 43.5 | 14.4 | 28.8 | 43.2 | 14.3 | 28.6 | 42.9 |
| | (RMS) | 11.4 | 22.8 | 34.2 | 10.6 | 21.2 | 31.8 | 10.4 | 20.8 | 31.2 | 10.3 | 20.5 | 30.8 | 10.2 | 20.4 | 30.5 | 10.1 | 20.2 | 30.3 |
| Continuous Current | A pk sine | 3.6 | 7.2 | 10.8 | 3.4 | 6.8 | 10.2 | 3.3 | 6.6 | 9.9 | 3.2 | 6.4 | 9.6 | 3.2 | 6.4 | 9.6 | 3.2 | 6.4 | 9.6 |
| | (RMS) | 2.5 | 5.1 | 7.6 | 2.4 | 4.8 | 7.2 | 2.5 | 4.7 | 7.0 | 2.3 | 4.5 | 6.8 | 2.3 | 4.5 | 6.8 | 2.3 | 4.5 | 6.8 |
| Force Constant | N/A peak | 13.7 | 6.8 | 4.6 | 27.3 | 13.6 | 9.1 | 40.9 | 20.5 | 13.6 | 54.7 | 27.4 | 18.2 | 68.1 | 34.0 | 22.7 | 81.8 | 40.9 | 27.3 |
| | lb/A peak | 3.1 | 1.5 | 1.0 | 6.1 | 3.1 | 2.0 | 9.2 | 4.6 | 3.1 | 12.3 | 6.2 | 4.1 | 15.3 | 7.7 | 5.1 | 18.4 | 9.2 | 6.1 |
| Back EMF | V/m/s | 15.7 | 7.8 | 5.2 | 31.5 | 15.7 | 10.5 | 47.2 | 23.6 | 15.7 | 63.0 | 31.5 | 21.0 | 78.7 | 39.4 | 26.2 | 94.5 | 47.2 | 31.5 |
| | V/in/s | 0.40 | 0.20 | 0.13 | 0.80 | 0.40 | 0.27 | 1.20 | 0.60 | 0.40 | 1.60 | 0.80 | 0.53 | 2.00 | 1.00 | 0.67 | 2.40 | 1.20 | 0.80 |
| Resistance 25°C, phase to phase | ohms | 4.3 | 1.1 | 0.5 | 8.6 | 2.2 | 1.0 | 12.9 | 3.2 | 1.4 | 17.2 | 4.3 | 1.9 | 21.5 | 5.4 | 2.4 | 25.8 | 6.5 | 2.9 |
| Inductance, phase to phase | mH | 3.0 | 0.8 | 0.3 | 6.0 | 1.5 | 0.7 | 9.0 | 2.3 | 1.0 | 12.0 | 3.0 | 1.3 | 15.0 | 3.8 | 1.7 | 18.0 | 4.5 | 2.0 |
| Electrical Time Constant | ms | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| Motor Constant | N/W | 6.67 | 6.67 | 6.67 | 9.43 | 9.43 | 9.43 | 11.57 | 11.57 | 11.57 | 13.34 | 13.34 | 13.34 | 14.95 | 14.95 | 14.95 | 16.37 | 16.37 | 16.37 |
| | lb/W | 1.50 | 1.50 | 1.50 | 2.12 | 2.12 | 2.12 | 2.60 | 2.60 | 2.60 | 3.00 | 3.00 | 3.00 | 3.36 | 3.36 | 3.36 | 3.68 | 3.68 | 3.68 |
| Max Terminal Voltage | VDC | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 |

***NOTE: S-Series P-Parallel T-Triple***

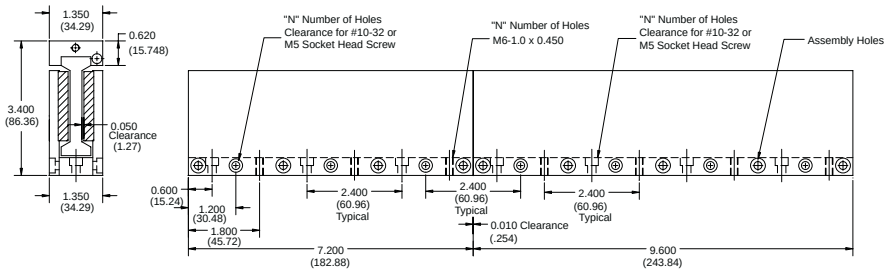
## THERMAL

| MOTOR MODEL | | 310-1 | 310-2 | 310-3 | 310-4 | 310-5 | 310-6 |
|---|---|---|---|---|---|---|---|
| Thermal Resistance Wind-Amb | degC / W | 1.39 | 0.79 | 0.56 | 0.43 | 0.35 | 0.29 |
| Thermal Time Constant | min | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 |
| Maximum Winding Temperature | °C | 100 | 100 | 100 | 100 | 100 | 100 |

## MECHANICAL

| MOTOR MODEL | | 310-1 | 310-2 | 310-3 | 310-4 | 310-5 | 310-6 |
|---|---|---|---|---|---|---|---|
| Coil Weight | kg | 0.31 | 0.55 | 0.80 | 1.03 | 1.27 | 1.53 |
| | lb | 0.69 | 1.22 | 1.75 | 2.27 | 2.80 | 3.36 |
| Coil Length | mm | 81.3 | 142.2 | 203.2 | 264.2 | 325.1 | 386.1 |
| | in | 3.2 | 5.6 | 8.0 | 10.4 | 12.8 | 15.2 |
| Attractive Force | N | 0 | 0 | 0 | 0 | 0 | 0 |
| | lbf | 0 | 0 | 0 | 0 | 0 | 0 |
| Electrical Cycle Length | mm | 60.96 | 60.96 | 60.96 | 60.96 | 60.96 | 60.96 |
| | in | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |

## MODULAR 31007M 31009M



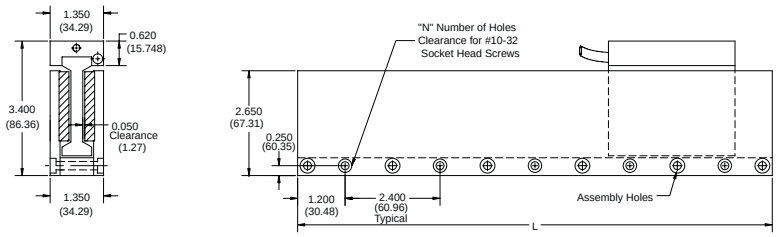

**Incremental Length:**
2.4in/60.96mm

**Minimum Length:**
2.4in/60.96mm

**Maximum Length:**
**(For Single Piece)**
64.8in/1645.9mm

**Weight/Foot:**
8.50lbs/ft

## MODULAR 310xxM1



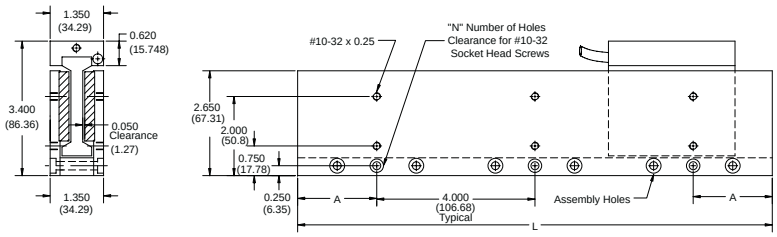

**Incremental Length:**
2.4in/60.96mm

**Minimum Length:**
2.4in/60.96mm

**Maximum Length:**
64.8in/1645.9mm

**Weight/Foot:**
8.50lbs/ft

## SINGLE PIECE 310xxS



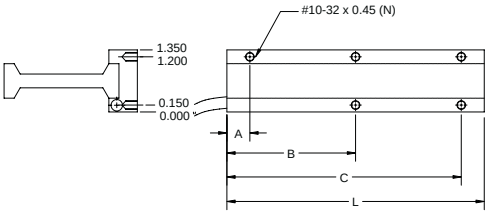

**Incremental Length:**
1.2in/30.48mm

**Minimum Length:**
8.4in/213.4mm

**Maximum Length:**
66in/1676.4mm

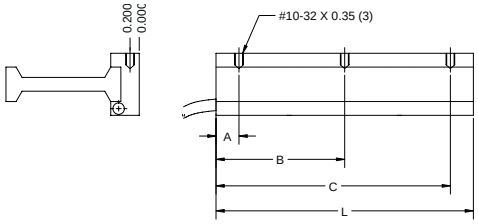
**Weight/Foot:**
8.50lbs/ft

## (A) ENGLISH TOP MOUNTING



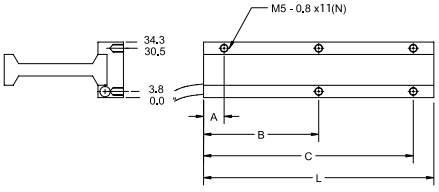

| COIL SIZE (inches) | L | N | A | B | C |
|---|---|---|---|---|---|
| 310-1A | 3.20 | 4 | 0.50 | 1.60 | 2.70 |
| 310-2A | 5.60 | 5 | 0.50 | 2.80 | 5.10 |
| 310-3A | 8.00 | 5 | 0.50 | 4.00 | 7.50 |
| 310-4A | 10.40 | 5 | 0.50 | 5.20 | 9.90 |
| 310-5A | 12.80 | 5 | 0.50 | 6.40 | 12.30 |
| 310-6A | 15.20 | 5 | 1.70 | 7.60 | 13.50 |

## (B) ENGLISH SIDE MOUNTING



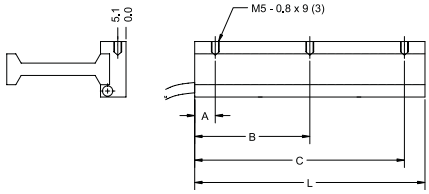

| COIL SIZE (inches) | L | N | A | B | C |
|---|---|---|---|---|---|
| 310-1B | 3.20 | 3 | 0.50 | 1.60 | 2.70 |
| 310-2B | 5.60 | 3 | 0.50 | 2.80 | 5.10 |
| 310-3B | 8.00 | 3 | 0.50 | 4.00 | 7.50 |
| 310-4B | 10.40 | 3 | 0.50 | 5.20 | 9.90 |
| 310-5B | 12.80 | 3 | 0.50 | 6.40 | 12.30 |
| 310-6B | 15.20 | 3 | 1.70 | 7.60 | 13.50 |

## (M) METRIC TOP MOUNTING




| COIL SIZE (mm) | L | N | A | B | C |
|---|---|---|---|---|---|
| 310-1M | 81.3 | 4 | 12.7 | 40.6 | 68.6 |
| 310-2M | 141.2 | 5 | 12.7 | 71.1 | 129.5 |
| 310-3M | 203.2 | 5 | 12.7 | 101.6 | 190.5 |
| 310-4M | 264.2 | 5 | 12.7 | 132.1 | 251.5 |
| 310-5M | 325.1 | 5 | 12.7 | 162.6 | 312.4 |
| 310-6M | 386.1 | 5 | 43.2 | 193.0 | 342.9 |

## (N) METRIC SIDE MOUNTING




| COIL SIZE (mm) | L | N | A | B | C |
|---|---|---|---|---|---|
| 310-1N | 81.3 | 3 | 12.7 | 40.6 | 68.6 |
| 310-2N | 141.2 | 3 | 12.7 | 71.1 | 129.5 |
| 310-3N | 203.2 | 3 | 12.7 | 101.6 | 190.5 |
| 310-4N | 264.2 | 3 | 12.7 | 132.1 | 251.5 |
| 310-5N | 325.1 | 3 | 12.7 | 162.6 | 312.4 |
| 310-6N | 386.1 | 3 | 43.2 | 193.0 | 342.9 |

## MODULAR TRACK COMBINATIONS

| LENGTH In Inches | LENGTH In mm | QUANTITY 31007M | QUANTITY 31009M |
|---|---|---|---|
| 7.2 | 182.9 | 1 | 0 |
| 9.6 | 243.8 | 0 | 1 |
| 12.0 | 304.8 | 1 | 0 |
| 14.4 | 365.8 | 2 | 0 |
| 16.8 | 426.7 | 1 | 1 |
| 19.2 | 487.7 | 0 | 2 |
| 21.6 | 548.6 | 3 | 0 |
| 24.0 | 609.6 | 2 | 1 |
| 26.4 | 670.6 | 1 | 2 |
| 28.8 | 731.5 | 0 | 3 |
| 31.2 | 792.5 | 3 | 1 |
| 33.6 | 853.4 | 2 | 2 |
| 36.0 | 914.4 | 1 | 3 |
| 38.4 | 975.4 | 0 | 4 |
| 40.8 | 1036.3 | 3 | 2 |
| 43.2 | 1097.3 | 2 | 3 |
| 45.6 | 1158.3 | 1 | 4 |
| 48.0 | 1219.2 | 0 | 5 |
| 50.4 | 1280.2 | 3 | 3 |
| 52.8 | 1341.1 | 2 | 4 |
| 55.2 | 1402.1 | 1 | 5 |
| 57.6 | 1463.0 | 0 | 6 |
| 60.0 | 1524.0 | 3 | 4 |
| 62.4 | 1585.0 | 2 | 5 |
| 64.8 | 1645.9 | 1 | 6 |
| 67.2 | 1706.9 | 0 | 7 |
| 69.6 | 1767.8 | 3 | 5 |
| 72.0 | 1828.8 | 2 | 6 |

*Please note that 72.0 inches is NOT the maximum length for modular tracks.

## 310xxS SINGLE PIECE

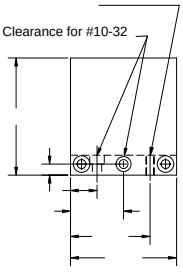
| P/N | 310xx | S | L (in) | L (mm) | A | A (mm) | N |
|---|---|---|---|---|---|---|---|
| | 31008 | S | 8.4 | 205.8 | 0.20 | 5.08 | 3 |
| | 31009 | S | 9.6 | 235.2 | 0.80 | 20.32 | 3 |
| | 31010 | S | 10.8 | 264.6 | 1.40 | 1.40 | 3 |
| | 31012 | S | 12.0 | 294.0 | 2.00 | 50.80 | 3 |
| | 31013 | S | 13.2 | 323.4 | 2.60 | 66.04 | 3 |
| | 31014 | S | 14.4 | 352.8 | 3.20 | 81.28 | 3 |
| | 31015 | S | 15.6 | 382.2 | 3.80 | 96.52 | 3 |
| | 31016 | S | 16.8 | 411.6 | 0.40 | 10.16 | 5 |
| | 31018 | S | 18.0 | 441.0 | 1.00 | 25.40 | 5 |
| | 31019 | S | 19.2 | 470.4 | 1.60 | 40.64 | 5 |
| | 31020 | S | 20.4 | 499.8 | 2.20 | 55.88 | 5 |
| | 31021 | S | 21.6 | 529.2 | 2.80 | 71.12 | 5 |
| | 31022 | S | 22.8 | 558.6 | 3.40 | 86.36 | 5 |
| | 31024 | S | 24.0 | 588.0 | 4.00 | 101.60 | 5 |
| | 31025 | S | 25.2 | 617.4 | 0.60 | 15.24 | 7 |
| | 31026 | S | 26.4 | 646.8 | 1.20 | 30.48 | 7 |
| | 31027 | S | 27.6 | 676.2 | 1.80 | 45.72 | 7 |
| | 31028 | S | 28.8 | 705.6 | 2.40 | 60.96 | 7 |
| | 31030 | S | 30.0 | 735.0 | 3.00 | 76.20 | 7 |
| | 31031 | S | 31.2 | 764.4 | 3.60 | 91.44 | 7 |
| | 31032 | S | 32.4 | 793.8 | 0.20 | 5.08 | 9 |
| | 31033 | S | 33.6 | 823.2 | 0.80 | 20.32 | 9 |
| | 31034 | S | 34.8 | 852.6 | 1.40 | 35.56 | 9 |
| | 31036 | S | 36.0 | 882.0 | 2.00 | 50.80 | 9 |
| | 31037 | S | 37.2 | 911.4 | 2.60 | 66.04 | 9 |

| P/N | 310xx | S | L (in) | L (mm) | A | A (mm) | N |
|---|---|---|---|---|---|---|---|
| | 31038 | S | 38.4 | 940.8 | 3.20 | 81.28 | 9 |
| | 31039 | S | 39.6 | 970.2 | 3.80 | 96.52 | 9 |
| | 31040 | S | 40.8 | 999.6 | 0.40 | 10.16 | 11 |
| | 31042 | S | 42.0 | 1029.0 | 1.00 | 25.40 | 11 |
| | 31043 | S | 43.2 | 1058.4 | 1.60 | 40.64 | 11 |
| | 31044 | S | 44.4 | 1087.8 | 2.20 | 55.88 | 11 |
| | 31045 | S | 45.6 | 1117.2 | 2.80 | 71.12 | 11 |
| | 31046 | S | 46.8 | 1146.6 | 3.40 | 86.36 | 11 |
| | 31048 | S | 48.0 | 1176.0 | 4.00 | 101.60 | 11 |
| | 31049 | S | 49.2 | 1205.4 | 0.60 | 15.24 | 13 |
| | 31050 | S | 50.4 | 1234.8 | 1.20 | 30.48 | 13 |
| | 31051 | S | 51.6 | 1264.2 | 1.80 | 45.72 | 13 |
| | 31052 | S | 52.8 | 1293.6 | 2.40 | 60.96 | 13 |
| | 31054 | S | 54.0 | 1323.0 | 3.00 | 76.20 | 13 |
| | 31055 | S | 55.2 | 1352.4 | 3.60 | 91.44 | 13 |
| | 31056 | S | 56.4 | 1381.8 | 0.20 | 5.08 | 15 |
| | 31057 | S | 57.6 | 1411.2 | 0.80 | 20.32 | 15 |
| | 31058 | S | 58.8 | 1440.6 | 1.40 | 35.56 | 15 |
| | 31060 | S | 60.0 | 1470.0 | 2.00 | 50.80 | 15 |
| | 31061 | S | 61.2 | 1499.4 | 2.60 | 66.04 | 15 |
| | 31062 | S | 62.4 | 1528.8 | 3.20 | 81.28 | 15 |
| | 31063 | S | 63.6 | 1558.2 | 3.80 | 96.52 | 15 |
| | 31064 | S | 64.8 | 1587.6 | 0.40 | 10.16 | 17 |
| | 31066 | S | 66.0 | 1617.0 | 1.00 | 25.40 | 17 |

## 310xxM AND 310xxM1 MODULAR

| P/N | 310xx | M1 | L (in) | L (mm) | N |
|---|---|---|---|---|---|
| | 31002 | M/M1 | 2.4 | 60.96 | 1 |
| | 31004 | M/M1 | 4.8 | 121.92 | 2 |
| | 31007 | M/M1 | 7.2 | 182.88 | 3 |
| | 31009 | M/M1 | 9.6 | 243.84 | 4 |
| | 31012 | M/M1 | 12.0 | 304.80 | 5 |
| | 31014 | M/M1 | 14.4 | 365.76 | 6 |
| | 31016 | M/M1 | 16.8 | 426.72 | 7 |
| | 31019 | M/M1 | 19.2 | 487.68 | 8 |
| | 31021 | M/M1 | 21.6 | 548.64 | 9 |
| | 31024 | M/M1 | 24.0 | 609.60 | 10 |
| | 31026 | M/M1 | 26.4 | 670.56 | 11 |

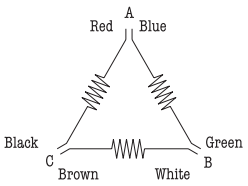
| P/N | 310xx | M/M1 | L (in) | L (mm) | N |
|---|---|---|---|---|---|
| | 31028 | M/M1 | 28.8 | 731.52 | 12 |
| | 31031 | M/M1 | 31.2 | 792.48 | 13 |
| | 31033 | M/M1 | 33.6 | 853.44 | 14 |
| | 31036 | M/M1 | 36.0 | 914.40 | 15 |
| | 31038 | M/M1 | 38.1 | 975.36 | 16 |
| | 31040 | M/M1 | 40.8 | 1036.32 | 17 |
| | 31043 | M/M1 | 43.2 | 1097.28 | 18 |
| | 31045 | M/M1 | 45.6 | 1158.20 | 19 |
| | 31048 | M/M1 | 48.0 | 1219.20 | 20 |
| | 31050 | M/M1 | 50.4 | 1280.16 | 21 |
| | 31052 | M/M1 | 52.8 | 1341.12 | 22 |
| | 31055 | M/M1 | 55.2 | 1402.08 | 23 |
| | 31057 | M/M1 | 57.6 | 1463.04 | 24 |
| | 31060 | M/M1 | 60.0 | 1524.00 | 25 |
| | 31062 | M/M1 | 62.4 | 1584.96 | 26 |
| | 31064 | M/M1 | 64.8 | 1645.92 | 27 |




P/N 31002 M

## WD1

Delta wound with Thermistor
Single Cable: THF08



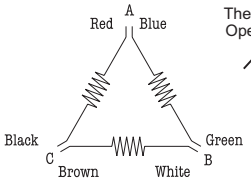

Orange
Thermistor Omega 44004
2.2 kOhms Resistance @ 25°C
Yellow

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = °Kelvin; R = Resistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_E$-8

## WD2

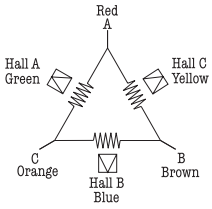
Delta wound with Thermostat
Single Cable: THF08




Thermostat(NC)
Opens at 90°C
Yellow(+)
Orange(-)

## WD3

Delta wound with Thermostat
Digital Hall Effect Devices
Single Cable: THF10



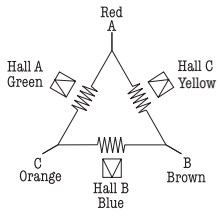

HED Power
Black(+)
White(gnd)

| Hall Effect Devices |
|---|
| Symmetrical Response |
| 4.5V to 18 V Operation |
| Open Collector Output |
| $I_{OUT}$ Continuous 15 mA |

Thermostat(NC)
Opens at 90°C
Grey(+)
Violet(-)

## WD4

Delta wound with Thermistor
Digital Hall Effect Devices
Single Cable: THF10




HED Power
Black(+)
White(gnd)

| Hall Effect Devices |
|---|
| Symmetrical Response |
| 4.5V to 18 V Operation |
| Open Collector Output |
| $I_{OUT}$ Continuous 15 mA |

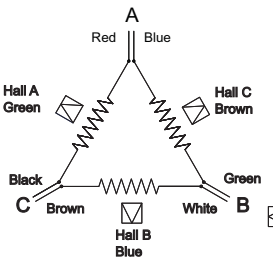
Grey
Thermistor Omega 44004
2.2 kOhms Resistance @ 25°C
Violet

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = °Kelvin; R = Reistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_E$-8

## WD7*

Delta wound with Thermostat
Digital Hall Effect Devices
Dual Cables: THF06 and THF08




Thermostat
(Normally Closed)
Opens at 90C
Orange (+)
Yellow (-)

HED Power
Black (+)
White (Gnd)

HALL EFFECT DEVICES
Symmetrical Response
4.5 to 18 Vdc power
Open Collector Output
15ma continuous

*Preferred Configuration with Parker Drives

## NOTES

1. Peak force and current based on 5% duty cycle and one second duration.
2. Continuous force and current based on coil winding temperature maintained at 100ºC.
3. Force constant is peak of resistive force produced by 1.0 amp thru one motor lead and 0.5 amps thru other two leads. Also, Back EMF (V/in/sec) * 7.665 = Force constant (lb/amp).
4. Motor resistance measured between any two motor leads with motor connected in Delta winding at 25ºC. For temperature at 100ºC, multiply resistance by 1.295 (75$^0$C rise * 0.393%/ºC)
5. Back EMF measured between any two motor leads while moving at constant velocity. Value is amplitude or 0-Peak of sine wave produced.
6. Motor inductance measured using 1Kz with the motor in the magnetic field.
7. Electrical Time Constant is time it takes for motor value to reach 63% of its final current after a step change in voltage.
8. Thermal Time Constant is time it takes for motor temperature to reach 63% of its final value after a step change in power.
9. Thermal Resistance is the number of degrees (Celsius) of temperature rise in the winding per watt of power dissipated. Determined experimentally.
10. Motor Constant is a measure of efficiency. Calculated by dividing the force constant by the square root of the motor resistance at maximum operating temperature.
11. Electrical Cycle Length is distance coil must travel to complete 360º electrical cycle.
12. Use TIPS sizing software for the most accurate estimate of coil temperature for a particular motion profile.
13. Motors available with nickel plating or black epoxy coating on magnets. Track part number modified with -N or -B at end. Must be specified at time of order.
14. Electrical motor specifications are for delta wound motors. Consult factory for wye-wound motor specifications.

# 410 Specifications

I FORCE

- Ironless motor, patented, RE34674
- Cross-section: 4.50"H (114.3mm) x 2.00"W (50.8mm)
- Peak forces in two sizes to 883lbs (3928N), continuous forces to 197 lbs (878N)
- Precision ground 3-piece track (410 model)
- Two lengths of modular magnet tracks allow unlimited length of travel
- Single-piece magnet tracks to 72.24" length
- Prealigned embedded digital HEDs, also available in separate cable from motor leads
- Internal air cooling manifold or liquid cooling manifold
- Internal thermal cutout switch protects coil

## PERFORMANCE

| MOTOR MODEL | | 410-2 | 410-3 | 410-4 | 410-6 | 410-8 |
|---|---|---|---|---|---|---|
| Peak Force | N | 1041.4 | 1523.6 | 2006.3 | 2967.2 | 3928.1 |
| | lb | 234.1 | 342.5 | 451.0 | 667.0 | 883.0 |
| Continuous Force | N | 233.1 | 340.8 | 448.9 | 663.7 | 878.6 |
| | lb | 52.4 | 76.6 | 100.9 | 149.2 | 197.5 |
| Peak Power | W | 2835 | 4050 | 5265 | 7695 | 10125 |
| Continuous Power | W | 142 | 203 | 263 | 385 | 506 |

## ELECTRICAL

| MOTOR MODEL | | 410-2 | | | 410-3 | | | 410-4 | | | 410-6 | | | 410-8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WIRING TYPE | UNITS | S | P | T | S | P | T | S | P | T | S | P | T | S | P | T |
| Peak Current | A pk sine | 19.1 | 38.2 | 57.3 | 18.6 | 37.2 | 55.8 | 18.4 | 36.8 | 55.2 | 18.1 | 36.2 | 54.3 | 18.0 | 36.0 | 54.0 |
| | (RMS) | 13.5 | 27.0 | 40.5 | 13.2 | 23.6 | 39.5 | 13.0 | 26.0 | 39.0 | 12.8 | 25.6 | 38.4 | 12.7 | 25.5 | 38.2 |
| Continuous Current | A pk sine | 4.3 | 8.6 | 12.9 | 4.2 | 8.4 | 12.6 | 4.1 | 8.2 | 12.3 | 4.1 | 8.2 | 12.3 | 4.0 | 8.0 | 12.0 |
| | (RMS) | 3.0 | 6.1 | 9.1 | 3.0 | 5.9 | 8.9 | 2.9 | 5.8 | 8.7 | 2.9 | 5.8 | 8.7 | 2.8 | 5.7 | 8.5 |
| Force Constant | N/A peak | 54.5 | 27.3 | 18.2 | 81.8 | 40.9 | 27.3 | 109.0 | 54.5 | 36.3 | 163.7 | 81.8 | 54.6 | 218.4 | 109.2 | 72.8 |
| | lb/A peak | 12.3 | 6.1 | 4.1 | 18.4 | 9.2 | 6.1 | 24.5 | 12.3 | 8.2 | 36.8 | 18.4 | 12.3 | 49.1 | 24.6 | 16.4 |
| Back EMF | V/m/s | 63.0 | 31.5 | 21.0 | 94.5 | 47.2 | 31.5 | 126.0 | 63.0 | 42.0 | 189.0 | 94.5 | 63.0 | 252.0 | 126.0 | 84.0 |
| | V/in/s | 1.60 | 0.80 | 0.53 | 2.40 | 1.20 | 0.80 | 3.20 | 1.60 | 1.07 | 4.80 | 2.40 | 1.60 | 6.40 | 3.20 | 2.13 |
| Resistance 25°C, phase to phase | ohms | 8.0 | 2.0 | 0.9 | 12.0 | 3.0 | 1.3 | 16.0 | 4.0 | 1.8 | 24.0 | 6.0 | 2.7 | 32.0 | 8.0 | 3.6 |
| Inductance, phase to phase | mH | 10.0 | 2.5 | 1.1 | 15.0 | 3.8 | 1.7 | 20.0 | 5.0 | 2.2 | 30.0 | 7.5 | 3.3 | 40.0 | 10.0 | 4.4 |
| Electrical Time Constant | ms | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| Motor Constant | N/W | 19.57 | 19.57 | 19.57 | 23.98 | 23.98 | 23.98 | 27.67 | 27.67 | 27.67 | 33.90 | 33.90 | 33.90 | 39.14 | 39.14 | 39.14 |
| | lb/W | 4.40 | 4.40 | 4.40 | 5.39 | 5.39 | 5.39 | 6.22 | 6.22 | 6.22 | 7.62 | 7.62 | 7.62 | 8.80 | 8.80 | 8.80 |
| Max Terminal Voltage | VDC | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 |

***NOTE: S-Series P-Parallel T-Triple***

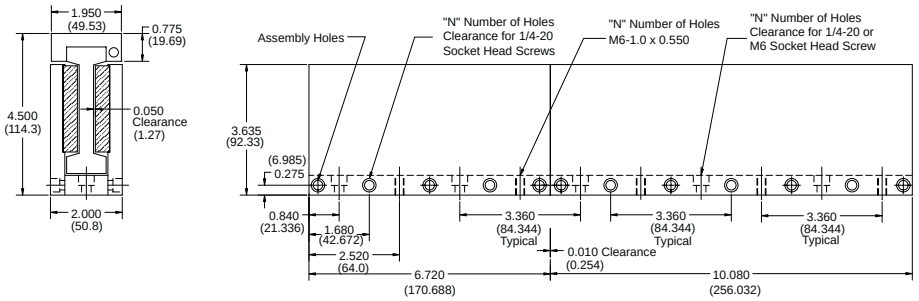
## THERMAL

| MOTOR MODEL | | 410-2 | 410-3 | 410-4 | 410-6 | 410-8 |
|---|---|---|---|---|---|---|
| Thermal Resistance Wind-Amb | degC / W | 0.53 | 0.37 | 0.26 | 0.19 | 0.15 |
| Thermal Time Constant | min | 15.1 | 15.1 | 15.1 | 15.1 | 15.1 |
| Maximum Winding Temperature | °C | 100 | 100 | 100 | 100 | 100 |

## MECHANICAL

| MOTOR MODEL | | 410-2 | 410-3 | 410-4 | 410-6 | 410-8 |
|---|---|---|---|---|---|---|
| Coil Weight | kg | 1.59 | 2.27 | 2.95 | 4.32 | 5.68 |
| | lb | 3.5 | 5.0 | 6.5 | 9.5 | 12.5 |
| Coil Length | mm | 199.1 | 284.5 | 369.8 | 540.5 | 711.2 |
| | in | 7.84 | 11.20 | 14.56 | 21.28 | 28.00 |
| Attractive Force | N | 0 | 0 | 0 | 0 | 0 |
| | lbf | 0 | 0 | 0 | 0 | 0 |
| Electrical Cycle Length | mm | 85.34 | 85.34 | 85.34 | 85.34 | 85.34 |
| | in | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 |

## MODULAR 41006M 41010M



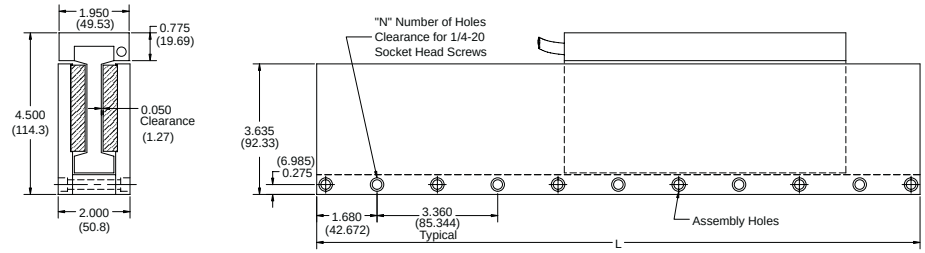

**Incremental Length:**
3.36in/85.34mm

**Minimum Length:**
6.72in/170.7mm

**Maximum Length:**
70.56in/1792.22mm

**Weight/Foot:**
20.0lbs/ft

## MODULAR 410xxM1



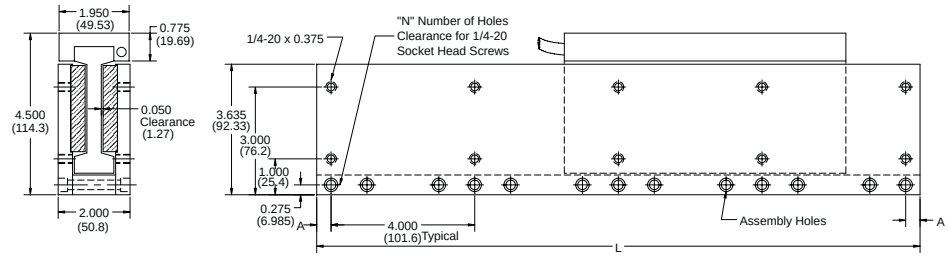

**Incremental Length:**
3.36in/85.34mm

**Minimum Length:**
6.72in/170.7mm

**Maximum Length:**
70.56in/1792.22mm

**Weight/Foot:**
20.0lbs/ft

## SINGLE PIECE 410xxS



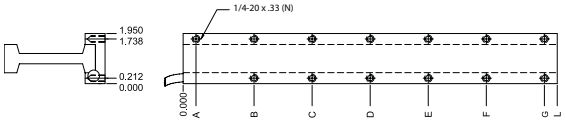

**Incremental Length:**
1.68in/42.67mm

**Minimum Length:**
16.80in/426.72mm

**Maximum Length:**
72.24in/1834.9mm

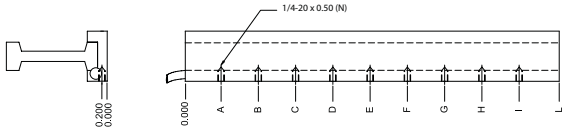
**Weight/Foot:**
20.0lbs/ft

## (A) ENGLISH TOP MOUNTING



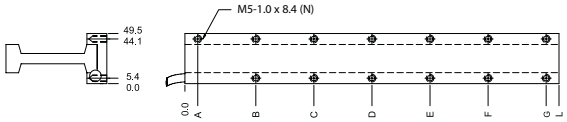

| COIL SIZE (in) | L | N | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|---|
| 410-2A | 7.84 | 5 | 0.50 | 3.92 | 7.34 | --- | --- | --- | --- |
| 410-3A | 11.20 | 8 | 0.50 | 1.60 | 5.60 | 9.60 | 10.70 | --- | --- |
| 410-4A | 14.56 | 9 | 0.50 | 3.28 | 7.28 | 11.28 | 14.06 | --- | --- |
| 410-6A | 21.28 | 13 | 0.50 | 2.64 | 6.64 | 10.64 | 14.64 | 18.64 | 20.78 |
| 410-8A | 28.00 | 13 | 2.00 | 6.00 | 10.00 | 14.00 | 18.00 | 22.00 | 26.00 |

## B) ENGLISH SIDE MOUNTING



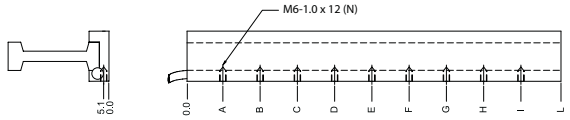

| COIL SIZE (in) | L | N | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 410-2B | 7.84 | 3 | 2.90 | 4.90 | 6.90 | --- | --- | --- | --- | --- | --- |
| 410-3B | 11.20 | 3 | 4.10 | 7.10 | 10.10 | --- | --- | --- | --- | --- | --- |
| 410-4B | 14.56 | 4 | 2.78 | 5.78 | 8.78 | 11.78 | --- | --- | --- | --- | --- |
| 410-6B | 21.28 | 6 | 3.14 | 6.14 | 9.14 | 12.14 | 15.14 | 18.14 | --- | --- | --- |
| 410-8B | 28.00 | 9 | 3.50 | 6.50 | 9.50 | 12.50 | 15.50 | 18.50 | 21.50 | 24.50 | 27.50 |

## (M) METRIC TOP MOUNTING




| COIL SIZE (mm) | L | N | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|---|
| 410-2M | 199.1 | 5 | 12.7 | 99.6 | 186.4 | --- | --- | --- | --- |
| 410-3M | 284.5 | 8 | 12.7 | 40.6 | 142.2 | 243.8 | 271.8 | --- | --- |
| 410-4M | 369.8 | 9 | 12.7 | 83.3 | 184.9 | 286.5 | 357.1 | --- | --- |
| 410-6M | 540.5 | 13 | 12.7 | 67.1 | 168.7 | 270.3 | 371.9 | 473.4 | 527.8 |
| 410-8M | 711.2 | 13 | 50.8 | 152.4 | 254.0 | 355.6 | 457.2 | 558.8 | 660.4 |

## (N) METRIC SIDE MOUNTING



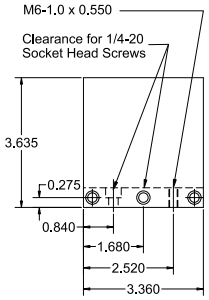

| COIL SIZE (mm) | L | N | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 410-2N | 199.1 | 3 | 73.7 | 124.5 | 175.3 | --- | --- | --- | --- | --- | --- |
| 410-3N | 284.5 | 3 | 104.1 | 180.3 | 256.5 | --- | --- | --- | --- | --- | --- |
| 410-4N | 369.8 | 4 | 70.6 | 146.8 | 223.0 | 299.2 | --- | --- | --- | --- | --- |
| 410-6N | 540.5 | 6 | 79.7 | 156.0 | 232.2 | 308.4 | 384.6 | 460.8 | --- | --- | --- |
| 410-8N | 711.2 | 9 | 88.9 | 165.1 | 241.3 | 317.5 | 393.7 | 469.9 | 546.1 | 622.3 | 698.5 |

## MODULAR TRACK COMBINATIONS

| LENGTH Inches | LENGTH In mm | QUANTITY 41006M | QUANTITY 41010M |
|---|---|---|---|
| 6.72 | 170.69 | 1 | 0 |
| 10.08 | 256.03 | 0 | 1 |
| 13.44 | 341.38 | 0 | 0 |
| 16.80 | 426.72 | 1 | 1 |
| 20.16 | 512.06 | 0 | 2 |
| 23.52 | 597.41 | 2 | 1 |
| 26.88 | 682.75 | 1 | 2 |
| 30.24 | 768.10 | 0 | 3 |
| 33.60 | 853.44 | 2 | 2 |
| 36.96 | 938.78 | 1 | 3 |
| 40.32 | 1024.13 | 0 | 4 |
| 43.68 | 1109.47 | 2 | 3 |
| 47.04 | 1194.82 | 1 | 4 |
| 50.40 | 1280.16 | 0 | 5 |
| 53.76 | 1365.50 | 2 | 4 |
| 57.12 | 1450.85 | 1 | 5 |
| 60.48 | 1536.19 | 0 | 6 |
| 63.84 | 1621.54 | 2 | 5 |
| 67.20 | 1706.88 | 1 | 6 |
| 70.56 | 1792.22 | 0 | 7 |
| 73.92 | 1877.57 | 2 | 6 |
| 77.28 | 1962.91 | 1 | 7 |
| 80.64 | 2048.26 | 0 | 8 |
| 84.00 | 2133.60 | 2 | 7 |
| 87.36 | 2218.94 | 1 | 8 |
| 90.72 | 2304.29 | 0 | 9 |
| 94.08 | 2389.63 | 2 | 8 |
| 97.44 | 2474.98 | 1 | 9 |

## 410 xxM AND 410 xxM1 MODULAR

| P/N 410xx | M/M1 | L (in) | L (mm) | N |
|---|---|---|---|---|
| 41006 | M/M1 | 6.72 | 170.69 | 2 |
| 41010 | M/M1 | 10.08 | 256.03 | 3 |
| 41013 | M/M1 | 13.44 | 341.38 | 4 |
| 41016 | M/M1 | 16.80 | 426.72 | 5 |
| 41020 | M/M1 | 20.16 | 512.06 | 6 |
| 41023 | M/M1 | 23.52 | 597.41 | 7 |
| 41026 | M/M1 | 26.88 | 682.75 | 8 |
| 41030 | M/M1 | 30.24 | 768.10 | 9 |
| 41033 | M/M1 | 33.60 | 853.44 | 10 |
| 41036 | M/M1 | 36.96 | 938.78 | 11 |
| 41040 | M/M1 | 40.32 | 1024.13 | 12 |
| 41043 | M/M1 | 43.68 | 1109.47 | 13 |
| 41047 | M/M1 | 47.04 | 1194.82 | 14 |
| 41050 | M/M1 | 50.40 | 1280.16 | 15 |
| 41053 | M/M1 | 53.76 | 1365.50 | 16 |
| 41057 | M/M1 | 57.12 | 1450.85 | 17 |
| 41060 | M/M1 | 60.48 | 1536.19 | 18 |
| 41063 | M/M1 | 63.84 | 1621.54 | 19 |
| 41067 | M/M1 | 67.20 | 1706.88 | 20 |
| 41070 | M/M1 | 70.56 | 1792.22 | 21 |



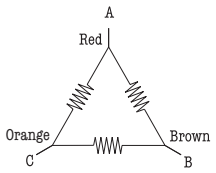

P/N 41003 M

## 410xxS SINGLE PIECE

| P/N 410xx | S | L | A | N |
|---|---|---|---|---|
| 41016 | S | 16.80 | 1.68 | 5 |
| 41018 | S | 18.48 | 2.52 | 5 |
| 41020 | S | 20.16 | 3.36 | 5 |
| 41021 | S | 21.84 | 0.84 | 7 |
| 41023 | S | 23.52 | 1.68 | 7 |
| 41025 | S | 25.20 | 2.52 | 7 |
| 41026 | S | 26.88 | 3.36 | 7 |
| 41028 | S | 28.56 | 0.84 | 9 |
| 41030 | S | 30.24 | 1.68 | 9 |
| 41031 | S | 31.92 | 2.52 | 9 |
| 41033 | S | 33.60 | 3.36 | 9 |
| 41035 | S | 35.28 | 0.84 | 11 |
| 41036 | S | 36.96 | 1.68 | 11 |
| 41038 | S | 38.64 | 2.53 | 11 |
| 41040 | S | 40.32 | 3.36 | 11 |
| 41042 | S | 42.00 | 0.84 | 13 |
| 41043 | S | 43.68 | 1.68 | 13 |
| 41045 | S | 45.36 | 2.52 | 13 |
| 41047 | S | 47.04 | 3.36 | 13 |
| 41048 | S | 48.72 | 0.84 | 15 |
| 41050 | S | 50.40 | 1.68 | 15 |
| 41052 | S | 52.08 | 2.52 | 15 |
| 41053 | S | 53.76 | 3.36 | 15 |
| 41055 | S | 55.44 | 0.84 | 17 |
| 41057 | S | 57.12 | 1.68 | 17 |
| 41058 | S | 58.80 | 2.52 | 17 |
| 41060 | S | 60.48 | 3.36 | 17 |
| 41062 | S | 62.16 | 0.84 | 19 |
| 41063 | S | 63.84 | 1.68 | 19 |
| 41065 | S | 65.52 | 2.52 | 19 |
| 41067 | S | 67.20 | 3.36 | 19 |
| 41068 | S | 68.88 | 0.84 | 21 |
| 41070 | S | 70.56 | 1.68 | 21 |
| 41072 | S | 72.24 | 2.52 | 21 |

## WD1

Delta wound with Thermistor
Single Cable: THF05



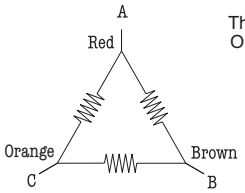

Orange
Thermistor Omega 44004
2.2 kOhms Resistance @ 25°C
Yellow

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = °Kelvin; R = Resistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_E$-8

## WD2

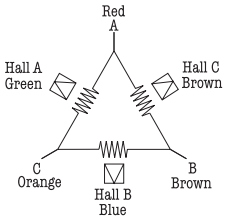
Delta wound with Thermostat
Single Cable: THF05




Thermostat(NC)
Opens at 90°C
Yellow(+)
Orange(-)

## WD3

Delta wound with Thermostat
Digital Hall Effect Devices
Dual Cable: THF05 and THF06




HED Power
Black(+)
White(gnd)

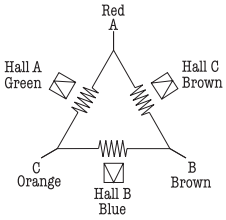
Hall Effect Devices

| |
|---|
| Symmetrical Response |
| 4.5V to 18 V Operation |
| Open Collector Output |
| $I_{OUT}$ Continuous 15 mA |

Thermostat(NC)
Opens at 90°C
Grey(+)
Violet(-)

## WD4

Delta wound with Thermistor
Digital Hall Effect Devices
Dual Cable: THF05 and THF06




HED Power
Black(+)
White(gnd)

Hall Effect Devices

| |
|---|
| Symmetrical Response |
| 4.5V to 18 V Operation |
| Open Collector Output |
| $I_{OUT}$ Continuous 15 mA |

Grey
Thermistor Omega 44004
2.2 kOhms Resistance @ 25°C
Violet

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = °Kelvin; R = Reistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_E$-8

## NOTES

1. Peak force and current based on 5% duty cycle and one second duration.
2. Continuous force and current based on coil winding temperature maintained at 100°C.
3. Force constant is peak of resistive force produced by 1.0 amp thru one motor lead and 0.5 amps thru other two leads. Also, Back EMF (V/in/sec) * 7.665 = Force constant (lb/amp).
4. Motor resistance measured between any two motor leads with motor connected in Delta winding at 25°C. For temperature at 100°C, multiply resistance by 1.295 (75°C rise * 0.393%/°C)
5. Back EMF measured between any two motor leads while moving at constant velocity. Value is amplitude or 0-Peak of sine wave produced.
6. Motor inductance measured using 1Kz with the motor in the magnetic field.
7. Electrical Time Constant is time it takes for motor value to reach 63% of its final current after a step change in voltage.
8. Thermal Time Constant is time it takes for motor temperature to reach 63% of its final value after a step change in power.
9. Thermal Resistance is the number of degrees (Celsius) of temperature rise in the winding per watt of power dissipated. Determined experimentally.
10. Motor Constant is a measure of efficiency. Calculated by dividing the force constant by the square root of the motor resistance at maximum operating temperature.
11. Electrical Cycle Length is distance coil must travel to complete 360° electrical cycle.
12. Use TIPS sizing software for the most accurate estimate of coil temperature for a particular motion profile.
13. Motors available with nickel plating or black epoxy coating on magnets. Track part number modified with -N or -B at end. Must be specified at time of order.
14. Electrical motor specifications are for delta wound motors. Consult factory for wye-wound motor specifications.

