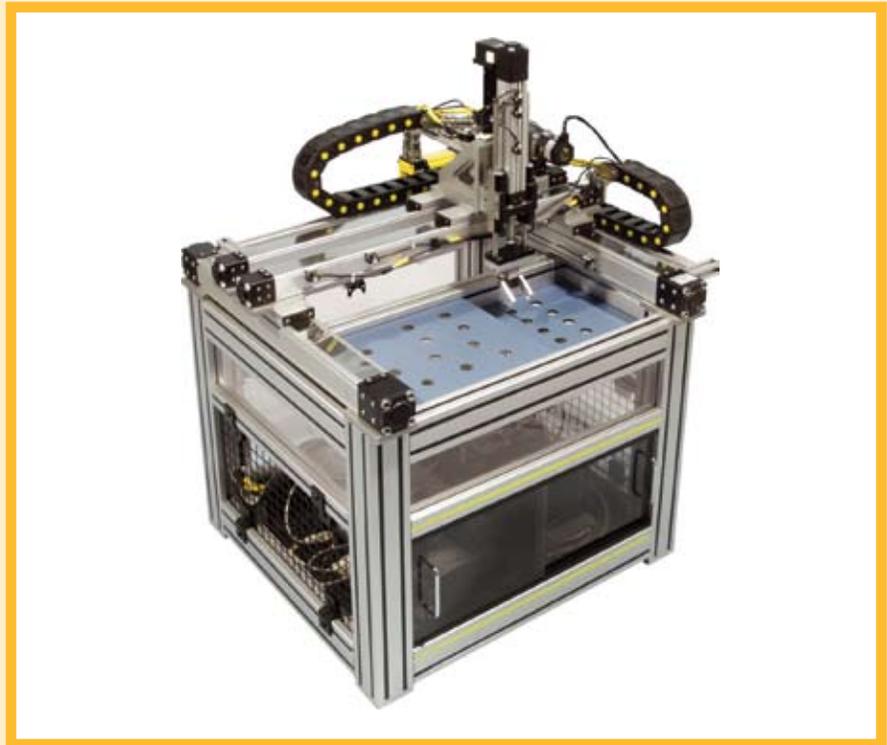


Multi-Axis Systems



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Systems

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website: www.parker.com/actuator

Overview



Multi-Axis Solutions from the Actuator Division

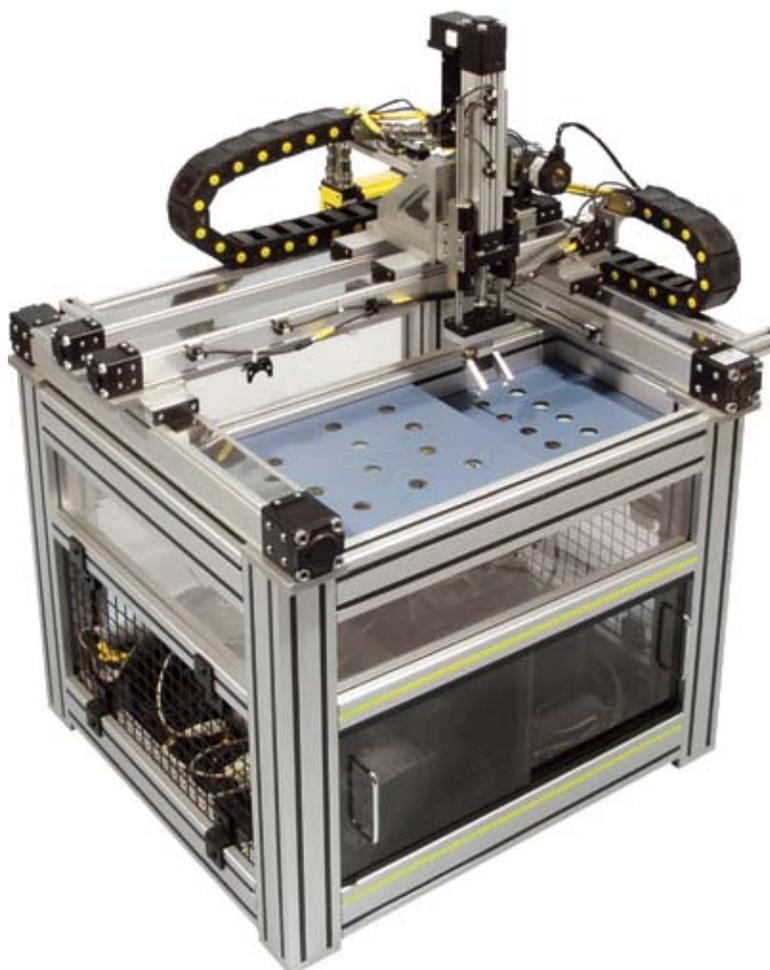
Using Parker Electric Cylinders, Rodless Actuators and Structural Aluminum Framework

