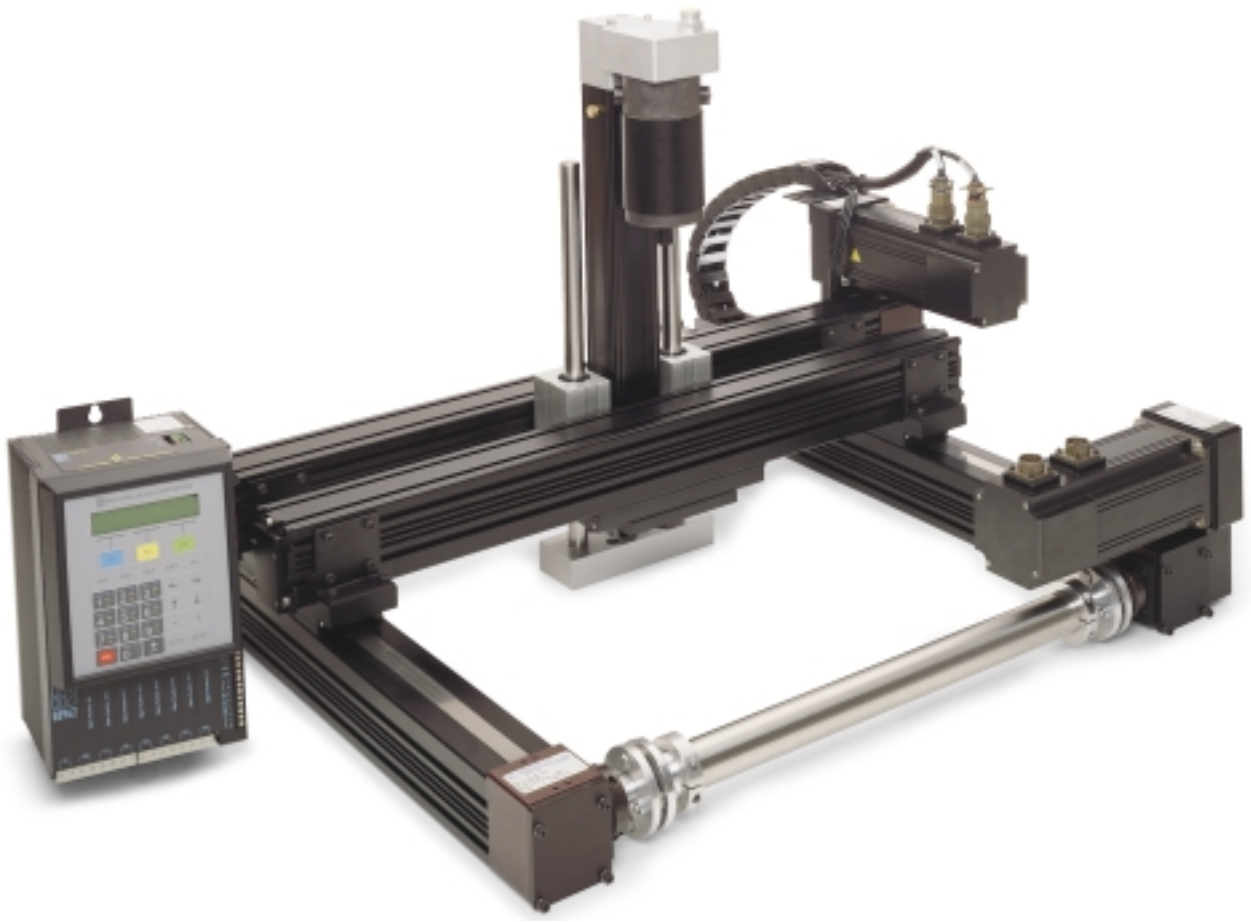
Cartesian Actuator Systems



Overview

Cartesian Actuator Systems combine R3 or R4 Series rodless actuators to create two and three-axis linear motion systems. Work areas range up to 4 by 8 feet, depending on mechanical configuration, with optional Z-axis options up to 12 inches. IDC offers a complete system, including motors and controls, a driveshaft, interface brackets, and cable track kits. Factory-based engineering services include component selection assistance, CAD drawings of your system, and your choice of shipped assembled, or as components.