# How to order - 110

## Motor Coil

Order Example:

110 - 2 B - NC - WD2 P - 8

**Series**
110

**Coil size**
1 or 2 poles

**Mounting**
**A** top, English
**B** side, English
**M** top, metric
**N** side, metric
**C** custom

**Cooling**
**NC** no cooling
**AC** not available
**LC** not available

**Cable Length**
in feet (8 ft. standard)

**Winding**
**S** Series
**P** Parallel
**T** Triple (not available for 1-pole motor)

**Wiring**
WD0*, WD1, WD2, WD3, WD4

## Magnet Track:

11024M1 - N

| | | | |
|---|---|---|---|
| **110xxM:** | 11007M, 11009M | 7.20”, 9.60 | modular sections |
| **11507M:** | 11507M, 11509M | 7.20”, 9.60 | modular sections |
| **110xxM1:** | 11036M1, max | 36.00” max | single piece, 2.4” incr. |
| **110xxM:** | 11036M, max | 36.00” max | single piece, 2.4” incr. |
| **115xxM:** | 11524M, max | 24.00” max | single piece, 2.4” incr. |
| **110xxS:** | 11036M, max | 36.00” max | single piece, 1.2” incr. |

**Magnet coating**
**N** nickel (standard)
**B** black epoxy

## Motor Coil

Order Example:

210 - 2 M - NC - WD2 P - 8

**Series**
210

**Coil size**
1, 2, 3 or 4 poles

**Mounting**
**A** top, English
**B** side, English
**M** top, metric
**N** side, metric
**C** custom

**Cooling**
**NC** no cooling
**AC** air cooling
**LC** liquid cooling

**Cable Length**
in feet (8 ft. standard)

**Winding**
**S** Series
**P** Parallel
**T** Triple (not available for 1-pole motor)

**Wiring**
WD1, WD2,
WD3, WD4, WD7

## Magnet Track:

21024M1 - N

| | | |
|---|---|---|
| **210xxM:** | 21007M, 21009M | 7.20”, 9.60” modular sections |
| **21507M:** | 21507M, 21509M | 7.20”, 9.60” modular sections |
| **210xxM1:** | 21048M1 max | 48.00” max single piece, 2.4” incr. |
| **210xxM:** | 21048M max | 48.00” max single piece, 2.4” incr. |
| **215xxM:** | 21524M max | 24.00” max single piece, 2.4” incr. |
| **210xxS:** | 21048S max | 48.00” max single piece, 1.2” incr. |

**Magnet coating**
**N** nickel (standard)
**B** black epoxy

## Motor Coil

Order Example:

310 - 2 A - NC - WD2 P - 8

**Series**
310

**Coil size**
1, 2, 3, 4, 5, or 6 poles

**Mounting**
**A** top, English
**B** side, English
**M** top, metric
**N** side, metric
**C** custom

**Cooling**
**NC** no cooling
**AC** air cooling
**LC** liquid cooling

**Cable Length**
in feet (8 ft. standard)

**Winding**
**S** Series
**P** Parallel
**T** Triple (not available for 1-pole motor)

**Wiring**
WD1, WD2,
WD3, WD4, WD7

## Magnet Track:

31024M1 - N

| | | |
|---|---|---|
| **310xxM:** | 31007M, 31009M | 7.20”, 9.60” modular sections |
| **31507M:** | 31507M, 31509M | 7.20”, 9.60” modular sections |
| **310xxM1:** | 31064M1 max | 64.8” max single piece, 2.4” incr. |
| **310xxM:** | 31064M max | 64.80” max single piece, 2.4” incr. |
| **315xxM:** | 31524M max | 24.00” max single piece, 2.4” incr. |
| **310xxS:** | 31066S max | 64.8” max single piece, 1.2” incr. |

**Magnet coating**
**N** nickel (standard)
**B** black epoxy

## Motor Coil

Order Example:

410 - 2 B - NC - WD2 P - 8

**Series**
410

**Coil size**
1, 2, 3, 4, 5, or 6 poles

**Mounting**
**A** top, English
**B** side, English
**M** top, metric
**N** side, metric
**C** custom

**Cooling**
**NC** no cooling
**AC** air cooling
**LC** liquid cooling

**Cable Length**
in feet (8 ft. standard)

**Winding**
**S** Series
**P** Parallel
**T** Triple (not available for 1-pole motor)

**Wiring**
WD1, WD2,
WD3, WD4

## Magnet Track:

41024M1 - N

| | | |
|---|---|---|
| **410xxM:** | 41006M, 41010M | 6.72", 10.08" modular sections |
| **410xxM1:** | 41070M1max | 70.56" max single piece, 3.36" incr. |
| **410xxM:** | 41070M max | 70.56" max single piece, 3.36" incr. |
| **410xxS:** | 41072S max | 70.56" max single piece, 1.68" |

**Magnet coating**
**N** nickel (standard)
**B** black epoxy

# ML50 Specifications

I FORCE

- Ironless motor, patented, RE34674
- Cross-section: 155mm x 50mm
- Peak forces to 3811N (856lbs), continuous forces to 852N (191lbs)
- Precision ground 3 piece track with magnet spacers
- Two lengths of modular magnet tracks allow unlimited length of travel
- Single piece magnet tracks to 480mm
- Connector module allows quick and easy installation
- HED sensors and overtravel limits available in connector module
- Internal thermal cutout switch protects coil

## PERFORMANCE

| MOTOR MODEL | | ML50-2 | ML50-3 | ML50-4 | ML50-6 | ML50-8 | ML50-9 |
|---|---|---|---|---|---|---|---|
| Peak Force | N | 847 | 1270 | 1694 | 2541 | 3387 | 3811 |
| | lbs | 190.4 | 285.6 | 380.8 | 571.1 | 761.5 | 856.7 |
| Continuous Force | N | 189 | 284 | 379 | 568 | 757 | 852 |
| | lbs | 42.6 | 63.9 | 85.1 | 127.7 | 170.3 | 191.6 |
| Peak Power | W | 1560 | 2340 | 3120 | 4680 | 6240 | 7020 |
| Continuous Power | W | 78 | 117 | 156 | 234 | 312 | 351 |

## ELECTRICAL

| MOTOR MODEL | | ML50-2 | | ML50-3 | | ML50-4 | | | ML50-6 | | | ML50-8 | | ML50-9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WIRING TYPE | UNITS | S | P | S | T | S | P | D | S | P | T | P | D | T |
| Peak Current | A pk sine | 19.9 | 39.8 | 19.9 | 59.7 | 19.9 | 39.8 | 79.7 | 19.9 | 39.8 | 59.7 | 39.8 | 79.7 | 59.7 |
| | (RMS) | 14.1 | 28.1 | 14.1 | 42.2 | 14.1 | 28.1 | 53.4 | 14.1 | 28.1 | 42.2 | 28.1 | 53.4 | 42.2 |
| Continuous Current | A pk sine | 4.5 | 8.9 | 4.5 | 13.4 | 4.5 | 8.9 | 17.8 | 4.5 | 8.9 | 13.4 | 8.9 | 17.8 | 13.4 |
| | (RMS) | 3.2 | 6.3 | 3.2 | 9.5 | 3.2 | 6.3 | 12.6 | 3.2 | 6.3 | 9.5 | 6.3 | 12.6 | 9.5 |
| Force Constant | N/A | 42.5 | 21.3 | 63.8 | 21.3 | 85.0 | 42.5 | 21.3 | 127.6 | 63.8 | 42.5 | 85.0 | 42.5 | 63.8 |
| | lbs/A | 9.6 | 4.8 | 14.3 | 4.8 | 19.1 | 9.6 | 4.8 | 28.7 | 14.3 | 9.6 | 19.1 | 9.6 | 14.3 |
| Back EMF | V/m/s | 49.1 | 24.5 | 73.6 | 24.5 | 98.2 | 49.1 | 24.5 | 147.3 | 73.6 | 49.1 | 98.2 | 49.1 | 73.6 |
| | V/ips | 1.2 | 0.6 | 1.9 | 0.6 | 2.5 | 1.2 | 0.6 | 3.7 | 1.9 | 1.2 | 2.5 | 1.2 | 1.9 |
| Resistance | Ohms | 4.1 | 1.0 | 6.1 | 0.7 | 8.1 | 2.0 | 0.5 | 12.2 | 3.0 | 1.4 | 4.1 | 1.0 | 2.0 |
| Inductance | mH | 3.3 | 0.8 | 5.0 | 0.6 | 6.6 | 1.7 | 0.4 | 9.9 | 2.5 | 1.1 | 3.3 | 0.8 | 1.7 |
| Electrical Time Constant | ms | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| Motor Constant | N/√W | 21.4 | 21.4 | 26.3 | 26.3 | 30.3 | 30.3 | 30.3 | 37.1 | 37.1 | 37.1 | 42.9 | 42.9 | 45.5 |
| | lbs/√W | 4.82 | 4.8 | 5.90 | 5.9 | 6.82 | 6.8 | 6.8 | 8.35 | 8.3 | 8.3 | 9.6 | 9.6 | 10.2 |
| Max Terminal Voltage | VDC | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 330 |

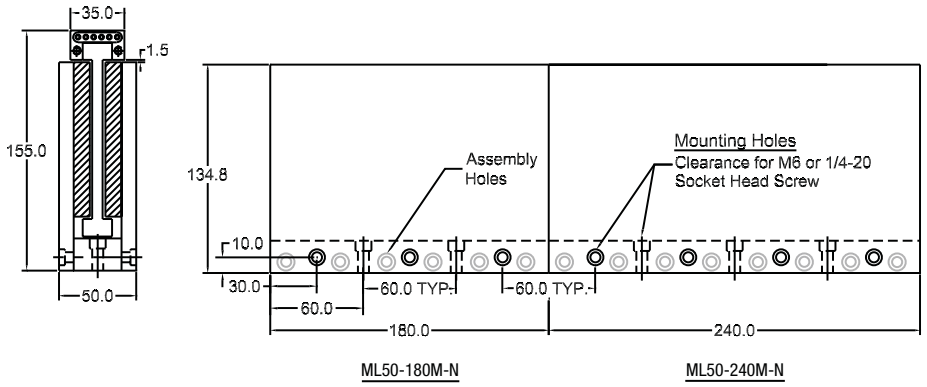
## THERMAL

| MOTOR MODEL | | ML50-2 | ML50-3 | ML50-4 | ML50-6 | ML50-8 | ML50-9 |
|---|---|---|---|---|---|---|---|
| Thermal Resistance Wind-Amb | degC / W | 0.96 | 0.64 | 0.48 | 0.32 | 0.24 | 0.21 |
| Thermal Time Constant | min | 9.2 | 9.2 | 9.2 | 9.2 | 9.2 | 9.2 |
| Maximum Winding Temperature | degC | 100 | 100 | 100 | 100 | 100 | 100 |

## MECHANIC

| MOTOR MODEL | | ML50-2 | ML50-3 | ML50-4 | ML50-6 | ML50-8 | ML50-9 |
|---|---|---|---|---|---|---|---|
| Coil Weight | kg | 0.7 | 1.1 | 1.5 | 2.2 | 2.9 | 3.3 |
| | lbs | 1.6 | 2.4 | 3.2 | 4.8 | 6.4 | 7.2 |
| Coil Length | mm | 120 | 180 | 240 | 360 | 480 | 540 |
| (does not include connector module | in | 4.724 | 7.087 | 9.449 | 14.173 | 18.898 | 21.260 |
| Attractive Force | N | 0 | 0 | 0 | 0 | 0 | 0 |
| | lbs | 0 | 0 | 0 | 0 | 0 | 0 |
| Electrical Cycle Length | mm | 60 | 60 | 60 | 60 | 60 | 60 |

## MODULAR TRACKS ML50-180M-N ML50-240M-N



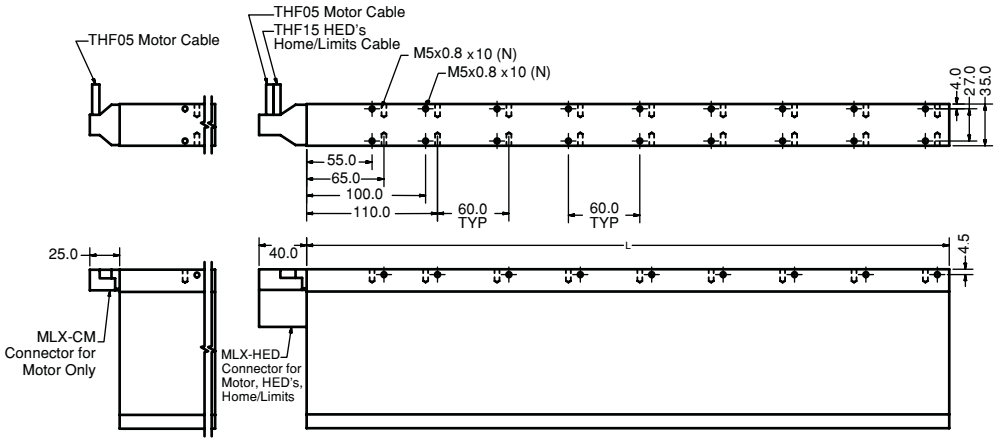

**Incremental Length:**
60mm

**Maximum Single Piece Length:**
480mm

**Minimum Length:**
180mm

**Weight:**
37.9 kg/m (25.4 lbs/ft)

## COIL ASSEMBLY ML50-xE-NC-Mx




| ML50 COIL ASSEMBLY | | |
|---|---|---|
| ML50-XE | L | N |
| ML50-2E | 120 | 4 |
| ML50-3E | 180 | 6 |
| ML50-4E | 240 | 8 |
| ML50-6E | 360 | 12 |
| ML50-8E | 480 | 16 |
| ML50-9E | 540 | 18 |

| ML50 CONNECTOR MODULE | Motor connector | Digital HEDs | Limit sensor |
|---|---|---|---|
| MLX-CM-R-x | ● | | |
| MLX-HED-R-x | ● | ● | ● |

*x = Cable length in meters*

## NOTES

1. Peak force and current based on 5% duty cycle and 1 sec duration.
2. Continuous force and current based on coil winding temperature maintained at 100°C.
3. Force constant is peak of resistive force produced by 1.0A thru one motor lead and 0.5A thru other two leads. Also, BackEMF (V/in/sec) * 7.665 = Force constant (lb/A).
4. Motor resistance measured between any two motor leads with motor connected in WYE winding at 25°C. For temperature at $100^0$C, multiply resistance by 1.295 (75°C rise * 0.393%/°C)
5. Back EMF measured between any two motor leads while moving at constant velocity. Value is amplitude or 0-Peak of sine wave produced.
6. Motor inductance measured using 1kHz with the motor in the magnetic field.
7. Electrical Time Constant is time it takes for motor current to reach 63% of it's final value after a step change in voltage.
8. Thermal Time Constant is time it takes for motor temperature to reach 63% of it's final value after a step change in power.
9. Thermal Resistance is the number of degrees (Celsius) of temperature rise in the winding per watt of power dissipated. Determined experimentally.
10. Motor Constant is a measure of efficiency. Calculated by dividing the force constant by the square root of the motor resistance at maximum operating temperature.
11. Electrical Cycle Length is distance coil must travel to complete 360° electrical cycle.
12. Use TIPS sizing software for the most accurate estimate of coil temperature for a particular motion profile.

## Motor Coil

Order Example:

ML50 - 2 E - NC - M S

**Series**
ML50

**Coil size**
2, 3, 4, 6, 8, or 9 poles

**Mounting**
**E** Standard
**C** custom

**Winding**
**S** Series
**P** Parallel
**T** Triple
**D** Double parallel

**Module ready**
Receives connector module

**Cooling**
NC no cooling
AC not available
LC not available

## Magnet Track:

ML50 240M M - N

**Series**
ML50

**Track length**
180 - 240 mm

**Magnet coating**
**N** nickel (standard)

**Magnet coating**
**M** modular
**C** custom

## Magnet Track:

MLX CM R - 1

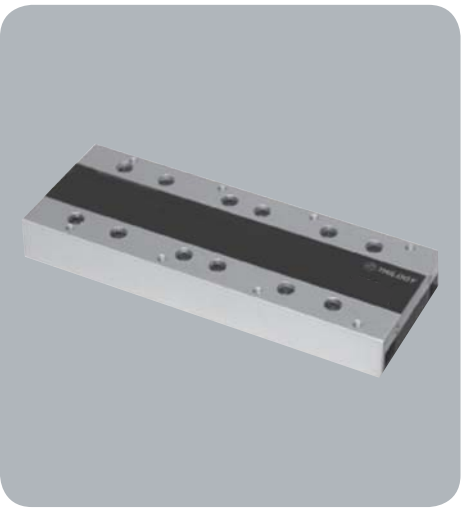
**Series**
MLX

**device description**
CM connector module
HED Hall effects device with limits

**Cable length**
1 meter (standard)

Module type

# RIPPED Ironcore Linear Motors



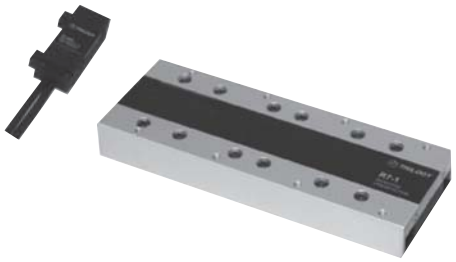
**Parker Trilogy's RIPPED ironcore linear motors, with their patent-pending anti-cog technology, can produce the large forces needed for many industrial applications – without the roughness associated with traditional ironcore linear motors. With forces ranging from 13 lbf (57.8 N) continuous up to 1671 lbf (7433 N) peak, the RIPPED family is well suited for a broad range of extremely demanding applications.**

**The RIPPED motor connector modules allow quick and easy installation while reducing overall maintenance costs. Ultra-high-flex cables come standard. In addition, we offer modular magnet tracks for unrestricted travel length.**

**Virtually cog-free operation combined with powerful ironcore technology make the RIPPED family of motors a superior choice for high-force, ultra-smooth motion and affordability.**

**Features and Benefits**

- RIPPED Ironcore Linear Motor for high force applications
- Patent Pending ultra-smooth anti-cog technology
- Connector modules allow quick and easy installation
- Internal thermal cutout switch protects coil
- Digital HEDs, Home & +/-Limit Sensors incorporated into Connector Module
- Modular magnet tracks with flush mounted magnet separators
- Built in cable strain relief
- Two lengths of modular magnet tracks allow unlimited length of travel



- RIPPED Ironcore motor, patent pending
- Cross-section: 55mm (2.165”) x 37.5mm (1.476”)
- Peak forces to 325N (73lbs), continuous forces to 97N (22lbs)
- Two lengths of modular magnet tracks allow unlimited length of travel
- Connector module allows quick and easy installation
- Internal thermal cutout switch protects coil

## PERFORMANCE

| MOTOR MODEL | | R5-1 | R5-2 |
|---|---|---|---|
| Peak Force* | N | 190 | 325 |
| | lbs | 43 | 73 |
| Continuous Force | N | 56 | 97 |
| | lbs | 13 | 22 |
| Peak Power | W | 1920 | 2806 |
| Continuous Power | W | 96 | 140 |

## ELECTRICAL

| MOTOR MODEL | | R5-1 | R5-2 |
|---|---|---|---|
| **WIRING TYPE** | **Units** | **S-Series** | **S-Series** |
| Peak Current | A $^{pk\ sine}$ | 11.2 | 19.2 |
| | (RMS) | 7.9 | 13.5 |
| Continuous Current | A $^{pk\ sine}$ | 2.5 | 4.3 |
| | (RMS) | 1.7 | 3.0 |
| Force Constant * | N/A | 22.5 | 22.5 |
| | lbs/A | 5.1 | 5.1 |
| Back EMF | Vm/s | 26.0 | 26.0 |
| | V/ips | 0.66 | 0.66 |
| Resistance | Ohms | 15.7 | 7.8 |
| Inductance | mH | 21.5 | 11.2 |
| Electrical Time Constant | ms | 1.4 | 1.4 |
| Motor Constant | N/√W | 5.8 | 8.2 |

## THERMAL

| MOTOR MODEL | | R5-1 | R5-2 |
|---|---|---|---|
| Thermal Resistance Wind-Amb | degC / W | 0.78 | 0.53 |
| Thermal Time Constant | min | 5.9 | 5.9 |
| Maximum Winding Temperature | ° C | 100 | 100 |

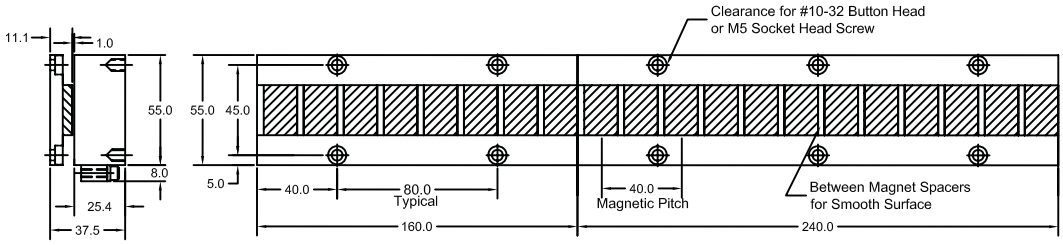
## MECHANICAL

| MOTOR MODEL | | R5-1 | R5-2 |
|---|---|---|---|
| Coil Weight | kg | 0.6 | 1.0 |
| | lbs | 1.4 | 2.1 |
| Coil Length (does not include connector module) | mm | 130 | 190 |
| | in | 5.118 | 7.480 |
| Attractive Force | N | 667 | 979 |
| | lbs | 150 | 220 |
| Electrical Cycle Length | mm | 40 | 40 |
| | in | 1.575 | 1.575 |

***Note:** The force constant decreases at high current levels. The force constant at peak current is 3.80 lbs/A/pole.

# R5 Dimensions

## MODULAR TRACKS R5-160-M-N R5-240-M-N




**Incremental Length:**
80mm (3.1496)

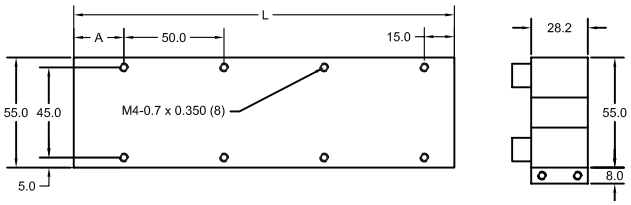
**Minimum Length:**
40mm (1.5748)

**Weight:**
3.0kg/m (2.0lb/ft)

R5-160-M-N (Nickel Plated Magnets)
R5-240-M-N (Nickel Plated Magnets)

R5-160-COVER (Optional)
R5-240-COVER (Optional)

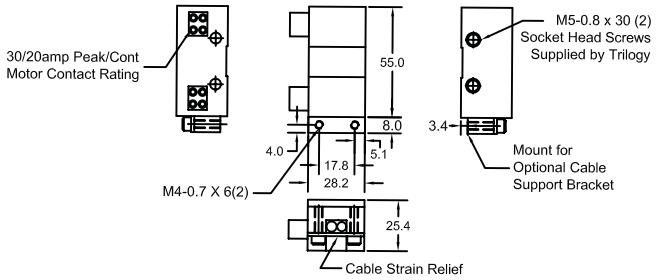
## COIL ASSEMBLY R5-xxxxx




| R5 COIL ASSEMBLY | | | | |
|---|---|---|---|---|
| R5-xA-NC-MS | L | N | OAL | A |
| R5-1A-NC-MS | 130 | 6 | 158.2 | 15 |
| R5-2A-NC-MS | 190 | 8 | 218.2 | 25 |

R5-1A-NC-MS Series Winding only
R5-2A-NC-MS Series Winding only

## CONNECTOR MODULE R5-xxx-xx-x




| R5 CONNECTOR MODULE | | | |
|---|---|---|---|
| R5-xxx-Rx-x | Motor Connector | Digital HED's | Limit Sensors |
| R5-CM-Rx-x | ✔ | | |
| R5-HED-Rx-x | ✔ | ✔ | ✔ |

R5-xxx-RS-1 or -RP-1 or -RT-1: 1m cable standard.
Module and Coil Assembly winding (S, P or T) must match.

## NOTES

1. Peak force and current based on 5% duty cycle results in the maximum temperature rise.
2. The force constant gradually decreases at high current levels. At the peak current the force constant is reduced by 24%. Refer to www.trilogysystems.com for motor performance curves at different current levels. TIPS sizing software accommodates the changing force constant with current in its algorithms.
3. Specifications are based on the maintaining the air gap between the coil and track shown in the drawings. Refer to www.trilogysystems.com for motor performance curves at different air gaps.
4. Continuous force and current based on coil winding temperature maintained at 100˚C.
5. Motor resistance measured between any two motor leads with motor connected in Wye winding at 25˚C. For temperature at 100˚C, multiply resistance by 1.295 (75˚C rise * 0.393%/˚C).
6. Thermal Resistance is the number of degrees (Celsius) of temperature rise in the winding per watt of power dissipated. Determined experimentally.
7. Motor Constant is a measure of efficiency. Calculated by dividing the force constant by the square root of the motor resistance at maximum operating temperature.
8. Use TIPS sizing software for the most accurate estimate of coil temperature for a particular motion profile.

## SAFETY

1. USE EXTREME CAUTION IN HANDLING TRACKS. Ironcore Linear Motors contain exposed magnets and have an open magnetic field. Any ferrous metal, steel or iron, will be attracted to the magnet track. The amount of attractive force increases significantly as the distance from the magnet decreases. Severe injury may occur to fingers or hands if caught between the track and coil or other metal object.
2. USE EXTREME CAUTION WHEN INSTALLING THE COIL. The data sheet lists the attractive force between the coil and track. Refer to the "Motor Installation Guide" for proper installation instructions.
3. ANY PERSON WITH MEDICAL ELECTRONIC IMPLANTS SHOULD USE EXTREME CAUTION WHEN NEAR AN OPEN MAGNETIC FIELD. The magnetic field could interfere with the medical device's operation.
4. ANY PERSON WORKING OR HANDLING THE TRACKS SHOULD REMOVE PERSONAL EFFECTS. Items such as jewelry, watches, keys and credit cards may be damaged or adversely affected by the magnetic field.

- RIPPED Ironcore motor, patent pending
- Cross-section: 70mm (2.756") x 37.5mm (1.476")
- Peak forces in three sizes to 1761N (396lbs), continuous forces to 462N (104lbs)
- Two lengths of modular magnet tracks allow unlimited length of travel
- Connector modules allow quick and easy installation
- Internal thermal cutout switch protects coil

## PERFORMANCE

| MOTOR MODEL | | R7-1 | R7-2 | R7-3 |
|---|---|---|---|---|
| Peak Force | N | 587 | 1174 | 1761 |
| | lb | 132 | 264 | 396 |
| Continuous Force | N | 154 | 308 | 462 |
| | lb | 35 | 69 | 104 |
| Peak Power | W | 3600 | 7200 | 10800 |
| Continuous Power | W | 180 | 360 | 540 |

## ELECTRICAL

| MOTOR MODEL | | R7-1 | R7-2 | | R7-3 | |
|---|---|---|---|---|---|---|
| WIRING TYPE | UNITS | S-Series | S-Series | P-Parallel | S-Series | T-Triple |
| Peak Current | A pk sine | 29.7 | 29.7 | 59.4 | 29.7 | 89.1 |
| | (RMS) | 21.0 | 21.0 | 42.0 | 21.0 | 63.0 |
| Continuous Current | A pk sine | 6.6 | 6.6 | 13.2 | 6.6 | 19.8 |
| | (RMS) | 4.6 | 4.6 | 9.3 | 4.6 | 14.0 |
| Force Constant | N/A peak | 23.2 | 46.4 | 23.2 | 69.6 | 23.2 |
| | lb/A peak | 5.2 | 10.4 | 5.2 | 15.6 | 5.2 |
| Back EMF | V/m/s | 26.8 | 53.5 | 26.8 | 80.3 | 26.8 |
| | V/in/s | 0.68 | 1.36 | 0.68 | 2.04 | 0.68 |
| Resistance 25°C, phase to phase | ohms | 4.2 | 8.4 | 2.1 | 12.6 | 1.4 |
| Inductance, phase to phase | mH | 6.1 | 12.2 | 3.1 | 18.3 | 2.0 |
| Electrical Time Constant | ms | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Motor Constant | N/√W | 11.5 | 16.2 | 16.2 | 19.9 | 19.9 |
| | lb/√W | 2.58 | 3.65 | 3.65 | 4.47 | 4.47 |
| Max Terminal Voltage | VDC | 330 | 330 | | 330 | |

## THERMAL

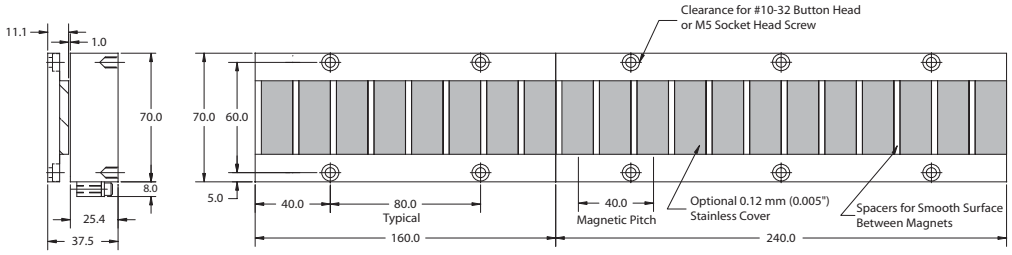
| MOTOR MODEL | | R7-1 | R7-2 | R7-3 |
|---|---|---|---|---|
| Thermal Resistance Wind-Amb | degC / W | 0.42 | 0.21 | 0.14 |
| Thermal Time Constant | min | 12.7 | 12.7 | 12.7 |
| Maximum Winding Temperature | °C | 100 | 100 | 100 |

## MECHANICAL

| MOTOR MODEL | | R7-1 | R7-2 | R7-3 |
|---|---|---|---|---|
| Coil Weight | kg | 1.5 | 3.0 | 4.5 |
| | lb | 3.3 | 6.7 | 10.0 |
| Coil Length | mm | 218.2 | 378.2 | 538.2 |
| (includes connector module) | in | 8.590 | 14.890 | 21.189 |
| Attractive Force | N | 1557 | 3114 | 4671 |
| | lbf | 350 | 700 | 1050 |
| Electrical Cycle Length | mm | 40 | 40 | 40 |
| | in | 1.575 | 1.575 | 1.575 |

# R7 Dimensions

## MODULAR TRACKS R7-160-M-x R7-240-M-x




**Incremental Length:**
80.0mm (3.1496")

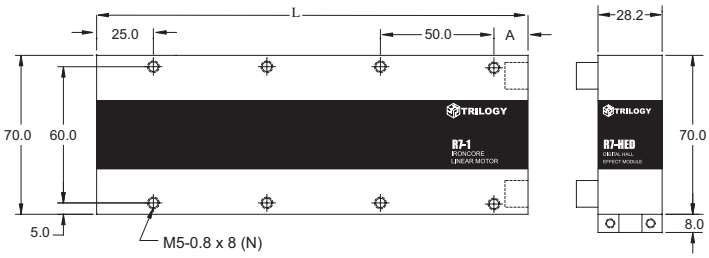
**Minimum Length:**
160.0mm (6.2992")

**Weight:**
4.57Kg/m (3.08lbs/ft)

R7-160-M-N (Nickel Plated Magnets)
R7-240-M-N (Nickel Plated Magnets)

R7-160-COVER (Optional)
R7-240-COVER (Optional)

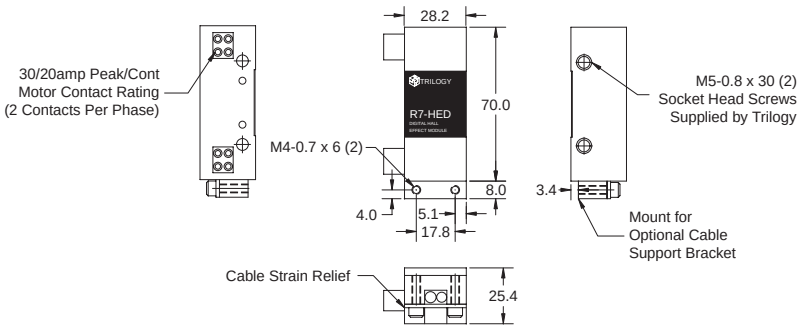
## COIL ASSEMBLY R7-xA-NC-Mx




| R7 COIL ASSEMBLY | | | | |
|---|---|---|---|---|
| **R7-xA-NC-Mx** | **L** | **N** | **OAL** | **A** |
| R7-1A-NC-Mx | 190.0 | 8 | 218.2 | 15 |
| R7-2A-NC-Mx | 350.0 | 14 | 378.2 | 25 |
| R7-3A-NC-Mx | 510.0 | 20 | 538.2 | 35 |

| | |
|---|---|
| R7-1A-NC-MS | Series Winding |
| R7-2A-NC-MS or -MP | Series or Parallel Winding |
| R7-3A-NC-MS or -MT | Series or Triple Winding |

## CONNECTOR MODULE R7-xxx-Rx-x




| R7 CONNECTOR MODULE | | | |
|---|---|---|---|
| **R7-xxx-Rx-x** | **Motor Connector** | **Digital HED's** | **Limit Sensors** |
| R7-CM-Rx-x | ✔ | | |
| R7-HED-Rx-x | ✔ | ✔ | ✔ |

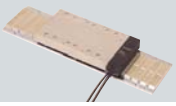
R7-xxx-RS-1 or -RP-1 or -RT-1: 1m cable standard.
Module and Coil Assembly winding (S, P or T) must match.

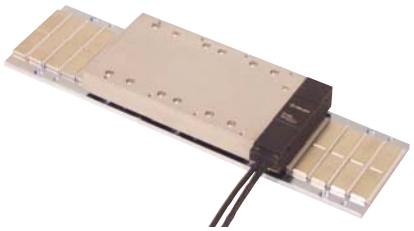
## NOTES

1. Peak force and current based on 5% duty cycle results in the maximum temperature rise.
2. The force constant gradually decreases at high current levels. At the peak current the force constant is reduced by 24%. Refer to www.trilogysystems.com for motor performance curves at different current levels. TIPS sizing software accommodates the changing force constant with current in its algorithms.
3. Specifications are based on the maintaining the air gap between the coil and track shown in the drawings. Refer to www.trilogysystems.com for motor performance curves at different air gaps.
4. Continuous force and current based on coil winding temperature maintained at 100˚C.
5. Motor resistance measured between any two motor leads with motor connected in Wye winding at 25˚C. For temperature at 100˚C, multiply resistance by 1.295 (75˚C rise * 0.393%/˚C).
6. Thermal Resistance is the number of degrees (Celsius) of temperature rise in the winding per watt of power dissipated. Determined experimentally.
7. Motor Constant is a measure of efficiency. Calculated by dividing the force constant by the square root of the motor resistance at maximum operating temperature.
8. Use TIPS sizing software for the most accurate estimate of coil temperature for a particular motion profile.

## SAFETY

1. USE EXTREME CAUTION IN HANDLING TRACKS. Ironcore Linear Motors contain exposed magnets and have an open magnetic field. Any ferrous metal, steel or iron, will be attracted to the magnet track. The amount of attractive force increases significantly as the distance from the magnet decreases. Severe injury may occur to fingers or hands if caught between the track and coil or other metal object.
2. USE EXTREME CAUTION WHEN INSTALLING THE COIL. The data sheet lists the attractive force between the coil and track. Refer to the "Motor Installation Guide" for proper installation instructions.
3. ANY PERSON WITH MEDICAL ELECTRONIC IMPLANTS SHOULD USE EXTREME CAUTION WHEN NEAR AN OPEN MAGNETIC FIELD. The magnetic field could interfere with the medical device's operation.
4. ANY PERSON WORKING OR HANDLING THE TRACKS SHOULD REMOVE PERSONAL EFFECTS. Items such as jewelry, watches, keys and credit cards may be damaged or adversely affected by the magnetic field.





- RIPPED Ironcore motor, patent pending
- Cross-section: 110mm (4.331) x 37.5mm (1.476)
- Peak forces to 3184N (716lbs), continuous forces to 918N (206lbs)
- Two lengths of modular magnet tracks allow unlimited length of travel
- Connector module allows quick and easy installation
- Internal thermal cutout switch protects coil

## PERFORMANCE

| MOTOR MODEL | | R9-1 | R9-2 | R9-3 |
|---|---|---|---|---|
| Peak Force | N | 1061 | 2123 | 3184 |
| | lb | 239 | 477 | 716 |
| Continuous Force | N | 306 | 612 | 918 |
| | lb | 69 | 138 | 206 |
| Peak Power | W | 4800 | 9600 | 14400 |
| Continuous Power | W | 240 | 480 | 720 |

## ELECTRICAL

| MOTOR MODEL | | R9-1 | R9-2 | | R9-3 | |
|---|---|---|---|---|---|---|
| WIRING TYPE | UNITS | S-Series | S-Series | P-Parallel | S-Series | T-Triple |
| Peak Current | A pk sine | 29.5 | 29.5 | 59.1 | 29.5 | 88.6 |
| | (RMS) | 20.8 | 20.8 | 41.8 | 20.8 | 62.6 |
| Continuous Current | A pk sine | 6.6 | 6.6 | 13.2 | 6.6 | 19.8 |
| | (RMS) | 4.6 | 4.6 | 9.3 | 4.6 | 14.0 |
| Force Constant | N/A | 46.5 | 92.7 | 46.4 | 139.1 | 46.4 |
| | lbs/A | 10.4 | 20.8 | 10.4 | 31.3 | 10.4 |
| Back EMF | V/m/s | 53.5 | 107.1 | 53.5 | 160.6 | 53.5 |
| | V/ips | 1.36 | 2.72 | 1.4 | 4.08 | 1.4 |
| Resistance | Ohms | 5.7 | 11.3 | 2.8 | 17.0 | 1.9 |
| Inductance | mH | 11.5 | 22.9 | 5.7 | 34.4 | 3.8 |
| Electrical Time Constant | ms | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Motor Constant | N/√W | 19.8 | 27.9 | 27.9 | 34.2 | 34.2 |
| | lbs/√W | 4.44 | 6.28 | 6.3 | 7.69 | 7.7 |
| Max Terminal Voltage | VDC | 330 | 330 | | 330 | |

## THERMAL

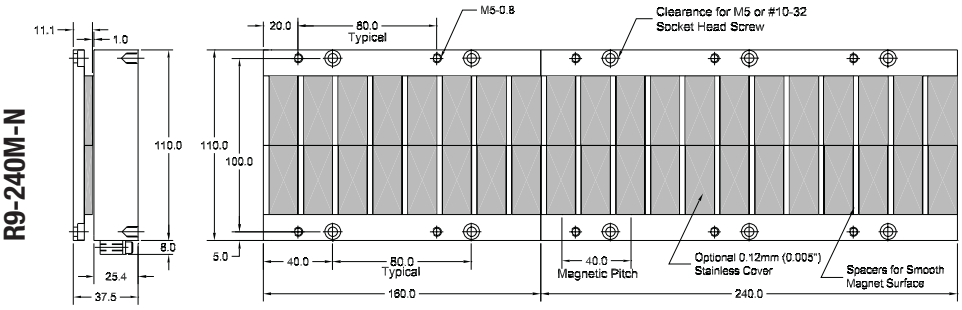
| MOTOR MODEL | | R9-1 | R9-2 | R9-3 |
|---|---|---|---|---|
| Thermal Resistance Wind-Amb | degC / W | 0.31 | 0.16 | 0.10 |
| Thermal Time Constant | min | 32.3 | 32.3 | 32.3 |
| Maximum Winding Temperature | deg C | 100 | 100 | 100 |

## MECHANICAL

| MOTOR MODEL | | R9-1 | R9-2 | R9-3 |
|---|---|---|---|---|
| Coil Weight | kg | 3.0 | 6.0 | 9.0 |
| | lbs | 6.6 | 13.2 | 19.8 |
| Coil Length | mm | 190 | 350 | 510 |
| (does not include connector module) | in | 7.480 | 13.780 | 20.080 |
| Attractive Force | N | 3114 | 6227 | 9341 |
| | lbs | 700 | 1400 | 2100 |
| Electrical Cycle Length | mm | 40 | 40 | 40 |

# R9 Dimensions

## MODULAR TRACKS R9-160M-N R9-240M-N



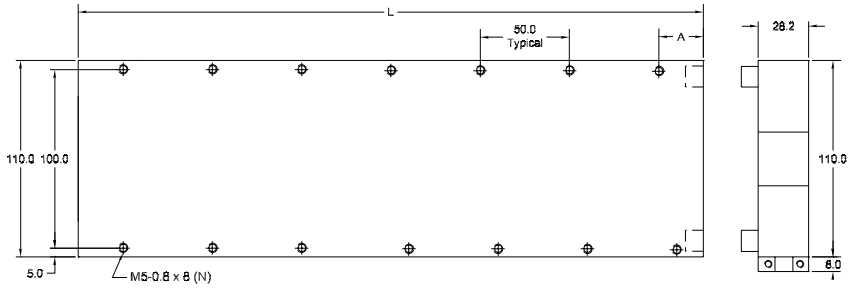

**Incremental Length:**
80mm (3.150)

**Minimum Length:**
40.0mm (1.575)

**Weight:**
7.8 kg/m (5.2 lbs/ft)

**R9-160M-N** (Nickel Plated Magnets)
**R9-240M-N** (Nickel Plated Magnets)

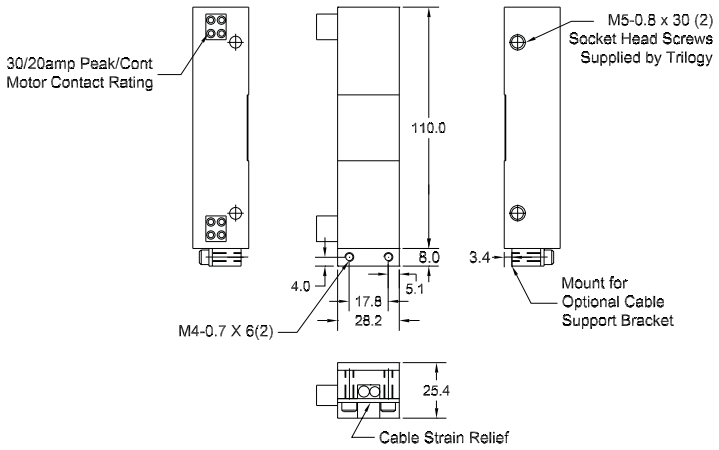
## COIL ASSEMBLY R9-XA-NC-Mx




| R9 COIL ASSEMBLY | | | | |
|---|---|---|---|---|
| R9-XA-NC-Mx | L | A | N | OAL |
| R9-1A-NC-MS | 190.0 | 15.0 | 8 | 218.2 |
| R9-2A-NC-Mx | 350.0 | 25.0 | 14 | 378.2 |
| R9-3A-NC-Mx | 510.0 | 35.0 | 20 | 538.2 |

**R9-1A-NC-MS** Series Winding Only
**R9-2A-NC-MS or MP** Series or Parallel Winding
**R9-3A-NC-MS or MT** Series or Triple Parallel Winding

## CONNECTOR MODULE R9-xxx-Rx-x




| R9 CONNECTOR MODULE | Motor Connector | Digital HEDs | Limit Sensor |
|---|---|---|---|
| R9-CM-Rx-x | ● | | |
| R9-HED-Rx-x | ● | ● | ● |

**R9-xxx-RS-1 or -RP-1 or -RT-1: 1m cable standard**
**Module and Coil Assembly winding (S, P or T) must match**

## NOTES

1. Peak force for the R9 is not limited by the temperature rise. Using the peak current at a 6.4% duty cycle results in the maximum temperature rise.
2. The force constant gradually decreases at high current levels. At the peak current the force constant is reduced by 27%. www.trilogysystems.com for motor performance curves at different current levels. TIPS sizing software accommodates the changing force constant with current in its algorithms.
3. Specifications are based on the maintaining the air gap between the coil and track shown in the drawings. Refer to www.trilogysystems.com for motor performance curves at different air gaps.
4. Continuous force and current based on coil winding temperature maintained at 100˚C.
5. Motor resistance measured between any two motor leads with motor connected in Wye winding at 25˚C. For temperature at 100˚C, multiply resistance by 1.295 (75˚C rise * 0.393% / ˚C).
6. Thermal Resistance is the number of degrees (Celsius) of temperature rise in the winding per watt of power dissipated. Determined experimentally.
7. Motor Constant is a measure of efficiency. Calculated by dividing the force constant by the square root of the motor resistance at maximum operating temperature.
8. Use TIPS sizing software for the most accurate estimate of coil temperature for a particular motion profile.