Many applications require multi-axis integration rather than a single axis solution. With their modular design, both ET Series Electric Cylinders and ER, ERV and LCB Series Rodless Actuators are well suited to multi-axis connection. The Actuator Division is ready to provide a multi-axis solution to your application by providing the connection hardware in addition to standard and modified actuator products to make integration of the system into the application simple and reliable.

Multi-Axis Features:

- Transition kits for connecting ER Series Rodless Actuators
- Transition kits to connect ET Series Linear Actuators to ER Series Rodless Actuators
- Non-driven Idler Units to provide additional bearing support
- Outrigger bearing units to control deflection and provide additional loading capacity
- Link-shafts to connect belt-driven actuators to a single motor/gearbox

Sample System



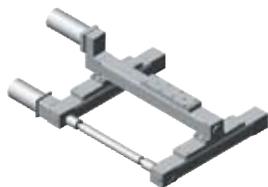
Statement of the System Provider: The Actuator Division provides multi-axis actuator systems as unassembled kits, unless agreed to otherwise, with the understanding that the end user is responsible for final field assembly and electronic integration. Each kit will include re-assembly instructions in the form of mechanical assembly drawings.



System Types

Using the ET, ER, ERV and LCB actuators as building blocks, Parker can create economical and customized cartesian systems. These work cell-level robotic solutions are ideal for pick-and-place and dispensing applications. Beyond the base system, Parker can integrate pneumatic axes, grippers, vacuum cups, custom structures and guarding.

- Standard or custom configurations available
- Economical robotic solution
- Optional hardware:
 - Cable management
 - Machine base and guarding
 - Pneumatic actuators
 - Vacuum cups and generators



System 1
XX'-Y'

A dual actuator X-axis supports a single Y-axis actuator. The dual X-axis may be belt-driven with a linked drive shaft, dual screw drive or driven by one actuator, while the other actuator serves as a non-driven idler.



System 2
XX'-YY'

A dual actuator X-axis supports dual Y-axis actuators. Better suited to large or cumbersome loads.



System 3
X-Z

A single actuator X-axis supports a single Z-axis. The Z-axis may be electromechanical or pneumatic.



System 4
XX'-Z

A dual actuator X-axis supports a single Z-axis. Offers increased rigidity for pick and place applications.



System 5
XX'-Y-Z

A Z-axis is added to System 1. The third axis may be electromechanical or pneumatic and may carry Parker end effector hardware.



System 6
XX'-YY'-Z

A Z-axis is added to System 2. The third axis may be electromechanical or pneumatic and may carry Parker end effector hardware.

Systems

Application Considerations



Application Considerations for Multi-Axis Systems:

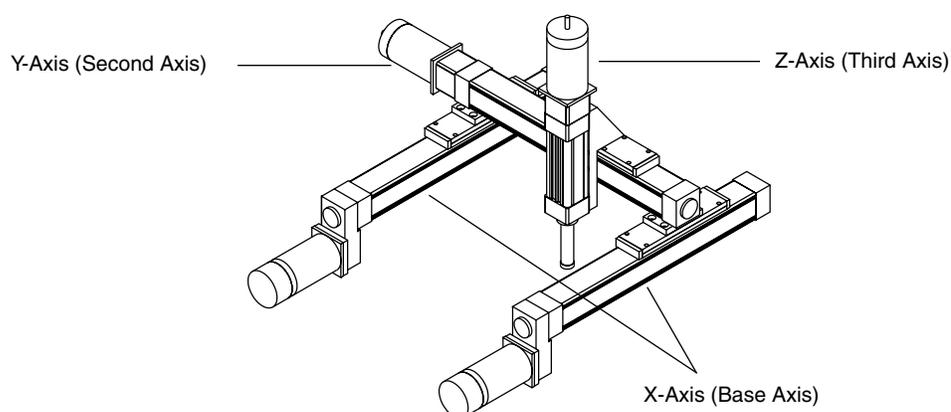
1. Number of Axes of Motion

It is important to understand the operating environment of the motion system and the most cost effective quantity and placement of motion components. It is equally important when ordering to understand the orientation of systems as specified by the Actuator Division.