Cartesian Actuator Capabilities

- Speeds up to 120 in/sec
- Payloads from 0 to 150 lb
- Speed/Thrust performance characterized for all cataloged motors
- 2", 3" and 4" Brushless Servo Motors
- NEMA 23, 34, and 42 Step Motors

Design Services

To assist in the integration process, IDC's engineering staff offers the following:

- Component sizing and part number selection
- System configuration
- Verifying available work area, load/actuator interference checking
- Dimensional/layout drawing of Assembled System
- Shipped as a fully assembled, crated system (optional)

Custom Capabilities

Consult the factory regarding the following options:

- Larger work areas
- Higher payloads
- Precision planetary gearheads, mounted between motor and actuator, for lower backlash or alternate speed range
- Custom carriage options for special Z-axis or special mounting hole pattern
- Complete Cartesian Systems, pre-assembled by our factory technical staff
- High flex cables for motors, limit switches

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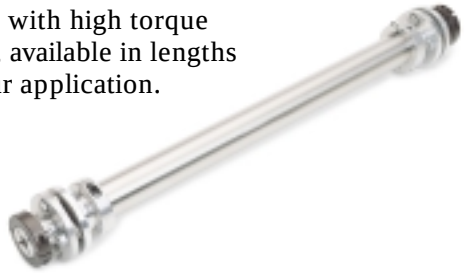
Cartesian Actuator Systems

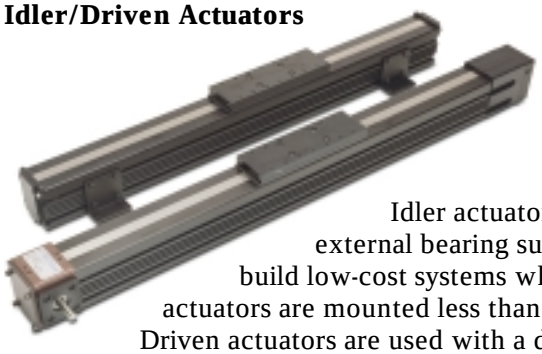
Multi-Axis Integration Components

Driveshaft

Tubular driveshaft with high torque flexible couplings, available in lengths as required by your application.



Idler/Driven Actuators

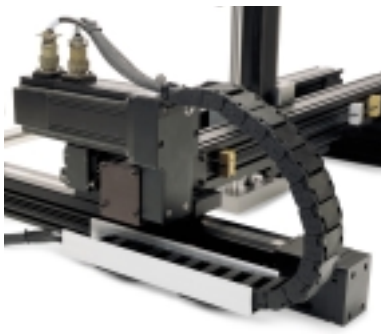


Idler actuators provide external bearing support to build low-cost systems when actuators are mounted less than 15" apart. Driven actuators are used with a driveshaft.

Brackets/Adapters

Standard mounting brackets are available for the following:

- Z-axis actuators
- A second Y actuator for added stiffness
- Inverted Y axis actuator(s)
- X-axis adapter to aluminum framing vendors (universal for Item, 80/20, Bosch, and others)

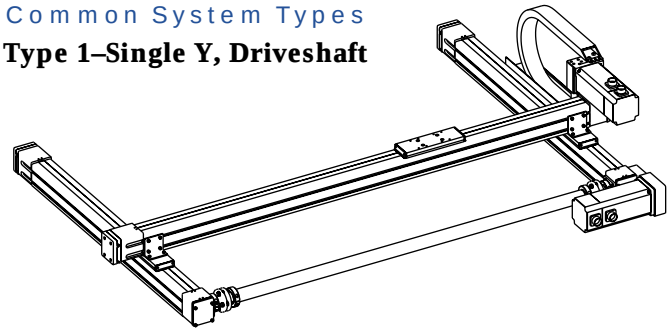


Cable Track Kits

Flexible cable track for routing motor, feedback, and limit switch cables to Y and Z axes.

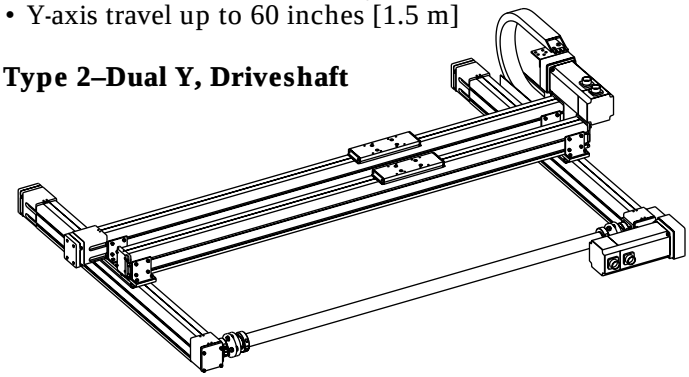
Common System Types

Type 1–Single Y, Driveshaft



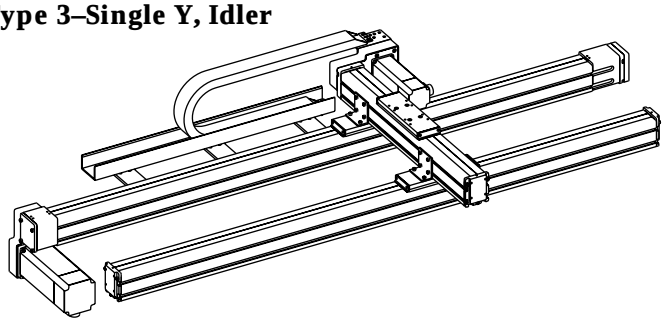
- Basic Cartesian system
- Driveshaft increases accuracy
- Y-axis travel up to 60 inches [1.5 m]