## SAFETY

1. USE EXTREME CAUTION IN HANDLING TRACKS. Ironcore Linear Motors contain exposed magnets and have an open magnetic field. Any ferrous metal, steel or iron, will be attracted to the magnet track. The amount of attractive force increases significantly as the distance from the magnet decreases. Severe injury may occur to fingers or hands if caught between the track and coil or other metal object.
2. USE EXTREME CAUTION WHEN INSTALLING THE COIL. The data sheet lists the attractive force between the coil and track. Refer to the “Motor Installation Guide” for proper installation instructions.
3. ANY PERSON WITH MEDICAL ELECTRONIC IMPLANTS SHOULD USE EXTREME CAUTION WHEN NEAR AN OPEN MAGNETIC FIELD. The magnetic field could interfere with the medical device’s operation.
4. ANY PERSON WORKING OR HANDLING THE TRACKS SHOULD REMOVE PERSONAL EFFECTS. Items such as jewelry, watches, keys and credit cards may be damaged or adversely affected by the magnetic field.

- RIPPED Ironcore motor, patent pending
- Cross-section: 100mm (3.94”) x 58mm (2.28”)
- Peak forces in three sizes to 4097N (921lbs), continuous forces to 1121N (252lbs)
- Two lengths of modular magnet tracks allow unlimited length of travel
- Connector modules allow quick and easy installation
- Internal thermal cutout switch protects coil

## PERFORMANCE

| MOTOR MODEL | | R10-1 | R10-2 | R10-3 |
|---|---|---|---|---|
| Peak Force | N | 1366 | 2731 | 4097 |
| | lb | 307 | 614 | 921 |
| Continuous Force | N | 374 | 747 | 1121 |
| | lb | 84 | 168 | 252 |
| Peak Power | W | 6098 | 12196 | 18294 |
| Continuous Power | W | 305 | 610 | 915 |

## ELECTRICAL

| MOTOR MODEL | | R10-1 | R10-2 | | R10-3 | |
|---|---|---|---|---|---|---|
| WIRING TYPE | UNITS | S-Series | S-Series | P-Parallel | S-Series | T-Triple |
| Peak Current | $A^{pk\ sine}$ | 35.1 | 35.1 | 70.2 | 35.1 | 105.3 |
| | (RMS) | 24.8 | 24.8 | 49.6 | 24.8 | 74.4 |
| Continuous Current | $A^{pk\ sine}$ | 7.8 | 7.8 | 15.6 | 7.8 | 23.4 |
| | (RMS) | 5.5 | 5.5 | 11.0 | 5.5 | 16.5 |
| Force Constant | N/A peak | 47.7 | 95.5 | 47.7 | 143.2 | 47.7 |
| | lb/A peak | 10.7 | 21.5 | 10.7 | 32.2 | 10.7 |
| Back EMF | V/m/s | 55.1 | 110.2 | 55.1 | 165.4 | 55.1 |
| | V/in/s | 1.40 | 2.80 | 1.40 | 4.20 | 1.40 |
| Resistance 25°C, phase to phase | ohms | 5.1 | 10.2 | 2.6 | 15.3 | 1.7 |
| Inductance, phase to phase | mH | 15.4 | 30.8 | 7.7 | 46.2 | 5.1 |
| Electrical Time Constant | ms | 3 | 3 | 3 | 3 | 3 |
| Motor Constant | N/√W | 21.4 | 30.3 | 30.3 | 37.1 | 37.1 |
| | lb/√W | 4.82 | 6.82 | 6.82 | 8.35 | 8.35 |
| Max Terminal Voltage | VDC | 330 | 330 | | 330 | |

## THERMAL

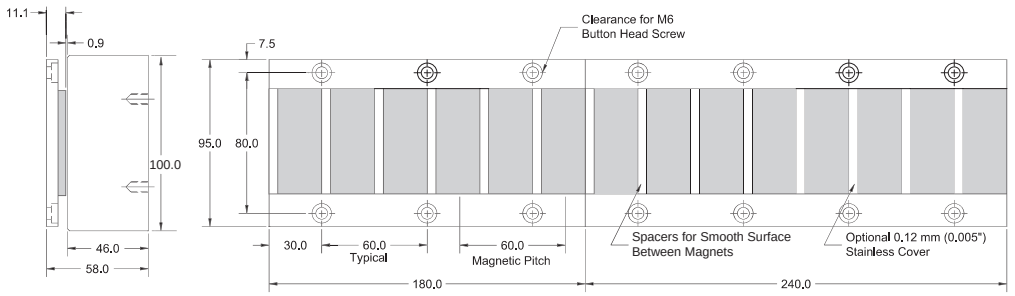
| MOTOR MODEL | | R10-1 | R10-2 | R10-3 |
|---|---|---|---|---|
| Thermal Resistance Wind-Amb | degC / W | 0.24 | 0.12 | 0.08 |
| Thermal Time Constant | min | 14.6 | 14.6 | 14.6 |
| Maximum Winding Temperature | °C | 100 | 100 | 100 |

## MECHANICAL

| MOTOR MODEL | | R10-1 | R10-2 | R10-3 |
|---|---|---|---|---|
| Coil Weight | kg | 4.5 | 9.1 | 13.6 |
| | lb | 10.0 | 20.0 | 30.0 |
| Coil Length | mm | 305.5 | 545.5 | 785.5 |
| (includes connector module) | in | 12.027 | 21.476 | 30.925 |
| Attractive Force | N | 3559 | 7117 | 10675 |
| | lbf | 800 | 1600 | 2400 |
| Electrical Cycle Length | mm | 60 | 60 | 60 |
| | in | 2.362 | 2.362 | 2.362 |

# R10 Dimensions

## MODULAR TRACKS R10-180-M-x R10-240-M-x




**Incremental Length:**
60.0mm (2.3622")

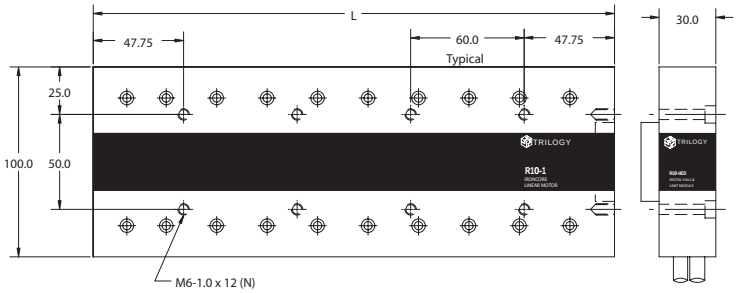
**Minimum Length:**
180.0mm (7.0866")

**Weight:**
6.51Kg/m (4.38lbs/ft)

R10-180-M-N (Nickel Plated Magnets)
R10-240-M-N (Nickel Plated Magnets)

R10-180-COVER (Optional)
R10-240-COVER (Optional)

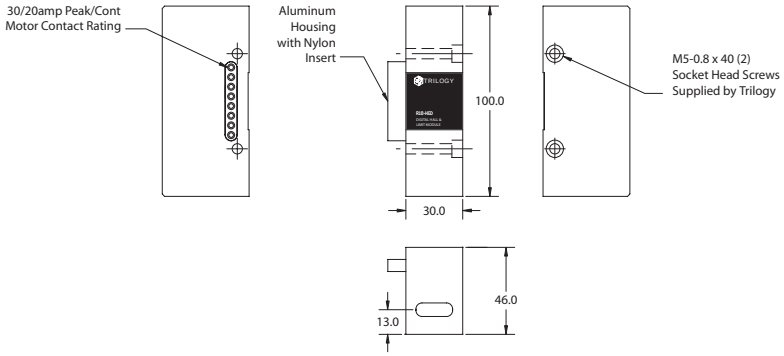
## COIL ASSEMBLY R10-xA-NC-Mx




| R10 COIL ASSEMBLY | | | |
|---|---|---|---|
| **R10-xA-NC-Mx** | **L** | **N** | **OAL** |
| R10-1A-NC-Mx | 275.5 | 8 | 305.5 |
| R10-2A-NC-Mx | 505.5 | 16 | 535.5 |
| R10-3A-NC-Mx | 755.5 | 24 | 785.5 |

| | |
|---|---|
| R10-1A-NC-MS | Series Winding |
| R10-2A-NC-MS or -MP | Series or Parallel Winding |
| R10-3A-NC-MS or -MT | Series or Triple Winding |

## CONNECTOR MODULE R10-xxx-Rx-x




| R10 CONNECTOR MODULE | | | |
|---|---|---|---|
| **R10-xxx-Rx-x** | **Motor Connector** | **Digital HED's** | **Limit Sensors** |
| R10-CM-Rx-x | ✔ | | |
| R10-HED-Rx-x | ✔ | ✔ | ✔ |

R10-xxx-RS-1 or -RP-1 or -RT-1: 1m cable standard.
Module and Coil Assembly winding (S, P or T) must match.

## NOTES

1. Peak force for the R10 is not limited by the temperature rise. Using the peak current at a 6.4% duty cycle results in the maximum temperature rise.
2. The force constant gradually decreases at high current levels. At the peak current the force constant is reduced by 27%. Refer to www.trilogysystems.com for motor performance curves at different current levels. TIPS sizing software accommodates the changing force constant with current in its algorithms.
3. Specifications are based on the maintaining the air gap between the coil and track shown in the drawings. Refer to www.trilogysystems.com for motor performance curves at different air gaps.
4. Continuous force and current based on coil winding temperature maintained at 100˚C.
5. Motor resistance measured between any two motor leads with motor connected in Wye winding at 25˚C. For temperature at 100˚C, multiply resistance by 1.295 (75˚C rise * 0.393%/˚C).
6. Thermal Resistance is the number of degrees (Celsius) of temperature rise in the winding per watt of power dissipated. Determined experimentally.
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## SAFETY

1. USE EXTREME CAUTION IN HANDLING TRACKS. Ironcore Linear Motors contain exposed magnets and have an open magnetic field. Any ferrous metal, steel or iron, will be attracted to the magnet track. The amount of attractive force increases significantly as the distance from the magnet decreases. Severe injury may occur to fingers or hands if caught between the track and coil or other metal object.
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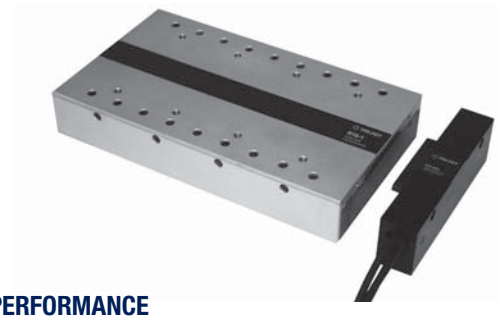
4. ANY PERSON WORKING OR HANDLING THE TRACKS SHOULD REMOVE PERSONAL EFFECTS. Items such as jewelry, watches, keys and credit cards may be damaged or adversely affected by the magnetic field.



- RIPPED Ironcore motor, patent pending
- Cross-section: 160mm (6.30") x 58mm (2.28")
- Peak forces in three sizes to 7435N (1671lbs), continuous forces to 2230N (501lbs)
- Two lengths of modular magnet tracks allow unlimited length of travel
- Connector modules allow quick and easy installation
- Internal thermal cutout switch protects coil

## PERFORMANCE

| MOTOR MODEL | | R16-1 | R16-2 | R16-3 |
|---|---|---|---|---|
| Peak Force | N | 2478 | 4955 | 7433 |
| | lb | 557 | 1114 | 1671 |
| Continuous Force | N | 743 | 1487 | 2230 |
| | lb | 167 | 334 | 501 |
| Peak Power | W | 7065 | 14130 | 21195 |
| Continuous Power | W | 353 | 707 | 1060 |

## ELECTRICAL

| MOTOR MODEL | | R16-1 | R16-2 | | R16-3 | |
|---|---|---|---|---|---|---|
| WIRING TYPE | UNITS | S-Series | S-Series | P-Parallel | S-Series | T-Triple |
| Peak Current | $A^{pk\ sine}$ | 34.8 | 34.8 | 69.8 | 34.8 | 104.5 |
| | (RMS) | 24.6 | 24.6 | 49.3 | 24.6 | 73.9 |
| Continuous Current | $A^{pk\ sine}$ | 7.8 | 7.8 | 15.6 | 7.8 | 23.4 |
| | (RMS) | 5.5 | 5.5 | 11.0 | 5.5 | 16.5 |
| Force Constant | N/A peak | 95.5 | 190.9 | 95.5 | 286.4 | 95.5 |
| | lb/A peak | 21.5 | 42.9 | 21.5 | 64.4 | 21.5 |
| Back EMF | V/m/s | 110.2 | 220.5 | 110.2 | 330.7 | 110.2 |
| | V/in/s | 2.80 | 5.60 | 2.80 | 8.40 | 2.80 |
| Resistance 25°C, phase to phase | ohms | 6.0 | 12.0 | 3.0 | 18.0 | 2.0 |
| Inductance, phase to phase | mH | 29.0 | 58.0 | 14.5 | 87.0 | 9.7 |
| Electrical Time Constant | ms | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 |
| Motor Constant | N/√W | 39.6 | 55.9 | 55.9 | 68.5 | 68.5 |
| | lb/√W | 8.89 | 12.57 | 12.57 | 15.40 | 15.40 |
| Max Terminal Voltage | VDC | 330 | 330 | | 330 | |

## THERMAL

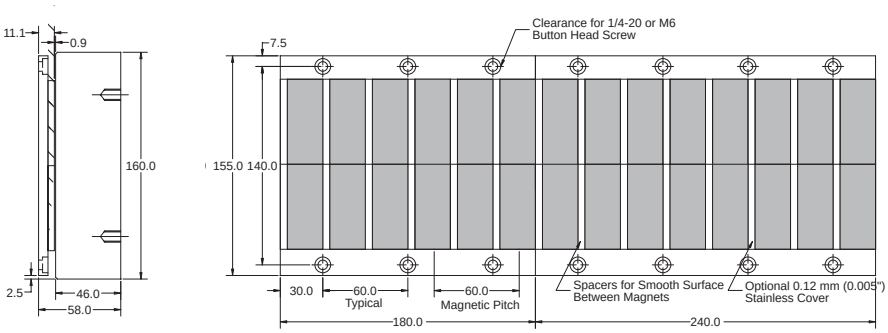
| MOTOR MODEL | | R16-1 | R16-2 | R16-3 |
|---|---|---|---|---|
| Thermal Resistance Wind-Amb | degC/ /W | 0.21 | 0.11 | 0.07 |
| Thermal Time Constant | min | 37.1 | 37.1 | 37.1 |
| Maximum Winding Temperature | °C | 100 | 100 | 100 |

## MECHANICAL

| MOTOR MODEL | | R16-1 | R16-2 | R16-3 |
|---|---|---|---|---|
| Coil Weight | kg | 9.10 | 18.20 | 27.30 |
| | lb | 20.0 | 40.0 | 60.0 |
| Coil Length | mm | 305.5 | 545.5 | 785.5 |
| (includes connector module) | in | 12.027 | 21.476 | 30.925 |
| Attractive Force | N | 7117 | 14234 | 21351 |
| | lbf | 1600 | 3200 | 4800 |
| Electrical Cycle Length | mm | 60 | 60 | 60 |
| | in | 2.3622 | 2.3622 | 2.3622 |

# R16 Dimensions

## MODULAR TRACKS R16-180-M-x R16-240-M-x




**Incremental Length:**
60.0mm (2.3622")

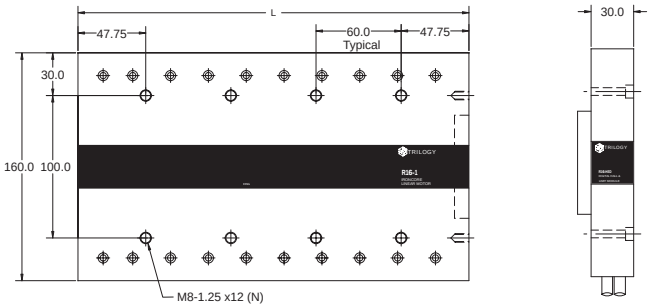
**Minimum Length:**
180.0mm (7.0866")

**Weight:**
11.34Kg/m (7.60lbs/ft)

R16-180-M-N (Nickel Plated Magnets)
R16-240-M-N (Nickel Plated Magnets)

R16-180-COVER (Optional)
R16-240-COVER (Optional)

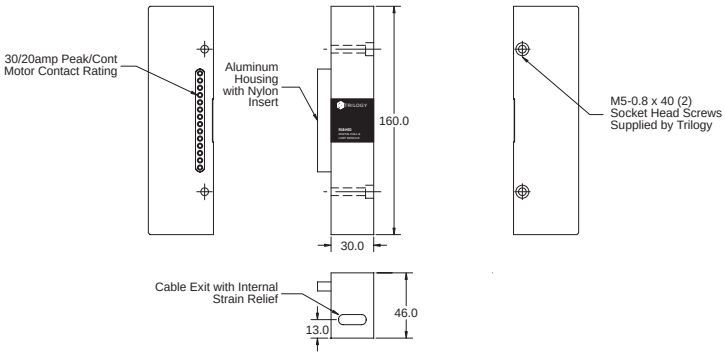
## COIL ASSEMBLY R16-xA-NC-Mx




| R16 COIL ASSEMBLY | | | |
|---|---|---|---|
| **R16-xA-NC-Mx** | **L** | **N** | **OAL** |
| R16-1A-NC-Mx | 275.5 | 8 | 305.5 |
| R16-2A-NC-Mx | 515.5 | 16 | 545.5 |
| R16-3A-NC-Mx | 755.5 | 24 | 785.5 |

R16-1A-NC-MS Series Winding
R16-2A-NC-MS or -MP Series or Parallel Winding
R16-3A-NC-MS or -MT Series or Triple Winding

## CONNECTOR MODULE R16-xxx-Rx-x




| R16 CONNECTOR MODULE | | | |
|---|---|---|---|
| **R16-xxx-Rx-x** | **Motor Connector** | **Digital HED's** | **Limit Sensors** |
| R16-CM-Rx-x | ✔ | | |
| R16-HED-Rx-x | ✔ | ✔ | ✔ |

R16-xxx-RS-1 or -RP-1 or -RT-1: 1m cable standard.
Module and Coil Assembly winding (S, P or T) must match.

## NOTES

1. Peak force for the R16 is not limited by the temperature rise. Using the peak current at a 6.4% duty cycle results in the maximum temperature rise.
2. The force constant gradually decreases at high current levels. At the peak current the force constant is reduced by 27%. Refer to www.trilogysystems.com for motor performance curves at different current levels. TIPS sizing software accommodates the changing force constant with current in its algorithms.
3. Specifications are based on the maintaining the air gap between the coil and track shown in the drawings. Refer to www.trilogysystems.com for motor performance curves at different air gaps.
4. Continuous force and current based on coil winding temperature maintained at 100˚C.
5. Motor resistance measured between any two motor leads with motor connected in Wye winding at 25˚C. For temperature at 100˚C, multiply resistance by 1.295 (75˚C rise * 0.393%/˚C).
6. Thermal Resistance is the number of degrees (Celsius) of temperature rise in the winding per watt of power dissipated. Determined experimentally.
7. Motor Constant is a measure of efficiency. Calculated by dividing the force constant by the square root of the motor resistance at maximum operating temperature.
8. Use TIPS sizing software for the most accurate estimate of coil temperature for a particular motion profile.

## SAFETY

1. USE EXTREME CAUTION IN HANDLING TRACKS. Ironcore Linear Motors contain exposed magnets and have an open magnetic field. Any ferrous metal, steel or iron, will be attracted to the magnet track. The amount of attractive force increases significantly as the distance from the magnet decreases. Severe injury may occur to fingers or hands if caught between the track and coil or other metal object.
2. USE EXTREME CAUTION WHEN INSTALLING THE COIL. The data sheet lists the attractive force between the coil and track. Refer to the "Motor Installation Guide" for proper installation instructions.
3. ANY PERSON WITH MEDICAL ELECTRONIC IMPLANTS SHOULD USE EXTREME CAUTION WHEN NEAR AN OPEN MAGNETIC FIELD. The magnetic field could interfere with the medical device's operation.
4. ANY PERSON WORKING OR HANDLING THE TRACKS SHOULD REMOVE PERSONAL EFFECTS. Items such as jewelry, watches, keys and credit cards may be damaged or adversely affected by the magnetic field.

## Motor Coil:

Order Example:

R7 - 1 A - NC - M S

**Series**
R5, R7, R9, R10, R16

**Coil size**
1, 2 or 3 poles

**Mounting Type**
**A** standard top mount
**C** custom

**Winding type**
**S** series
**P** parallel (R7-2 only)
**T** triple (R7-3 only)

**Module ready**
receives connector module

**Cooling**
**NC** no cooling
**AC** not available
***LC** not available

*Consult factory for water cooling options.

## Magnet Track:

Order Example:

R7 - 240 M - N

**Series**
R5, R7, R9, R10, R16

**Track length**
160 mm or 240 mm for R5, R7 and R9
180 mm or 240 mm for R10 and R16

**Magnet coating**
**N** nickel

**Mounting**
**M** modular
**C** custom

## Connector Module:

Order Example:

R7 - CM - R S - 1

**Series**
R5, R7, R9, R10, R16

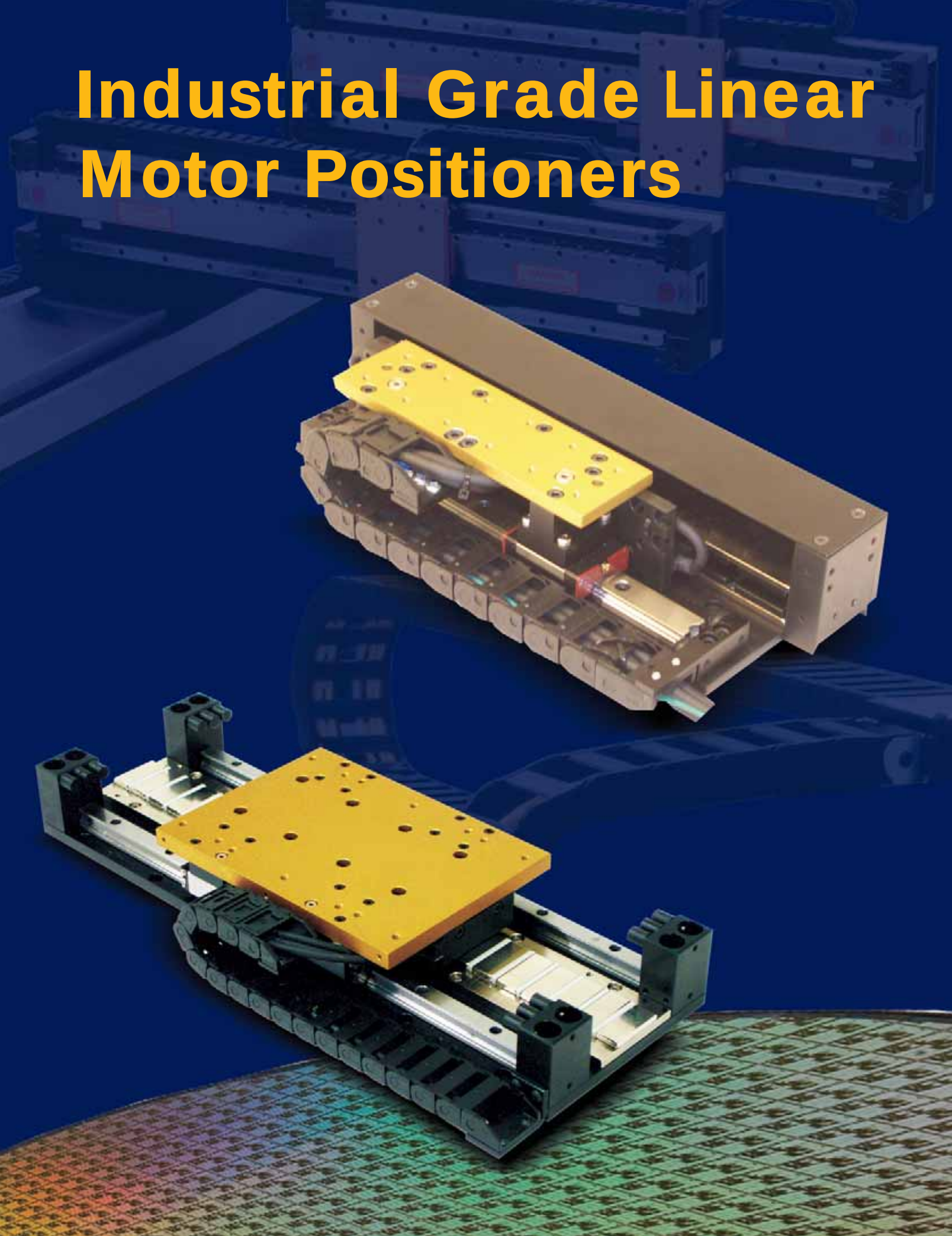
**Device description**
**CM** connector module
**HED** Hall effects device with limits

**Module type**

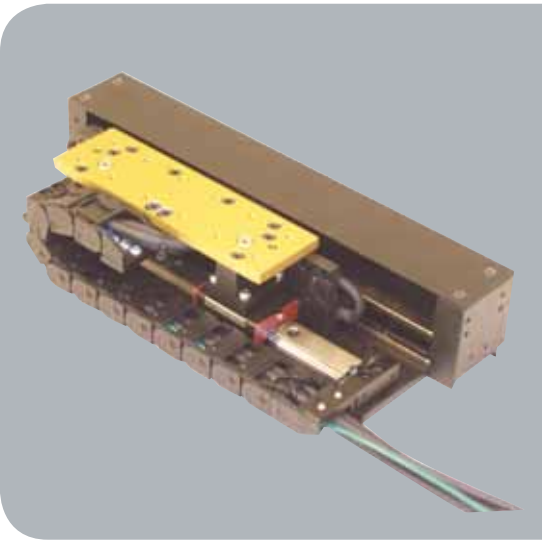
**Cable lengh**
1 meter (standard)

**Module winding**
**S** series
**P** parallel
**T** triple
(must correspond to coil winding)

# Industrial Grade Linear Motor Positioners



# I-FORCE Ironless Linear Positioners



**Parker Trilogy's I-Force linear positioners utilize our high-performance I-Force ironless linear motors in a pre-engineered, easily integrated, ready-to-run package. The principal design goal for these positioners is to achieve high performance at an economical cost while preserving the design flexibility to accommodate customization.**

**Trilogy's positioners have selectable single- or dual-bearing to match the performance and cost requirements for each application. In addition, they are designed to connect together using transition plates for XY or multi-axis configurations. Options include a variety of cable management systems in addition to bellows and hard covers.**

**Flexibility, multi-axis compatibility, and ease of customization make the I-Force linear positioners a superior choice for high performance and value.**

- Trilogy positioners use ground steel or aluminum bases for flatness and parallelism because aluminum extrusions often do not meet the accuracy requirements for straightness and flatness.
- Trilogy has single- or dual-bearing rail positioners to better match the performance and cost requirements for each application.
- Every positioner includes a magnetic encoder for industrial environments or an optical encoder with resolutions down to 0.1um (0.000 04").
- Dual-rail positioners have bellows as a standard option.
- Multiple carriage options are available on all positioner series.
- Different cable track widths available for added stiffness and rigidity
- Different cable track widths available as custom options for user payload tubes and cables

# T1D Specifications

| PERFORMANCE | | LINEAR MAGNETIC ENCODER 5.0µm | LINEAR MAGNETIC ENCODER 1.0µm | RENISHAW ENCODER OPTIONS (Note 5) 0.5µm | RENISHAW ENCODER OPTIONS (Note 5) 0.1µm |
|---|---|---|---|---|---|
| Peak Velocity | in/s [m/s] | 275 [7] | 100 [2.5] | 120 [3] | 15 [0.4] |
| Resolution | in [µm] | 0.0002 [5] | 0.000 04 [1.0] | 0.000 02 [0.5] | 0.000 004 [0.1] |
| Repeatability | in [µm] | ±0.0004 [±10] | ±0.000 8 [2.0] | ±0.000 06 [1.5] | ±0.000 04 [1.0] |
| Accuracy – LME | | ±(30µm +50µm/m) | ±(25µm +50µm/m) | | |
| Accuracy – Renishaw | | | | ±(5µm +30µm/m) | |

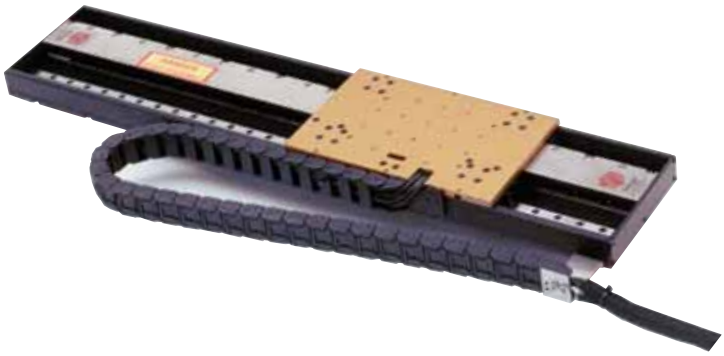
*Note: For travels less than 1 meter, accuracy should be calculated at 1 meter*

| MOTOR MODEL | | 110-1 | 110-2 |
|---|---|---|---|
| Peak Force | N | 108.5 | 202.5 |
| | lb | 24.4 | 45.5 |
| Continuous Force | N | 24.5 | 45.4 |
| | lb | 5.5 | 10.2 |
| Peak Power | W | 938 | 1641 |
| Continuous Power | W | 47 | 82 |

| ACCURACY | STANDARD | LASER ALIGNMENT OPTION |
|---|---|---|
| Straightness restrained on flat surface in [µm] | ±0.000127 in/in [±127µm/m] | ±.0000127 in/in |
| Flatness restrained on flat surface in [µm] | ±0.013 [±330] | |

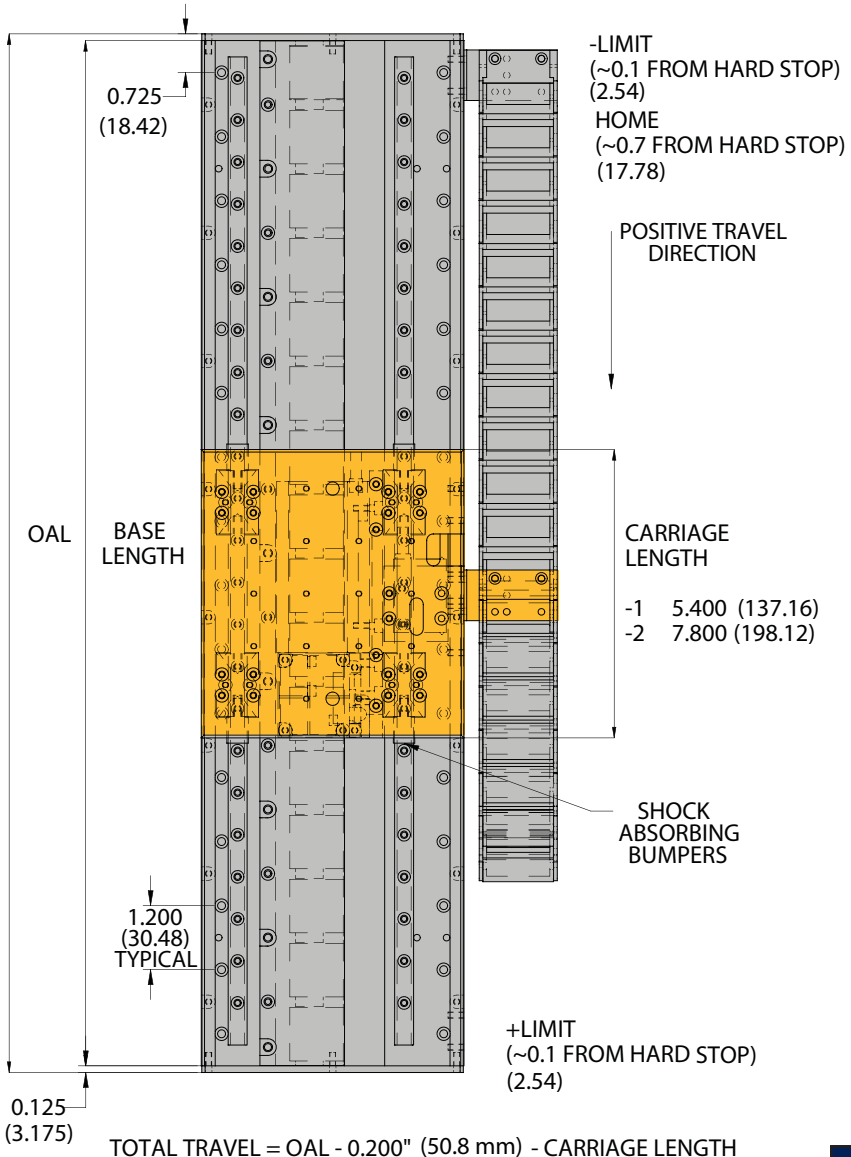
*Note: Straightness/Flatness specifications based on system mounted to surface of flatness ±0.0005in/ft*

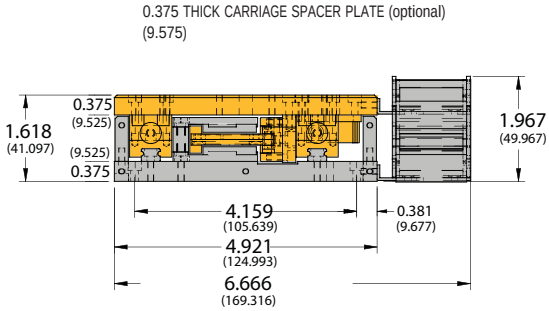
| LOAD | | - 1 | - 2 |
|---|---|---|---|
| Vertical (Fv) see note 11 | lbs [kg] | 30 [13, 5] | 30 [13, 5] |
| Side (Fs) see note 11 | lbs [kg] | 15 [6, 8] | 15 [6, 8] |
| Moments–Roll (Mr) see note 11 | lb-ft [N-m] | 15 [20] | 15 [20] |
| Moments–Pitch (Mp) see note 11 | lb-ft [N-m] | 52 [70] | 52 [70] |
| Moments–Yaw (My) see note 11 | lb-ft [N-m] | 52 [70] | 52 [70] |



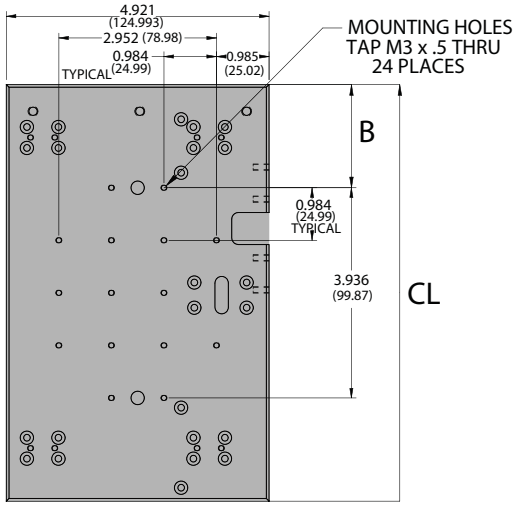
**Dimensions shown in inches.**

- Moving Carriage Assembly
- Stationary Base Assembly




w/ std size 73 cable track




TOTAL TRAVEL = OAL - 0.200" (50.8 mm) - CARRIAGE LENGTH
OAL = BASE LENGTH + 0.250" (6.35 mm)
BASE LENGTH = MULTIPLE OF 2.400" (60.96)

| CARRIAGE SIZE | | | | |
|---|---|---|---|---|
| | -1 | mm | -2 | mm |
| CL | 5.400 | 137.16 | 7.800 | 198.12 |
| B | 0.732 | 18.59 | 1.932 | 49.07 |
| Coil | 110-1 | 110-1 | 110-2 | 110-2 |

# T1S Specifications

| PERFORMANCE | | LINEAR MAGNETIC ENCODER 5.0µm | LINEAR MAGNETIC ENCODER 1.0µm | RENISHAW ENCODER OPTIONS (Note 5) 0.5µm | RENISHAW ENCODER OPTIONS (Note 5) 0.1µm |
|---|---|---|---|---|---|
| Peak Velocity | in/s [m/s] | 275 [7] | 100 [2.5] | 120 [3] | 15 [0.4] |
| Resolution | in [µm] | 0.0002 [5] | 0.000 04 [1.0] | 0.000 02 [0.5] | 0.000 004 [0.1] |
| Repeatability | in [µm] | ±0.0004 [±10] | ±0.000 8 [2.0] | ±0.000 06 [1.5] | ±0.000 04 [1.0] |
| Accuracy – LME | | ±(30µm +50µm/m) | ±(25µm +50µm/m) | | |
| Accuracy – Renishaw | | | | ±(5µm +30µm/m) | |

*Note: For travels less than 1 meter, accuracy should be calculated at 1 meter*

| MOTOR MODEL | | 110-1 | 110-2 |
|---|---|---|---|
| Peak Force | N | 108.5 | 202.5 |
| | lb | 24.4 | 45.5 |
| Continuous Force | N | 24.5 | 45.4 |
| | lb | 5.5 | 10.2 |
| Peak Power | W | 938 | 1641 |
| Continuous Power | W | 47 | 82 |

| ACCURACY | STANDARD | LASER ALIGNMENT OPTION |
|---|---|---|
| Straightness restrained on flat surface in [µm] | ±0.000127 in/in [±127µm/m] | ±.000013 in/in [±13 µm/m] |
| Flatness restrained on flat surface in [µm] | ±0.013 [±330] | |

*Note: Straightness/Flatness specifications based on system mounted to surface of flatness ±0.0005in/ft*

| PHYSICAL | | - 2 | - 3 |
|---|---|---|---|
| Carriage Assembly | lbs [kg] | 1.10 [0,50] | 1.50 [0,68] |
| Base Assembly | | | |
| T1SD Aluminum (0.250'' thick)) | lbs/ft [kg/m] | 2.25 [3,35] | ·····► |
| T1SA Aluminum (0.375'' thick)) | lbs/ft [kg/m] | 2.78. [4,13] | ·····► |
| Carriage Length | in [mm] | 3.40 [86,4] | 5.80 [147,3] |
| Coil Bar Length | in [mm] | 3.20 [81,3] | 5.60 [142,2] |

| LOAD | | - 1 | - 2 |
|---|---|---|---|
| Vertical (Fv) see note 11 | lbs [kg] | 25 [11, 3] | 25 [11, 3] |
| Side (Fs) see note 11 | lbs [kg] | 13 [5, 7] | 13 [5, 7] |
| Moments–Roll (Mr) see note 11 | lb-ft [N-m] | 11 [15] | 11 [15] |
| Moments–Pitch (Mp) see note 11 | lb-ft [N-m] | 44 [60] | 44 [60] |
| Moments–Yaw (My) see note 11 | lb-ft [N-m] | 44 [60] | 44 [60] |

## NOTES

1 Total travel (in) = BASE LENGTH - 1.6 (40.64 mm) - CARRIAGE LENGTH.

2 Maximum base length is 40.8″, 1m

3 Aluminum base is black anodized.

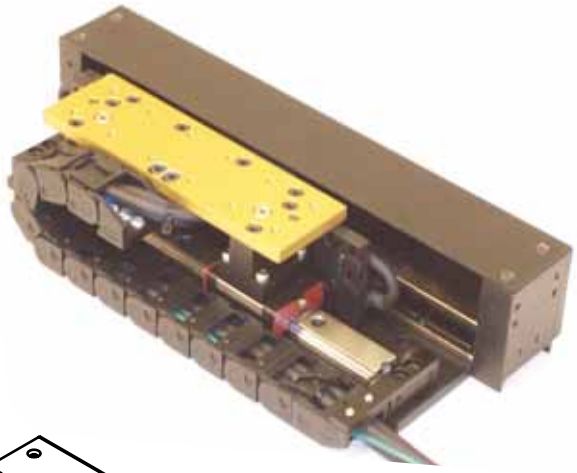
4 For complete motor specifications, refer to 110 series motor data sheet.

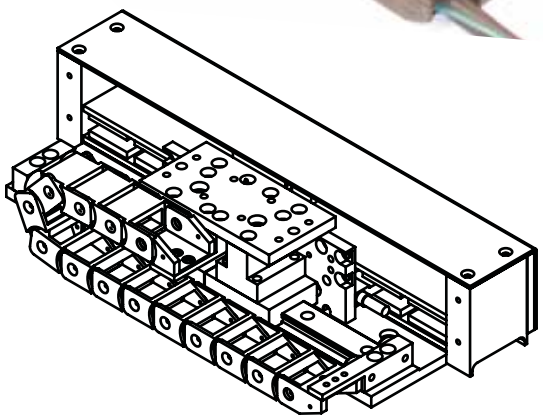
5 Renishaw encoder, RGH24 series, available in 0.05µm, 0.1µm, 0.5µm, 1.0µm, 5.0µm.

7 Standard cable track provided is Igus 07.20.018.

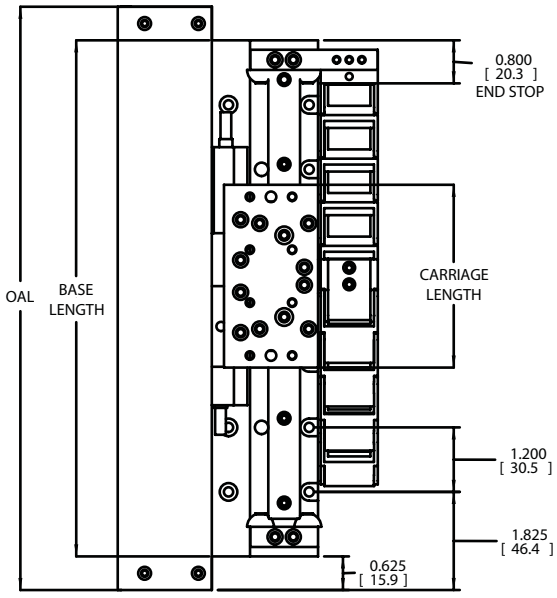
8 Specification subject to change without notice.

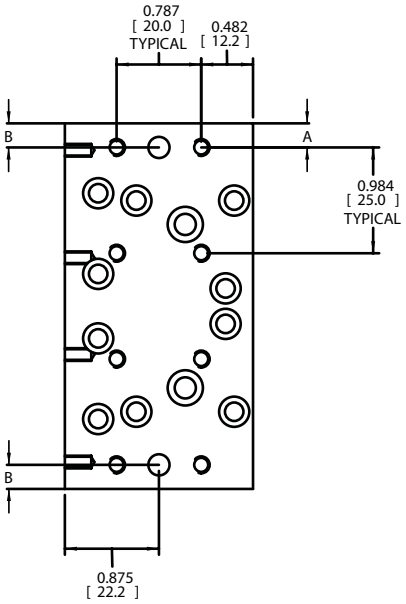
9 Listed specifications based on motor size and typical performance requirements. Bearing manufacturer specifications exceed listed specifications.