The X, or Base Axis. The axis which provides the base for all other axes of motion is referred to as the x-axis in all System Type considerations. Regardless of whether the base axis rests on a horizontal or on a vertical surface, the most heavily loaded axis shall be called the x-axis.

The Second Axis. When placed on a base axis and traveling in the same plane, the second axis is referred to as the y-axis. When placed on a base axis and traveling in the plane perpendicular to the base axis plane, the second axis becomes the z-axis, as in System Types 3 and 4. The second axis may be mounted upright, inverted or on its side.

The Third Axis. The third axis is referred to as the z-axis when traveling perpendicular to the plane of the base x-axis and second y-axis.



2. Orientation of the Load

Does the load need to be free from any interference from the motion components?

The ET Series Electric Cylinder is non-intrusive and allows the load to travel free from interference when mounted to the rod end. The ER Series Rodless Actuator may or may not create interference, depending on load orientation and placement of the actuator.

Does the load need to be free of vibration or any other movement while being positioned?

Depending on the size and center of gravity of the load, any movement may induce a response to acceleration and deceleration from the load. This means that the load may not come completely to rest for several seconds, even though the motion system has stopped. The introduction of parallel bearing systems, as in the X-X' and Y-Y' dual axis configurations, serves to minimize this effect. For ET Series Electric Cylinders, adding a Linear Rod Guide Module option minimizes rod end movement and increases side load capacity (see ET Rod Options).

Does the load need to be free of deflection?

Again, depending on the size and center of gravity of the load, any acceleration or deceleration may cause the load bearing carriage to deflect and thereby cause the load to leave its "at rest" position. The introduction of parallel bearing systems, as in the X-X' and Y-Y' dual axis configuration usually eliminates this problem. Rod side load curves for the ET Series Electric Cylinder are located on page 10, while deflection curves for the Linear Rod Guide Module option may be found on page 13. Consult the factory for ER Series carriage deflection information.



Application Considerations

3. Motion Profile Consideration

What is the speed requirement of the application?

Higher speed motion typically requires belt drive actuators. In general, any speed over 20 in/sec may exceed the capabilities of a screw drive system. Higher accelerations may also make non-driven idler units ineffective, as the non-driven units will tend to lag behind the driven axis and cause the system to bind.

What is the repeatability and accuracy requirement of the motion profile?

Screw drive systems offer repeatability values 10 times smaller than those of belt drive systems. Linear accuracy values are comparable for both systems, with the exception of precision ground ball screws.

4. Dual Drive Actuators

If the dual axis option has been selected for balanced load support, there are three basic options.

Idler Separation

In most cases, the idler separation from the drive axis should not exceed the length of a single bearing carriage. As a general rule, any separation greater than 10 inches (254 mm) may present a problem. The idler separation problem resides in the case of the idler bearing axis lagging behind the drive bearing axis upon acceleration and deceleration, or lagging due to misalignment or friction. If the attachment between the two axes is not rigid, the lagging may become more pronounced. Any idler bearing application is best discussed with the Applications Department.

Linked Belt Drive (Link Shafts)

Linked belt drive parallel axes are simple and cost-effective. In this case, a link shaft is coupled between the output shaft of the drive axis and the input shaft of a driven axis. Depending on the parallel axis separation, the link shaft may or may not require additional bearing support. Link shafts are speed limited, which is dependent upon axis separation.

5. Environmental Considerations

Environmental conditions can affect the performance and life expectancy of an electromechanical system. Extreme temperatures may compromise the functionality of actuators with aluminum housings and steel drive screws, bearings and fasteners. Particulate matter and other debris can damage the actuator drive system if not accounted for. In many cases, it may be advantageous to invert one or more actuators to shield the carriage from airborne matter. Positive actuator body pressurization also serves to minimize damage. Considerations are discussed in detail in both the ET and ER sections or consult the factory with any environmental concerns.