Type 2–Dual Y, Driveshaft



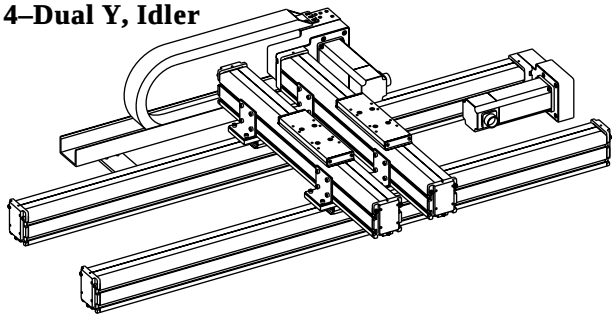
- Recommended for Z-axis application
- Stiffest Y-axis configuration
- Driveshaft increases accuracy
- Y-axis travel up to 60 inches [1.5 m]

Type 3–Single Y, Idler



- Lowest cost X-Y system
- 15" max. spacing between X and X'

Type 4–Dual Y, Idler



- Lowest cost Z-axis capable system
- 15" max. spacing between X and X'
- Increased roll stiffness (Y-axis)

Programmable Smart Drives

IDC offers a broad range of motion controls, offering stepper, brushless servo and brush-type DC technologies. The controls described on the following two pages are well-suited to multi-axis applications.

SmartStep Microstepping Smart Drive

The is a complete, packaged microstepping indexer/drive that combines the breakthrough drive technology of the , with IDC's powerful *IDeal*™ programming language. The result is a control that solves demanding applications easily, while providing superior performance.

- Up to 8 amps of current (software configurable), compatible with 17 frame to 42 frame step motors.
- Uses IDC's IDeal™ programmable language also found in our SmartDrive and 961/2 products
- 60K memory standard
- Flash Memory allows easy firmware upgrades over the internet.
- Operates from 120 VAC standard, or 240 VAC optional (SmartStep-240)
- Accepts encoder feedback for Stall Detect, Closed Loop operation, and Position Maintenance.
- See page G-1 for more information.

Programmable Microstepping and Brushless Servo Smart Drives

IDC's S6961 (1-axis microstepping) and S6962 (2-axis microstepping), and B8961 (1-axis brushless servo) and B8962 (2-axis brushless servo) programmable SmartDrives were designed for ease of use, and to minimize setup and programming time. When using a SmartDrive you can literally have your system up and running in a matter of minutes! Additional features to be found in the Smart Drives are:

- Fully integrated motion controller/drive/power supply/operator interface
- Powerful, and flexible IDeal™ programming language
- 30 I/O, 6 dedicated and 24 configurable
- 8 OPTO 22 I/O slots located right on the control
- Optional Keypad that functions as both a programming tool and an operator interface
- For more information:

  S6961/2: See page G-1

  B8961/2: See page H-1

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Drives and Controls

Stand-alone Programmable Motion Controllers

For applications that require a stand-alone motion controller, consider the 961 one axis and 962 two axis indexers.

- Integrated Motion Controller/Power Supply/Operator Interface/and I/O rack provides the user with an industrial motion control solution
- 30 I/O, 8 Opto 22 I/O slots
- Uses IDC's IDeal™ programming language
- See page G-1 for more information

Microstepping Drives

For high performance microstepping drives, consider IDC's and S6002. These drives use innovative anti-resonance technology to achieve clearly superior step motor performance, and improve machine throughput. For a comparison of the and S6002, see the table below.

NextStep	S6002
Single Axis	Two Axis
0.1-7.9 amps	0.1-6 amps
Anti-Resonance Circuitry	Anti-Resonance Circuitry
Internal Fan/Heatsink	Conventional Heatsink
Auto-Adjusting Current Loop	Rotary Inductance Adjustment
See page G-1	

Digital Brushless Servo Drive

For high performance brushless servo drives, consider IDC's B8001. This DSP-based, high bandwidth servo uses an innovative vector control motor commutation scheme that delivers exceptional shaft power and performance. For more information on this technology, see page H-1.