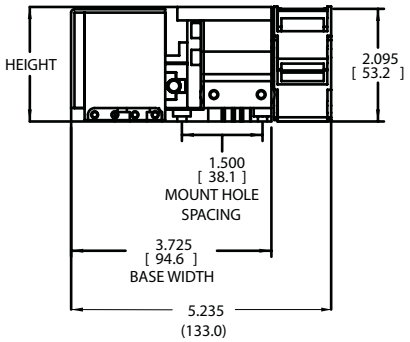




## T1S




OAI = BASE LENGTH + 1.25 IN (31.75)
TRAVEL = BASE LENGTH - 1.6 - CARRIAGE LENGTH
TRAVEL (mm) = BASE LENGTH - 40.64 - CARRIAGE LENGTH

| CARRIAGE TABLE | | |
|---|---|---|
| **COIL SIZE** | **-1** | **-2** |
| CARRIAGE LENGTH | 3.4 [86.4] | 5.8 [147.3] |
| A (1ST MOUNTING HOLE) | 0.224 [5.7] | 0.440 [11.2] |
| B (DOWEL PIN HOLE) | 0.224 [5.7] | 0.440 [11.2] |

# T2D Specifications

| PERFORMANCE | | LINEAR MAGNETIC ENCODER 5.0µm | LINEAR MAGNETIC ENCODER 1.0µm | RENISHAW ENCODER OPTIONS (Note 5) 0.5µm | RENISHAW ENCODER OPTIONS (Note 5) 0.1µm |
|---|---|---|---|---|---|
| Peak Velocity | in/s [m/s] | 275 [7] | 100 [2.5] | 120 [3] | 15 [0.4] |
| Resolution | in [µm] | 0.0002 [5] | 0.000 04 [1.0] | 0.000 02 [0.5] | 0.000 004 [0.1] |
| Repeatability | in [µm] | ±0.0004 [±10] | ±0.000 8 [2.0] | ±0.000 06 [1.5] | ±0.000 04 [1.0] |
| Accuracy – LME | | ±(30µm +50µm/m) | ±(25µm +50µm/m) | | |
| Accuracy – Renishaw | | | | ±(5µm +30µm/m) | |

*Note: For travels less than 1 meter, accuracy should be calculated at 1 meter*

| MOTOR MODEL | | 210-2 | 210-3 | 210-4 |
|---|---|---|---|---|
| Peak Force | N | 255.8 | 375.0 | 494.2 |
| | lb | 57.5 | 84.3 | 111.1 |
| Continuous Force | N | 57.4 | 84.1 | 110.3 |
| | lb | 12.9 | 18.9 | 24.8 |
| Peak Power | W | 1583 | 2261 | 2940 |
| Continuous Power | W | 79 | 113 | 147 |

| ACCURACY | STANDARD | LASER ALIGNMENT OPTION |
|---|---|---|
| Straightness restrained on flat surface in [µm] | ±0.000127in/in [±127µm/m] | ±.0.0000127 in/in [±13µm/m] |
| Flatness restrained on flat surface in [µm] | ±0.003 + 000254 in/in [±76 + 254µm/m] | |

*Note: For travels less than 1 meter, Flatness should be calculated at 1 meter*
*Straightness/Flatness specifications based on system mounted to surface of flatness ±0.0005in/ft*

| PHYSICAL | | - 2 | - 3 | - 4 |
|---|---|---|---|---|
| Carriage Assembly | lbs [kg] | 3.10 [1,4] | 4.10 [2,1] | 5.50 [2,5] |
| Base Assembly | | | | |
| T2DA Aluminum (0.375" thick) | lbs/ft [kg/m] | 10.80 [16,1] | | |
| T2DB Aluminum (0.500" thick) | lbs/ft [kg/m] | 11.70 [17,4] | | |
| T2DS Steel (0.500" thick) | lbs/ft [kg/m] | 18.10 [26,9] | | |
| Carriage Length | in [mm] | 4.20 [106,7] | 6.60 [167,6] | 9.00 [228,6] |
| Coil Bar Length | in [mm] | 7.20 [182,9] | 9.60 [243,8] | 12.00 [304,8] |

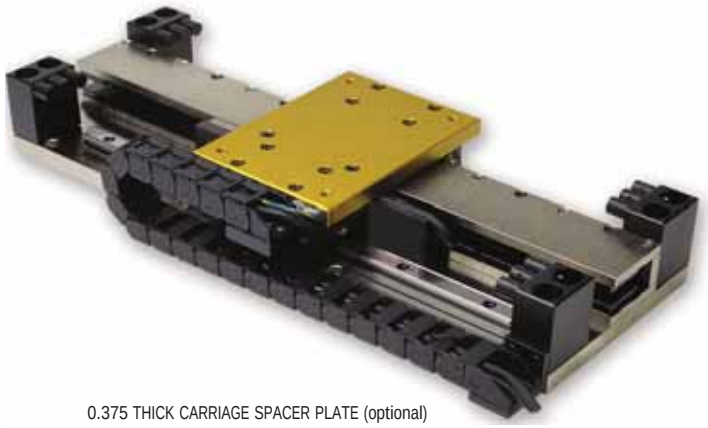
| LOAD | | - 2 | - 3 | - 4 |
|---|---|---|---|---|
| Vertical (Fv) see note 11 | lbs [kg] | 60 [27,1] | 80 [36,3] | 100 [45,3] |
| Side (Fs) see note 11 | lbs [kg] | 40 [18,1] | 60 [27,2] | 60 [27,2] |
| Moments–Roll (Mr) see note 11 | lb-ft [N-m] | 40 [53] | 60 [80] | 60 [80] |
| Moments–Pitch (Mp) see note 11 | lb-ft [N-m] | 100 [134] | 200 [270] | 200 [270] |
| Moments–Yaw (My) see note 11 | lb-ft [N-m] | 100 [134] | 200 [270] | 200 [270] |

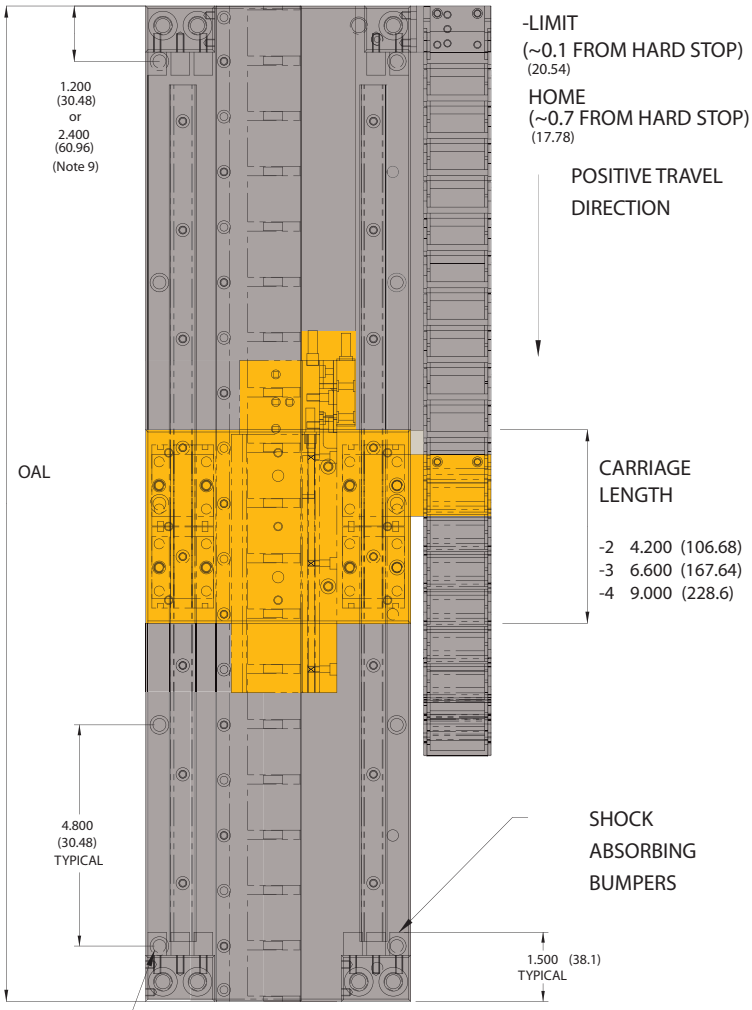
## NOTES

1 Total travel = OAL – 3.00″ (76.2 mm) – carriage length.
2 Maximum base length is 120″ (3048 mm).
3 Aluminum base is black anodized. Steel base is nickel plated.
4 For complete motor specifications, refer to 210 series motor data sheet.
5 Renishaw encoder, RGH24 series, available in 0.05µm, 0.1µm, 0.5µm, 1.0µm, 5.0µm.
6 Cables extend past base by approximately 0.6″ when carriage is at negative hard stop.
7 Cable Track extends 0.175″ higher than carriage mounting surface. It is recommended to use optional Spacer Plate for custom mounting holes.
8 Standard cable track provided is Igus 07.30.018.
9 Base mounting holes are equidistant, 1.200" (12.0, 16.8, 21.6....) or 2.400" (9.6, 14.4, 19.2, 24.0....) from each end depending on base length.
10 Specification subject to change without notice.
11 Listed specifications based on motor size and typical performance requirements. Bearing manufacturer specifications exceed listed specifications.

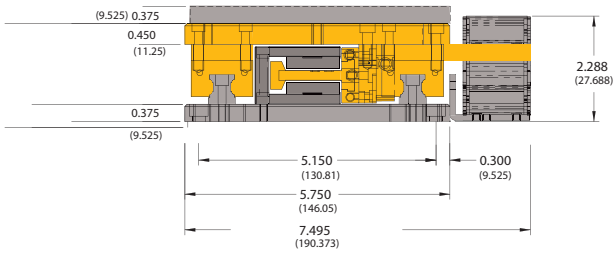
**Dimensions shown in inches.**

- Moving Carriage Assembly
- Stationary Base Assembly

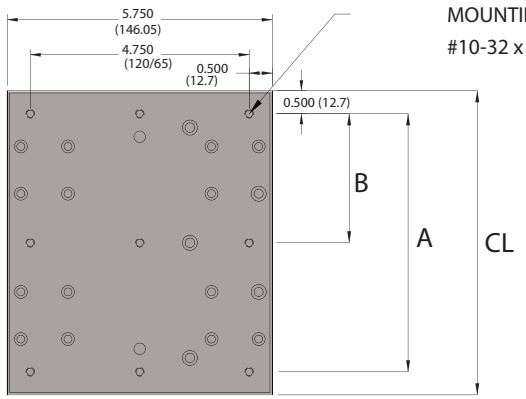





0.375 THICK CARRIAGE SPACER PLATE (optional)
(9.525)



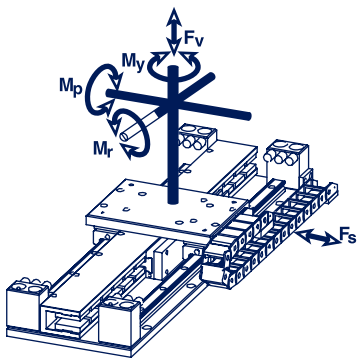

w/ std size 73 cable track




TOTAL TRAVEL = OAL - 3.00" (76.2 mm) - CARRIAGE LENGTH

OAL = MULTIPLE OF 2.400" (60.96)

| CARRIAGE SIZE | - 2 | mm | - 3 | mm | - 4 | mm |
|---|---|---|---|---|---|---|
| CL | 4.200 | 106.68 | 6.600 | 167.64 | 9.000 | 228.6 |
| A | 3.200 | 81.28 | 5.600 | 142.24 | 8.000 | 203.80 |
| B | — | — | 2.800 | 71.12 | 4.000 | 101.60 |
| COIL | 210-2 | | 210-3 | | 210-4 | |



# T2S Specifications

| PERFORMANCE | | LINEAR MAGNETIC ENCODER 5.0µm | LINEAR MAGNETIC ENCODER 1.0µm | RENISHAW ENCODER OPTIONS (Note 5) 0.5µm | RENISHAW ENCODER OPTIONS (Note 5) 0.1µm |
|---|---|---|---|---|---|
| Peak Velocity | in/s [m/s] | 275 [7] | 100 [2.5] | 120 [3] | 15 [0.4] |
| Resolution | in [µm] | 0.0002 [5] | 0.000 04 [1.0] | 0.000 02 [0.5] | 0.000 004 [0.1] |
| Repeatability | in [µm] | ±0.0004 [±10] | ±0.000 8 [2.0] | ±0.000 06 [1.5] | ±0.000 04 [1.0] |
| Accuracy – LME | | ±(30µm +50µm/m) | ±(25µm +50µm/m) | | |
| Accuracy – Renishaw | | | | ±(5µm +30µm/m) | |

*Note: For travels less than 1 meter, accuracy should be calculated at 1 meter*

| MOTOR MODEL | | 210-2 | 210-3 | 210-4 |
|---|---|---|---|---|
| Peak Force | N | 255.8 | 375.0 | 494.2 |
| | lb | 57.5 | 84.3 | 111.1 |
| Continuous Force | N | 57.4 | 84.1 | 110.3 |
| | lb | 12.9 | 18.9 | 24.8 |
| Peak Power | W | 1583 | 2261 | 2940 |
| Continuous Power | W | 79 | 113 | 147 |

| ACCURACY | STANDARD | LASER ALIGNMENT OPTION |
|---|---|---|
| Straightness restrained on flat surface in [µm] | ±0.000127 in/m [±127mm/m] | ±0.0000127 in/in [±13mm/m] |
| Flatness restrained on flat surface in [µm] | ±0.003 +.000254 in/in [±76 + 254µm/m] | |

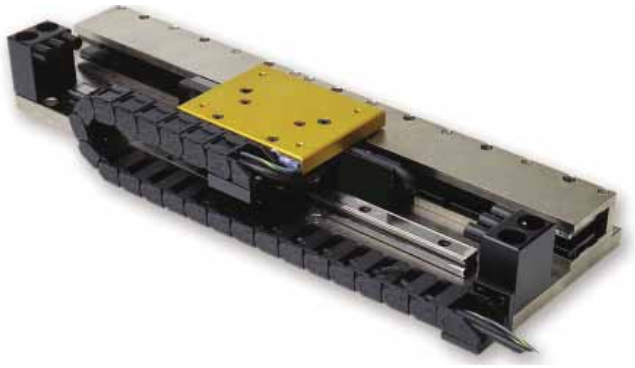
*Note: For travels less than 1 meter, Flatness should be calculated at 1 meter*
*Straightness/Flatness specifications based on system mounted to surface of flatness ±0.0005in/ft*

| PHYSICAL | | - 2 | - 3 | - 4 |
|---|---|---|---|---|
| Carriage Assembly | lbs [kg] | 2.10 [0,95] | 3.10 [1,38] | 3.80 [1,70] |
| Base Assembly | | | ..... | ..... |
| T2SA Aluminum (0.375" thick) | lbs/ft [kg/m] | 9.10 [13,5] | ..... | ..... |
| T2SB Aluminum (0.500" thick) | lbs/ft [kg/m] | 9.90 [14,7] | | |
| T2SS Steel (0.500" thick) | lbs/ft [kg/m] | 15.10 [22,5] | ..... | ..... |
| Carriage Length | in [mm] | 4.20 [106,7] | 6.60 [167,6] | 9.00 [228,6] |
| Coil Bar Length | in [mm] | 7.20 [182,9] | 9.60 [243,8] | 12.00 [304,8] |

| LOAD | | - 2 | - 3 | - 4 |
|---|---|---|---|---|
| Vertical (Fv) see note 11 | lbs [kg] | 40 [18,1] | 50 [22,7] | 60 [27,2] |
| Side (Fs) see note 11 | lbs [kg] | 20 [9,1] | 30 [13,6] | 30 [13,6] |
| Moments–Roll (Mr) see note 11 | lb-ft [N-m] | 20 [27] | 30 [40] | 30 [40] |
| Moments–Pitch (Mp) see note 11 | lb-ft [N-m] | 50 [67] | 100 [135] | 100 [135] |
| Moments–Yaw (My) see note 11 | lb-ft [N-m] | 50 [67] | 100 [135] | 100 [135] |

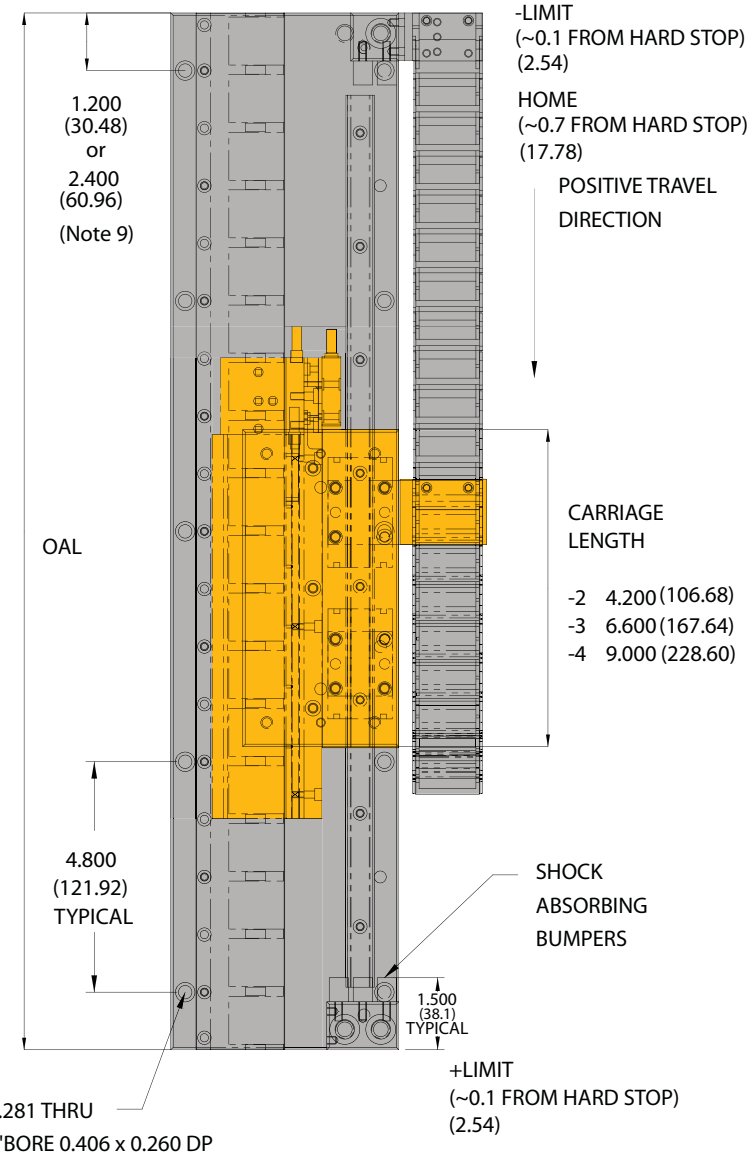
## NOTES

1 Total travel = OAL – 3.00″ (76.2 mm) – carriage length.
2 Maximum base length is 120″ (3048 mm).
3 Aluminum base is black anodized. Steel base is nickel plated.
4 For complete motor specifications, refer to 210 series motor data sheet.
5 Renishaw encoder, RGH24 series, available in 0.05µm, 0.1µm, 0.5µm, 1.0µm, 5.0µm.
6 Cable extends past base by approximately 0.6" when carriage is at negative hard stop.
7 Cable Track extends 0.175″ higher than carriage mounting surface. It is recommended to use optional Spacer Plate for custom mounting holes.
8 Standard cable track provided is lgus 07.30.018.
9 Base mounting holes are equidistant, 1.200" (12.0, 16.8, 21.6....) or 2.400" (9.6, 14.4, 19.2, 24.0....) from each end depending on base length.
10 Specification subject to change without notice.
11 Listed specifications based on motor size and typical performance requirements. Bearing manufacturer specifications exceed listed specifications. ments. Bearing manufacturer specifications exceed listed specifications.

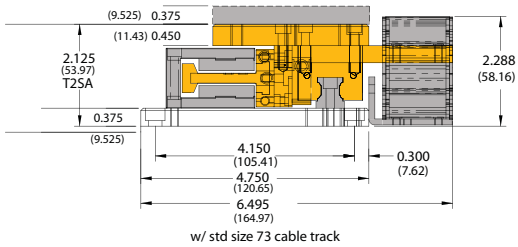


**Dimensions shown in inches.**

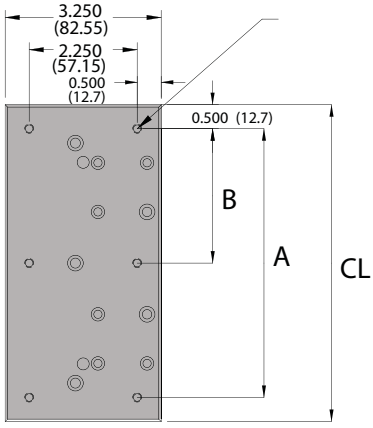
- Moving Carriage Assembly
- Stationary Base Assembly




0.375 THICK CARRIAGE SPACER PLATE (optional)
(9.525)

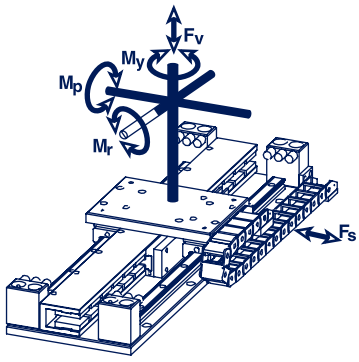



w/ std size 73 cable track




MOUNTING HOLES
#10-32 x 0.450 DP

TOTAL TRAVEL = OAL - 3.00" - CARRIAGE LENGTH
= OAL - 76.2 mm - CARRIAGE LENGTH
OAL = MULTIPLE OF 2.400" (60.96)




| CARRIAGE SIZE | - 2 | mm | - 3 | mm | - 4 | mm |
|---|---|---|---|---|---|---|
| CL | 4.200 | 106.68 | 6.600 | 167.64 | 9.000 | 228.60 |
| A | 3.200 | 81.28 | 5.600 | 142.24 | 8.000 | 203.20 |
| B | — | 71.12 | 2.800 | 101.60 | 4.000 | 101.64 |
| COIL | 210-2 | | 210-3 | | 210-4 | |

# T3D Specifications

| PERFORMANCE | | LINEAR MAGNETIC ENCODER 5.0µm | LINEAR MAGNETIC ENCODER 1.0.1µm | RENISHAW ENCODER OPTIONS (Note 5) 0.5µm | RENISHAW ENCODER OPTIONS (Note 5) 0.1µm |
|---|---|---|---|---|---|
| Peak Velocity | in/s [m/s] | 275 [7] | 100 [2.5] | 120 [3] | 15 [0.4] |
| Resolution | in [µm] | 0.0002 [5] | 0.000 04 [1.0] | 0.000 02 [0.5] | 0.000 004 [0.1] |
| Repeatability | in [µm] | ±0.0004 [±10] | ±0.000 8 [2.0] | ±0.000 06 [1.5] | ±0.000 04 [1.0] |
| Accuracy – LME | | ±(30µm +50µm/m) | ±(25µm +50µm/m) | | |
| Accuracy – Renishaw | | | | ±(5µm +30µm/m) | |

*Note: For travels less than 1 meter, accuracy should be calculated at 1 meter*

| MOTOR MODEL | | 310-2 | 310-3 | 310-4 | 310-5 | 310-6 |
|---|---|---|---|---|---|---|
| Peak Force | N | 409.3 | 600.0 | 790.0 | 980.0 | 1170.0.1 |
| | lb | 92.0 | 135.1 | 177.2 | 220.3 | 263.2 |
| Continuous Force | N | 91.6 | 133.9 | 176.2 | 219.3 | 262.0 |
| | lb | 20.6 | 30.1 | 39.6 | 49.3 | 589 |
| Peak Power | W | 1885 | 2693 | 3500 | 4308 | 5116 |
| Continuous Power | W | 4 | 135 | 179 | 215 | 256 |

| ACCURACY | STANDARD | LASER ALIGNMENT OPTION |
|---|---|---|
| Straightness restrained on flat surface in [µm] | ±0.000127in/in [ ±127µm/m] | ±.000013 in/in [13µm/m] |
| Flatness restrained on flat surface in [µm] | ±0.003 + .000254 in/in [±76 + 254µm/m] | |

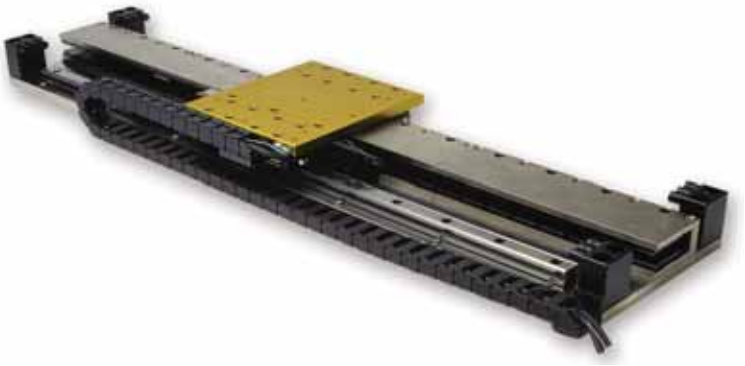
*Note: For travels less than 1 meter, Flatness should be calculated at 1 meter*
*Straightness/Flatness specifications based on system mounted to surface of flatness ±0.0005in/ft*

| PHYSICAL | | - 2 | - 3 | - 4 | - 5 | - 6 |
|---|---|---|---|---|---|---|
| Carriage Assembly | lbs [kg] | 4.60 [2,1] | 6.70 [3,0] | 8.10 [3,7] | 9.50 [4,3] | 11.00 [5,0] |
| Base Assembly | | | | | | |
| T3DA Aluminum (3.375 ″ thick) | lbs/ft [kg/m] | 15.75 [23,4] | ► | ► | ► | ► |
| T3DB Aluminum (0.500 ″ thick) | lbs/ft [kg/m] | 16.88 [25,1] | ► | ► | ► | ► |
| T3DS Steel (0.500 ″ thick) | lbs/ft [kg/m] | 25.27 [37,6] | ► | ► | ► | ► |
| Carriage Length | in [mm] | 4.20 [106,7] | 6.60 [167,6] | 9.00 [228,6] | 11.40 [289,6] | 13.80 [350,5] |
| Coil Bar Length | in [mm] | 7.20 [182,9] | 9.60 [243,8] | 12.00 [304,8] | 14.40 [365,8] | 16.80 [426,7] |

| LOAD | | - 2 | - 3 | - 4 | - 5 | - 6 |
|---|---|---|---|---|---|---|
| Vertical (Fv) see note 11 | lbs [kg] | 120 [54] | 150 [68] | 180 [81] | 210 [95] | 240 [108] |
| Side (Fs) see note 11 | lbs [kg] | 80 [36] | 100 [45] | 100 [45] | 100 [45] | 100 [45] |
| Moments–Roll (Mr) see note 11 | lb-ft [N-m} | 80 [107] | 100 [134] | 100 [134] | 100 [134] | 100 [134] |
| Moments–Pitch (Mp) see note 11 | lb-ft [N-m} | 160 [214] | 300 [402] | 300 [402] | 300 [402] | 300 [402] |
| Moments–Yaw (My) see note 11 | lb-ft [N-m} | 160 [214] | 300 [402] | 300 [402] | 300 [402] | 300 [402] |

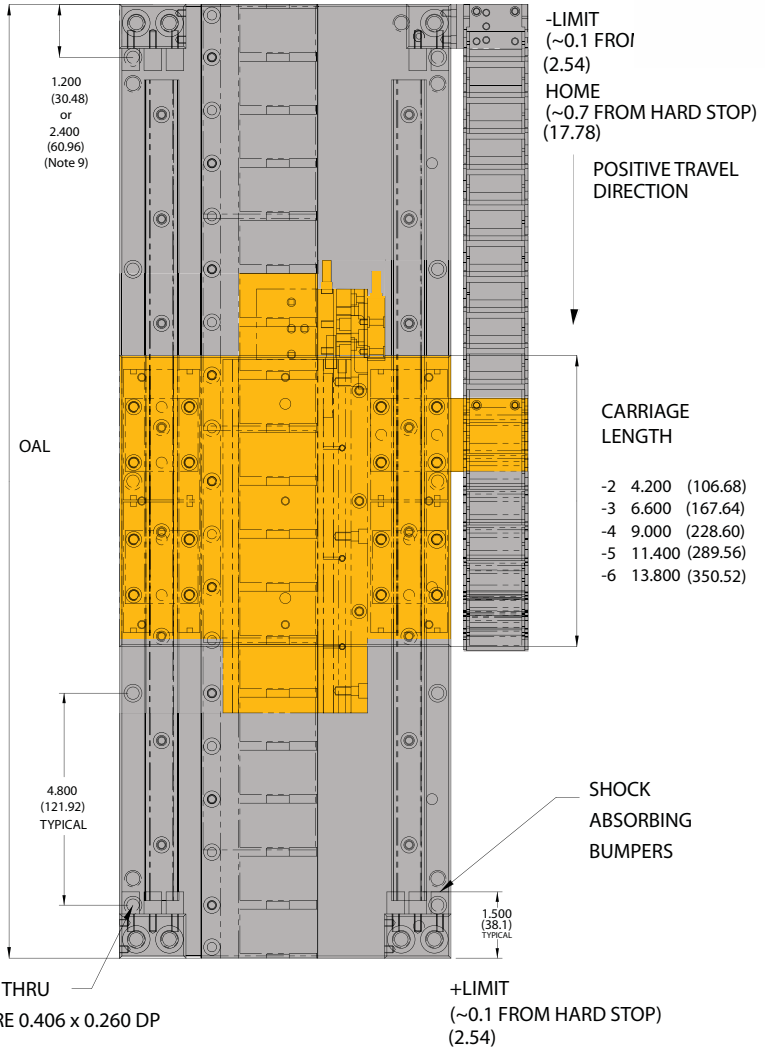
## NOTES

1 Total travel = OAL – 3.00″ (76.2 mm) – carriage length.
2 Maximum base length is 120″ (3048 mm).
3 Aluminum base is black anodized. Steel base is nickel plated.
4 For complete motor specifications, refer to 310 series motor data sheet.
5 Renishaw encoder, RGH24 series, available in 0.05.0µm. 0.1µm, 0.5µm, 1.0µm, 5.0µm.
6 Cable extends past base by approximately 0.6" when carriage is at negative hard stop.
7 Cable Track extends 0.175″ higher than carriage mounting surface. It is recommended to use optional Spacer Plate for custom mounting holes.
8 Standard cable track provided is Igus 07.30.018.
9 Base mounting holes are equidistant, 1.200″ (12.0, 16.8, 21.6...) or 2.400″ (9.6, 14.4, 19.2, 24.0...) from each end depending on base length.
10 Specification subject to change without notice.
11 Listed specifications based on motor size and typical performance requirements Bearing manufacturer specifications exceed listed specifications.

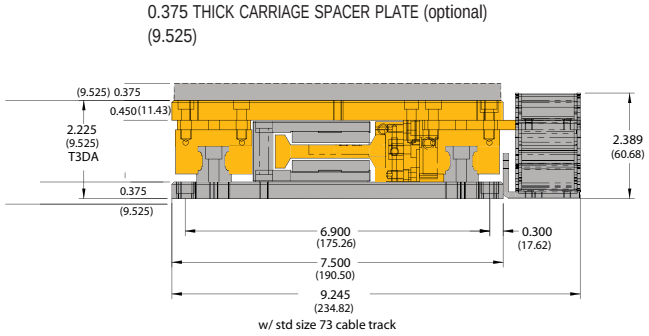


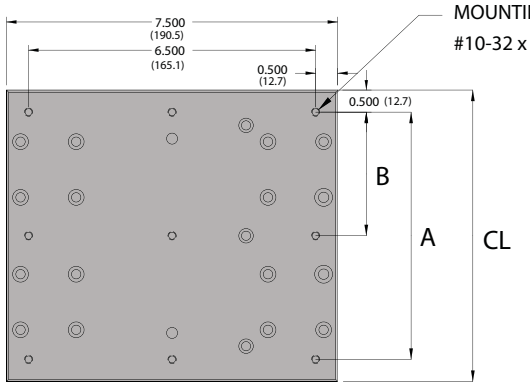
**Dimensions shown in inches.**

- Moving Carriage Assembly
- Stationary Base Assembly

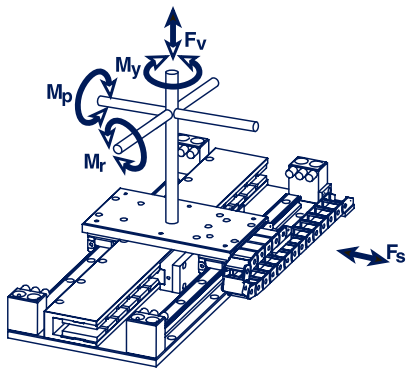



TOTAL TRAVEL = OAL - 3.00" (76.2) - CARRIAGE LENGTH
OAL = MULTIPLE OF 2.400" (60.96)




| CARRIAGE SIZE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -2 | mm | -3 | mm | -4 | mm | -5 | mm | -6 | mm |
| CL | 4.200 | 106.68 | 6.600 | 167.64 | 9.000 | 228.60 | 11.400 | 289.56 | 13.800 | 350.52 |
| A | 3.200 | 81.28 | 5.650 | 142.24 | 8.000 | 203.20 | 10.400 | 264.16 | 12.800 | 325.12 |
| B | — | | 2.800 | 71.12 | 4.000 | 101.60 | 5.200 | 132.08 | 6.400 | 162.56 |
| COIL | 310-2 | | 310-3 | | 310-4 | | 310-5 | | 310-6 | |



# T3S Specifications

| PERFORMANCE | | LINEAR MAGNETIC ENCODER 5.0µm | LINEAR MAGNETIC ENCODER 1.0µm | RENISHAW ENCODER OPTIONS (Note 5) 0.5µm | RENISHAW ENCODER OPTIONS (Note 5) 0.1µm |
|---|---|---|---|---|---|
| Peak Velocity | in/s [m/s] | 275 [7] | 100 [2.5] | 120 [3] | 15 [0.4] |
| Resolution | in [µm] | 0.0002 [5] | 0.000 04 [1.0] | 0.000 02 [0.5] | 0.000 004 [0.1] |
| Repeatability | in [µm] | ±0.0004 [±10] | ±0.000 8 [2.0] | ±0.000 06 [1.5] | ±0.000 04 [1.0] |
| Accuracy – LME | | ±(30µm +50µm/m) | ±(25µm +50µm/m) | | |
| Accuracy – Renishaw | | | | ±(5µm +30µm/m) | |

*Note: For travels less than 1 meter, accuracy should be calculated at 1 meter*

| MOTOR MODEL | | 310-2 | 310-3 | 310-4 | 310-5 | 310-6 |
|---|---|---|---|---|---|---|
| Peak Force | N | 409.3 | 600.0 | 790.0 | 980.0 | 1170.0.1 |
| | lb | 92.0 | 135.1 | 177.2 | 220.3 | 263.2 |
| Continuous Force | N | 91.6 | 133.9 | 176.2 | 219.3 | 262.0 |
| | lb | 20.6 | 30.1 | 39.6 | 49.3 | 589 |
| Peak Power | W | 1885 | 2693 | 3500 | 4308 | 5116 |
| Continuous Power | W | 4 | 135 | 179 | 215 | 256 |

| ACCURACY | STANDARD | LASER ALIGNMENT OPTION |
|---|---|---|
| Straightness restrained on flat surface in [µm] | ±0.000127 [±127µm/m] | ±.00013 in/in [±13µm/m] |
| Flatness restrained on flat surface in [µm] | ±0.003 + .00254 in/in [±76 + 254µm/m] | |

*Note: For travels less than 1 meter, Flatness should be calculated at 1 meter*
*Straightness/Flatness specifications based on system mounted to surface of flatness ±0.0005in/ft*

| PHYSICAL | | - 2 | - 3 | - 4 | - 5 | - 6 |
|---|---|---|---|---|---|---|
| Carriage Assembly | lbs [kg] | 3.00 [1,4] | 4.40 [2,0] | 5.50 [2,5] | 6.40 [2,9] | 7.40 [3,3] |
| Base Assembly | | | | | | |
| T3SA Aluminum (3.375 ″ thick) | lbs/ft [kg/m] | 13.30 [19,8] | ► | ► | ► | ► |
| T3SB Aluminum (0.500 ″ thick) | lbs/ft [kg/m] | 14.25 [21,2] | ► | ► | ► | ► |
| T3SS Steel (0.500 ″ thick) | lbs/ft [kg/m] | 21.24 [31,6] | ► | ► | ► | ► |
| Carriage Length | in [mm] | 4.20 [106,7] | 6.60 [167,6] | 9.00 [228,6] | 11.40 [289,6] | 13.80 [350,5] |
| Coil Bar Length | in [mm] | 7.20 [182,9] | 9.60 [243,8] | 12.00 [304,8] | 14.40 [365,8] | 16.80 [426,7] |

| LOAD | | - 2 | - 3 | - 4 | - 5 | - 6 |
|---|---|---|---|---|---|---|
| Vertical (Fv) see note 11 | lbs [kg] | 80 [36] | 100 [45] | 120 [54] | 140 [63] | 160 [72] |
| Side (Fs) see note 11 | lbs [kg] | 30 [13] | 50 [22] | 50 [22] | 50 [22] | 50 [22] |
| Moments–Roll (Mr) see note 11 | lb-ft [N-m} | 35 [47] | 50 [67] | 50 [67] | 50 [67] | 50 [67] |
| Moments–Pitch (Mp) see note 11 | lb-ft [N-m} | 75 [100] | 150 [201] | 150 [201] | 150 [201] | 150 [201] |
| Moments–Yaw (My) see note 11 | lb-ft [N-m} | 75 [100] | 150 [201] | 150 [201] | 150 [201] | 150 [201] |

## NOTES

1 Total travel = OAL – 3.00″ (76.2 mm) – carriage length.
2 Maximum base length is 120″ (3048 mm).
3 Aluminum base is black anodized. Steel base is nickel plated.
4 For complete motor specifications, refer to 310 series motor data sheet.
5 Renishaw encoder, RGH24 series, available in 0.05.0µm. 0.1µm, 0.5µm, 1.0µm, 5.0µm.
6 Cable extends past base by approximately 0.6” when carriage is at negative hard stop.
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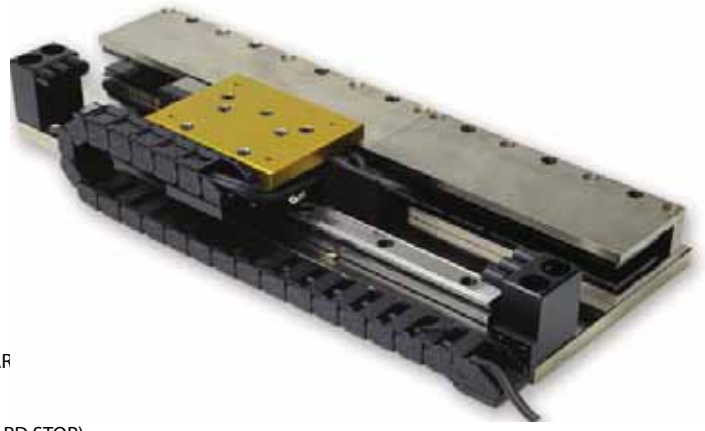
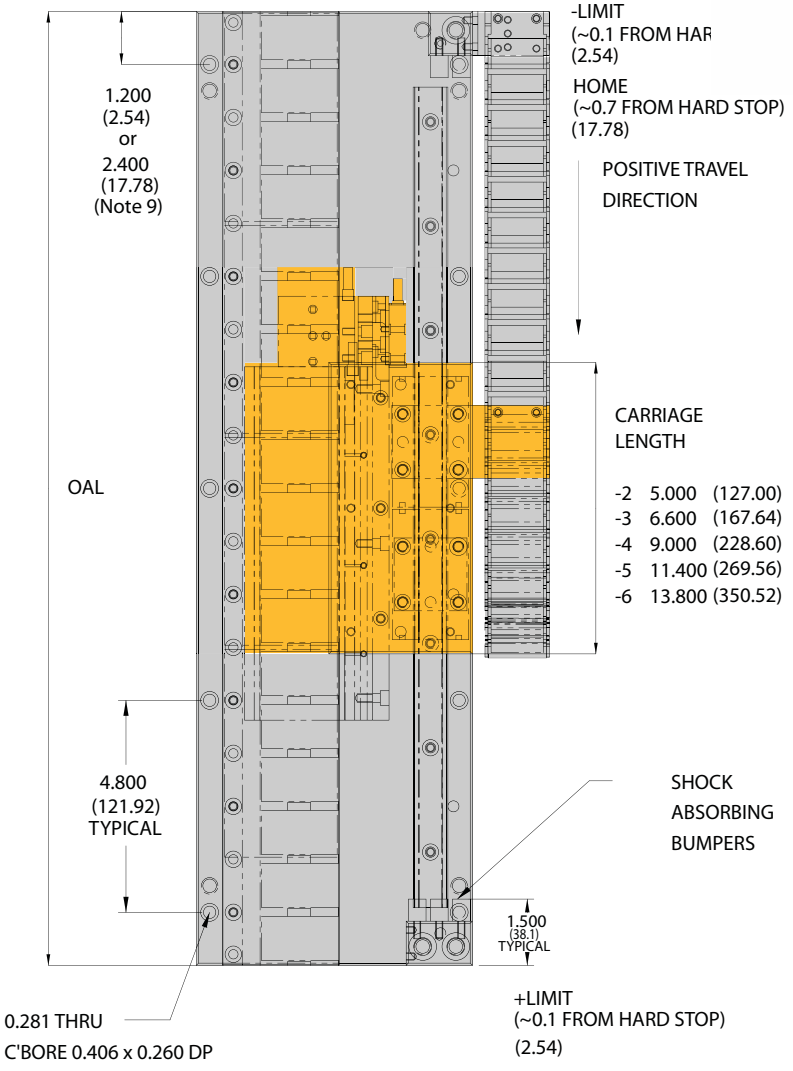
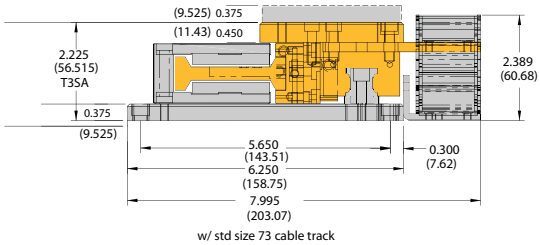


**Dimensions shown in inches.**

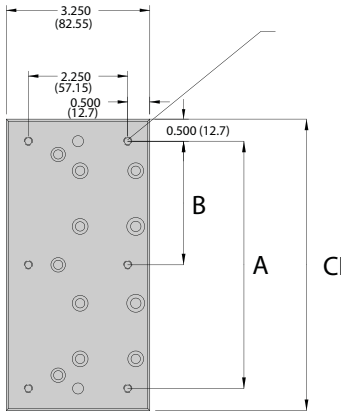
- Moving Carriage Assembly
- Stationary Base Assembly




0.375 THICK CARRIAGE SPACER PLATE (optional)
(9.525)



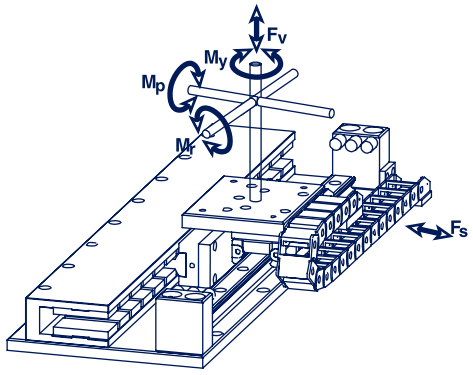

w/ std size 73 cable track




MOUNTING HOLES
#10-32 x 0.450 DP

TOTAL TRAVEL = OAL - 3.00" (76.2) - CARRIAGE LENGTH
OAL = MULTIPLE OF 2.400" (60.96)

| CARRIAGE SIZE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -2 | mm | -3 | mm | -4 | mm | -5 | mm | -6 | mm |
| CL | 5.000 | 127.00 | 6.600 | 167.64 | 9.000 | 228.60 | 11.400 | 289.56 | 13.800 | 350.52 |
| A | 4.000 | 101.60 | 5.650 | 142.24 | 8.000 | 203.20 | 10.400 | 264.16 | 12.800 | 325.12 |
| B | 2.000 | 50.8 | 2.800 | 71.12 | 4.000 | 101.60 | 5.200 | 132.08 | 6.400 | 162.56 |
| COIL | 310-2 | | 310-3 | | 310-4 | | 310-5 | | 310-6 | |



# T4D Specifications

| PERFORMANCE | | LINEAR MAGNETIC ENCODER 5.0µm | LINEAR MAGNETIC ENCODER 1.0.1µm | RENISHAW ENCODER OPTIONS (Note 5) 0.5µm | RENISHAW ENCODER OPTIONS (Note 5) 0.1µm |
|---|---|---|---|---|---|
| Peak Velocity | in/s [m/s] | 275 [7] | 100 [2.5] | 120 [3] | 15 [0.4] |
| Resolution | in [µm] | 0.0002 [5] | 0.000 04 [1.0] | 0.000 02 [0.5] | 0.000 004 [0.1] |
| Repeatability | in [µm] | ±0.0004 [±10] | ±0.000 8 [2.0] | ±0.000 06 [1.5] | ±0.000 04 [1.0] |
| Accuracy – LME | | ±(30µm +50µm/m) | ±(25µm +50µm/m) | | |
| Accuracy – Renishaw | | | | ±(5µm +30µm/m) | |