Systems

Application Consideration Summary

Application Consideration	Potential Issues	System Solutions
Overhung Load	Carriage deflection, oscillatory response from acceleration forces	Dual axis bearing, both driven or one driven, one idler
Speeds Below 500 mm/sec (20 in/sec)	Low speed smoothness	Screw drive actuator for smoothness
Speeds Above 500 mm/sec (20 in/sec)	Screw whipping (critical speed), screw noise, reduced screw life	Belt drive actuator for high speeds (to 200 inches)
Travel Beyond 1500 mm (59 in)	Low critical speed for screw drives	Belt drive actuator for long travel
Dual drive actuator separation greater than 10 inches	Idler unit lagging driven unit	Dual drive screw or linked belt drives
Repeatability less than 0.004 in	Beyond capabilities of belt drive actuator	Screw drive actuator for repeatability
Airborne particles and other debris	May damage drive train or bearings	Invert actuator, positively pressurize the cylinder body
Load-Motor Inertia Matching	Little mechanical advantage with belt drive, more advantage with screw drive	Consider inline gearbox reducer or timing belt reduction

System Ordering



Systems Ordering Procedure

Actuator Division uses several quality verification steps to guaranty that a system will arrive at the customer with an accurate and complete component set.

The first step is a hard quote from the EM Applications Department. The basic information for the hard quote comes from several different sources such as:

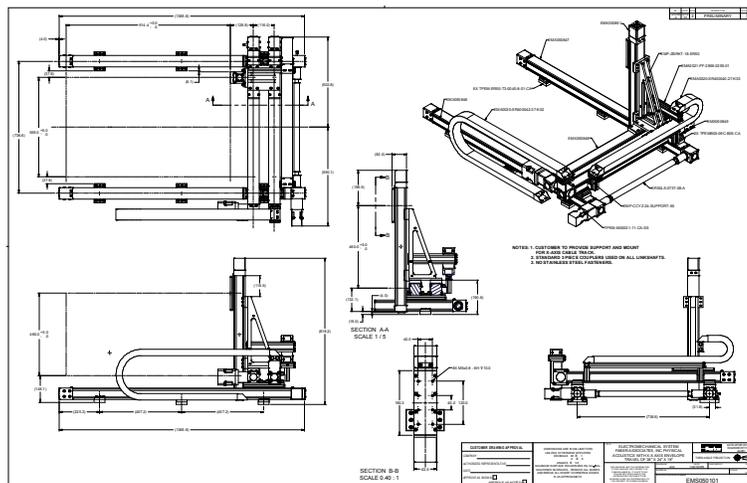
- Budgetary Quoting Software
- Multi-Axis Systems Application Fax Page
- Customer Fax

The Customer verifies the quote content.

The verified hard quote is then used by Actuator Division's Engineering Department to prepare the Customer Sign-off Print. *This is the second and probably one of the most important quality checks.*

For every new system that is ordered, a System Print is developed by Actuator Division.

- This print details the various components to be incorporated as well as basic system orientations and dimensions.
- This print is used by the Customer to verify that the system is dimensionally acceptable for their application.



After the print is verified by the Customer, a signed-off copy is returned to Actuator Division for the development of the production bill of materials.

Typical Lead Time for a system from this point is 4 to 6 weeks. This lead time depends on the complexity of the system and the level of integration that is requested of Actuator Division. Please consult Actuator Division Electromechanical Applications Engineering for a specific application lead time.

After the Bill of Materials is produced the production of the system falls into Actuator Division's standard quality system and its associated quality checks.

Actuator and System Prints

At the time of this publication Actuator Division uses Inventor Release 10 as their CAD/CAM interface. Actuator Division is capable of generating most of the generic file formats (DXF, IGS, SAT, STP, PDF, etc.)



System Accessories

Connection Kits

With each type of system, there are standardized kits for each connection required. Certain applications may require custom kits due to application envelope or loading. The Actuator Division will submit the standard kits for each application, and will design custom hardware as the application demands.