B8001
Operates from 120/240 VAC
5A/10A cont/peak current
Internal power supply
See page H-1

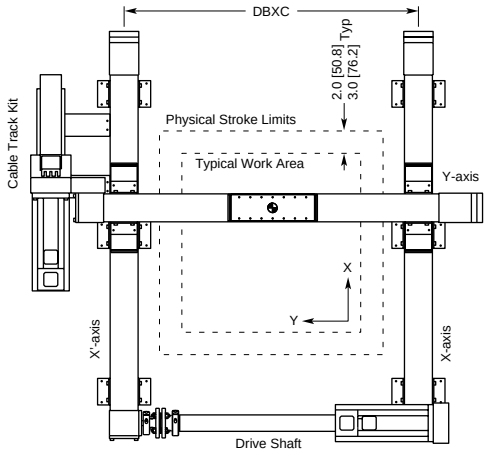
Cartesian System Examples

Simple Selection

IDC offers four standard 2-axis (XY) system types to aid in designing your multi-axis Cartesian System. Adding a Z-axis is easy with interface components shown on page D-17.

Type 1: Dual X with Driveshaft, Single Y-axis

X/X': Two R3 or R4 Series, coupled with driveshaft
Y: One R3 or R4 Series

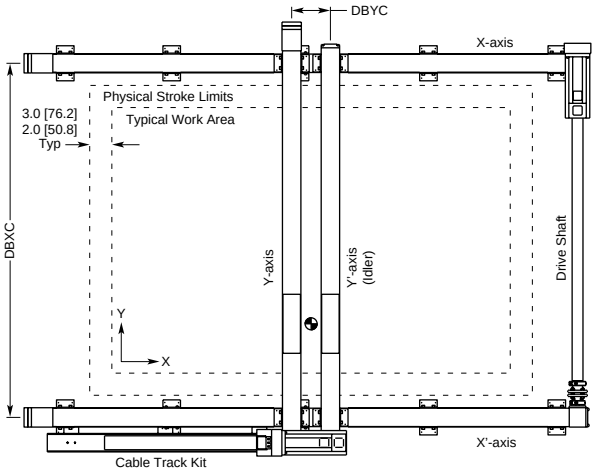


Sample Components List

X-axis:	R3S33V-50T-S-24-AR-ASE
X'-axis:	R3-T-SR-24-ASE
Y-axis:	R3S23V-20T-18-BR-ASE
Driveshaft:	DS-R3-25
Cable Track:	CT-R3–R3-24-B
Limit Switches:	2 RP1-25 (home), 4 RP2-25 (end-of-travel)

Type 2: Dual X with Driveshaft, Dual Y-axis

X/X': Two R3 or R4 Series, coupled with driveshaft
Y: Two R3 or R4 Series: One with motor, one Idler



Sample Components List

X-axis:	R3B32-50T-S-60-AR-ASE
X'-axis:	R3-T-SR-60-ASE
Y-axis:	R3B32-50T-42-AR-ASE
Y'-axis:	R3-IDLER-42-ASE
Driveshaft:	DS-R3-49
Cable Track:	CT-R3–R3-60-A
Limit Switches:	2 RP1-25 (home), 4 RP2-25 (end-of-travel)
Mtg. Brackets:	2 MB-2R3-R3 (mounts Y & Y' to X & X' carriages)

		R3/R3 Driveshaft (Type 1, 2)	R4/R4 Driveshaft (Type 1, 2)
Max. Travel Area (X by Y)	in [mm]	72 x 60 [1829 x 1520]	108 x 60 [2750 x 1520]
Max. spacing between X & X'	in [mm]	to 67 [1700]	to 67 [1700]
Load capacity	lb [N]	0-50 [220]	0-150 [660]
Max. speed	in/s [mm/s]	120 [3000]	120 [3000]
Repeatability (per axis)	in [mm]	±0.004 [±0.10]	±0.004 [±0.10]
Backlash 20T, 30T models	in [mm]	0.03 [±0.75]	0.03 [±0.75]
50T, 70T, 100T models	in [mm]	0.06 [±1.50]	0.06 [±1.50]
Motor Types Available		1.8° Step Motor Brushless Servo	1.8° Step Motor Brushless Servo