*Note: For travels less than 1 meter, accuracy should be calculated at 1 meter*

| MOTOR MODEL | | 410-2 | 410-3 | 410-4 | 410-6 | 410-8 |
|---|---|---|---|---|---|---|
| Peak Force | N | 1041.4 | 1523.6 | 2006.3 | 2967.2 | 3928.1 |
| | lb | 234.1 | 342.5 | 451.0 | 667.0 | 883.0 |
| Continuous Force | N | 233.1 | 340.8 | 448.9 | 663.7 | 878.6 |
| | lb | 52.4 | 76.6 | 100.9 | 149.2 | 197.5 |
| Peak Power | W | 2835 | 4050 | 5265 | 7695 | 10125 |
| Continuous Power | W | 142 | 203 | 263 | 385 | 506 |

| ACCURACY | STANDARD | LASER ALIGNMENT OPTION |
|---|---|---|
| Straightness restrained on flat surface in [µm] | ±0.000127 in/in [±127µm/m] | ±.000013 in/in [±13µm/m] |
| Flatness restrained on flat surface in [µm] | ±.003 + .000254 in/in [±76 + 254µm/m] | |

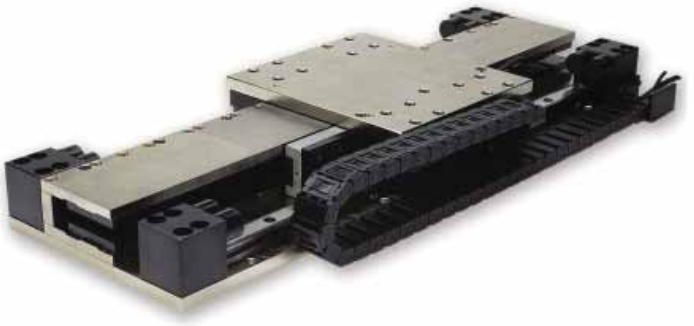
*Note: For travels less than 1 meter, Flatness should be calculated at 1 meter*
*Straightness/Flatness specifications based on system mounted to surface of flatness ±0.0005in/ft*

| PHYSICAL | | - 2 | - 3 | - 4 | - 6 | - 8 |
|---|---|---|---|---|---|---|
| Carriage Assembly | | | | | | |
| T4DB Aluminum | lbs [kg] | 9.0 [4,1] | 14.9 [6,8] | 18.1 [8,2] | 24.1 [10,9] | 30.2 [13,7] |
| T4DS Steel | lbs [kg] | 13.29 [6,0] | 22.20 [10,1] | 28.46 [12,9] | 40.51 [18,4] | 52.59 [23,9] |
| Base Assembly | | | | | | |
| T4DB Aluminum | lbs/ft [kg/m] | 29.4 [43,8] | ► | ► | ► | ► |
| T4DS Steel | lbs/ft [kg/m] | 39.3 [58,5] | ► | ► | ► | ► |
| Carriage Length | in [mm] | 4.80 [121,9] | 8.15 [207,0] | 11.50 [292,1] | 18.20 [462,3] | 24.90 [632,5] |
| Coil Bar Length | in [mm] | 10.00 [254] | 13.36 [339] | 16.72 [424] | 23.44 [595] | 30.16 [766] |

| LOAD | | - 2 | - 3 | - 4 | - 6 | - 8 |
|---|---|---|---|---|---|---|
| Vertical (Fv) see note 11 | lbs [kg] | 200 [90] | 250 [113] | 300[136] | 400 [181] | 400 [181] |
| Side (Fs) see note 11 | lbs [kg] | 150 [68] | 150 [68] | 150 [68] | 150 [68] | 150 [68] |
| Moments–Roll (Mr) see note 11 | lb-ft [N-m} | 100 [133] | 150 [200] | 150 [200] | 150 [200] | 150 [200] |
| Moments–Pitch (Mp) see note 11 | lb-ft [N-m} | 200 [266] | 400 [532] | 400 [532] | 400 [532] | 400 [532] |
| Moments–Yaw (My) see note 11 | lb-ft [N-m} | 200 [266] | 400 [532] | 400 [532] | 400 [532] | 400 [532] |

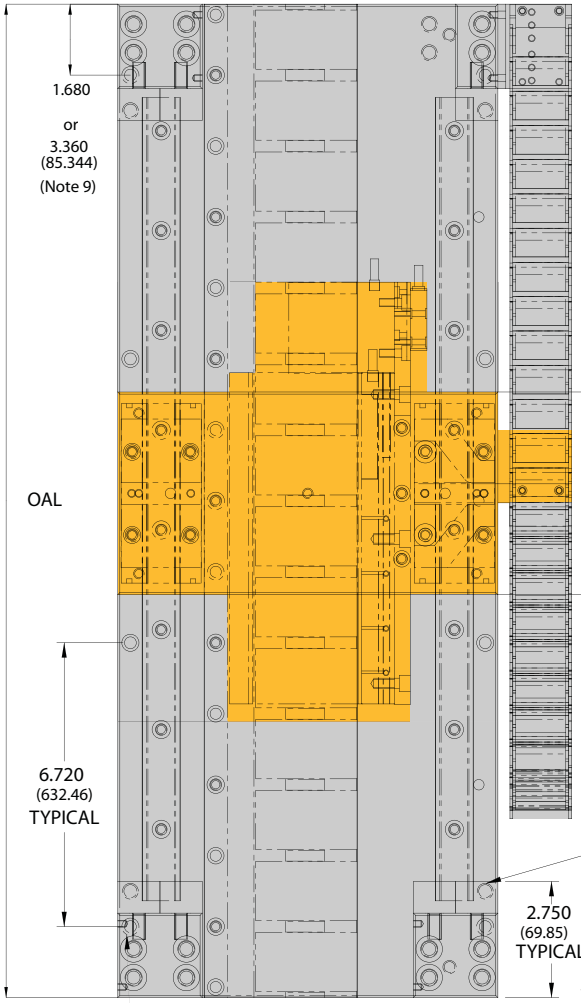
## NOTES

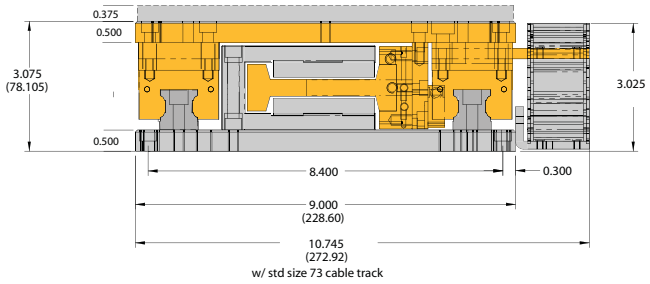
1 Total travel = OAL – 5.50" (139.7 mm) – carriage length.
2 Maximum base length is 120" (3048)
3 Aluminum base is black anodized. Steel base is nickel plated.
4 For complete motor specifications, refer to 410 series motor data sheet.
5 Renishaw encoder, RGH24 series, available in 0.05.0µm. 0.1µm, 0.5µm, 1.0µm, 5.0µm.
6 Cable extends past base by approximately 0.6" when carriage is at negative hard stop.
7 Cable Track extends 0.175" higher than carriage mounting surface. It is recommended to use optional Spacer Plate for custom mounting holes.
8 Standard cable track provided is Igus 07.30.028.
9 Base mounting holes are equidistant, 1.680" (16.80, 23.52....) or 3.360" (20.16, 26.88....) from each end depending on base length.
10 Specification subject to change without notice.
11 Listed specifications based on motor size and typical performance requirements Bearing manufacturer specifications exceed listed specifications.

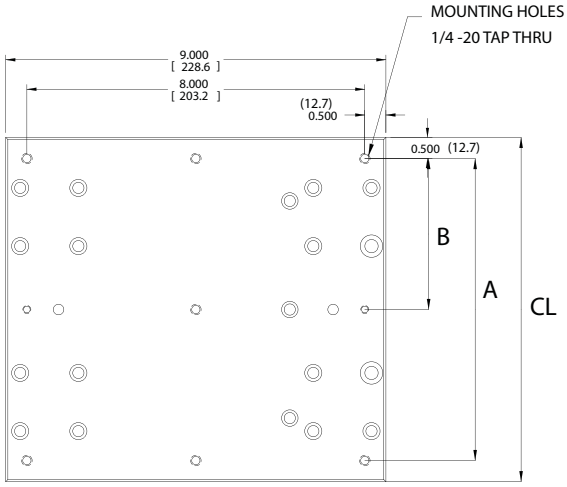


**Dimensions shown in inches.**

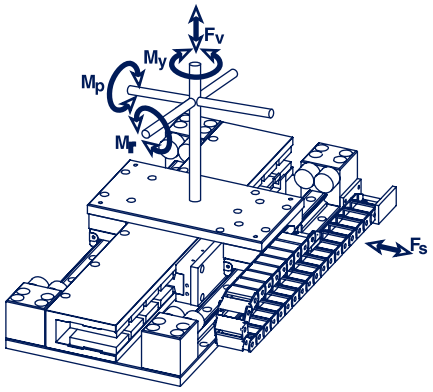
- Moving Carriage Assembly
- Stationary Base Assembly




TOTAL TRAVEL = OAL - 5.50" (139.7) - CARRIAGE LENGTH
OAL = MULTIPLE OF 3.360" (85.34)




| CARRIAGE SIZE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -2 | mm | -3 | mm | -4 | mm | -6 | mm | -8 | mm |
| CL | 4.800 | 121.92 | 8.150 | 207.01 | 11.500 | 292.10 | 18.200 | 462.28 | 24.900 | 632.46 |
| A | 3.800 | 96.52 | 7.150 | 181.61 | 10.500 | 266.70 | 17.200 | 436.88 | 23.900 | 607.66 |
| B | — | — | 3.575 | 90.805 | 5.250 | 133.35 | 8.600 | 218.44 | 11.950 | 303.53 |
| COIL | 410-2 | | 410-3 | | 410-4 | | 410-6 | | 410-8 | |

# T4S Specifications

| PERFORMANCE | | LINEAR MAGNETIC ENCODER 5.0µm | LINEAR MAGNETIC ENCODER 1.0µm | RENISHAW ENCODER OPTIONS (Note 5) 0.5µm | RENISHAW ENCODER OPTIONS (Note 5) 0.1µm |
|---|---|---|---|---|---|
| Peak Velocity | in/s [m/s] | 275 [7] | 100 [2.5] | 120 [3] | 15 [0.4] |
| Resolution | in [µm] | 0.0002 [5] | 0.000 04 [1.0] | 0.000 02 [0.5] | 0.000 004 [0.1] |
| Repeatability | in [µm] | ±0.0004 [±10] | ±0.000 8 [2.0] | ±0.000 06 [1.5] | ±0.000 04 [1.0] |
| Accuracy – LME | | ±(30µm +50µm/m) | ±(25µm +50µm/m) | | |
| Accuracy – Renishaw | | | | ±(5µm +30µm/m) | |

*Note: For travels less than 1 meter, accuracy should be calculated at 1 meter*

| MOTOR MODEL | | 410-2 | 410-3 | 410-4 | 410-6 | 410-8 |
|---|---|---|---|---|---|---|
| Peak Force | N | 1041.4 | 1523.6 | 2006.3 | 2967.2 | 3928.1 |
| | lb | 234.1 | 342.5 | 451.0 | 667.0 | 883.0 |
| Continuous Force | N | 233.1 | 340.8 | 448.9 | 663.7 | 878.6 |
| | lb | 52.4 | 76.6 | 100.9 | 149.2 | 197.5 |
| Peak Power | W | 2835 | 4050 | 5265 | 7695 | 10125 |
| Continuous Power | W | 142 | 203 | 263 | 385 | 506 |

| ACCURACY | STANDARD | LASER ALIGNMENT OPTION |
|---|---|---|
| Straightness restrained on flat surface in [µm] | ±0.000125in/in [±127µm/m] | ±0.000013 in/in [±13µm/m] |
| Flatness restrained on flat surface in [µm] | ±0.003 + .000254 in/in [±76 + 254µm/m] | |

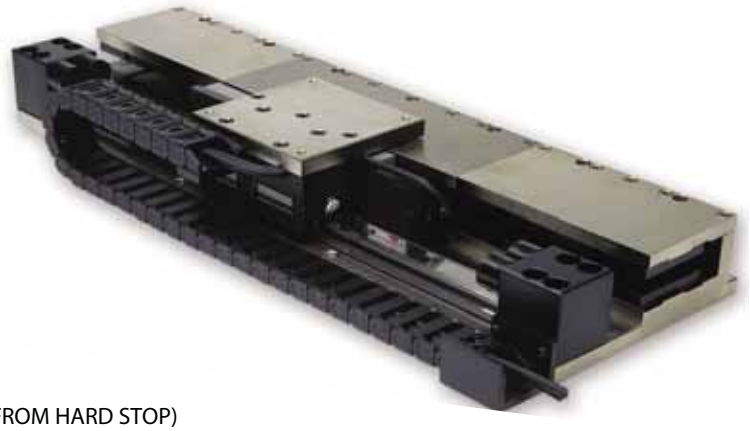
*Note: For travels less than 1 meter, Flatness should be calculated at 1 meter*
*Straightness/Flatness specifications based on system mounted to surface of flatness ±0.0005in/ft*

| PHYSICAL | | - 2 | - 3 | - 4 | - 6 | - 8 |
|---|---|---|---|---|---|---|
| Carriage Assembly | | | | | | |
| T4SB Aluminum | lbs [kg] | 6.5 [3,0] | 10.3 [4,7] | 13.0 [5,9] | 17.8 [8,1] | 22.7 [10,3] |
| T4SS Steel | lbs [kg] | 8.78 [4,0] | 14.22 [6,5] | 18.47 [8,4] | 26.49 [12,0] | 34.54 [15,7] |
| Base Assembly | | | | | | |
| T4SB Aluminum | lbs/ft [kg/m] | 26.7 [39,8] | ► | ► | ► | ► |
| T4SS Steel | lbs/ft [kg/m] | 34.9 [52,0] | ► | ► | ► | ► |
| Carriage Length | in [mm] | 4.80 [121,9] | 8.15 [207,0] | 11.50 [292,1] | 18.20 [462,3] | 24.90 [632,5] |
| Coil Bar Length | in [mm] | 10.00 [254] | 13.36 [339] | 16.72 [424] | 23.44 [595] | 30.16 [766] |

| LOAD | | - 2 | - 3 | - 4 | - 6 | - 8 |
|---|---|---|---|---|---|---|
| Vertical (Fv) see note 11 | lbs [kg] | 150 [68] | 175 [79] | 175 [79] | 200 [90] | 200 [90] |
| Side (Fs) see note 11 | lbs [kg] | 75 [34] | 75 [34] | 75 [34] | 75 [34] | 75 [34] |
| Moments–Roll (Mr) see note 11 | lb-ft [N-m} | 50 [66] | 100 [133] | 100 [133] | 100 [133] | 100 [133] |
| Moments–Pitch (Mp) see note 11 | lb-ft [N-m} | 100 [133] | 200 [266] | 200 [266] | 200 [266] | 200 [266] |
| Moments–Yaw (My) see note 11 | lb-ft [N-m} | 100 [133] | 200 [266] | 200 [266] | 200 [266] | 200 [266] |

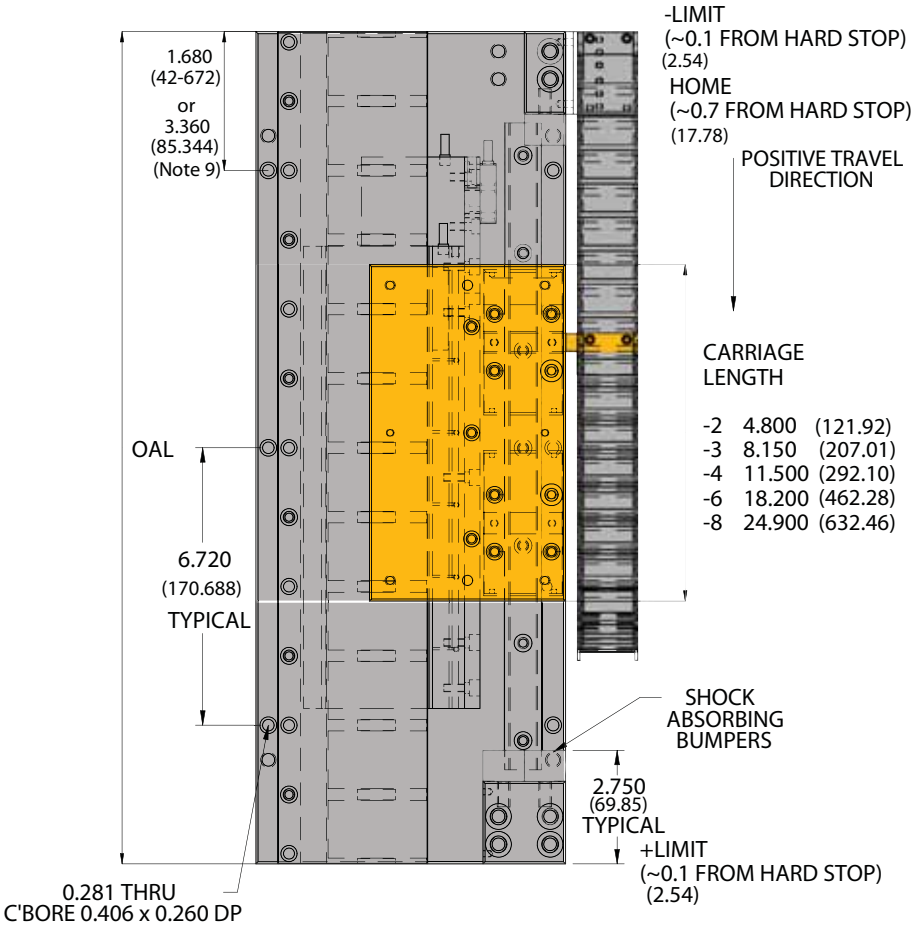
## NOTES

1 Total travel = OAL – 5.50″ (139.7 mm) – carriage length.
2 Maximum base length is 168″, 4.2 meters.
3 Aluminum base is black anodized. Steel base is nickel plated.
4 For complete motor specifications, refer to 410 series motor data sheet.
5 Renishaw encoder, RGH24 series, available in 0.05µm, 0.1µm, 0.5µm, 1.0µm, 5.0µm.
6 Cable extends past base by approximately 0.6” when carriage is at negative hard stop.
7 Cable Track extends 0.175″ higher than carriage mounting surface. It is recommended to use optional Spacer Plate for custom mounting holes.
8 Standard cable track provided is Igus 07.30.028.
9 Base mounting holes are equidistant, 1.680” (16.80, 23.52....) or 3.360” (20.16, 26.88....) from each end depending on base length.
10 Specification subject to change without notice.
11 Listed specifications based on motor size and typical performance require Bearing manufacturer specifications exceed listed specifications.



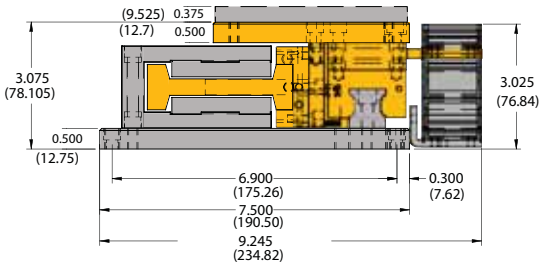
**Dimensions shown in inches.**

- Moving Carriage Assembly
- Stationary Base Assembly

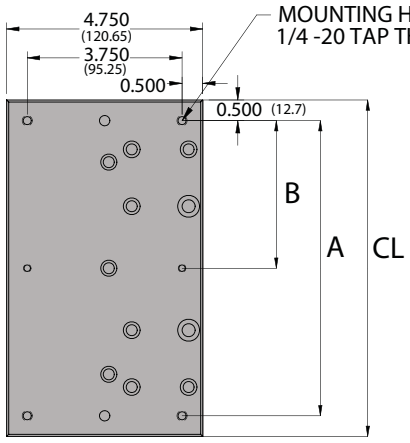


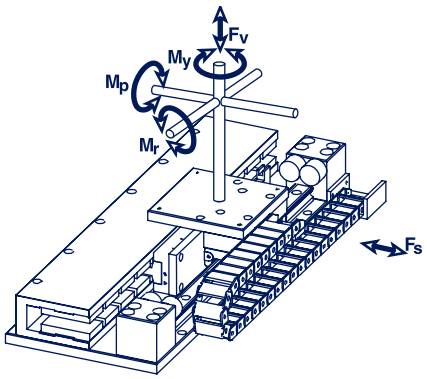

TOTAL TRAVEL = OAL - 5.50" (139.7) - CARRIAGE LENGTH
OAL = MULTIPLE OF 3.360" (985.34)

0.375 THICK CARRIAGE SPACER PLATE (optional)
9.525




w/ std size 73 cable track




| CARRIAGE SIZE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -2 | mm | -3 | mm | -4 | mm | -6 | mm | -8 | mm |
| CL | 4.800 | 121.92 | 8.150 | 207.01 | 11.500 | 292.10 | 18.200 | 462.28 | 24.900 | 632.46 |
| A | 3.800 | 96.52 | 7.150 | 181.61 | 10.500 | 266.70 | 17.200 | 436.88 | 23.900 | 607.66 |
| B | — | — | 3.575 | 90.805 | 5.250 | 133.35 | 8.600 | 218.44 | 11.950 | 303.53 |
| COIL | 410-2 | | 410-3 | | 410-4 | | 410-6 | | 410-8 | |

Order Example:

| T | 1 | D | A | 012 | 3 | N | S | B | A | G | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|

**Series**
**T** = Open Positioner

**Motor Coil Series**
**1** = 110 Motor Coil

**Bearing Rail Configuration**
**D** = Dual Bearing Rails
**S** = Single Bearing Rails

**Base Material**
**A** = 3/8″ Al

**Length of Base**
**XXX =** Length of base In inches
Max.: 33.6″
Min.: 9.6″
Increment: 2.4″

***** Truncate base length in part number. Example: for a 16.8 inch base, "XXX" equal "016″

T1S Base Length = Travel (increments of 2.4″ [60.96mm])
+1.6″ [40.64] + carriage length
T1D Base Length = Travel Travel (increments of 2.4″ [60.96 mm])
-0.05″ [1027 mm] + carriage length

**Coil Size**
**1** = 1 pole, T1S 3.4″ (86.4 mm)
**2 =** 2 pole T1S 5.8″ (147.3 mm)
T1D 5.4″ (137.6 mm)
T1D 7.8″ (198.12 mm)
T1S 3.4″ (86.4 mm)

**Cooling**
**N** no cooling

**Winding Type**
**S** Series
**P** Parallel

**Cable track**
**0** = None
**2** = Std.

**Connector**
Cable Connectorization
**A** = Aries
**B** = Flying Leads
**C** = Compax3
**G** = Gemini
**V** = ViX
**Z** = no cables

*Connectorized cables only available with Connector Box

**Cable length**
Cable Length
**A** = 1 Meter Flying Leads
**B** = 3 Meter Flying Leads
**C** = 7.5 Meter Flying Leads
**L** = 3 Extension Cables (with Connector Box)
**M** = 7.5 Extension Cables (with Connector Box)
**Z** = Connector Box ONLY (no extension cables)

*Flying leads – cable measured from last cable carrier link
*Extension Cables – cable measured from connection box at end of base

**Encoder**
**A** = LME, 1um
**B** = LME, 5um
**Q** = Renishaw, 5um
**L** = Renishaw, 1um
**M** = Renishaw, 0.5m
**P** = Renishaw, 0.1um
**R** = Renishaw, 1 V p-p sine/cosine
**X** = No encoder

Order Example:

| T | 2 | D | A | 012 | 3 | N | S | B | A | B | 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|

**Series**
**T** = Open Posititioner
**B** = Bellows Posititioner

**Motor Coil Series**
**2** = 210 motor coil

**Bearing Rail Configuration**
**D** = Dual Bearing Rails
**S** = Single Bearing Rails
* Bellows positioners not available in single rail

**Base material**
**A** = 0.375″ Al

**Length of Base**
**XXX** = Length of base In inches
Max.: 120″*****
Min.: 9.6″
Increment: 2.4″

***** Truncate base length in part number. Example: for a 16.8 inch base, "XXX" equal "016″

T1S Base Length = Travel (increments of 2.4″ [60.96 mm])
+3.0″ [76.2] + carriage length
T1D Base Length = Travel Travel (increments of 2.4″ [60.96 mm])

**Coil size**
**2** = 2 pole, 4.2 in (106.68 mm)
**3** = 3 pole, 6.6 in (106.64 mm)
**4** = 4 pole, 9.0 in (228.60 mm)

**Cooling**
**N** no cooling

**Winding Type**
**S** Series
**P** Parallel

*****Consult factory for longer lengths.

**Encoder**
**A** = LME 1 um
**B** = LME 5 um
**Q** = Renishaw 5 um
**L** = Renishaw 1 um
**M** = Renishaw 0.5 um
**P** = Renishaw 0.1 um
**R** = Renishaw IV p-p sine/cosine
**X** = No Encoder

**Cable length**
**A** = 1 Meter Flying Leads
**B** = 3 Meter Flying Leads
**C** = 7.5 Meter Flying Leads
**L** = 3 Extension Cables (with Connector Box)
**M** = 7.5 Extension Cables (with Connector Box)
**Z** = Connector Box ONLY (no extension cables)

*Flying leads – cable measured from last cable carrier link
*Extension Cables – cable measured from connection box at end of base
*7.5 Meter Flying Lead Cables available on:
All bases with LME encoder
All bases with Renishaw encoder under 86″
For bases with Renishaw encoder over 86″ the cable length (CL) will be CL = 10M - (base length in meters + 0.3M)

**Connector**
Cable Connectorization
**A** = Aries
**B** = Flying Leads
**C** = Compax3
**G** = Gemini
**V** = ViX
**Z** = no cables

*Connectorized cables only available with Connector Box

**Cable track**
**0** = (no track)
**3** = (standard)

Order Example:

| T | 3 | D | B | 012 | 3 | N | S | B | A | C | 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|

**Series**
**T** = Open Positioner
**B** = Bellows Positioner

**Motor Coil Series**
**3** = 310 Motor Coil

**Bearing Rail Configuration**
**D** = Dual Bearing Rails
**S** = Single Bearing Rails
* Bellows positioners not available in single rail

**Base Material**
**B** = 1/2″ Al

**Length of Base**
**XXX =** Length of base In inches
Max.: 118″
Min.: 9.6″
Increment: 2.4″

***** Truncate base length in part number. Example: for a 16.8 inch base, "XXX" equal "016″
Base Length = Travel (increments of 2.4″ [60.96mm])
+3.0″ [76.2 mm] + carriage length

**Coil Size**
**2** = 2 pole T3S 5.0″ [127 mm], T3D 4.2″ [106.68]
**3** = 3 pole 6.6″ [167.64 mm]
**4** = 4 pole 9.0″ [228.60 mm]
**5** = 5 pole 11.4″ [289.56 mm]
**6** = 6 pole 13.3″ [350.62 mm]

**Cooling**
**N** no cooling

**Winding Type**
**S** Series
**P** Parallel

**Cable track**
**0** = None
**3** = Std.

**Connector**
Cable Connectorization
**A** = Aries
**B** = Flying Leads
**C** = Compax3
**G** = Gemini
**V** = ViX
**Z** = no cables

*Connectorized cables only available with Connector Box

**Cable length**
Cable Length
**A** = 1 Meter Flying Leads
**B** = 3 Meter Flying Leads
**C** = 7.5 Meter Flying Leads
**L** = 3 Extension Cables (with Connector Box)
**M** = 7.5 Extension Cables (with Connector Box)
**Z** = Connector Box ONLY (no extension cables)

*Flying leads – cable measured from last cable carrier link
*Extension Cables – cable measured from connection box at end of base
*7.5 Meter Flying Lead Cables available on:
All bases with LME encoder
All bases with Renishaw encoder under 86″
For bases with Renishaw encoder over 86″ the cable length (CL) will be CL = 10M - (base length in meters + 0.3M)

**Encoder**
**A** = LME, 1um
**B** = LME, 5um
**Q** = Renishaw, 5um
**L** = Renishaw, 1um
**M** = Renishaw, 0.5m
**P** = Renishaw, 0.1um
**R** = Renishaw, 1 V p-p sine/cosine
**X** = No encoder

Order Example:

| T | 4 | D | B | XXX | 3 | N | S | B | A | B | 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|

**Series**
**T** = Open Posititioner
**B** = Bellows Posititioner

**Motor Coil Series**
4 = 410 motor coil

**Bearing Rail Configuration**
**D** = Dual Bearing Rails
**S** = Single Bearing Rails
* Bellows positioners not available in single rail

**Base material**
**B** = 1/2″ Al

**Length of Base**
**XXX** = Length of base in inches
Max.: 120″ *
Min.: 13.44″
Increment: 3.36″

* Truncate base length in part number.
Example: for a 16.8 inch base, "XXX" equal "016″

Base Length = Travel (increments of 2.4″ [60.96mm])
+5.5″ [39.7 mm] + carriage length

**Coil size**
**2** = 2 pole 4.8″ [121.92 mm]
**3** = 3 pole 8.15″ [207.01 mm]
**4** = 4 pole 11.5″ [292.10 mm]
**6** = 6 pole 18.2″ [462.28 mm]
**8** = 8 pole 24.9″ [632.46 mm]

**Cooling**
**N** no cooling

**Winding Type**
**S** Series
**P** Parallel

*Consult factory for longer lengths.

**Cable track**
0 = (no track)
4 = (standard)

**Connector**
Cable Connectorization
**A** = Aries
**B** = Flying Leads
**C** = Compax3
**G** = Gemini
**V** = ViX
**Z** = no cables

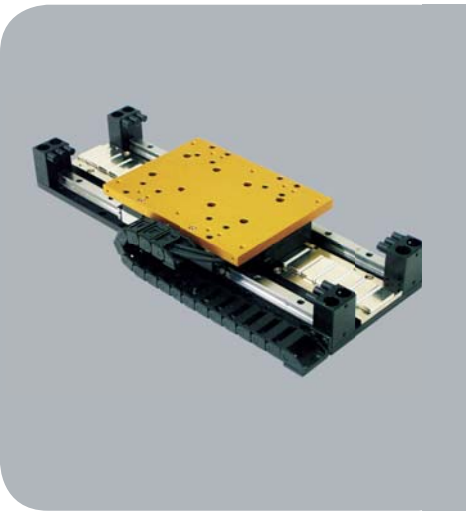
*Connectorize cables only available with Connector Box

**Cable length**
**A** = 1 Meter Flying Leads
**B** = 3 Meter Flying Leads
**C** = 7.5 Meter Flying Leads
**L** = 3 Extension Cables (with Connector Box)
**M** = 7.5 Extension Cables (with Connector Box)
**Z** = Connector Box ONLY (no extension cables)

*Flying leads – cable measured from last cable carrier link
*Extension Cables – cable measured from connection box at end of base
*7.5 Meter Flying Lead Cables available on:
All bases with LME encoder
All bases with Renishaw encoder under 86″
For bases with Renishaw encoder over 86″ the cable length (CL) will be CL = 10M - (base length in meters + 0.3M)

**Encoder**
**A** = LME 1 um
**B** = LME 5 um
**Q** = Renishaw 5 um
**L** = Renishaw 1 um
**M** = Renishaw 0.5 um
**P** = Renishaw 0.1 um
**R** = Renishaw IV p-p sine/cosine
**X** = No Encoder

# RIPPED Ironcore Linear Positioners



**Parker Trilogy's RIPPED linear positioners utilize our high-performance RIPPED ironcore linear motors in a pre-engineered, easily integrated, ready-to-run package. These positioners are engineered to achieve high performance at an economical cost while preserving design flexibility to accommodate customization. Combined with RIPPED ironcore motors – with their patent-pending anti-cog technology, these linear motor tables produce extremely smooth motion and can be used in many applications where ironless motors traditionally were needed.**

**Trilogy's positioners utilize high-precision square rail bearings. In addition, they are designed to connect together using transition plates for XY or multi-axis configurations. Options include a variety of cable management systems in addition to bellows and hard covers.**

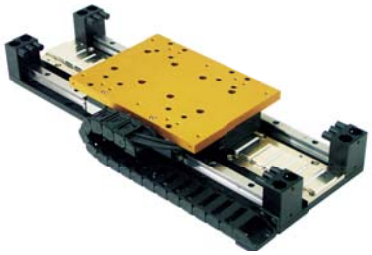
**High force capability, multi-axis compatibility, and ease of customization make the RIPPED ironcore linear positioners an optimal choice for high performance and value.**

**Features**

- Standard lengths to 3 meters
- Extended lengths as standard options
- Incremental length of 60mm for TR10 and TR16
- Incremental length of 80mm for TR07
- Stainless cover options for TR07, TR10 and TR16
- Maximum cover length of 144”
- Optical or magnetic encoders
- Optical encoders; 1.0um, 0.50um, 0.10um
- Magnetic encoder: 5.0um
- Magnetic Home and End-of-Travel limits

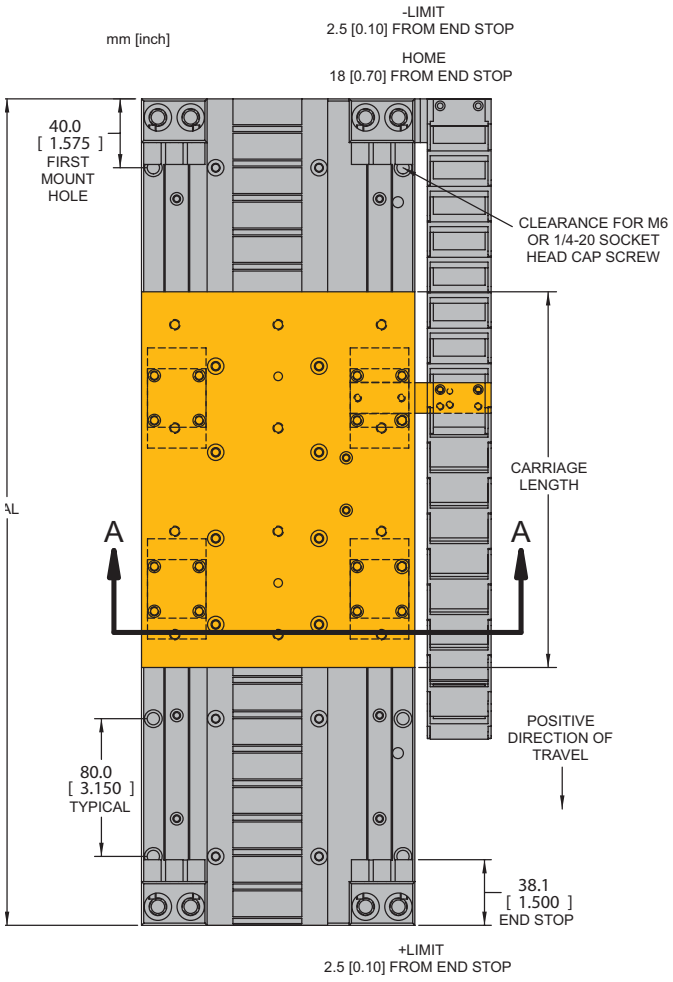
# TR07

## open design

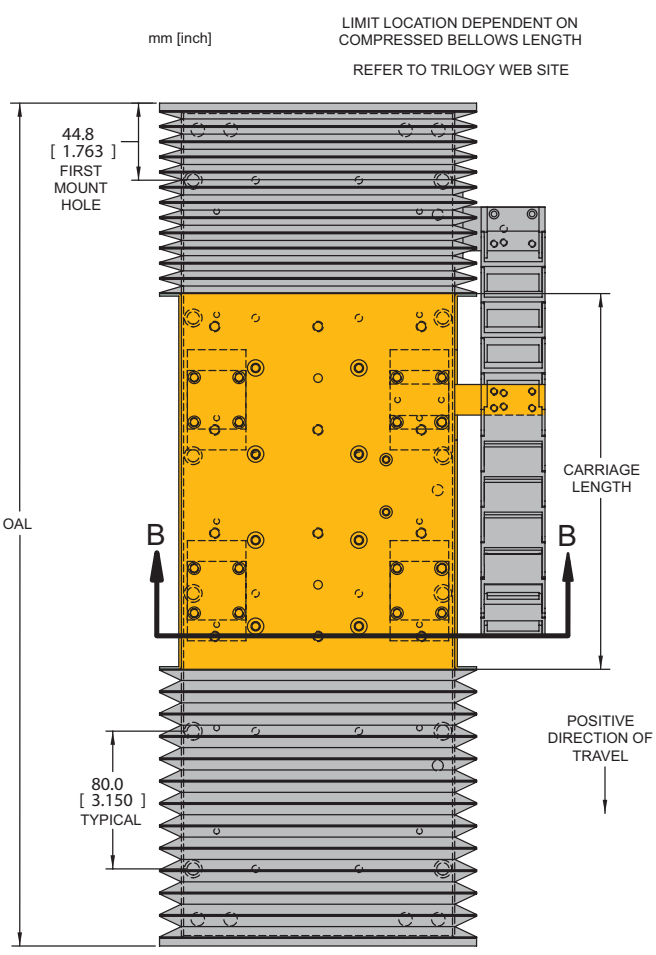


# BR07

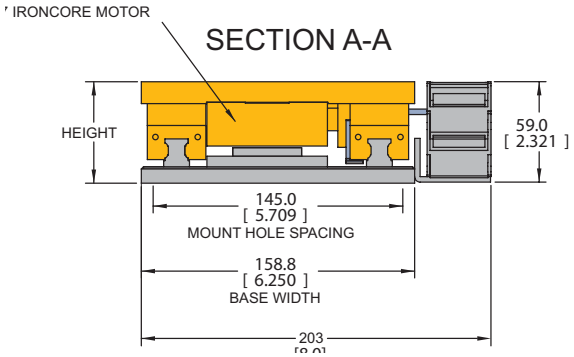
## bellows design

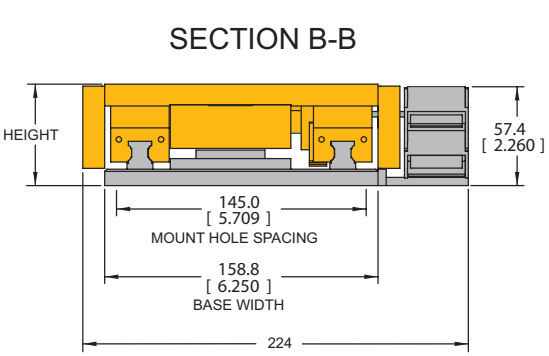



TRAVEL (mm) = OAL - 76.2 - CARRIAGE LENGTH
OVERALL LENGTH (OAL) = MULTIPLE OF 80 mm UP TO 3040 mm




REFER TO TRILOGY WEB SITE FOR TRAVEL
BASE LENGTH = MULTIPLE OF 80 mm UP TO 3040 mm
OAL = BASE LENGTH + 9.5 mm

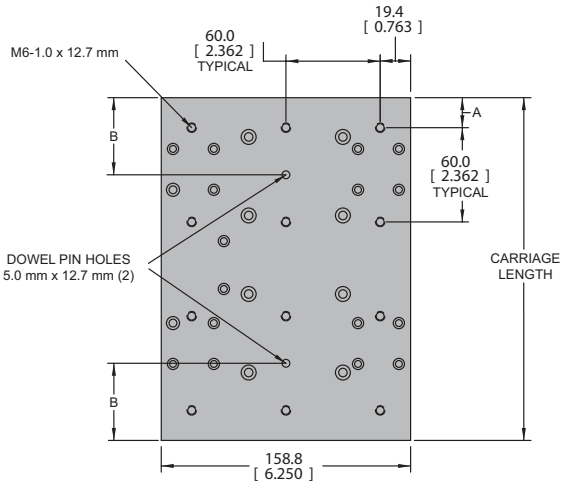


| OVERALL WIDTH (OAW) | | | |
|---|---|---|---|
| IGUS CABLE TRACK | PART NO. DESIGNATOR | TR07 mm [in] | BR07 mm [in] |
| 07-20-18 | Custom | 193 [7.6] | 214 [8.4] |
| 07-30-18 | 3 | 203 [8.0] | 224 [8.8] |
| 07-40-18 | Custom | 213 [8.4] | 234 [9.2] |
| 07-50-18 | Custom | 223 [8.8] | 244 [9.6] |
| 07-64-18 | Custom | 237 [9.3] | 258 [10.2] |

| CARRIAGE LENGTH | | | |
|---|---|---|---|
| COIL SIZE | -1 | -2 | -3 |
| TR07/BR07 CARRIAGE | 218.2 [8.591] | 378.2 [14.890] | 538.2 [21.189] |
| A (1st MOUNT HOLE) | 19.1 [0.752] | 9.1 [0.358] | 29.1 [1.146] |
| NUMBER OF MOUNTING HOLES | 12 | 21 | 27 |
| B (DOWEL PIN HOLE) | 49.1 [1.933] | 99.1 [3.901] | 119.1 [4.689] |

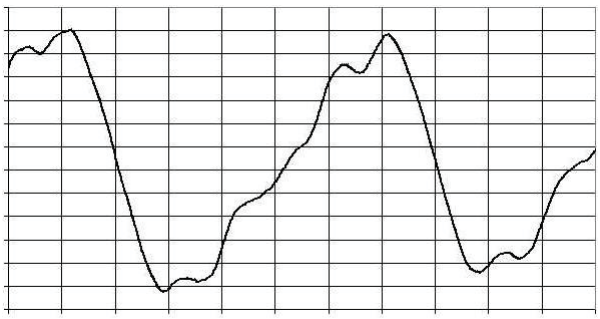
**TR07/BR07 CARRIAGE**



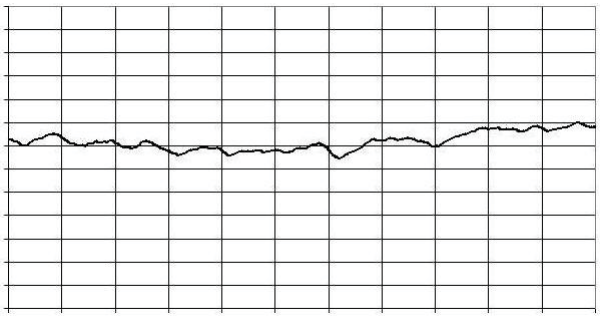

## Smooth operation with Anti-Cogging features –

Parker Trilogy's RIPPED Series Ironcore Positioners utilize Parker's patent pending Anti-Cogging techniques for superior smoothness. Traditional ironcore motors exhibit cogging forces when the internal iron laminations exhibit a horizontal force on the motor when trying to line up with their "preferred" positions over the magnets. Cogging limits the overall smoothness of the motion system.

Parker Trilogy has developed an Anti-Cogging technological breakthrough that virtually eliminates cogging and allows ironcore motors to be used in applications where only ironless motors were used before. This offers the user a powerful combination of extremely high force and smooth operation in an economical package.