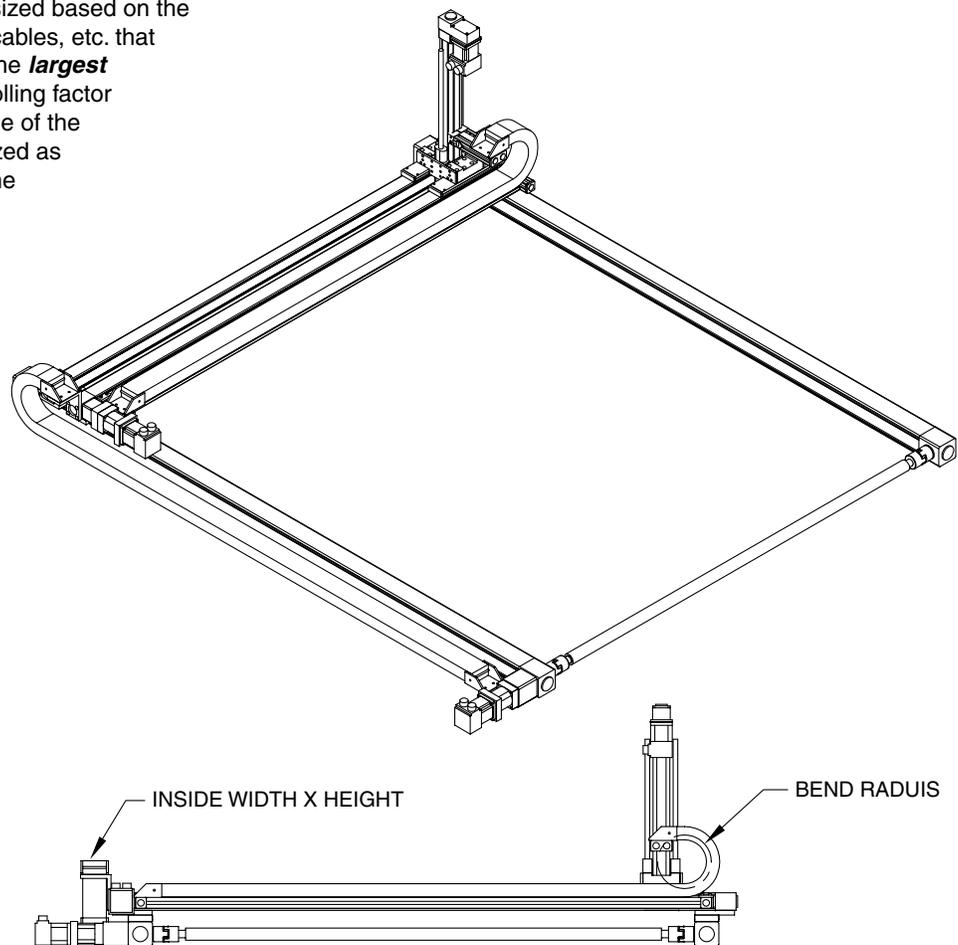
System Accessories

Upon request, the Actuator Division can include the following system accessories:

- Cable Carriers and Supports
- Special Motor, Brake and Limit Switch/Sensor Cabling
- Structural Framework and Related Accessories (See following pages)
- System Safety Guarding
- Custom Mounting Hardware for Customer Supplied Accessories

Cable Carrier Assemblies

Please note that cable carriers are sized based on the electrical cables, air hoses, sensor cables, etc. that pass through them. The cable with the **largest minimum bend radius** is the controlling factor along with the cross sectional volume of the cables. The cable carrier is then sized as the next larger standard radius for the cable track.



Systems

Developing Multi-Axis Applications

Consult the Application Considerations in this section. We have included a Multi-Axis Application Worksheet at the end of this section. Use this as a guide and also as a fax form when contacting the Actuator Division or your local Automation Technology Center.

Fax: (330) 334-3335
Attention: Electromechanical Application Dept.

System Application Fax Form



Fax completed form to (330) 334-3335 or email to actuatorsales@parker.com

Contact Information:

Name _____ Phone _____
 Company _____ email _____
 City, State, Zip _____

Application Sketch

NOTES:

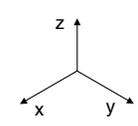
Please include the critical dimensions in your sketch.
 In order to achieve the best solution, it is important that you provide as much information as possible.