*Typical Ironcore Positioner Cogging Forces*



*Cogging forces with Parker Trilogy's patent-pending Anti-Cog Technology*

## PERFORMANCE

| ENCODER | | LINEAR MAGNETIC ENCODER | | RENISHAW OPTICAL ENCODER | | |
|---|---|---|---|---|---|---|
| | | 1.0 µm | 5.0 µm | 0.5 µm | 1.0 µm | 5.0 µm |
| Part Number Designator | | A | B | M | L | Q |
| Encoder Model | | LME1 | LME5 | RGH24Z | RGH24X | RGH24D |
| Peak Velocity | m/s [in/s] | 2.5 [100] | 7 [275] | 3 [120] | 5 [200] | 5 [200] |
| Resolution | µm [in] | 1.0 [0.00004] | 5.0 [0.0002] | 0.5 [0.00002] | 1.0 [0.00004] | 5.0 [0.0002] |
| Repeatability | µm [in] | ±2.0 [±0.00008] | ±10.0 [±0.0004] | ±1.5 [±0.00006] | ±2.0 [±0.00008] | ±10.0 [±0.0004] |
| Accuracy - LME | | ±(25 µm + 50 µm/m) | ±(30 µm + 50 µm/m) | | | |
| Accuracy - Renishaw | | | | ±(5 µm + 30 µm/m) | | ±(10 µm + 30 µm/m) |

*Note: For travels less than 1 meter, accuracy should be calculated at 1 meter*

| MOTOR MODEL | | R07-1 | R07-2 | R07-3 |
|---|---|---|---|---|
| Peak Force | N | 587 | 1174 | 1761 |
| | lb | 132 | 264 | 396 |
| Continuous Force | N | 154 | 308 | 462 |
| | lb | 35 | 69 | 104 |
| Peak Power | W | 3600 | 7200 | 10800 |
| Continuous Power | W | 180 | 360 | 540 |

## ACCURACY

| Base Length | < 1 meter | > 1 meter |
|---|---|---|
| Straightness restrained on a flat surface µm [in] | ±127µm/m [±0.000127 in/in] | ±127µm/m [±0.000127 in/in] |
| Flatness restrained on a flat surface µm [in] | ±330 [±0.013] | ±76 + 254µm/m [±0.003 +.000254 in/in] |

*Note: Straightness/Flatness specifications based on system mounted to surface of flatness ±0.0005 in/ft*

## PHYSICAL

| COIL SIZE | | -1 | -2 | -3 |
|---|---|---|---|---|
| Carriage Assembly | | | | |
| TR07 | kg [lb] | 3.5 [7.7] | 6.3 [13.9] | 9.1 [19.9] |
| BR07 | kg [lb] | 3.6 [7.9] | 6.5 [14.2] | 9.3 [20.4] |
| Base Assembly (0.375" thick aluminum) | | | | |
| TR07A | kg/mm [lb/in] | 0.0128 [0.714] | ----------> | ----------> |
| BR07A | kg/mm [lb/in] | 0.0131 [0.733] | ----------> | ----------> |
| Base Assembly (0.500" thick aluminum) | | | | |
| TR07B | kg/mm [lb/in] | 0.0141 [0.791] | ----------> | ----------> |
| BR07B | kg/mm [lb/in] | 0.0145 [0.810] | ----------> | ----------> |

## LOAD (Recommended)

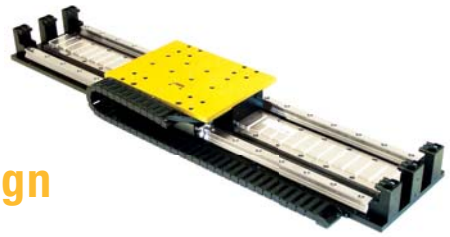
| COIL SIZE | | -1 | -2 | -3 |
|---|---|---|---|---|
| Vertical (Fv) see note 4 | kg [lb] | 100 [220] | 150 [330] | 200 [440] |
| Side (Fs) see note 4 | kg [lb] | 50 [110] | 75 [165] | 100 [220] |
| Moments-Roll (Mr) see note 4 | N-m [lb-ft] | 50 [37] | 75 [55] | 100 [74] |
| Moments-Pitch (Mp) see note 4 | N-m [lb-ft] | 100 [74] | 250 [184] | 400 [295] |
| Moments-Yaw (My) see note 4 | N-m [lb-ft] | 100 [74] | 250 [184] | 400 [295] |

### NOTES

1. Maximum base length is 3040 mm (limited by maximum single piece bearing rail).
2. Refer to R07 motor data sheet for complete motor specifications.
3. Motor force must be derated by 50% in a "stalled motor" operating condition.
4. Recommended loads based on motor size and typical performance requirements (consult factory if desired loads are greater).
5. Specifications subject to change without notice. Most current brochure available online in PDF format.
6. Refer to website for Ironcore Motor Safe Handling and Cautionary guidelines.

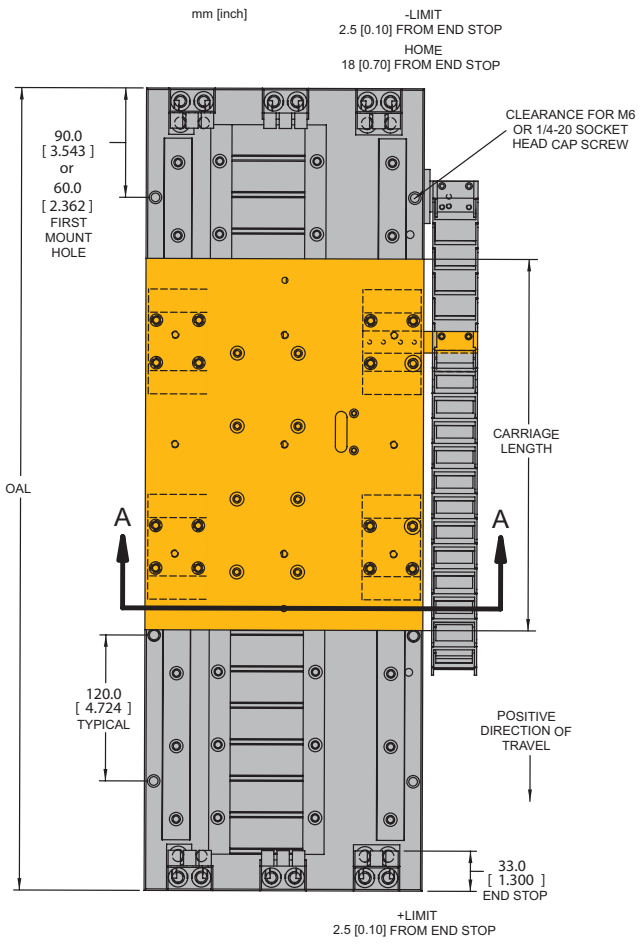
# TR10

## open design

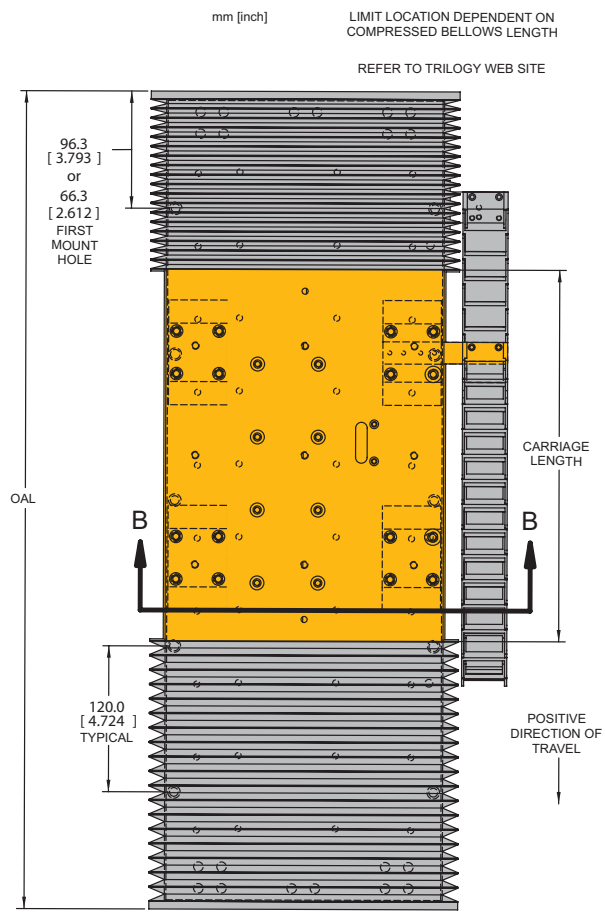


# BR10

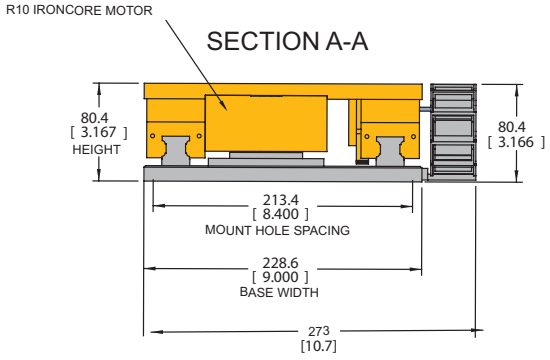
## bellows design

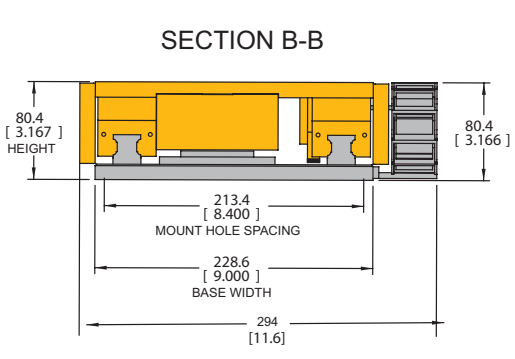



TRAVEL (mm) = OAL - 66.0 - CARRIAGE LENGTH
OVERALL LENGTH (OAL) = MULTIPLE OF 60 mm UP TO 4080 mm




REFER TO TRILOGY WEB SITE FOR TRAVEL
BASE LENGTH = MULTIPLE OF 60 mm UP TO 4080 mm
OAL = BASE LENGTH + 12.7 mm

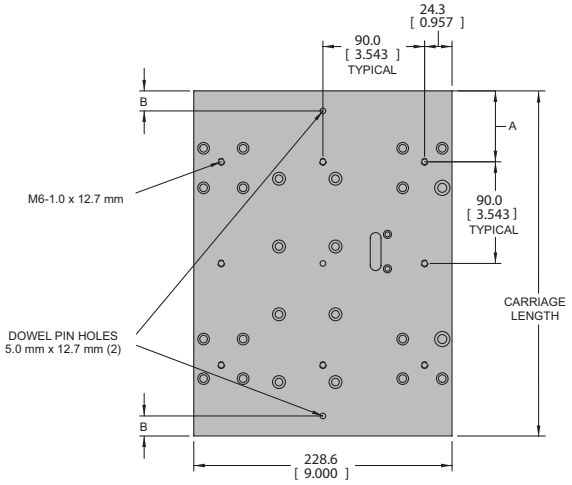


| OVERALL WIDTH (OAW) | | | |
|---|---|---|---|
| IGUS CABLE TRACK | PART NO. DESIGNATOR | TR10 mm [in] | BR10 mm [in] |
| 07-20-18 | Custom | 263 [10.4] | 284 [11.2] |
| 07-30-18 | 3 | 273 [10.7] | 294 [11.6] |
| 07-40-18 | Custom | 283 [11.1] | 304 [12.0] |
| 07-50-18 | Custom | 293 [11.5] | 314 [12.4] |
| 07-64-18 | Custom | 307 [12.1] | 328 [12.9] |

| CARRIAGE LENGTH | | | |
|---|---|---|---|
| COIL SIZE | -1 | -2 | -3 |
| TR10/BR10 CARRIAGE | 305.5 [12.027] | 545.5 [21.475] | 785.5 [30.924] |
| A (1st MOUNT HOLE) | 62.7 [2.470] | 47.7 [1.879] | 77.7 [3.060] |
| NUMBER OF MOUNTING HOLES | 9 | 18 | 24 |
| B (DOWEL PIN HOLE) | 17.7 [0.699] | 92.7 [3.651] | 212.7 [8.375] |

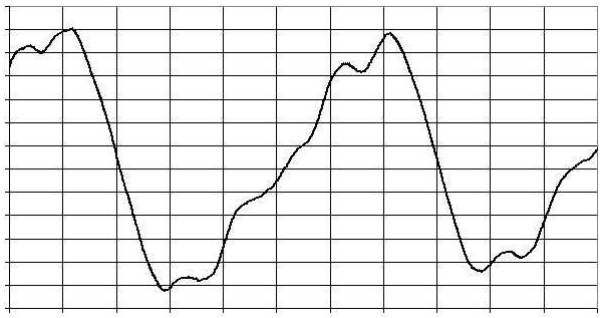
**TR10/BR10 CARRIAGE**



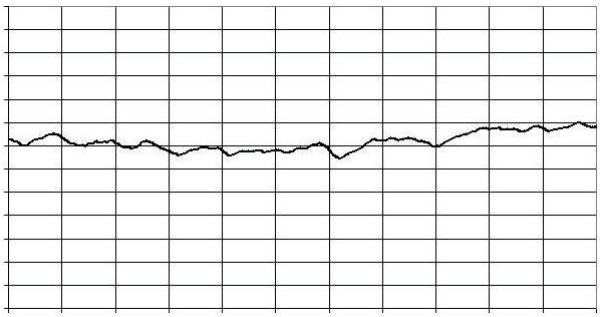

## Smooth operation with Anti-Cogging features –

Parker Trilogy's RIPPED Series Ironcore Positioners utilize Parker's patent pending Anti-Cogging techniques for superior smoothness. Traditional ironcore motors exhibit cogging forces when the internal iron laminations exhibit a horizontal force on the motor when trying to line up with their "preferred" positions over the magnets. Cogging limits the overall smoothness of the motion system.

Parker Trilogy has developed an Anti-Cogging technological breakthrough that virtually eliminates cogging and allows ironcore motors to be used in applications where only ironless motors were used before. This offers the user a powerful combination of extremely high force and smooth operation in an economical package.



*Typical Ironcore Positioner Cogging Forces*



*Cogging forces with Parker Trilogy's patent-pending Anti-Cog Technology*

## PERFORMANCE

| ENCODER | | LINEAR MAGNETIC ENCODER | | RENISHAW OPTICAL ENCODER | | |
|---|---|---|---|---|---|---|
| | | 1.0 µm | 5.0 µm | 0.5 µm | 1.0 µm | 5.0 µm |
| Part Number Designator | | A | B | M | L | Q |
| Encoder Model | | LME1 | LME5 | RGH24Z | RGH24X | RGH24D |
| Peak Velocity | m/s [in/s] | 2.5 [100] | 7 [275] | 3 [120] | 5 [200] | 5 [200] |
| Resolution | µm [in] | 1.0 [0.00004] | 5.0 [0.0002] | 0.5 [0.00002] | 1.0 [0.00004] | 5.0 [0.0002] |
| Repeatability | µm [in] | ±2.0 [±0.00008] | ±10.0 [±0.0004] | ±1.5 [±0.00006] | ±2.0 [±0.00008] | ±10.0 [±0.0004] |
| Accuracy - LME | | ±(25 µm + 50 µm/m) | ±(30 µm + 50 µm/m) | | | |
| Accuracy - Renishaw | | | | ±(5 µm + 30 µm/m) | | ±(10 µm + 30 µm/m) |

*Note: For travels less than 1 meter, Accuracy should be calculated at 1 meter*

| MOTOR MODEL | | R10-1 | R10-2 | R10-3 |
|---|---|---|---|---|
| Peak Force | N | 1366 | 2731 | 4097 |
| | lb | 307 | 614 | 921 |
| Continuous Force | N | 374 | 747 | 1121 |
| | lb | 84 | 168 | 252 |
| Peak Power | W | 6098 | 12196 | 18294 |
| Continuous Power | W | 305 | 610 | 915 |

## ACCURACY

| Base Length | < 1 meter | > 1 meter |
|---|---|---|
| Straightness restrained on a flat surface µm [in] | ±127µm/m [±0.000127 in/in] | ±127µm/m [±0.000127 in/in] |
| Flatness restrained on a flat surface µm [in] | ±330 [±0.013] | ±76 + 254µm/m [±0.003 + .000254 in/in] |

*Note: Straightness/Flatness specifications based on system mounted to surface of flatness ±0.0005 in/ft*

## PHYSICAL

| COIL SIZE | | -1 | -2 | -3 |
|---|---|---|---|---|
| Carriage Assembly | | | | |
| TR10 | kg [lb] | 9.5 [20.9] | 17.1 [37.5] | 24.6 [54.2] |
| BR10 | kg [lb] | 9.7 [21.3] | 17.4 [38.2] | 25.1 [55.2] |
| Base Assembly (0.500" thick aluminum) | | | | |
| TR10B | kg/mm [lb/in] | 0.0186 [1.042] | ----------> | ----------> |
| BR10B | kg/mm [lb/in] | 0.0194 [1.084] | ----------> | ----------> |

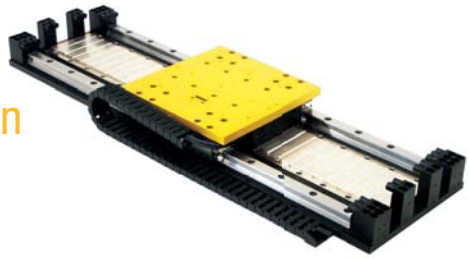
## LOAD (Recommended)

| COIL SIZE | | -1 | -2 | -3 |
|---|---|---|---|---|
| Vertical (Fv) see note 4 | kg [lb] | 200 [440] | 250 [550] | 300 [660] |
| Side (Fs) see note 4 | kg [lb] | 100 [220] | 125 [275] | 150 [330] |
| Moments-Roll (Mr) see note 4 | N-m [lb-ft] | 100 [74] | 125 [92] | 150 [111] |
| Moments-Pitch (Mp) see note 4 | N-m [lb-ft] | 200 [148] | 400 [295] | 600 [443] |
| Moments-Yaw (My) see note 4 | N-m [lb-ft] | 200 [148] | 400 [295] | 600 [443] |

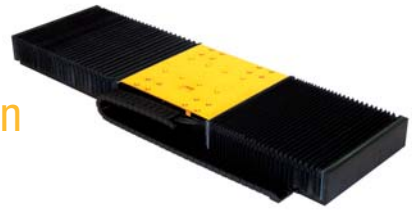
### NOTES

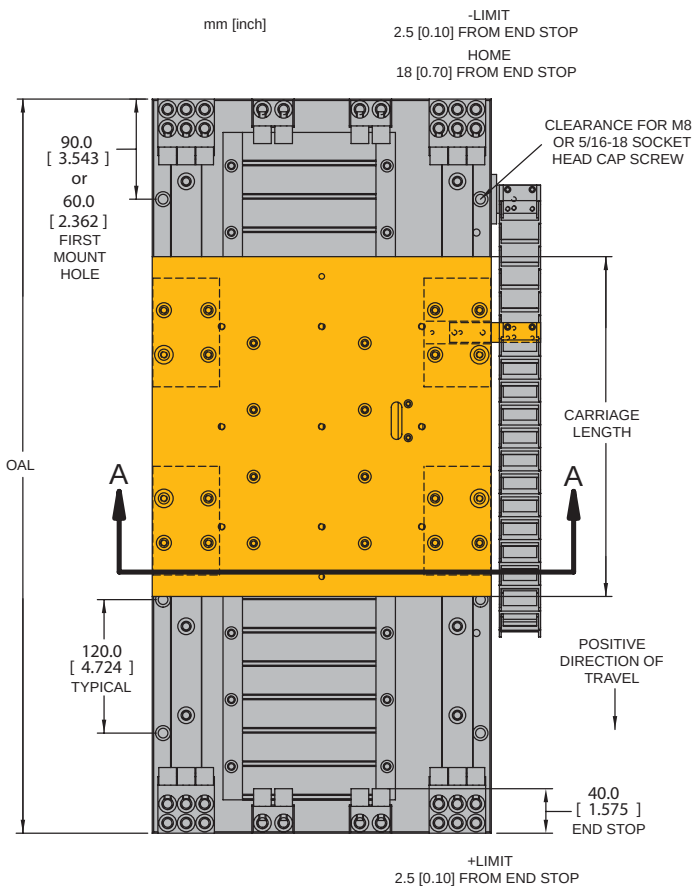
1. Maximum base length is 3040 mm (limited by maximum single piece bearing rail).
2. Refer to R10 motor data sheet for complete motor specifications.
3. Motor force must be derated by 50% in a "stalled motor" operating condition.
4. Recommended loads based on motor size and typical performance requirements (consult factory if desired loads are greater).
5. Specifications subject to change without notice. Most current brochure available online in PDF format.
6. Refer to website for Ironcore Motor Safe Handling and Cautionary guidelines.

# TR16
## open design

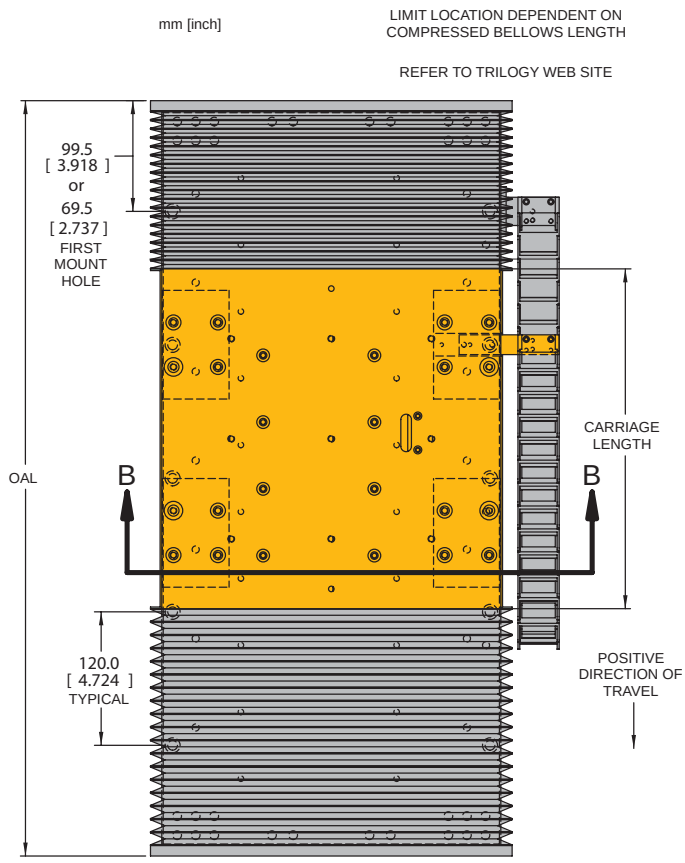


# BR16
## bellows design

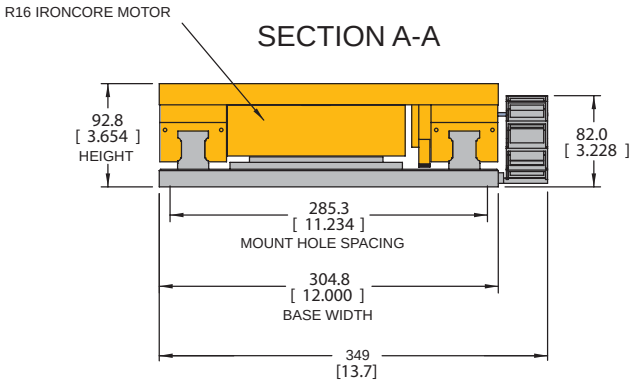


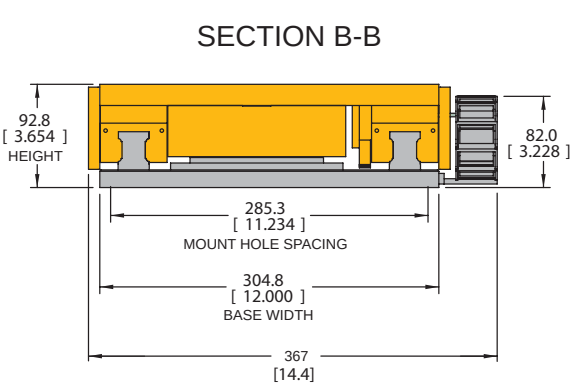



TRAVEL (mm) = OAL - 80.0 - CARRIAGE LENGTH
OVERALL LENGTH (OAL) = MULTIPLE OF 60 mm UP TO 4080 mm




REFER TO TRILOGY WEB SITE FOR TRAVEL
BASE LENGTH = MULTIPLE OF 60 mm UP TO 4080 mm
OAL = BASE LENGTH + 19.1 mm

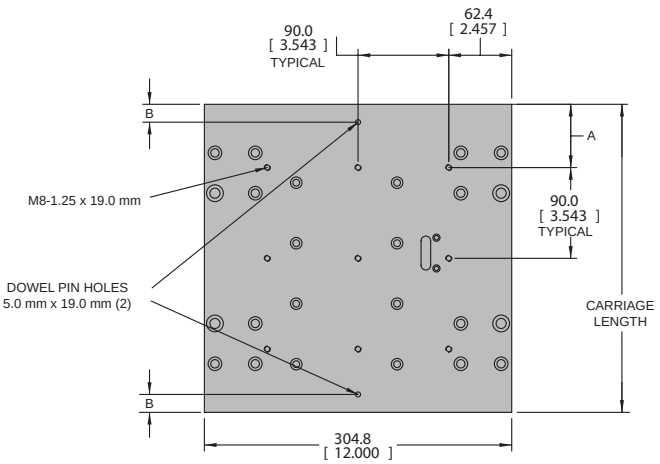


| OVERALL WIDTH (OAW) | | | |
|---|---|---|---|
| IGUS CABLE TRACK | PART NO. DESIGNATOR | TR16 mm [in] | BR16 mm [in] |
| 07-20-18 | Custom | 339 [13.3] | 357 [14.1] |
| 07-30-18 | 3 | 349 [13.7] | 367 [14.4] |
| 07-40-18 | Custom | 359 [14.1] | 377 [14.8] |
| 07-50-18 | Custom | 369 [14.5] | 387 [15.2] |
| 07-64-18 | Custom | 383 [15.1] | 401 [15.8] |

| CARRIAGE LENGTH | | | |
|---|---|---|---|
| COIL SIZE | -1 | -2 | -3 |
| TR16/BR16 CARRIAGE | 305.5 [12.027] | 545.5 [21.475] | 785.5 [30.924] |
| A (1st MOUNT HOLE) | 62.7 [2.470] | 47.7 [1.879] | 77.7 [3.060] |
| NUMBER OF MOUNTING HOLES | 9 | 18 | 24 |
| B (DOWEL PIN HOLE) | 17.7 [0.698] | 92.7 [3.651] | 212.7 [8.375] |

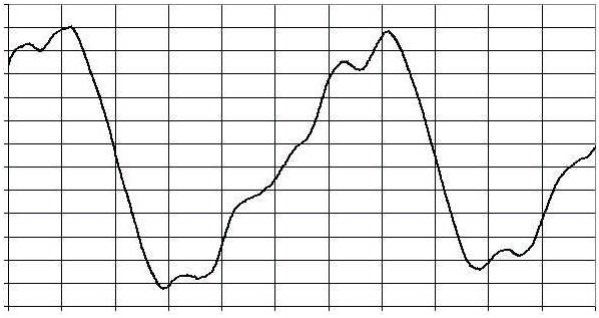
**TR16/BR16 CARRIAGE**



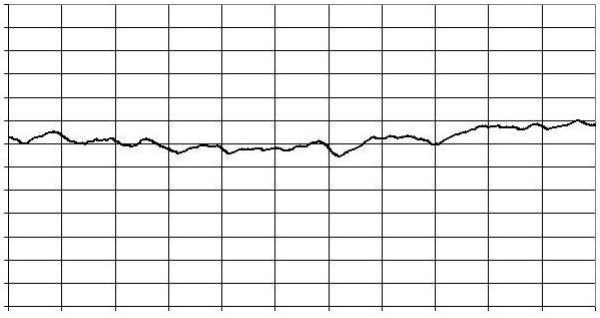

## Smooth operation with Anti-Cogging features –

Parker Trilogy's RIPPED Series Ironcore Positioners utilize Parker's patent pending Anti-Cogging techniques for superior smoothness. Traditional ironcore motors exhibit cogging forces when the internal iron laminations exhibit a horizontal force on the motor when trying to line up with their "preferred" positions over the magnets. Cogging limits the overall smoothness of the motion system.

Parker Trilogy has developed an Anti-Cogging technological breakthrough that virtually eliminates cogging and allows ironcore motors to be used in applications where only ironless motors were used before. This offers the user a powerful combination of extremely high force and smooth operation in an economical package.



*Typical Ironcore Positioner Cogging Forces*



*Cogging forces with Parker Trilogy's patent-pending Anti-Cog Technology*

## PERFORMANCE

| ENCODER | | LINEAR MAGNETIC ENCODER | | RENISHAW OPTICAL ENCODER | | |
|---|---|---|---|---|---|---|
| | | 1.0 µm | 5.0 µm | 0.5 µm | 1.0 µm | 5.0 µm |
| Part Number Designator | | A | B | M | L | Q |
| Encoder Model | | LME1 | LME5 | RGH24Z | RGH24X | RGH24D |
| Peak Velocity | m/s [in/s] | 2.5 [100] | 7 [275] | 3 [120] | 5 [200] | 5 [200] |
| Resolution | µm [in] | 1.0 [0.00004] | 5.0 [0.0002] | 0.5 [0.00002] | 1.0 [0.00004] | 5.0 [0.0002] |
| Repeatability | µm [in] | ±2.0 [±0.00008 | ±10.0 [±0.0004] | ±1.5 [±0.00006] | ±2.0 [±0.00008] | ±10.0 [±0.0004] |
| Accuracy - LME | | ±(25 µm + 50 µm/m) | ±(30 µm + 50 µm/m) | | | |
| Accuracy - Renishaw | | | | ±(5 µm + 30 µm/m) | | ±(10 µm + 30 µm/m) |

*Note: For travels less than 1 meter, Accuracy should be calculated at 1 meter*

| MOTOR MODEL | | R16-1 | R16-2 | R16-3 |
|---|---|---|---|---|
| Peak Force | N | 2478 | 4955 | 7433 |
| | lb | 557 | 1114 | 1671 |
| Continuous Force | N | 743 | 1487 | 2230 |
| | lb | 167 | 334 | 501 |
| Peak Power | W | 7065 | 14130 | 21195 |
| Continuous Power | W | 353 | 707 | 1060 |

## ACCURACY

| Base Length | < 1 meter | > 1 meter |
|---|---|---|
| Straightness restrained on a flat surface µm [in] | ±127µm/m [±0.000127 in/in] | ±127µm/m [±0.000127 in/in] |
| Flatness restrained on a flat surface µm [in] | ±330 [±0.013] | ±76 + 254µm/m [±0.003 + .000254 in/in] |

*Note: Straightness/Flatness specifications based on system mounted to surface of flatness ±0.0005 in/ft*

## PHYSICAL

| COIL SIZE | | -1 | -2 | -3 |
|---|---|---|---|---|
| Carriage Assembly | | | | |
| TR16 | kg [lb] | 14.1 [31.0] | 24.7 [54.4] | 35.3 [77.7] |
| BR16 | kg [lb] | 14.3 [31.5] | 25.0 [55.1] | 35.8 [78.8] |
| Base Assembly (0.625" thick aluminum) | | | | |
| TR16E | kg/mm [lb/in] | 0.0318 [1.778] | ----------> | ----------> |
| BR16E | kg/mm [lb/in] | 0.0327 [1.825] | ----------> | ----------> |

## LOAD (Recommended)

| COIL SIZE | | -1 | -2 | -3 |
|---|---|---|---|---|
| Vertical (Fv) see note 4 | kg [lb] | 250 [550] | 350 [770] | 450 [990] |
| Side (Fs) see note 4 | kg [lb] | 125 [275] | 175 [385] | 225 [495] |
| Moments-Roll (Mr) see note 4 | N-m [lb-ft] | 125 [92] | 175 [129] | 225 [166] |
| Moments-Pitch (Mp) see note 4 | N-m [lb-ft] | 250 [184] | 500 [369] | 750 [553] |
| Moments-Yaw (My) see note 4 | N-m [lb-ft] | 250 [184] | 500 [369] | 750 [553] |

### NOTES

1. Maximum base length is 3040 mm (limited by maximum single piece bearing rail).
2. Refer to R16 motor data sheet for complete motor specifications.
3. Motor force must be derated by 50% in a "stalled motor" operating condition.
4. Recommended loads based on motor size and typical performance requirements (consult factory if desired loads are greater).
5. Specifications subject to change without notice. Most current brochure available online in PDF format.
6. Refer to website for Ironcore Motor Safe Handling and Cautionary guidelines.

# How to order - TR07

Order Example:

| TR | 07 | A | 0480 | 3 | N | S | B | A | B | 3 |
|---|---|---|---|---|---|---|---|---|---|---|

**Series**
**TR** = Open Positioner
**BR** = Bellows Positioner

**Motor Coil Series**
**07** = R07 Motor Coil

**Base Material**
**A =** 3/8" Al

**Length of Base**
**XXXX** = Length of base In millimeters
Max.: 3040mm
Min.: 400mm
Increment: 80mm

*Base Length = Travel + 76.2 + Carriage length
carriage length 1 pole = 218.2 mm
2 pole = 378.2 mm
3 pole = 536.2 mm
Tr only, consult factory for BR length

**Coil Size**
**1** = 1 pole
**2** = 2 pole
**3** = 3 pole

**Cooling**
**N =** None

**Winding**
**S** Series
**P** Parallel (2-pole coil only)
**T** Triple (3-pole coil only)

**Encoder**
**A =** LME 1 um
**B =** LME 5 um
**Q =** Renishaw 5 um
**L =** Renishaw 1 u=m
**M =** Renishaw 0.5 um
**P =** Renishaw 0.1 um
**R =** Renishaw IV p-p sine/cosine
**X** = None

Cable length
**A** = 1 Meter Flying Leads
**B** = 3 Meter Flying Leads
**C** = 7.5 Meter Flying Leads
**L** = 3 Extension Cables (with Connector Box)
**M** = 7.5 Extension Cables (with Connector Box)
**Z** = Connector Box ONLY (no extension cables)

**Flying leads – cable measured from last cable carrier link
*Extension Cables – cable measured from connection box at end of base
*7.5 Meter Flying Lead Cables available on:
All bases with LME encoder
All bases with Renishaw encoder under 2184mm
For bases with Renishaw encoder over 2184mm the cable length (CL) will be
CL = 10M - (base length in meters + 0.3M)

**Cable Connectorization**
A = Aries
B = Flying Leads
C = Compax3
G = Gemini
V = ViX
Z = no Cable
*Connectorized cables only available with Connector Box

**Cable track**
0 = None
3 = Std.

Order Example:

| TR | 10 | B | 0480 | 3 | N | S | B | A | B | 3 |
|---|---|---|---|---|---|---|---|---|---|---|

**Series**
**TR** = Open Positioner
**BR** = Bellows Positioner

**Motor Coil Series**
**10** = R10 Motor Coil

**Base Material**
**B =** 1/2" Al

**Length of Base**
**XXXX** = Length of base In millimeters
Max.: 3040mm
Min.: 480mm
Increment: 60mm

*Base Length = Travel + 66 + Carriage length
carriage length 1 pole = 305.5 mm
2 pole = 545.5 mm
3 pole = 785.5 mm
Tr only, consult factory for BR length

**Coil Size**
**1** = 1 pole
**2** = 2 pole
**3** = 3 pole

**Cooling**
**N =** None

**Winding**
**S** Series
**P** Parallel (2-pole coil only)
**T** Triple (3-pole only)

**Encoder**
**A =** LME 1 um
**B =** LME 5 um
**Q =** Renishaw 5 um
**L =** Renishaw 1 um
**M =** Renishaw 0.5 um
**P =** Renishaw 0.1 um
**R =** Renishaw 1 IV p-p sine/cosine
**X** = None

**Cable length**
**A** = 1 Meter Flying Leads
**B** = 3 Meter Flying Leads
**C** = 7.5 Meter Flying Leads
**L** = 3 Extension Cables (with Connector Box)
**M** = 7.5 Extension Cables (with Connector Box)
**Z** = Connector Box ONLY (no extension cables)

**Flying leads – cable measured from last cable carrier link
*Extension Cables – cable measured from connection box at end of base
*7.5 Meter Flying Lead Cables available on:
All bases with LME encoder
All bases with Renishaw encoder under 2184mm
For bases with Renishaw encoder over 2184mm the cable length (CL) will be
CL = 10M - (base length in meters + 0.3M)

**Cable Connectorization**
A = Aries
B = Flying Leads
C = Compax3
G = Gemini
V = ViX
Z = no Cable
*Connectorized cables only available with Connector Box

**Cable track**
0 = None
3 = Std.

# How to order - TR16

Order Example:

| TR | 16 | A | 0480 | 3 | N | S | B | A | B | 3 |
|---|---|---|---|---|---|---|---|---|---|---|

**Series**
**TR** = Open Positioner
**BR** = Bellows Positioner

**Motor Coil Series**
**16** = R16 Motor Coil

**Base Material**
**A =** 5/8" Al

**Length of Base**
**XXXX** = Length of base In millimeters
Max.: 3040mm
Min.: 480mm
Increment: 60mm

*Base Length = Travel + 80 + Carriage length
carriage length 1 pole = 305.5 mm
2 pole = 545.5 mm
3 pole = 785.5 mm
Tr only, consult factory for BR length

**Coil Size**
**1** = 1 pole
**2** = 2 pole
**3** = 3 pole

**Cooling**
**N =** None

**Winding**
**S** Series
**P** Parallel (2-pole coil only)
**T** Triple (3-pole coil only)

**Encoder**
**A =** LME 1 um
**B =** LME 5 um
**Q =** Renishaw 5 um
**L =** Renishaw 1 um
**M =** Renishaw 0.5 um
**P =** Renishaw 0.1 um
**R =** Renishaw IV p-p sine/cosine
**X** = None

**Cable track**
0 = None
3 = Std.

**Cable Connectorization**
A = Aries
B = Flying Leads
C = Compax3
G = Gemini
V = ViX
Z = no Cable
*Connectorized cables only available with Connector Box

Cable length
**A** = 1 Meter Flying Leads
**B** = 3 Meter Flying Leads
**C** = 7.5 Meter Flying Leads
**L** = 3 Extension Cables (with Connector Box)
**M** = 7.5 Extension Cables (with Connector Box)
**Z** = Connector Box ONLY (no extension cables)

**Flying leads – cable measured from last cable carrier link
*Extension Cables – cable measured from connection box at end of base
*7.5 Meter Flying Lead Cables available on:
All bases with LME encoder
All bases with Renishaw encoder under 2184mm
For bases with Renishaw encoder over 2184mm the cable length (CL) will be
CL = 10M - (base length in meters + 0.3M)

# Precision Grade Linear Motors

## Features

- Velocity to 4.5 m/sec
- Acceleration to 5 Gs
- Encoder resolution to 0.1 micron
- Cleanroom compatible
- Easy multi-axis mounting
- Cable management system
- Proven strip seal

### Performance Matched Components

The 400LXR Series linear servo motor tables achieve optimum performance by combining slotless or ironcore motor technology with performance matched mechanical elements and feedback devices. Fast response, high acceleration, smooth translation, high velocity, and quick settling time describe the performance characteristics found in the 400LXR while high repeatability, precise accuracy, and sub-micron resolution define the positioning attributes.

### Sized to fit

The 400LXR Tables are offered in three widths (100, 150, and 300 mm), and travel lengths up to 3 meters to accommodate the size and performance requirements of many industries including life sciences, photonics, semiconductor and general automation.

### "Designer Friendly" Features and Options

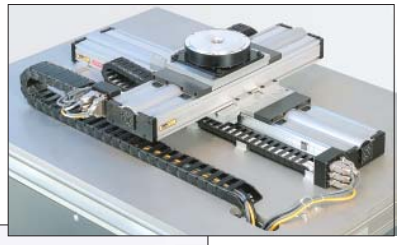
A vast assortment of "designer friendly" features and options simplify the engineering challenges often confronted with "base model" positioning devices. Features like the IP30 protective strip seal and long life cable man-agement system, exemplify the built-in value found in the 400LXR units. Other selectable enhancements like cleanroom compatibility, travel limit sensors, motor drives, encoder resolution, and pinning holes for tooling location, simplify machine design and integration efforts.

### Flexibility and Multi-Axis Compatibility

The 400LXR's selection flexibility and mounting compatibility with the 400XR ballscrew driven tables enables single axis or complex multi-axis units to be configured in a straightforward manner. Parker's matching servo drives and motion controllers can be included to complete the motion system.

### Customs and Systems

For specialized applications requiring customization, Parker design engineers can easily modify these tables to suit, or engineer complete interactive linear motion systems to desired specifications. Parker's 400LXR series tables have taken the mystery, difficulty and cost out of integrating linear motor tables into high throughput precision positioning applications.



## Specifications

| Model<br>Motor | 404LXR<br>8 Pole | 406LXR<br>8 Pole | 406LXR<br>12 Pole | 412LXR<br>12 Pole | 412LXR<br>24 Pole<br>(no cooling) |
|---|---|---|---|---|---|
| Rated Load kg (lb) | 45(99) | 180(396) | 180(396) | 950(2090) | 1148(2526) |
| Maximum Acceleration | | | 5 Gs | | |
| Maximum Velocity (m/sec.) | | | | | |
| Encoder Resolution: 0.1 µm | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 [0.3]* |
| 0.5 µm | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 [1.5]* |
| 1.0 µm | 3.0 | 3.0 | 3.0 | 3.0 | 2.0 [3.0]* |
| 5.0 µm | 3.0 | 3.0 | 3.0 | 3.0 | 2.0 [4.5]* |
| Sine Output | 3.0 | 3.0 | 3.0 | 3.0 | 2.0 [4.5]* |
| Positional Repeatability | | | | | |
| Encoder Resolution: 0.1 µm | | | ± 1.0 µm | | |
| 0.5 µm | | | | ± 1.0 µm | |
| 1.0 µm | | | | ± 2.0 µm | |
| 5.0 µm | | | | ±10.0 µm | |
| Sine Output | | | (interpolation dependent) | | |
| Peak Force<br>N (lb) | 180<br>(40) | 225<br>(50) | 330<br>(75) | 1000<br>(225) | 2650<br>(595) |
| Continuous Force<br>N (lb) | 50<br>(11) | 75<br>(17) | 110<br>(25) | 355<br>(80) | 750<br>(169) |
| Carriage Mass (kg) | 1.4 | 3.2 | 4.1 | 12.3 | 23 |

2D & 3D CAD files — Download from parkermotion.com

** Bracketed velocity values [ ] apply to 675VDC bus (480 VAC drive input).*

## Travel Dependent Specifications

| Travel (mm) | Accuracy* (µm) | | | Unit Weight (Kg) | | | | |
|---|---|---|---|---|---|---|---|---|
| | Positional | | Straightness & Flatness Accuracy* (µm) | | | | | |
| | 0.1,0.5,1.0 resolution (µm) | 5.0 resolution (µm) | | 404LXR 8 Pole | 406LXR 8 Pole | 406LXR 12 Pole | 412LXR 12 Pole | 412LXR 24 Pole |
| 50 | 6 | 16 | 6 | 4.4 | 8.7 | 11.1 | - | - |
| 100 | 7 | 17 | 6 | 4.8 | - | - | - | - |
| 150 | 8 | 18 | 9 | 5.2 | 10.3 | 13.4 | 41 | - |
| 200 | 10 | 20 | 10 | 5.6 | - | - | - | 49 |
| 250 | 12 | 22 | 12 | 6.0 | 12.6 | 14.1 | 45 | - |
| 300 | 14 | 24 | 13 | 6.4 | - | - | - | - |
| 350 | 16 | 26 | 15 | 6.8 | 13.3 | 15.7 | 49 | - |
| 400 | 18 | 28 | 16 | 7.2 | - | - | - | - |
| 450 | 20 | 30 | 18 | - | 14.8 | 17.2 | - | - |
| 500 | 21 | 31 | 19 | 8.0 | - | - | - | 61 |
| 550 | 23 | 33 | 21 | - | 16.4 | 18.7 | - | - |
| 600 | 25 | 35 | 22 | 8.9 | - | - | - | - |
| 650 | 26 | 36 | 24 | - | 17.9 | 20.2 | 61 | 67 |
| 700 | 28 | 38 | 25 | 9.7 | | - | - | - |
| 750 | 29 | 39 | 27 | - | 19.4 | 21.8 | - | - |
| 800 | 31 | 41 | 29 | 10.6 | - | - | 67 | - |
| 850 | 32 | 43 | 30 | - | 20.9 | 23.3 | - | 75 |
| 900 | 33 | 44 | 32 | 11.5 | - | - | - | - |
| 950 | 34 | 44 | 33 | - | 22.5 | - | - | - |
| 1000 | 35 | 45 | 35 | 12.4 | - | 27.1 | 75 | - |
| 1050 | 37 | 47 | 36 | - | - | - | - | 83 |
| 1200 | 39 | 49 | 41 | - | 26.3 | - | 83 | - |
| 1350 | 42 | 52 | 45 | - | - | 30.9 | - | 95 |
| 1450 | 43 | 53 | 48 | - | 30.1 | - | - | - |
| 1500 | 44 | 54 | 50 | - | - | - | 95 | - |
| 1600 | 45 | 55 | 53 | - | - | 34.7 | - | 105 |
| 1700 | 46 | 56 | 56 | - | 33.9 | - | - | - |
| 1750 | 46 | 56 | 57 | - | - | - | 105 | - |
| 1850 | 47 | 57 | 60 | - | - | 38.6 | - | 113 |
| 1950 | 48 | 58 | 63 | - | 37.7 | - | - | - |
| 2000 | 48 | 58 | 65 | - | - | - | 113 | - |
| 2350 | 49 | 59 | 76 | - | - | - | - | 133 |
| 2500 | 50 | 60 | 80 | - | - | - | 133 | - |
| 2850 | 50 | 60 | 84 | - | - | - | - | 153 |
| 3000 | 50 | 60 | 84 | - | - | - | 153 | - |

** Accuracy stated is at 20 degrees C, utilizing slope correction factor provided*

## Encoder Specifications

| Description | Specification |
|---|---|
| Input Power | 5 VDC +/- 5% 150 mA |
| Output (Incremental) | Square wave differential line driver (EIA RS422) 2 channels A and B in quadrature (90) phase shift. |
| Reference (Z channel) | Synchronized pulse, duration equal to one resolution bit. Repeatability of position is unidirectional moving toward positive direction. |

## Limit and Home Sensor Specifications

| Description | Specification |
|---|---|
| Input Power | +5 to +24 VDC 60 mA (20 mA per sensor) |
| Output | Output form is selectable with product:<br>Normally Closed Current Sinking<br>Normally Open Current Sinking<br>Normally Closed Current Sourcing<br>Normally Open Current Sourcing<br>All types Sink or Source maximum of 50 mA |
| Repeatability | Limits: +/- 10 microns (unidirectional)<br>Home: See Z channel specifications |

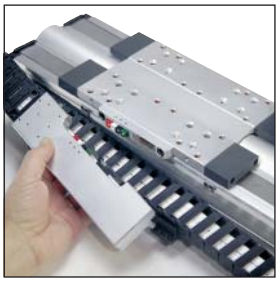
## Hall Effect Specifications

| Description | Specification |
|---|---|
| Input Power | +5 to +24 VDC, 30 mA |
| Output | Open Collector,Current Sinking,20 mA Max |

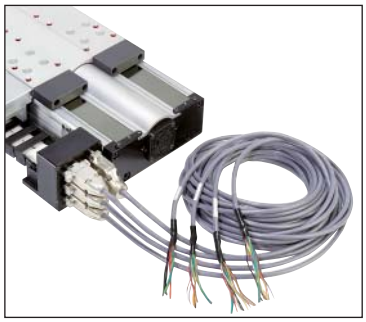
## Cable Transport Module

The LXR's Cable Transport Module offers the conven-ience of "plug and play" connectivity for fast, easy table installation and "quick change" replacement. This system of cable management includes the highest quality high-flex ribbon cable with a life rating of 30 million cycles, a cable track with support brackets, a "quick change" carriage cartridge, and a plug-in connector panel housing. It also provides a "pass-through" connection and cabling for customer application. This transport module option is ideal for high throughput continuous dutyrequirementswhere downtime is not acceptable.