Motion Profile

Move*	Axis of Motion	Distance (Stroke)	Time**	Thrust of Load	Dwell

NOTES:

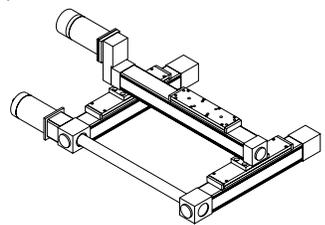
* Please indicate any moves that can be done simultaneously.
 ** If individual move times are not important, enter "x" and enter the total cycle time here _____.



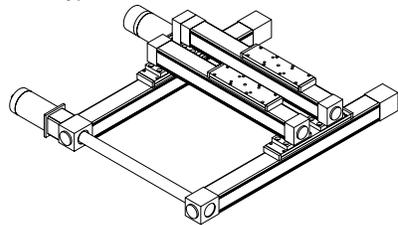
System Configuration

(Check the figure that resembles your system)

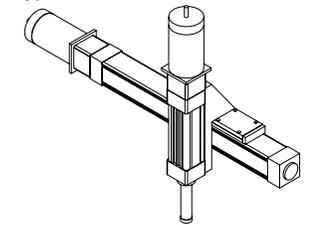
Type 1 X-X'-Y



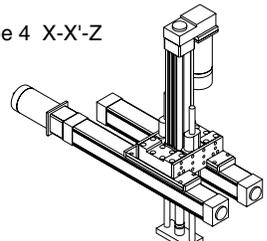
Type 2 X-X'-Y-Y'



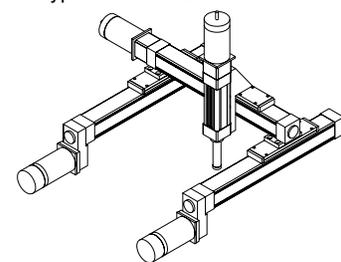
Type 3 X-Z



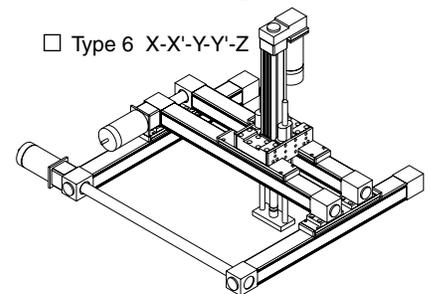
Type 4 X-X'-Z



Type 5 X-X'-Y-Z



Type 6 X-X'-Y-Y'-Z



Other (Provide sketch)



System Application Fax Form

Please note the following:

- a. The X and Y axes must be the same series of actuators.
- b. Idlers can only be used when actuators are less than 12" apart.
- c. A bearing block will be used when actuators are greater than 36" apart.

Application Requirements:

- 1. Stroke Length: X _____ Y _____ Z _____
- 2. X and/or Y axis:
 - ER ERV
- 3. IPS Framework needed? Yes No
 If yes, please describe your working envelope: Height _____ Length _____ Width _____
- 4. Load/Tooling Weight _____
- 5. Repeatability Requirements _____
 Unidirectional Bidirectional
- 6. Life Requirements (cycles, distance or years)
 Hours per day _____ Days per year _____
- 7. Special Considerations _____

Please attach another sheet if more room is needed.

Motor Mounting Options (check all that apply)

Please note that parallel mounts can limit the actuator's total thrust capacity.

- 1. Z-axis:
 - Inline Mount Parallel Mount Reverse
- 2. Y-axis:
 - Direct Drive Parallel Mount Reverse Best Way
- 3. X-axis:
 - Direct Drive Parallel Mount Reverse Best Way

Motor, Drive and Control Options:

- 1. Motor Options (check all that apply)
 - Stepper Servo
 - Parker Supplied Customer Supplied (provide print)
 - Gearhead(s) if needed:
 - Parker Supplied Customer Supplied
- 2. Other Options (check one)
 - Drive Controller
- 3. Available Line Voltage _____
- 4. Switches/Sensors (quantity)
 - End of Travel _____ Home _____
- 5. Brake Option (check one)
 - Actuator * Motor None
 - *With parallel motor mount only
- 6. Cable Track: Yes No
- 7. Special Options _____



Application Examples