The high-flex ribbon cable permits a cable track bend radius that is small enough to clear payloads of large dimension. The cable transport can be ordered with a variety of extension cable options. These cables provide extensions from the connector panel on the cable transport module, to the motor drive amplifier and controller. The cables are high-flex, long life cables so they can be utilized on a second or third axis unit.

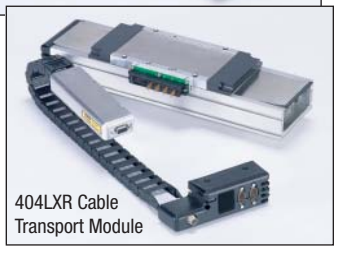


"Quick Change" Cartridge



Cable Extensions –
Flying Leads Terminations

2-Axis System
w/ Expandable
Cable Management



404LXR Cable
Transport Module

### Cable Transport Module – Order Code

| Order Code | Extension Cable Length | Extension Cable Termination |
|---|---|---|
| CM02 | No Extension Cables | |
| CM07 | 3.0 meters | flying leads |
| CM08 | 7.5 meters | flying leads |
| CM09 | 3.0 meters | Gemini Conn. |
| CM10 | 7.5 meters | Gemini Conn. |
| CM13 | 3.0 meters | Aries/Vix Conn. |
| CM14 | 7.5 meters | Aries/Vix Conn. |
| CM22* | 3.0 meters | Compax Conn. |
| CM23* | 7.5 meters | Compax Conn. |

* 24 Pole motor models only

Connection Ends

**404LXR**

**406LXR/412LXR**

## OEM Cable System

The LXR's unharnessed cable system is offered for OEMs and others who have independent methods of routing and managing cables. These systems offer the "quick change" cartridge, "pass-through" connection and round high-flex cables in lengths of 3.0 or 7.5 meters. They are available with flying lead end terminations, Gemini, Aries, or Compax3 Connectors.

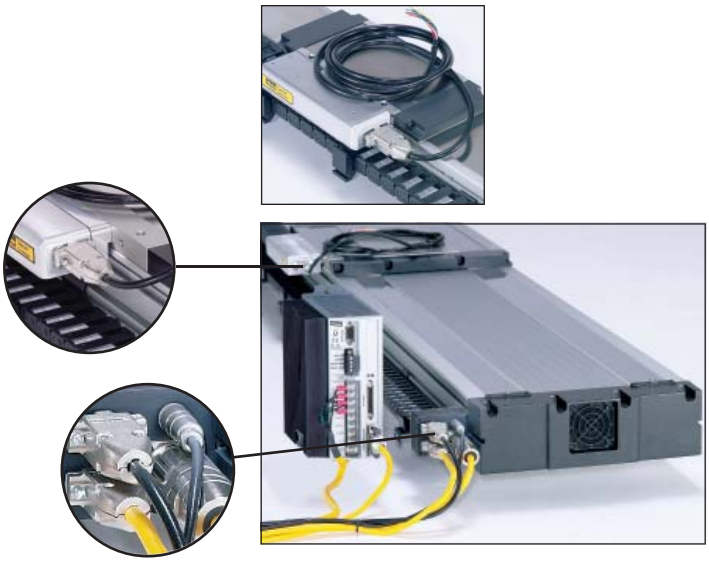
**OEM Cable System – Order Code**

| Order Code | Extension Cable Length | Extension Cable Termination |
|---|---|---|
| CM03 | 3.0 meters | flying leads |
| CM04 | 7.5 meters | flying leads |
| CM05 | 3.0 meters | Gemini Conn. |
| CM06 | 7.5 meters | Gemini Conn. |
| CM11 | 3.0 meters | Aries/Vix Conn. |
| CM12 | 7.5 meters | Aries/Vix Conn. |
| CM20* | 3.0 meters | Compax Conn. |
| CM21* | 7.5 meters | Compax Conn. |

* 24 Pole motor models only

406LXR with OEM cables and flying leads

## User "Pass-Through" Cabling Feature



- Pre-wired plug-in connection to the moving payload
- Nine user conductors for end-effectors or instruments
- High-Flex long life cables:
  Ribbon Cable – Transport Module System
  Round Cable – OEM System

Cable concerns regarding routing and durability for payload or instrument signals are addressed by the pass-through connectivity feature included with both of the LXR cable management systems. Nine pin D-connectors provided on the carriage (with the transport module units) and the cable connecting block combine with high-flex, long life cables for easy setup and dependable performance.

***Note:*** *Extension Cables are available and can be ordered seperately: 006-1743-01 (3 meters); 006-1743-02 (7.5 meters).*

## 400LXR Cleanroom Preparation R2

404LXR with cleanroom class 10 modification

Cleanroom compatible linear tables are often required for laboratory and production applications in industries such as semiconductor, life science, electronics, and pharmaceuticals.

400LXR tables with cleanroom preparation, were tested in Parker's vertical laminar flow work station, which utilizes ULPA filters to produce an environment having a cleanliness of class 1 prior to testing. Tables were tested in a variety of orientations with sampling both below the table and at the carriage mounting surface. Laminar flow rate is 0.65 inches W.C.

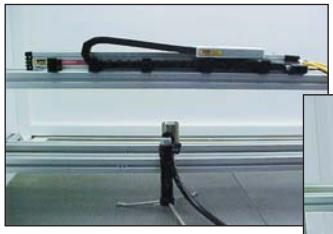
Special cleanroom testing can be provided upon request. For more information on cleanroom testing, contact a Parker Applications Engineer at 800-245-6903.

### Standard Cleanroom Preparation

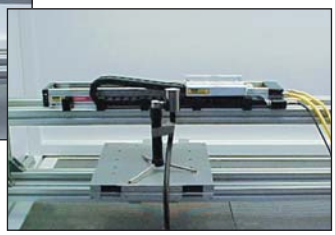
- Stringent cleaning and handling measures
- Cleanroom rated lubrication
- Strip seal replaced with hard shell cover

### 400LXR Cleanroom Compatibility

| Table Velocity | Class | | |
|---|---|---|---|
| | 4.5" below table | At carriage surface | |
| 250 | mm/sec | 10 | 1 |
| 500 | mm/sec | 25 | 1 |
| 1000 | mm/sec | 50 | 5 |
| 2000 | mm/sec | 250 | 25 |
| 3000 | mm/sec | 500 | 100 |



Testing at 4.5 inches below table



Testing at carriage mounting surface

### About Cleanrooms

A room in which the concentration of airborne particles is controlled within defined limits. Federal Standard 209E statistically defines the allowable number of particles per cubic foot of air.

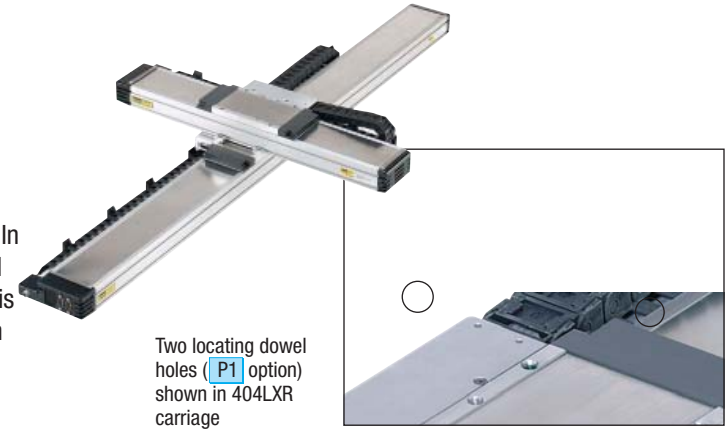
The chart (right) describes the conditions that must be maintained for the cleanroom to have a specific "class" rating.

| Class | Number of Allowable Particles (Measured particle size in microns [µm]) | | | | |
|---|---|---|---|---|---|
| | 0.1 | 0.2 | 0.3 | 0.5 | 5 |
| 1 | 35 | 7.5 | 3 | 1 | 0 |
| 10 | 350 | 75 | 30 | 10 | 0 |
| 100 | n/a | 750 | 300 | 100 | 0 |
| 1000 | n/a | n/a | n/a | 1000 | 7 |
| 10000 | n/a | n/a | n/a | 10000 | 70 |
| 100000 | n/a | n/a | n/a | 100000 | 700 |

## Dowel Pinning P_

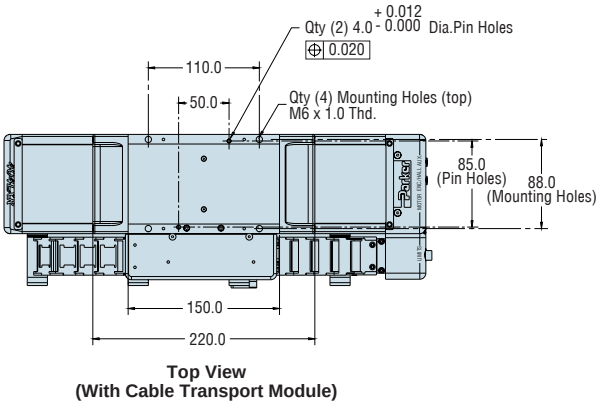
Standard dowel pin locating holes P1 are offered on all 400LXR units to facilitate repeatable mounting of tooling or payload.

In addition, pinning options P2 & P3 are offered for precise orthogonal mounting of the second axis in a multi-axis system. In this case, the bottom side of the table base is match drilled and reamed to the first axis to provide exact orthogonal location. This convenient option eliminates concerns regarding contamination or damage often associated with machining for locating pins in an assembled unit.

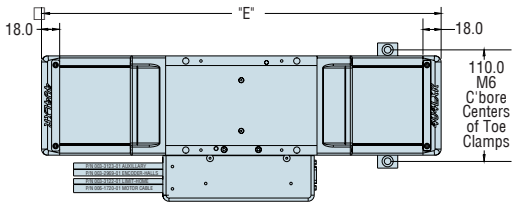


Two locating dowel holes ( P1 option) shown in 404LXR carriage

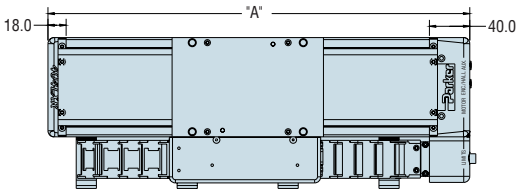
# 404LXR Series Dimensions (mm)



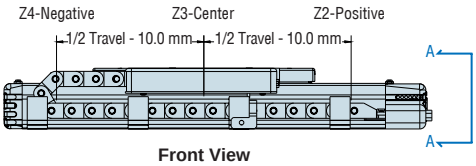

**Top View**
**(With Cable Transport Module)**



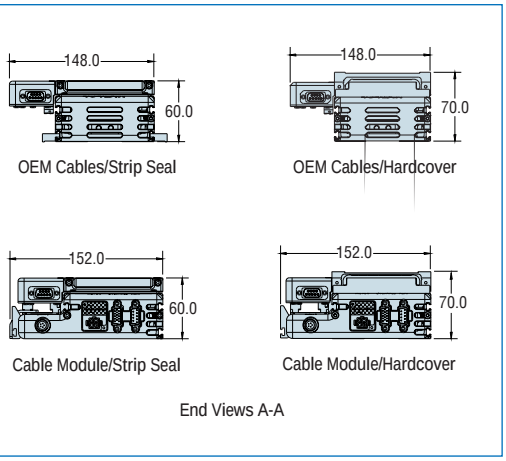

OEM Cables (Strip Seal/Hardcover)




Cable Module (Strip Seal/Hardcover)

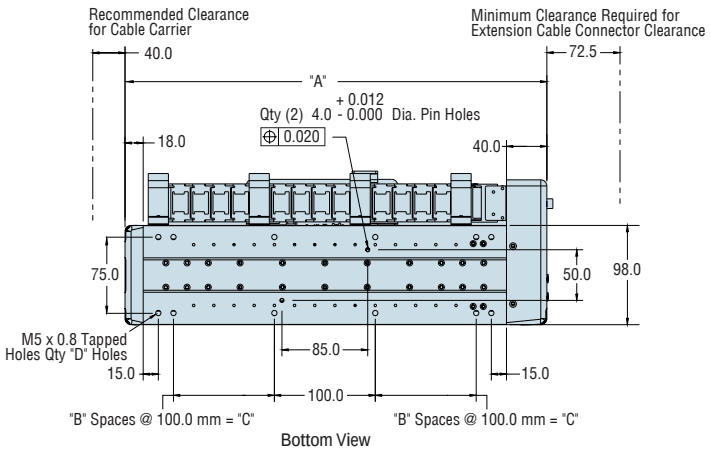



**Front View**
**Z-Channel Location**




OEM Cables/Strip Seal
OEM Cables/Hardcover
Cable Module/Strip Seal
Cable Module/Hardcover

End Views A-A




Bottom View

2D & 3D CAD files
Download from parkermotion.com

| Model | Travel (mm) | Dim A | B | C | D | E |
|---|---|---|---|---|---|---|
| 404T00LXR | 50 | 368.0 | 1 | 100.0 | 12 | 346.0 |
| 404T01LXR | 100 | 418.0 | 1 | 100.0 | 12 | 396.0 |
| 404T02LXR | 150 | 468.0 | 1 | 100.0 | 12 | 446.0 |
| 404T03LXR | 200 | 518.0 | 1 | 100.0 | 12 | 496.0 |
| 404T04LXR | 250 | 568.0 | 1 | 100.0 | 12 | 546.0 |
| 404T05LXR | 300 | 618.0 | 2 | 200.0 | 16 | 596.0 |
| 404T06LXR | 350 | 668.0 | 2 | 200.0 | 16 | 646.0 |
| 404T07LXR | 400 | 718.0 | 2 | 200.0 | 16 | 696.0 |
| 404T09LXR | 500 | 818.0 | 3 | 300.0 | 20 | 796.0 |
| 404T11LXR | 600 | 918.0 | 3 | 300.0 | 20 | 896.0 |
| 404T13LXR | 700 | 1018.0 | 4 | 400.0 | 24 | 996.0 |
| 404T15LXR | 800 | 1118.0 | 4 | 400.0 | 24 | 1096.0 |
| 404T17LXR | 900 | 1218.0 | 5 | 500.0 | 28 | 1196.0 |
| 404T19LXR | 1000 | 1318.0 | 5 | 500.0 | 28 | 1296.0 |

# How to Order - 404LXR

## Order Example

404 | T04 | LXR | M | P | D13 | H3 | L2 | CM09 | Z2 | E2 | R1 | A4 | P1

**Series** ..... 404

**Travel (mm)** 8 PoleMotor

| | |
|---|---|
| 50 | T00 |
| 100 | T01 |
| 150 | T02 |
| 200 | T03 |
| 250 | T04 |
| 300 | T05 |
| 350 | T06 |
| 400 | T07 |
| 500 | T09 |
| 600 | T11 |
| 700 | T13 |
| 800 | T15 |
| 900 | T17 |
| 1000 | T19 |

**Model** ..... LXR

**Mounting (metric)**..... M

**Grade**

Precision ..... P

**Drive Type**

Free Travel (No Motor)..... D3

8 Pole Motor ..... D13

**Home Sensor**

| | |
|---|---|
| None-Free Travel (only) | H1 |
| N.C. Current Sinking | H2 |
| N.O. Current Sinking | H3 |
| N.C. Current Sourcing | H4 |
| N.O. Current Sourcing | H5 |

**Limit Sensor**

| | |
|---|---|
| None-Free Travel (only) | L1 |
| N.C. Current Sinking | L2 |
| N.O. Current Sinking | L3 |
| N.C. Current Sourcing | L4 |
| N.O. Current Sourcing | L5 |

**Pinning Option**

| | |
|---|---|
| P1 | No multi-axis pinning |
| P2 | X axis transfer pinning to Y axis - 30 arc seconds |
| P3 | X axis transfer pinning to Y axis - 30 arc seconds |

**Digital Drive**

| | |
|---|---|
| A1 | No Drive .. |
| A4 | Gemini Drive GV-U6E |
| A5 | Gemini Controller/Drive GV6-U6E |
| A6 | Gemini Controller/Drive GV6K-U6E |
| A62 | Aries Drive AR-04AE |

**Environmental**

| | |
|---|---|
| R1 | Strip Seal.... |
| R2 | Hard Cover w/ Class 10 Cleanroom Prep |
| R3 | Hard Cover without Cleanroom Prep |

**Encoder Option**

| | |
|---|---|
| E1 | None |
| E2 | 1.0 µm Resolution |
| E3 | 0.5 µm Resolution |
| E4 | 0.1 µm Resolution |
| E5 | 5.0 µm Resolution |
| E7 | Sine Output Encoder |

**Z Channel Location***

| | |
|---|---|
| Z1 | None |
| Z2 | Positive End Position |
| Z3 | Center Position |
| Z4 | Negative End Position |

*Refer to dimension drawing on page A15.

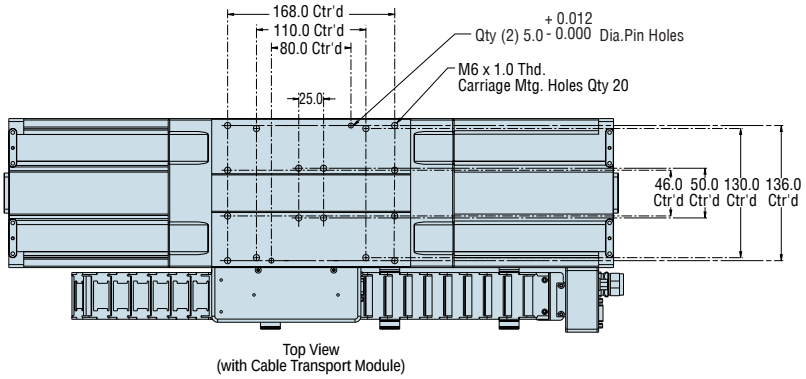
**Cable Management**

| | |
|---|---|
| CM01 | No Cables - Free Travel |
| CM02 | Cable Transport Module (only) |
| CM03 | 3.0 m OEM Cable Set-FL |
| CM04 | 7.5 m OEM Cable Set-FL |
| CM05 | 3.0 m OEM Cable Set-Gemini |
| CM06 | 7.5 m OEM Cable Set-Gemini |
| CM07 | Cable Trans Mod. w/3.0 m-FL* |
| CM08 | Cable Trans Mod. w/7.5 m-FL* |
| CM09 | Cable Trans Mod. w/3.0 m-Gemini* |
| CM10 | Cable Trans Mod. w/7.5 m-Gemini* |
| CM11 | 3.0 m OEM Cable Set-Aries/Vix |
| CM12 | 7.5 m OEM Cable Set-Aries/Vix |
| CM13 | Cable Trans Mod. w/3.0 m-Aries/Vix* |
| CM14 | Cable Trans Mod. w/7.5 m-Aries/Vix* |

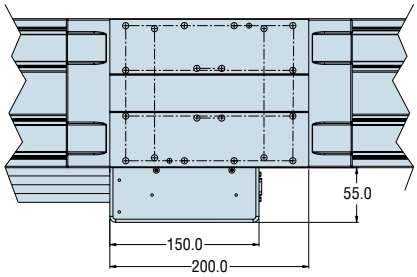
* Extension Cable for pass through connection is available and can be ordered seperately:
006-1743-01 (3 meters)
006-1743-02 (7.5 meters)

# 406LXR Series Dimensions (mm)

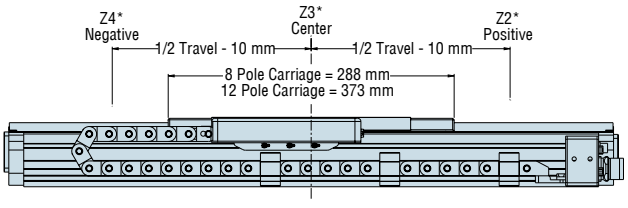
## 12 Pole Slotless Motor



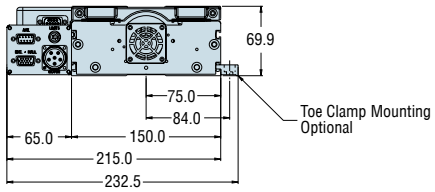

Top View
(with Cable Transport Module)



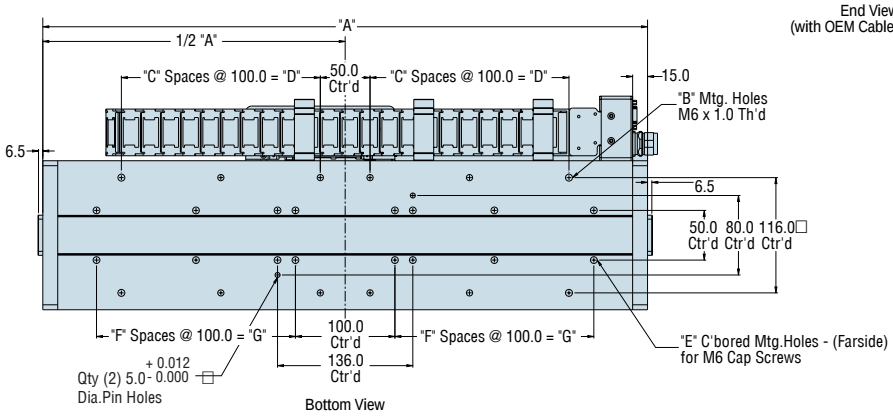

Top View
(with OEM Cable System)




Front View
(Z-Channel Location)
*Z2, Z3, Z4 shows Carriage Center-line Location for Selected Z-Channel Position




End View
(with OEM Cable System)




Bottom View

2D & 3D CAD files
Download from parkermotion.com

| Model | Travel (mm) 8 Pole | Travel (mm) 12 Pole | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|---|
| 406T01LXR | 50 | N/A | 408 | 8 | 1 | 100.0 | 12 | 1 | 100.0 |
| 406T02LXR | 150 | 50 | 508 | 8 | 1 | 100.0 | 12 | 1 | 100.0 |
| 406T03LXR | 250 | 150 | 608 | 12 | 2 | 200.0 | 16 | 2 | 200.0 |
| 406T04LXR | 350 | 250 | 708 | 12 | 2 | 200.0 | 16 | 2 | 200.0 |
| 406T05LXR | 450 | 350 | 808 | 16 | 3 | 300.0 | 20 | 3 | 300.0 |
| 406T06LXR | 550 | 450 | 908 | 16 | 3 | 300.0 | 20 | 3 | 300.0 |
| 406T07LXR | 650 | 550 | 1008 | 20 | 4 | 400.0 | 24 | 4 | 400.0 |
| 406T08LXR | 750 | 650 | 1108 | 20 | 4 | 400.0 | 24 | 4 | 400.0 |
| 406T09LXR | 850 | 750 | 1208 | 24 | 5 | 500.0 | 28 | 5 | 500.0 |
| 406T10LXR | 950 | 850 | 1308 | 24 | 5 | 500.0 | 28 | 5 | 500.0 |
| 406T11LXR | 1200 | 1100 | 1558 | 32 | 7 | 700.0 | 32 | 6 | 600.0 |
| 406T12LXR | 1450 | 1350 | 1808 | 36 | 8 | 800.0 | 40 | 8 | 800.0 |
| 406T13LXR | 1700 | 1600 | 2058 | 40 | 9 | 900.0 | 44 | 9 | 900.0 |
| 406T14LXR | 1950 | 1850 | 2308 | 44 | 10 | 1000.0 | 48 | 10 | 1000.0 |

# How to Order - 406LXR

## Order Example

406 | T09 | LXR | M | P | D13 | H2 | L2 | CM09 | Z2 | E2 | R1 | A4 | P1

**Series** ..... 406

**Travel (mm)**

| 8 Pole Motor | 12 Pole Motor | |
|---|---|---|
| 50 | n/a | T01 |
| 150 | 50 | T02 |
| 250 | 150 | T03 |
| 350 | 250 | T04 |
| 450 | 350 | T05 |
| 550 | 450 | T06 |
| 650 | 550 | T07 |
| 750 | 650 | T08 |
| 850 | 750 | T09 |
| 950 | 850 | T10 |
| 1200 | 1100 | T11 |
| 1450 | 1350 | T12 |
| 1700 | 1600 | T13 |
| 1950 | 1850 | T14 |

**Model** ..... LXR

**Mounting (metric)**..... M

**Grade**

Precision ..... P

**Drive Type**

**Free Travel (No Motor)**

8 Pole Carriage (no mtr.) ..... D3

12 Pole Carriage (no mtr.) ..... D5

**Linear Motor**

8 Pole Motor Carriage ..... D13

12 Pole Motor Carriage ..... D15

**Home Sensor**

None - Free Travel (only) ..... H1

N.C. Current Sinking ..... H2

N.O. Current Sinking ..... H3

N.C. Current Sourcing ..... H4

N.O. Current Sourcing ..... H5

**Limit Sensor**

None - Free Travel (only) ..... L1

N.C. Current Sinking ..... L2

N.O. Current Sinking ..... L3

N.C. Current Sourcing ..... L4

N.O. Current Sourcing ..... L5

**Cable Management**

- CM01 No Cables - Free Travel
- CM02 Cable Transport Module (only)
- CM03 3.0 m OEM Cable Set-FL
- CM04 7.5 m OEM Cable Set-FL
- CM05 3.0 m OEM Cable Set-Gemini
- CM06 7.5 m OEM Cable Set-Gemini
- CM07 Cable Trans Mod. w/ 3.0 m-FL*
- CM08 Cable Trans Mod. w/ 7.5 m-FL*
- CM09 Cable Trans Mod. w/ 3.0 m-Gemini*
- CM10 Cable Trans Mod. w/ 7.5 m-Gemini*
- CM11 3.0 m OEM Cable Set-Aries
- CM12 7.5 m OEM Cable Set-Aries
- CM13 Cable Trans Mod. w/ 3.0 m-Aries*
- CM14 Cable Trans Mod. w/ 7.5 m-Aries*

* Extension Cable for pass through connection is available and can be ordered seperately: #006-1743-01 (3 meters); #006-1743-02 (7.5 meters).

**Z Channel Location***

- Z1 None
- Z2 Positive End Position
- Z3 Center Position
- Z4 Negative End Position

*Refer to dimension drawing on page A17

**Environmental**

- R1 Strip Seal
- R2 Hard Cover w/ Class 10 Cleanroom Prep

**Encoder Option**

- E1 None
- E2 1.0 µm Resolution
- E3 0.5 µm Resolution
- E4 0.1 µm Resolution
- E5 5.0 µm Resolution
- E7 Sine Output Encoder

**Digital Drive**

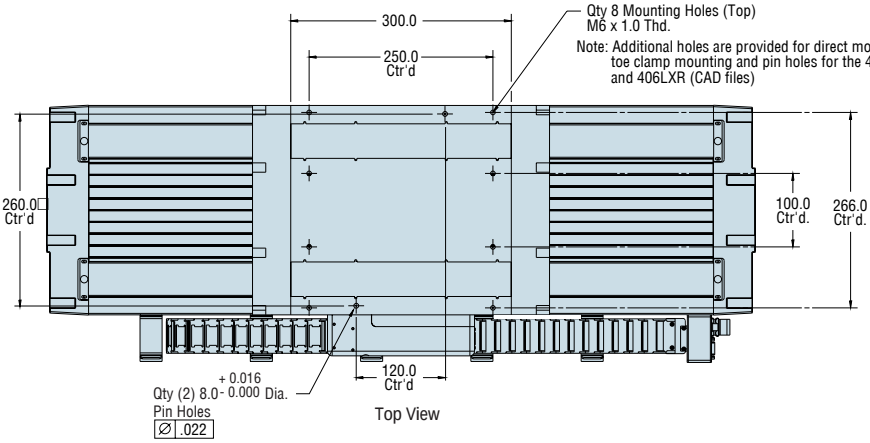
- A1 No Drive
- A4 Gemini Drive GV-U6E
- A5 Gemini Controller/Drive GV6-U6E
- A6 Gemini Controller/Drive GV6K-U6E
- A62 Aries Drive AR-04AE

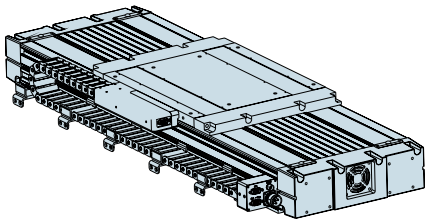
**Pinning Option**

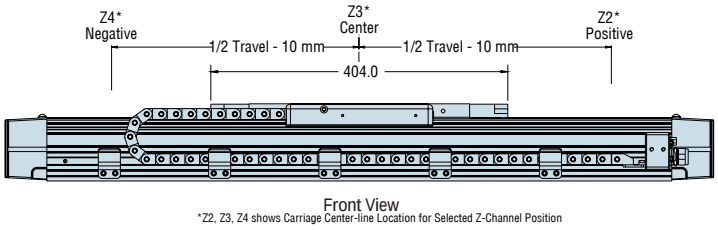
- P1 No multi-axis pinning
- P2 X axis transfer pinning to Yaxis - 30 arc seconds
- P3 Y axis transfer pinning to X axis - 30 arc seconds

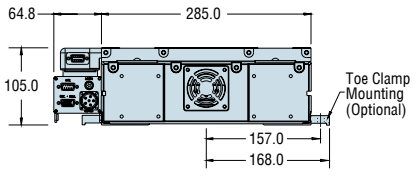
# 412LXR-D15 Series Dimensions (mm)

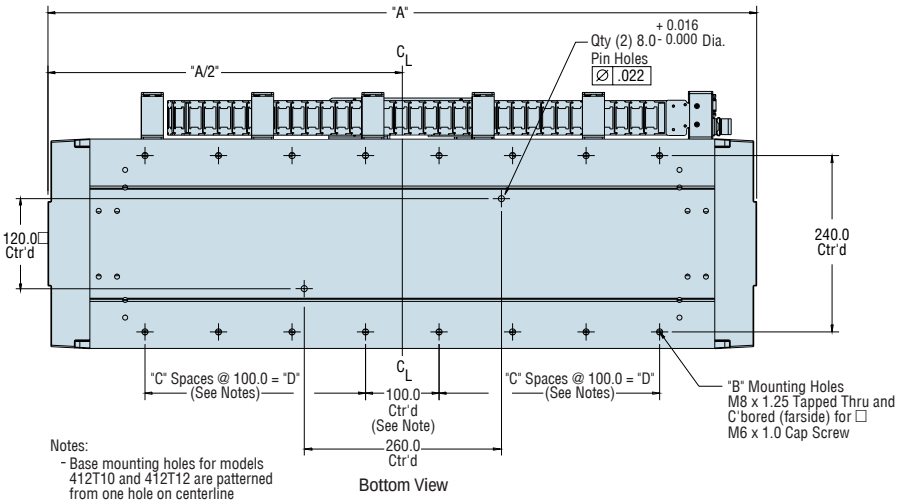
## 12 Pole Slotless Motor






Notes:
- Base mounting holes for models 412T10 and 412T12 are patterned from one hole on centerline

2D & 3D CAD files
Download from parkermotion.com

| Model | Travel (mm) | A | B | C | D |
|---|---|---|---|---|---|
| 412T01LXRD-15 | 150 | 764 | 12 | 2 | 200 |
| 412T02LXRD-15 | 250 | 864 | 16 | 3 | 300 |
| 412T03LXRD-15 | 350 | 964 | 16 | 3 | 300 |
| 412T04LXRD-15 | 650 | 1264 | 24 | 5 | 500 |
| 412T05LXRD-15 | 800 | 1414 | 24 | 5 | 500 |
| 412T06LXRD-15 | 1000 | 1614 | 28 | 6 | 600 |
| 412T07LXRD-15 | 1200 | 1814 | 32 | 7 | 700 |
| 412T08LXRD-15 | 1500 | 2114 | 40 | 9 | 900 |
| 412T09LXRD-15 | 1750 | 2364 | 44 | 10 | 1000 |
| 412T10LXRD-15 | 2000 | 2614 | 50 | 12 | 1200 |
| 412T11LXRD-15 | 2500 | 3114 | 60 | 14 | 1400 |
| 412T12LXRD-15 | 3000 | 3614 | 70 | 17 | 1700 |

# 412LXR - How to Order

## 12 Pole Slotless Linear Motor

### Order Example

412 | T09 | LXR | M | P | D15 | H3 | L3 | CM09 | Z2 | E2 | R1 | A7 | P1

**Series** ..... 412

**Travel (mm)** 12 Pole Motor

| | | | |
|---|---|---|---|
| 150.... | T01 | 1200..... | T07 |
| 250.... | T02 | 1500..... | T08 |
| 350.... | T03 | 1750 .... | T09 |
| 650.... | T04 | 2000 .... | T10 |
| 800.... | T05 | 2500 .... | T11 |
| 1000.... | T06 | 3000 .... | T12 |

**Model** ..... LXR

**Mounting (metric)** ..... M

**Grade**

Precision ..... P

**Drive Type**

Free Travel (No Motor)..... D5

12 Pole Motor ..... D15

Refer to page A22 for 24 pole iron core motor drive.

**Home Sensor**

None-Free Travel (only) ..... H1

N.C. Current Sinking ..... H2

N.O. Current Sinking ..... H3

N.C. Current Sourcing ..... H4

N.O. Current Sourcing ..... H5

**Limit Sensor**

None-Free Travel (only) ..... L1

N.C. Current Sinking ..... L2

N.O. Current Sinking ..... L3

N.C. Current Sourcing ..... L4

N.O. Current Sourcing ..... L5

**Cable Management**

No Cables - Free Travel..... CM01

Cable Transport Module (only)..... CM02

3.0 m OEM Cable Set-FL..... CM03

7.5 m OEM Cable Set-FL..... CM04

3.0 m OEM Cable Set-Gemini..... CM05

7.5 m OEM Cable Set-Gemini..... CM06

Cable Trans Mod. w/ 3.0 m-FL*..... CM07

Cable Trans Mod. w/ 7.5 m-FL*..... CM08

Cable Trans Mod. w/ 3.0 m-Gemini*..... CM09

Cable Trans Mod. w/ 7.5 m-Gemini*..... CM10

3.0 m OEM Cable Set-Aries..... CM11

7.5 m OEM Cable Set-Aries..... CM12

Cable Trans Mod. w/ 3.0 m-Aries*..... CM13

Cable Trans Mod. w/ 7.5 m-Aries*..... CM14

* Extension Cable for pass through connection is available and can be ordered seperately: #006-1743-01 (3 meters); #006-1743-02 (7.5 meters).

**Pinning Option**

P1 No multi-axis pinning

P2 X axis transfer pinning to Y axis- 30 arc seconds

P3 Y axis transfer pinning to X axis - 30 arc seconds*

*P3 Option includes a required 15 mm thick adapter.

**Digital Drive**

A1 No Drive

A7 Gemini Drive GV-U12E

A8 Gemini Controller/Drive GV6-U12E

A9 Gemini Controller/Drive GV6K-U12E

A63 Aries Drive AR-08AE

**Environmental**

R1 Class 1000, Strip Seals

R2 Class 10 Cleanroom Prep

**Encoder**

E1 None

E2 1.0 µm Resolution Linear

E3 0.5 µm Resolution Linear

E4 0.1 µm Resolution Linear

E5 5.0 µm Resolution Linear

E7 Sine Output Encoder

**Z Channel Location***

Z1 None

Z2 Positive End Position

Z3 Center Position

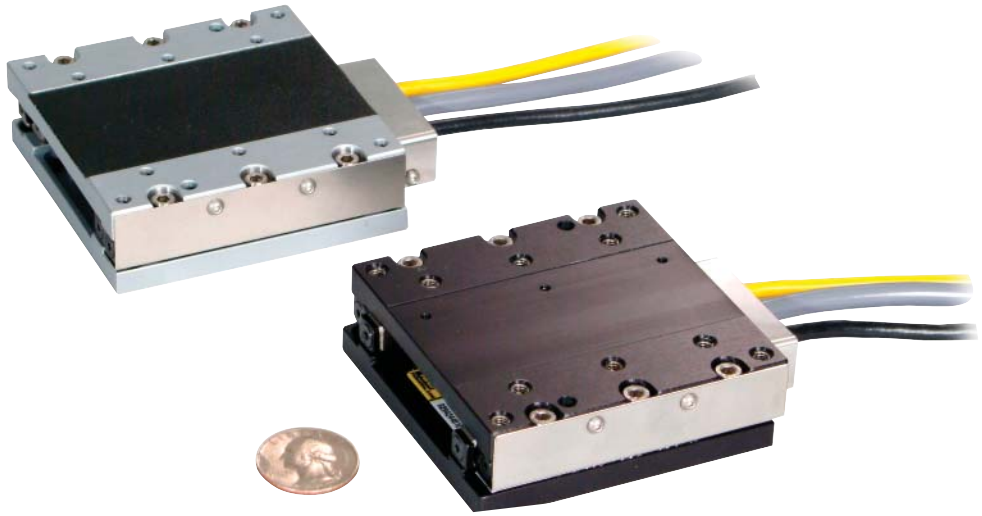
Z4 Negative End Position

*Refer to dimension drawing on page A19.

# MX80L Miniature Linear Motor Stages

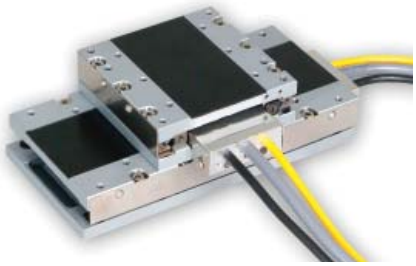
## Features

- Miniature size
- 5g acceleration
- Fast settling
- Submicron precision
- High velocity (2 m/sec.)
- Multi-axis platform



## Attributes:

- Low profile miniature size - (25 mm high X 80 mm wide)
- Linear servo motor drive
- Six linear encoder resolutions (0.01 µm to 5.0 µm)
- 25, 50, 100, 150 mm travels
- Cross Roller bearing (zero cage creep design)
- Precision or standard grade
- Cleanroom and low ESD options
- Fully adjustable home and limit sensors
- Dowel holes for repeatable mounting of payload
- Master reference surface to travel path
- "Plug-in" intelligent drive
- Pneumatic z-axis counterbalance
- No moving cables



## Introduction

Miniaturization of fiber optics, photonics, electronics and biomedical processes has driven the need for smaller and more efficient positioners. Parker's MX80 miniature stage, the smallest linear servomotor driven positioner in the industry, is loaded with high performance features for both rapid linear translation and precise positioning of lighter loads in small work envelopes. Designed for today's 24/7 production demands, the MX80 has redefined "high-throughput automation" in the world of miniature positioners.

High Performance in a small package: While the MX80 is small in size, it is large on performance and reliability. All key components are "built-in" - residing within the body of the stage to provide a clean looking, reliable, unobstructed package. At the heart of the MX80 is an innovative non-contact linear servo motor (patent pending). This direct drive motor has been optimized for force, speed, and acceleration, to deliver outstanding performance and response. A high precision non-contact linear encoder provides submicron resolution, repeatability and accuracy.

Selectable resolutions range from 10 nanometers to 5 microns. Precision ground cross roller bearing sets with a "zero cage creep" feature provide extremely smooth - precise linear translation. Digital Hall effect travel limit and home sensors are conveniently designed into the unit for easy adjustment over the entire travel of the stage. Although there are no moving cables, a meter of hi-flex cabling is included and wired directly into the units. This hi-flex cabling addresses cable flexing concerns associated with the second or third axis in multi-axis system.

# MX80L Miniature Linear Motor Stages

## Precision Series

**Precision grade** models are designed for high performance applications requiring the highest degree of positioning accuracy. They offer a steel body design with precisely ground mounting surfaces & bearing ways. They include higher resolution linear encoders, and are slope corrected, laser tested and certified for optimum precision.

- 4g acceleration
- Repeatability to ∓ 0.4 µm
- Straightness +- 0.4 µm
- Steel body construction
- Precision ground mounting and bearing surfaces
- Hard chrome protective finish

## Standard Series

**Standard grade** units offer a lower cost alternative for applications requiring high throughput performance with less demanding positioning requirements. They are constructed of high alloy aluminum, providing a lighter weight design which can accelerate to 5 g's.

- 5g acceleration
- Repeatability to ∓ 0.8 µm
- Straightness +- 0.8 µm
- Light weight aluminum body
- Low luster black anodize finish

## Specifications:

| | Travel | | | |
|---|---|---|---|---|
| | 25mm | 50mm | 100mm | 150mm |
| **Normal Load Capacity** | 8kg(18 lb) | 8kg(18 lb) | 8kg(18 lb) | 8kg(18 lb) |
| **Maximum Acceleration** | | | | |
| **Precision Grade** | 4g | 4g | 4g | 3g |
| **Standard Grade** | 5g | 5g | 5g | 4g |
| **Maximum Velocity** | | | | |
| 5.0µm resolution | 1100 mm/sec | 1500 mm/sec | 2000 mm/sec | 2000 mm/sec |
| 1.0µm resolution | 1100 mm/sec | 1500 mm/sec | 2000 mm/sec | 2000 mm/sec |
| 0.5µm resolution | 1100 mm/sec | 1500 mm/sec | 1500 mm/sec | 1500 mm/sec |
| 0.1µm resolution | 300 mm/sec | 300 mm/sec | 300 mm/sec | 300 mm/sec |
| 0.02µm resolution | 60 mm/sec | 60 mm/sec | 60 mm/sec | 60 mm/sec |
| 0.01µm resolution | 30 mm/sec | 30 mm/sec | 30 mm/sec | 30 mm/sec |
| **Peak Force** | 12N (2.7 lb) | 12N (2.7lb) | 24N (5.4 lb) | 24N (5.4 lb) |
| **Continuous Force** | 4N (.9 lb) | 4N (.9 lb) | 8N (1.8 lb) | 8N (1.8 lb) |
| **Duty Cycle** | 100% | 100% | 100% | 100% |
| **Straightness & Flatness** | | | | |
| **Precision Grade** | 4 microns | 4 microns | 5 microns | 6 microns |
| **Standard Grade** | 6 microns | 6 microns | 10 microns | 12 microns |
| **Positional Accuracy** | | | | |
| **Precision Grade** (1)(2)(3) | | | | |
| 0.01 µm resolution | 3 microns | 4 microns | 5 microns | 5 microns |
| 0.02 µm resolution | 3 microns | 4 microns | 5 microns | 5 microns |
| 0.1 µm resolution | 3 microns | 4 microns | 5 microns | 5 microns |
| 0.5 µm resolution | 4 microns | 5 microns | 6 microns | 6 microns |
| 1.0 µm resolution | 5 microns | 6 microns | 7 microns | 7 microns |
| 5.0 µm resolution | 13 microns | 14 microns | 15 microns | 15 microns |
| **Standard Grade** (2) | | | | |
| 0.01 µm resolution | 12 microns | 15 microns | 20 microns | 20 microns |
| 0.02 µm resolution | 12 microns | 15 microns | 20 microns | 20 microns |
| 0.1 µm resolution | 12 microns | 15 microns | 20 microns | 20 microns |
| 0.5 µm resolution | 12 microns | 15 microns | 20 microns | 20 microns |
| 1.0 µm resolution | 15 microns | 20 microns | 25 microns | 25 microns |
| 5.0 µm resolution | 25 microns | 30 microns | 35 microns | 35 microns |
| **Bi-directional Repeatability** | | | | |
| **Precision Grade** (1)(2)(3) | | | | |
| 0.01 µm resolution | | ∓0.4 microns | | |
| 0.02 µm resolution | | ∓0.4 microns | | |
| 0.1 µm resolution | | ∓0.5 microns | | |
| 0.5 µm resolution | | ∓1.0 microns | | |
| 1.0 µm resolution | | ∓2.0 microns | | |
| 5.0 µm resolution | | ±10.0 microns | | |
| **Standard Grade** (2) | | | | |
| 0.01 µm resolution | | ∓0.8 microns | | |
| 0.02 µm resolution | | ∓0.8 microns | | |
| 0.1 µm resolution | | ∓0.8 microns | | |
| 0.5 µm resolution | | ∓1.5 microns | | |
| 1.0 µm resolution | | ∓2.0 microns | | |
| 5.0 µm resolution | | ±10.0 microns | | |
| **Unit Mass** | | | | |
| **Precision Grade** | 590g | 590g | 1027g | 1345g |
| **Standard Grade** | 475g | 475g | 875g | 1125g |
| **Carriage Mass (unloaded)** | | | | |
| **Precision Grade** | 282g | 282g | 509g | 676g |
| **Standard Grade** | 213g | 213g | 405g | 537g |

(1) Measured at the carriage center, 35mm above the mounting surface @ 20 C with no load. Unit bolted to granite surface, flat to within 1micron/300mm.
(2) Total accuracy and bi-directional repeatability over full travel (peak to peak).
(3) Precision grade with slope correction value provided. Consult factory if better accuracy is required.

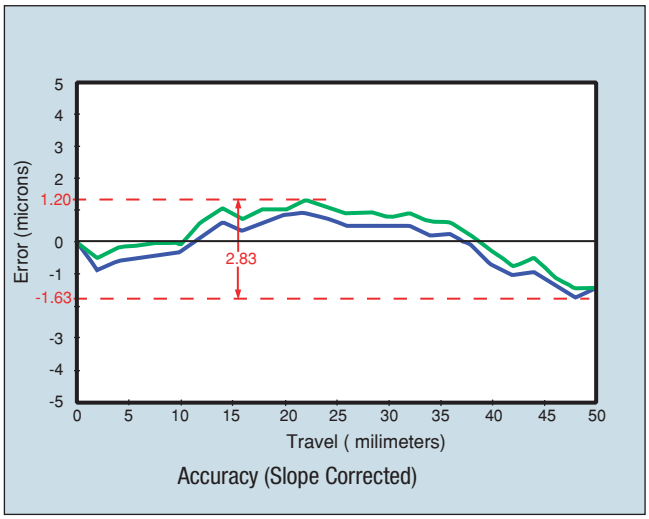
# MX80L Miniature Linear Motor Stage

## Specifications:

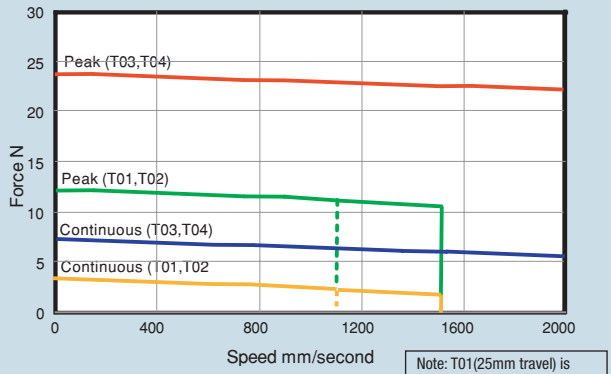
## How we measure accuracy:

All published linear table accuracy and repeatability specifications vary according to testing and reporting methodology. Parker methodology includes data reporting over the entire table travel length, regardless of the start or stop position.

Testing is performed with the table unloaded and mounted to a stable granite surface, at 20° C. Accuracy and repeatability specifications are based on a peak to peak range of error, measured by a laser interferometer with the beam located 35mm above the center of the table top. The reported error totals six degrees of freedom (x,y,z, plus roll, pitch and yaw errors). Final table specifications are established from the maximum positive (+) error to the maximum negative (–) error.

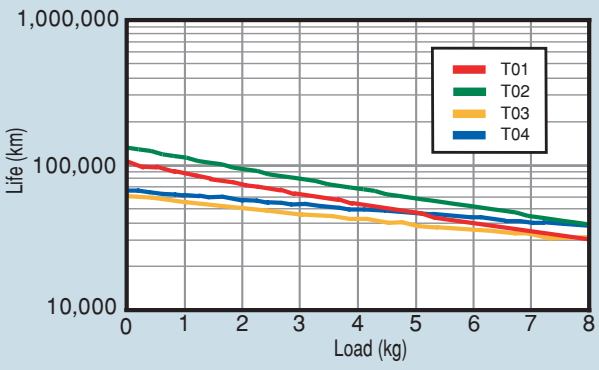



Accuracy (Slope Corrected)

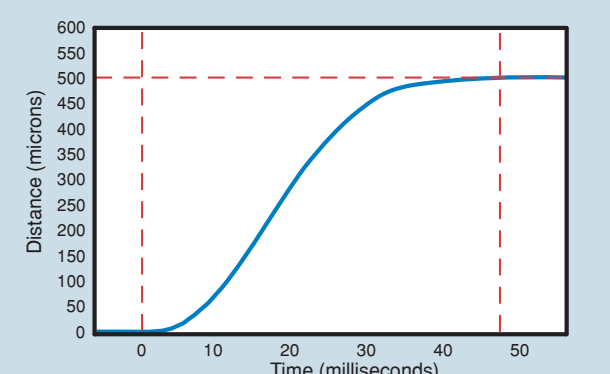



Force - Speed

Note: T01(25mm travel) is limited to a maximum speed of 1100 mm/sec. T02 (50mm) is limited to 1500. (due to limited travel)

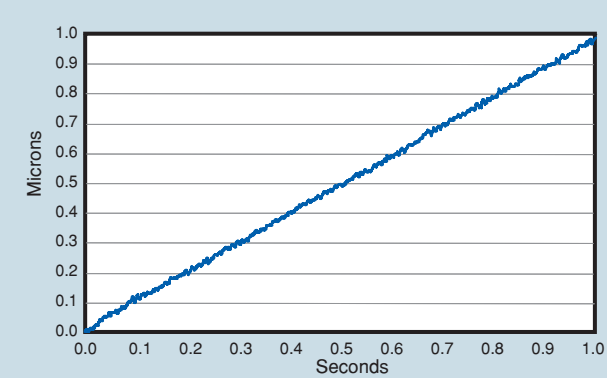



Life- Load (Normal load)




Distance vs Time

Note:
1 Kg payload,
500 micron move:
Move and settle to within
1 micron in 47 milliseconds.




Velocity Ripple

Test were peformed using a model MX80LT04D13E8 with a 20 nanometer linear encoder

CM04 to CM07

## "Plug & Run" Cables Options

- High flex cables
- Plug-in compatibility with ViX drive
- CE compliant connectors and shielding
- CE compliant ferrite beads
- Color coded jackets and labeling

"User convenience" is high on the list of cable attributes found in the MX80. The high flex cabling and connectors are reliable, durable and offer easy hook-up for "plug and run" installation. The cables are connectorized at the stage for easy field replacement and connectorized at the opposite end for ease of installation with the Parker Vix servo drive.

E _

**Encoder Options** A non-contact linear optical encoder provides a quadrature output and offers resolution ranging from 10 nanometer to 5 micron. On the MX80L, the encoder is internal to the stage body. There is no increase to the footprint of the unit and no additional external cabling is required.

H _ L _

Home and Limit Sensors Digital Hall effect home and limit sensors are completely housed within the body of the stage. An innovative design adds functionality without sacrificing geometry. Sensor triggers can be easily adjusted over the travel. The output format is an open collector type capable of sinking up to 50ma, and be set as N.O or N.C.

## Zero Cage Creep Feature

High acceleration and smooth translation are both desired attributes in a linear-motor stage. The cross roller bearing system found in the MX80 provides extremely smooth linear translation, and with an anti-cage creep design, oper ates very well in high acceleration applications. This design employs a rack and pinion feature within the bearing races to eliminate bearing creep. As a result, the MX80 performs well, even at 5g acceleration.

R2 R20

## Cleanroom Option

Both Precision and Standard grade products can be prepared for cleanroom compatibility. Preparation involves material changes, element modification and cleanroom compatible lubricants. The MX80L and MX80S with the R2 option are class 10 cleanroom compatible. When applying an XY or XYZ combination in a cleanroom environment, moving wires need to be considered - please consult a Parker application engineer. The R20 option includes both - low ESD and cleanroom preparation.

## Tooling Features

Innovative tooling features make mounting and alignment much quicker and easier.

- A hardened steel master reference surface is provided along the side of the stage to allow fixturing or other tooling elements to be precisely aligned with the actual travel path.
- Two dowel pin holes are provided on the carriage top and base for repeatable mounting of positioner or tooling.

R10 R20

## Low ESD Coating

An optional 'low ESD' electroless nickel or Armoloy coating is offered for improved electrically conductivity, providing a low resistance to ground path for electric discharge.

R1

**Environmental Protection** Both precision and standard grade units have a hard coat protective finish. The precision units have a hard coat (Rc 78) satin chrome finish, and the standard units have a low lustre black anodized finish.

X2

## Z-axis Counterbalance Option

A pneumatic Z-axis counterbalance is offered to prevent a sudden load drop if power to the motor is interrupted. A controlled vertical force is applied to the stage top to negate the effect of gravity and achieve equilibrium. A precisely regulated clean air supply of 0 to 60 psi is required for operation.

## Pneumatic Accessory Package (Part Number 002-2236-01)

This accessory is offered for use with the X2 pneumatic counterbalance option. It consists of a pre-filter, a pressure regulator, a coalescing filter, and a precision regulator to precisely regulate air pressure and remove oil, water or debris down to 3 microns.

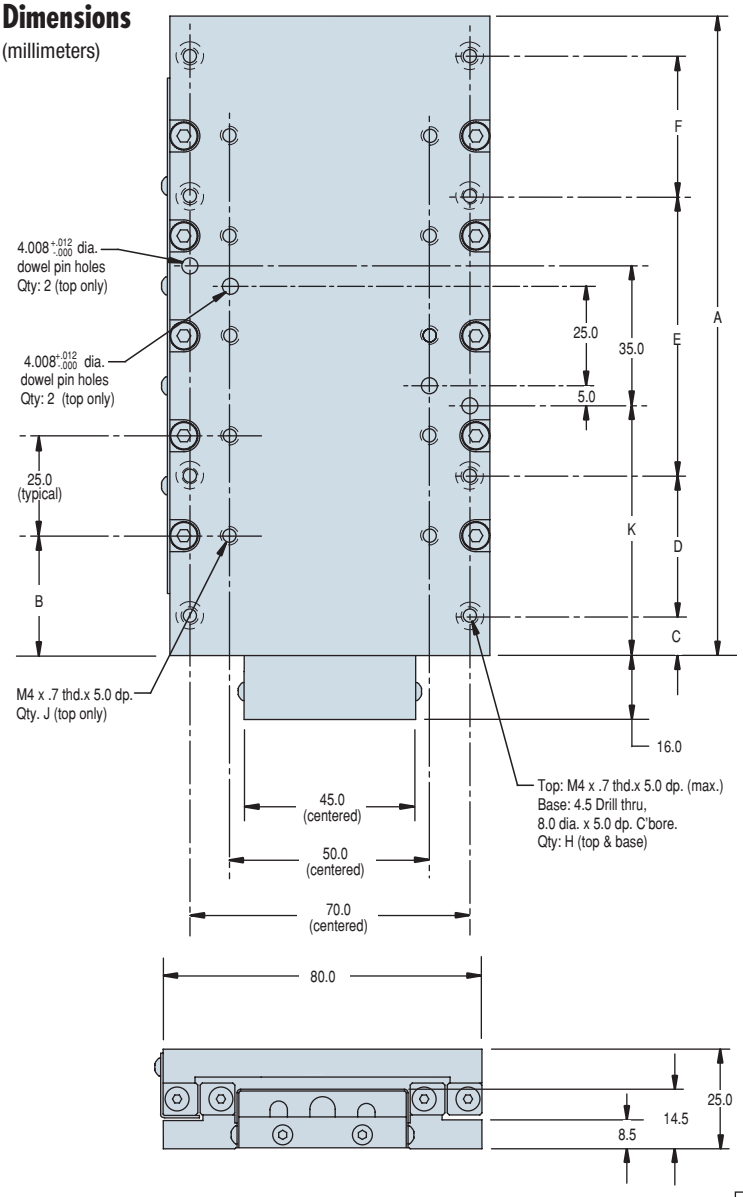
## ViX Intelligent Servo & controller

A1 A20 A21 A22 A25

The Vix servo drives are the perfect drive solution to be paired with the MX80 family. Depending on the selected version, the Vix will be configured for force, velocity, or step/direction input command signals. In addition, a complete packaged servo drive and controller is available."

## Dimensions

(millimeters)

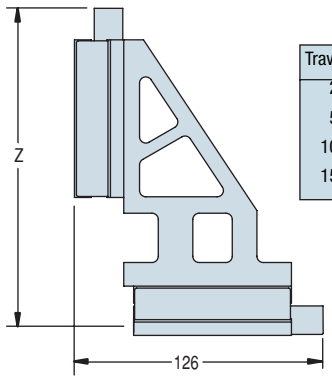




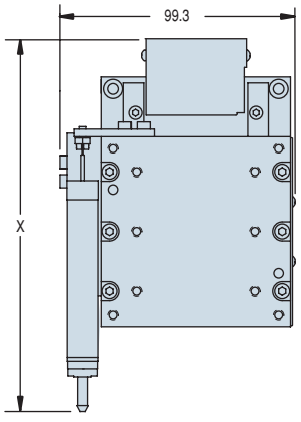


| Travel | Dimensions (mm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | H | J | K |
| 25 | 80 | 15 | 5 | 70 | n/a | n/a | 4 | 6 | 22.5 |
| 50 | 80 | 15 | 5 | 70 | n/a | n/a | 4 | 6 | 22.5 |
| 100 | 160 | 30 | 10 | 35 | 70 | 35 | 8 | 10 | 62.5 |
| 150 | 210 | 30 | 5 | 65 | 70 | 65 | 8 | 14 | 87.5 |

2D & 3D CAD files — Download from parkermotion.com




| Travel | Z |
|---|---|
| 25 | 166 |
| 50 | 166 |
| 100 | 251 |
| 150 | 326 |




| Travel | X |
|---|---|
| 25 | 156.6 |
| 50 | 156.6 |
| 100 | 230.6 |
| 150 | 310.6 |

## Order Example:

MX80L | T02 | M | P | - | D11 | H3 | L2 | CM05 | Z3 | E8 | R1 | A25 | X1 | S1

**Model** ..... MX80L

**Travel**
- 25 mm ..... T01
- 50 mm ..... T02
- 100 mm ..... T03
- 150 mm ..... T04

**Mounting** (metric) ..... M

**Grade**
- Precision ..... P
- Standard ..... S

**Drive Type**
- None - Free Travel ..... D1
- 4 Pole(25 & 50 mm travel only) ..... D11
- 8 Pole(100 & 150 mm travel only) D13

**Home Sensor**
- None ..... H1
- N.C. Current Sinking ..... H2
- N.O. Current Sinking ..... H3

**Limit Sensor**
- None ..... L1
- N.C. Current Sinking ..... L2
- N.O. Current Sinking ..... L3

**Cable Options**
- No Cables (free travel only) ..... CM03
- 1.0 meter high-flex cables w/ ViX connector CM04
- 3.0 meter high-flex cables w/ ViX connector CM05
- 1.0 meter high-flex cables w/ ViX connector (no limit/home cable) CM06
- 3.0 meter high-flex cables w/ ViX connector (no limit/home cable) CM07

**X-Y Orthogonality**
- S1 None (no X-Y configuration)
- S2 X axis unit (cables @12 o'clock)
- S3 60 arc sec. - Y-axis (3 o'clock)
- S4 60 arc sec. - Y-axis (9 o'clock)
- S5 15 arc sec. - Y-axis (3 o'clock)
- S6 15 arc sec. - Y-axis (9 o'clock)

**Other Options**
- X1 None
- X2 Z-axis Pneumatic c'balance

**Digital Drive Options**
- A1 No drive
- A20 ViX250-AH force mode
- A21 ViX250-AH velocity mode
- A22 ViX250-AH step/direction mode
- A25 ViX 250-IH drive/controller

**Environmental Options**
- R1 Standard finish
- R2 Clean room prep.
- R10 Low ESD finish
- R20 Low ESD finish and clean room prep.

**Digital Linear Encoder**
- E1 No encoder (free travel only)
- E9 .01 micron resolution (10 nanometer)
- E8 .02 micron resolution (20 nanometer)
- E4 0.1 micron resolution
- E3 0.5 micron resolution
- E2 1.0 micron resolution
- E5 5.0 micron resolution

**Z-Channel Location**
- Z1 No Z-Channel (free travel only)
- Z3 Center Position

# LX80L Linear Motor Tables

## Features

- Velocity to 3 m/sec
- Acceleration to 5 g's
- Encoder resolution to 0.1 micron
- Cleanroom compatible
- Easy multi-axis mounting
- Internal cable management

### Introduction

Miniaturization of life sciences, electronics, photonics, and fiber optic processes has driven the need for smaller and more efficient positioners. Parker's MX80, the smallest linear servomotor driven positioner in the industry, has redefined 'high-throughput automation' in the world of miniature positioners. It is loaded with high performance features for both rapid linear translation and precise positioning of smaller loads within very small work envelopes. The LX80L picks up where the MX80 leaves off, offering longer travels than the MX80 while maintaining a very small profile. Like the MX80, it is designed to meet the rigors of today's 24/7 production demands.

#### High Performance in a small package

Although it has a small profile, the LX80L is large on performance and reliability. All key components are "built-in", residing within the body of the table to provide a clean looking, reliable, unobstructed package. At the heart of the LX80L is an innovative non-contact linear servo motor (patent pending). This direct drive motor has been optimized for force, speed, and acceleration to deliver outstanding performance and response. A high precision non-contact linear encoder provides submicron resolution, repeatability and accuracy with selectable resolutions ranging from 0.1 microns to 5 microns. Digital Hall effect travel limit and home sensors are conveniently designed into the unit for easy adjustment over the entire travel of the table.

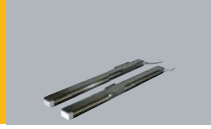
Precision square rail bearings provide load support and precise linear translation, while effectively countering the problematic effects of heat, high speeds, and high acceleration. Cable management is neatly packaged inside the unit so no moving cables are visible. From the end of the unit, "hi-flex" cabling is provided for direct connection to the servo drive. This "hi-flex" cabling alleviates cable flexing concerns associated with the second or third axis in multi-axis system.

#### Flexibility and Multi-Axis Compatibility

The LX80L's selection flexibility and mounting compatibility with the MX80 minature tables enables single axis or complex multi-axis units to be configured in a straightforward manner. Parker's matching servo drives and motion controllers can be included to complete the motion system.

#### Customs and Systems

For specialized applications requiring customization, Parker design engineers can easily modify LX80L tables to suit all application specific requirements. Parker has taken the mystery, difficulty and cost out of integrating linear motor tables into high throughput precision positioning applications.

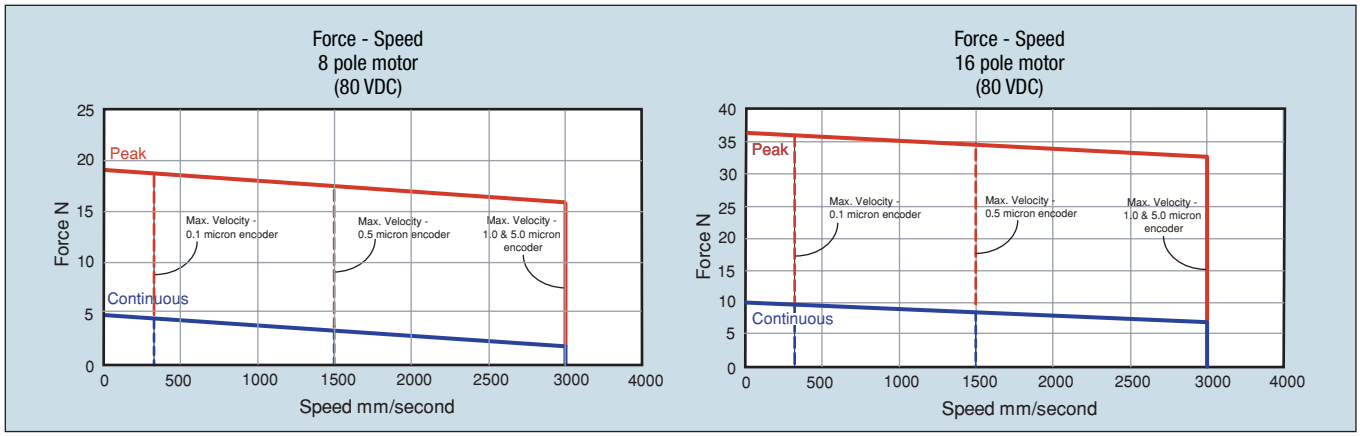


| Specifications | 8 Pole Single Rail | 8 Pole Double Rail | 16 Pole Single Rail | 16 Pole Double Rail |
|---|---|---|---|---|
| Rated Load (kg) | 3(6.5 lb.) | 3(6.5 lb.) | 6(13 lb.) | 6(13 lb.) |
| Maximum Acceleration | | 5 g's | | |
| Maximum Velocity (m/sec.) | | | | |
| Encoder Resolution: 0.1 µm | | 0.3 | | |
| 0.5 µm | | 1.5 | | |
| 1.0 µm | | 3.0 | | |
| 5.0 µm | | 3.0 | | |
| Positional Repeatability(µm) | | | | |
| Encoder Resolution: 0.1 µm | ±2.5 | ±1.5 | ±2.5 | ±1.5 |
| 0.5 µm | ±2.5 | ±1.5 | ±2.5 | ±1.5 |
| 1.0 µm | ±3.5 | ±2.5 | ±3.5 | ±2.5 |
| 5.0 µm | ±10.0 | ±10.0 | ±10.0 | ±10.0 |
| Maximum Peak Force N (lb) | 19 (4.3) | 19 (4.3) | 36 (8.1) | 36 (8.1) |
| Maximum Continuous 4.7 Force N (lb) | 4.7 (1.0) | 10 (1.0) | 10 (2.2) | (2.2) |
| Maximum Moment (Nm) .75 | 1.5 | .75 | 3.0 | |
| Carriage Weight (g) | 287 | 388 | 476 | 648 |

## Travel Dependent Specifications

| Code | Travel 8 pole (mm) | Travel 16 pole (mm) | Accuracy* (µm) Positional 0.1,0.5,1.0 resolution (µm) | Positional 5.0 resolution (µm) | Straightness & Flatness* (µm) | Length "L" (mm) | Unit Weight 8 pole (kg) | Unit Weight 16 pole (kg) |
|---|---|---|---|---|---|---|---|---|
| | Double Rail Models | | | | | | | |
| T02 | 150 | 80 | 8 | 18 | 9 | 325 | 1.590 | 1.854 |
| T04 | 250 | 180 | 12 | 22 | 14 | 425 | 1.944 | 2.207 |
| T06 | 350 | 280 | 16 | 26 | 19 | 525 | 2.300 | 2.563 |
| T08 | 450 | 380 | 20 | 30 | 24 | 625 | 2.652 | 2.915 |
| T10 | 550 | 480 | 23 | 33 | 29 | 725 | 3.006 | 3.269 |
| T14 | 750 | 680 | 29 | 39 | 37 | 922 | 3.713 | 3.976 |
| | Single Rail Models | | | | | | | |
| T02 | 150 | 80 | 12 | 22 | 13 | 325 | 1.396 | 1.586 |
| T04 | 250 | 180 | 16 | 26 | 18 | 425 | 1.714 | 1.905 |
| T06 | 350 | 280 | 20 | 30 | 23 | 525 | 2.035 | 2.225 |
| T08 | 450 | 380 | 24 | 34 | 28 | 625 | 2.352 | 2.543 |
| T10 | 550 | 480 | 27 | 37 | 33 | 725 | 2.671 | 2.861 |
| T14 | 750 | 680 | 33 | 43 | 41 | 922 | 3.308 | 3.498 |

* Accuracy stated is at 20 de grees C, utilizing slope correction factor provided.



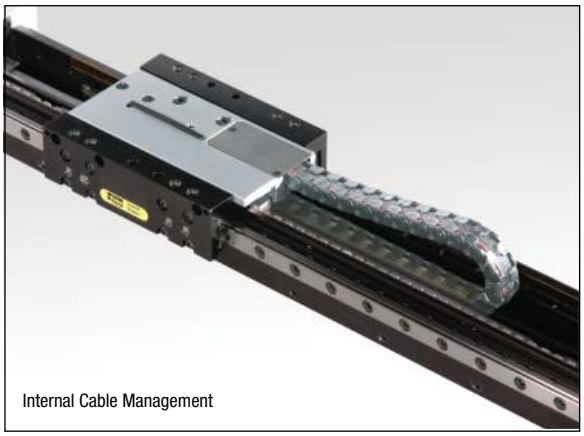
## Cable Management

### "Plug & Run" Cables

"User Friendly" and "robust" were the goals of the cabling design. All cables are 'hi-flex' for durability and are fully shielded. The cables are labeled for quick identification and have connectors at critical locations to simplify use. The drive end termination are ViX series servo drive compatible and have CE compliant connectors including a ferrite bead to improve EMI immunity.

### Internal Cable Management

The LX80's pre-engineered internal cable management offers several benefits. It preserves the LX80's narrow footprint by not requiring additional space for cable management. It allows the table to be mounted in any orientation without a need to re-engineer the cable management. The innovative design is field serviceable and can be maintained without a trip back to the factory. It is designed for and fully tested to last over 20 million cycles. And best of all, it is already done for you!

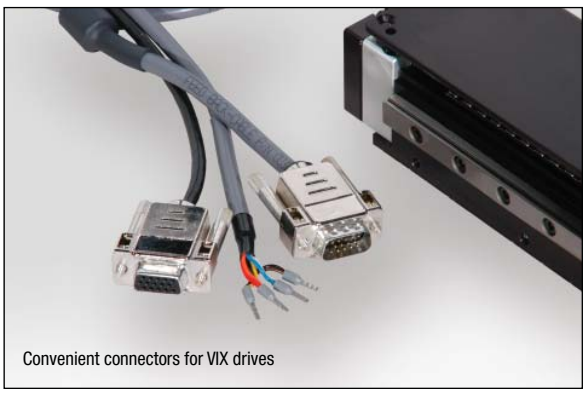


Internal Cable Management

### Cable Options

From the end of the LX80L, high flex extension cables are included for connection to the servo drive and control. They are offered in 1m and 3m lengths and are connectorized at both ends for easy installation or removal. The servo drive end is connectorized for Parker's ViX series servo drives.

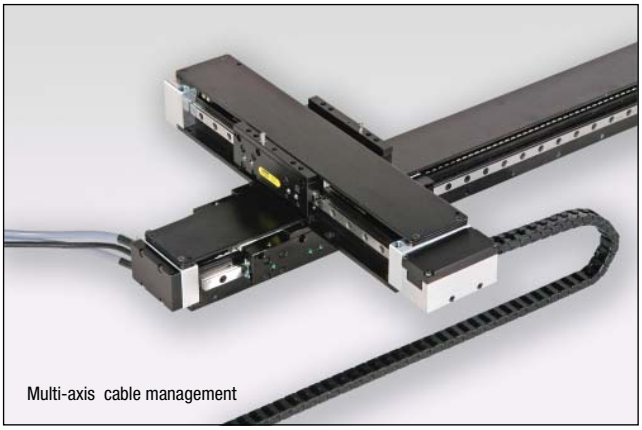
The extension cables egress from the table at a right angle to minimize the overall length of the system. In the standard configuration the cable egress to the left, however, the design is flexible and allows them to egress to the right if desired.



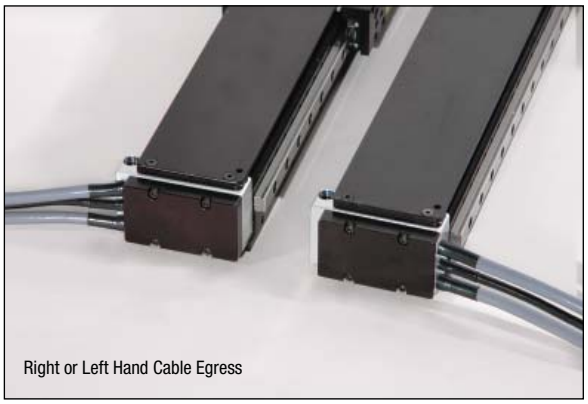
Convenient connectors for VIX drives

### Multi-Axis Cable Management

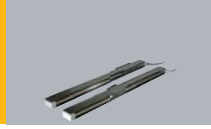
When building multi-axis systems, flexible cable management for the moving axes should be considered. Parker offers pre-engineered cable management for MX80s and LX80s used as the Y-axis. Contact Parker when putting multi-axis systems together to take advantage of these pre-engineered solutions.



Multi-axis cable management



Right or Left Hand Cable Egress



## Features

**SIngle or double row bearings -** Precision linear bearings support the carriage, motor, and payload. Sized to provide virtually unlimited life, the bearings provide stable and accurate linear motion while maintaining high rigidity even under combined or fluctuating loads. Unique in the

LX80L's design are single and double linear bearing rail options. The double rail design consists of two linear rails spaced apart with a total of four bearing trucks. This version offers the best load capacity, straightness/flatness, and stability. For applications requiring minimal load capacity and precision, a single rail version is offered with a single linear rail and two bearing trucks. This version reduces cost and further reduces the width to 63mm. The single rail version is also useful when building gantry systems where stability is achieved through use of a second axis or idler rail.

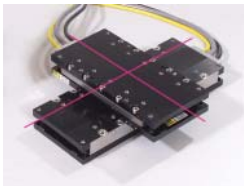
**Tooling Features -** Standard dowel pin locating holes facilitate

repeatable mounting of a table and payloads. Two dowel holes in the LX80L base enable simple, repeatable mounting of the table into a machine. Similarly, two dowel holes in the carriage enable simple, repeatable mounting of a fixture or payload onto the LX80L.

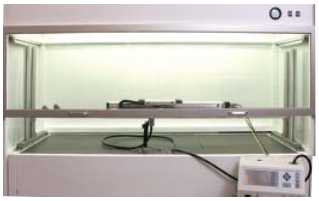
**Mounting Variations -** All versions of the LX80 can be mounted flat to

a surface using 4mm cap screws. The single rail version offers an additional mounting option where the table can be edge mounted. This allows further reduction of axis width to 45mm for applications where space is very limited.

**Orthogonality -** In any multi-axis positioning system, the perpendicular alignment of the axes must be clearly specified. "Degree of orthogonality" defines the perpendicular alignment of axis one to another. The LX80L is offered with two choices for orthogonality. As standard, (S3 or S4 designators) perpendicularity is held to within 60 arc seconds. For more exacting applications the LX80L can be optioned for 15 arc seconds orthogonality ( S5 or S6 designators).



**Cleanroom Option -** LX80 tables can be prepared for cleanroom compatibility. Preparation involves material changes, element modification and cleanroom compatible lubricants. The LX80L with the R2 option is class 100 cleanroom compatible. When applying an XY or XYZ combination in a cleanroom environment, moving wires need to be considered - please consult a Parker application engineer.



**Home and Limit Sensors -** Digital Hall effect home and limit sensors

are completely housed within the body of the motor driven table. An innovative design adds functionality without sacrificing geometry. Sensor triggers can be easily adjusted over the travel. The output format is an open collector type capable of sinking up to 50ma.

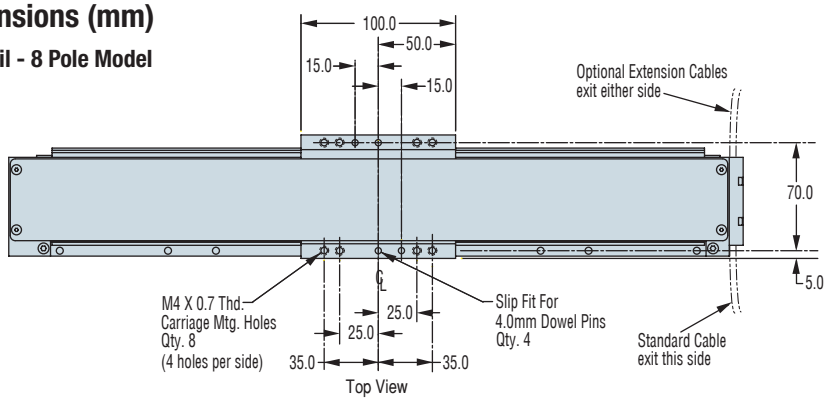
E _ **Encoder Options -** A non-contact linear optical encoder provides a quadrature output and offers resolution ranging from 0.1 micron to 5 micron. On the LX80L, the encoder is internal to the table body. There is no increase to the footprint of the unit and no additional external cabling is required.

**Z-axis Bracket-** Lightweight aluminum Z-brackets are available for easy construction of vertical axis combinations. These include brackets for mounting both the MX80L and MX80S tables as verticals.

**Idler Rail-** For gantry or cartesian configurations, an idler rail is available to provide greater system stability. Contact a Parker application engineer for detail on adding this to your system.

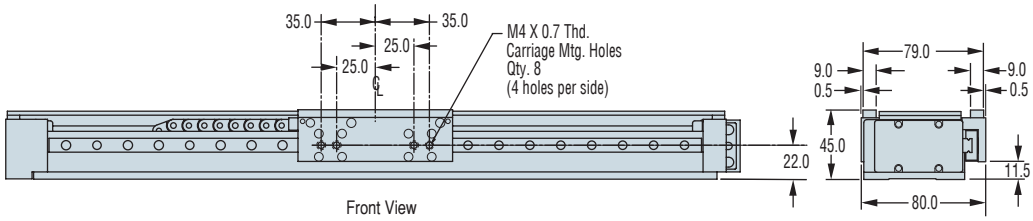
## Dimensions (mm)

### Two Rail - 8 Pole Model

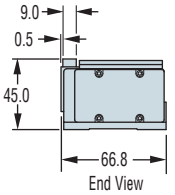



Top View

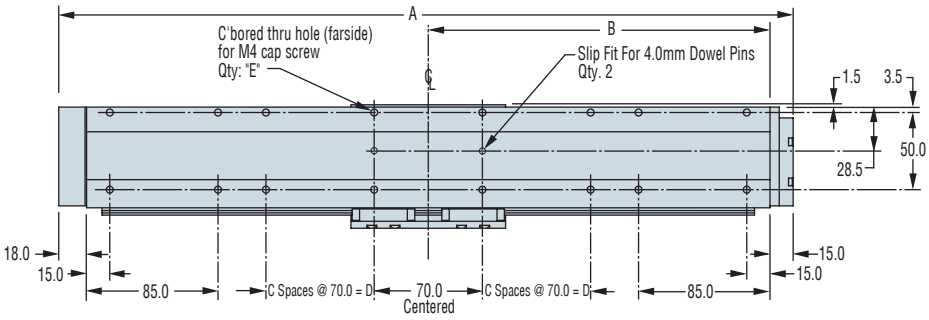
| Code | Travel | | Dimensions (mm) | | | | |
|---|---|---|---|---|---|---|---|
| | 8 pole | 16pole | A | B | C | D | E |
| T02 | 150 | 80 | 325 | 146 | - | - | 6 |
| T04 | 250 | 180 | 425 | 196 | 1 | 70 | 8 |
| T06 | 350 | 280 | 525 | 246 | 1 | 70 | 8 |
| T08 | 450 | 380 | 625 | 296 | 2 | 140 | 10 |
| T10 | 550 | 480 | 725 | 346 | 3 | 210 | 12 |
| T14 | 750 | 680 | 925 | 396 | 4 | 280 | 14 |




Front View




End View
Single Rail Models

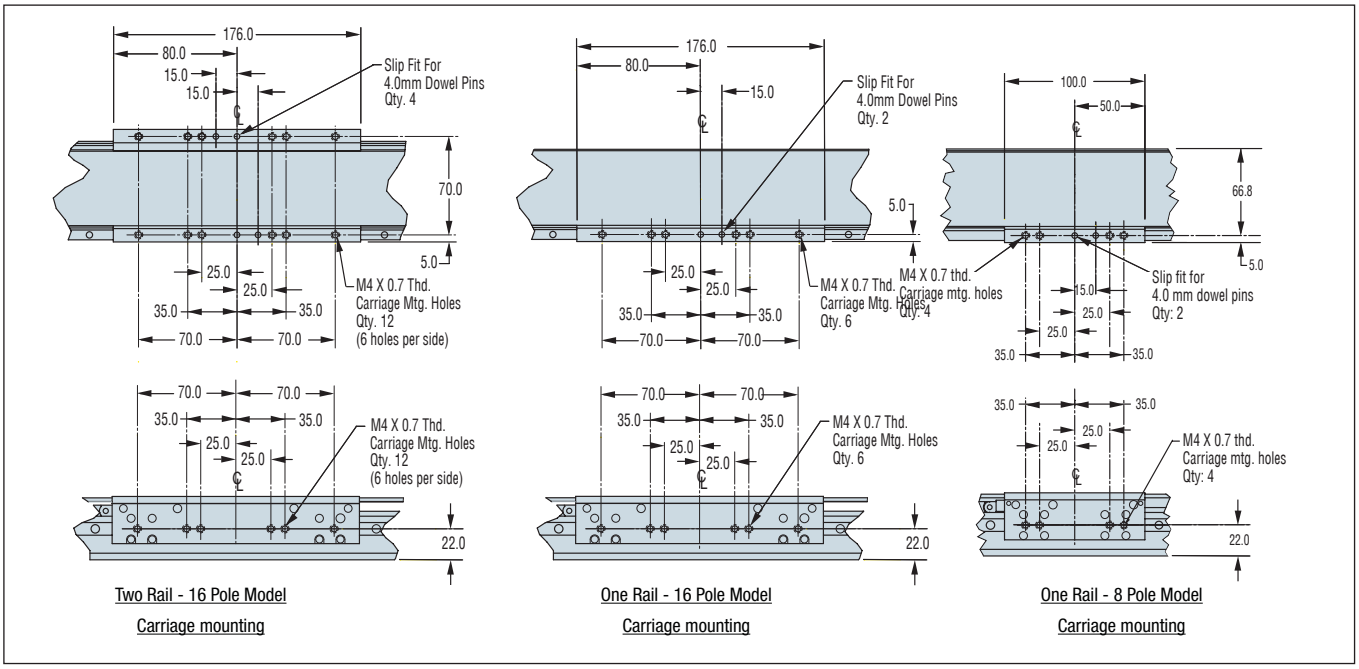



Bottom View

2D & 3D CAD files
Download from parkermotion.com

Note:

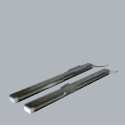
For edge mounting dimensions go to parkermotion.com - CAD Drawing files




Two Rail - 16 Pole Model
Carriage mounting

One Rail - 16 Pole Model
Carriage mounting

One Rail - 8 Pole Model
Carriage mounting



## Order Example:

LX80L | T04 | M | P | D | D13 | CM05 | Z3 | E3 | R1 | A25 | X1 | S1

**Model** ..... LX80L

**Travel**

| 8 pole | 16 pole (motor) | |
|---|---|---|
| 150mm..... | 80mm..... | T02 |
| 250mm..... | 180mm..... | T04 |
| 350mm..... | 280mm..... | T06 |
| 450 mm..... | 380mm..... | T08 |
| 550 mm..... | 480mm ..... | T10 |
| 750 mm..... | 680mm ..... | T14 |

**Mounting**...(metric)..... M

**Grade**.....(precision).... P

**Bearings**

Double Rail ..... D

Single Rail ..... S

**Drive Type**

None - 8 pole carriage ..... D3

None - 16 pole carriage .... D7

8 pole linear motor*..... D13

16 pole linear motor*..... D17

* includes home or limit sensors

**Cable Options**

No Cables (free travel) ..... CM03

1.0 meter high-flex cables w/ ViX connector ..... CM04

3.0 meter high-flex cables w/ ViX connector ..... CM05

**X-Y Orthogonality**

S1 None (no X-Y configuration)

S2 X axis unit (cables @12 o'clock)

S3 60 arc sec. - Y-axis (3 o'clock)

S4 60 arc sec. - Y-axis (9 o'clock)

S5 15 arc sec. - Y-axis (3 o'clock)

S6 5 arc sec. - Y-axis (9 o'clock)

**Other Options**

X1 None

**Digital Drive Options**

A1 No drive

A20 ViX250-AH force mode

A21 ViX250-AH velocity mode

A22 ViX250-AH step/direction mode

A25 ViX 250-IH drive/controller

**Environmental Options**

R1 Standard finish

R2 Cleanroom prep.

**Digital Linear Encoder**

E1 No encoder (free travel only)

E2 1.0 micron resolution

E4 0.1 micron resolution

E5 5.0 micron resolution

E3 0.5 micron resolution

**Z-Channel Location**

Z1 No Z-Channel (free travel only)

Z2 Positive end position

# Motion Control Technologies from Parker

Parker provides "perfect fit" electromechanical solutions for high-precision positioning and high-speed automation. These systems are offered at selectable levels of integration ranging from motor components... to basic single axis mechanical tables... to complete electromechanical systems and robots including motors, drives, controls, and machine interface.

### ACR Motion Controller

- ETHERNET Powerlink high speed digital communications
- Interpolation of up to 8 axes of servo or stepper control
- Advanced multitasking
- 10/100 Base T Ethernet and USB communications
- Absolute Encoder support via SSI
- Linear motor "gantry lock" feature to provide accurate skew control for gantry roots.

### EPX InteractX Powerstations

- InteractX Windows HMI with unlimited tags and 60+ drivers
- Hard drive or CompactFlash storage
- Ethernet, USB, RS232/422/485 communications
- Breakthrough graphic technology
- Panel tool library for easy screen development (no scripting)

### Aries servo amplifiers

- ETHERNET Powerlink high speed digital communications
- Fully digital, sinusoidally commutated brushless servo drive
- 7 power levels available up to 16 ARMS continuous current, or 3000 W
- Plug in and Spin - no set up required with Parker smart encoder
- Supports incremental, absolute and resolver feedback

# Engineered Precision Motion Systems

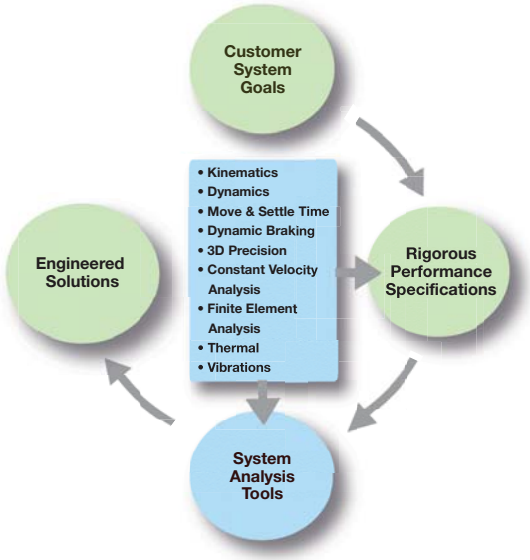
OEMs and manufacturers look to Parker because they know our extensive motion system design experience, systematic project management process, and global infrastructure ensure their needs are met.

Through years of motion system design and manufacturing, we have developed a collaborative development cycle and systematic six-step project management process that leads the motion industry.

Since our technology enables our customer's technology, we build strategic partnerships and strictly maintain confidentiality with our customers.

Parker's Engineered Solutions incorporate air-bearing, linear motor, and pneumatic technology with composite or conventional materials to create a total solution.

### Collaborative Development Cycle



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- Semiconductor
- Life Sciences and Biomedical
- Aerospace
- And other industries with rigorous performance specifications

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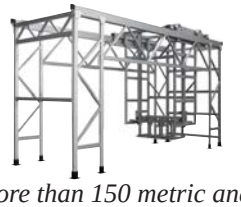

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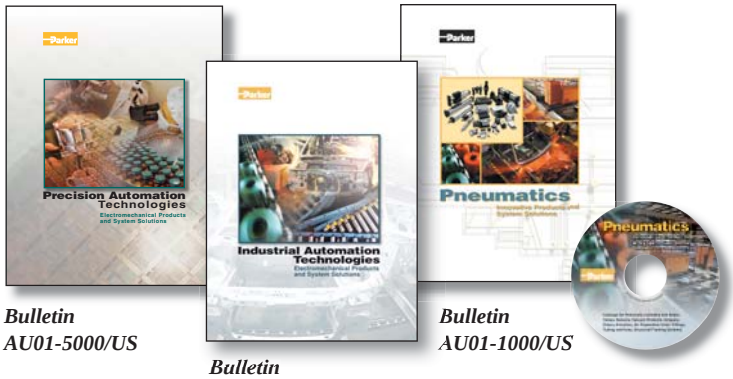


***Bulletin AU01-5000/US***

***Bulletin AU01-7500/US***

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