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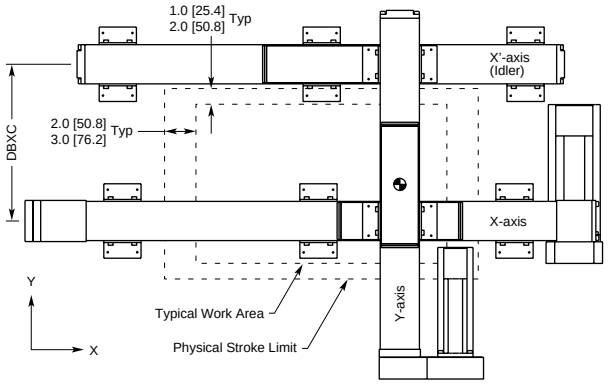
Cartesian System Examples

Type 3: Dual X with Idler, Single Y-axis

X/X': Two R3 or R4 Series: Screw or belt, one with motor, one Idler
Y: One R3 or R4 Series

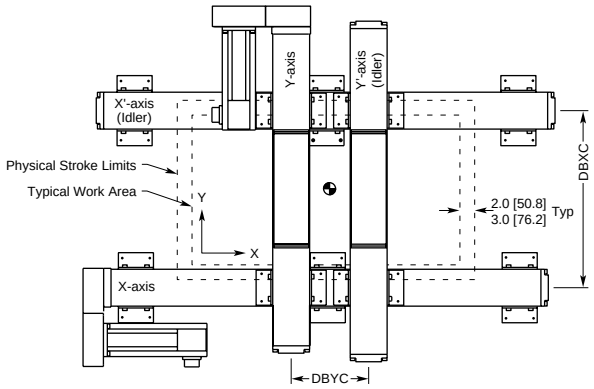


Sample Components List

X-axis:	R4B41-100T-36-CR-ASE
X'-axis:	R4-IDLER-36-ASE
Y-axis:	R4B32-501B-12-PR-ASE
Driveshaft:	Not required
Cable Track:	Optional
Limit Switches:	2 RP1-25 (home), 4 RP2-25 (end-of-travel)
Mtg. Brackets:	6 MB-R4-AF1 (mounts X & X' to aluminum framing)

Type 4: Dual X with Idler, Dual Y-axis

X/X': Two R3 or R4 Series: One with motor, one Idler, screw or belt
Y: Two R3 or R4 Series: One with motor, one Idler



Sample Components List

X-axis:	R3B23-105B-24-PR-ASE
X'-axis:	R3-IDLER-24-ASE
Y-axis:	R3B23-102B-18-PR-ASE
Y'-axis:	R3-IDLER-18-ASE
Driveshaft:	Not required
Cable Track:	Optional
Limit Switches:	2 RP1-25 (home), 4 RP2-25 (end-of-travel)
Mtg. Brackets:	2 MB-2R3-R3 (mounts Y & Y' to X & X' carriages)

		R3/R3 Idler (Type 3, 4)	R4/R4 Idler (Type 3, 4)
Max. Travel Area (X by Y)	in [mm]	108 x 24 [2750 x 610]	48 x 24 [1220 x 610]
Max. spacing between X & X'	in [mm]	to 15 [380]	to 15 [380]
Load capacity	lb [N]	0-50 [220]	0-150 [660]
Max. speed	in/s [mm/s]	120 [3000]	120 [3000]
Repeatability (per axis)	in [mm]	±0.004 [±0.10]	±0.004 [±0.10]
Backlash 20T, 30T models	in [mm]	0.03 [±0.75]	0.03 [±0.75]
50T, 70T, 100T models	in [mm]	0.06 [±1.50]	0.06 [±1.50]
Motor Types Available		1.8° Step Motor Brushless Servo	1.8° Step Motor Brushless Servo

Cartesian System Selection Checklist

Selecting A System

Recommended steps for selecting and ordering a Cartesian Actuator System

A. Describe your requirements using the *Caretesian Selection Worksheet* (see page D-12), and fax to your local distributor or IDC Applications Engineering at the factory for product selection assistance.

or

use the following selection checklist to choose your own components.

Selecting an IDC Cartesian Actuator System

❑ 1) General Considerations

Consult the R3 and R4 Series **General Specifications** in section B of this catalog for specifications not shown in this section. Specifications described in Section B must not be exceeded when R3 or R4 Series actuators are used as Cartesian System components.

a) Payload Requirements – R3 or R4?

Payload	Actuator Size
50 lbs or less	R3 or R4 Series are both candidates for the application
Between 50 and 150 lbs	R4 is required
Greater than 150 lbs	Consult the factory

b) Motion Precision

i) Straightness and Flatness
Check straightness and flatness requirement of motion. Is ±0.004 in/ft OK?

ii) Linear Repeatability

Is ±0.004 in OK?

iii) Linear Backlash

When moves repeat from the same direction each cycle, backlash is usually not important. Consult the factory for precision gearhead solutions to further reduce backlash.

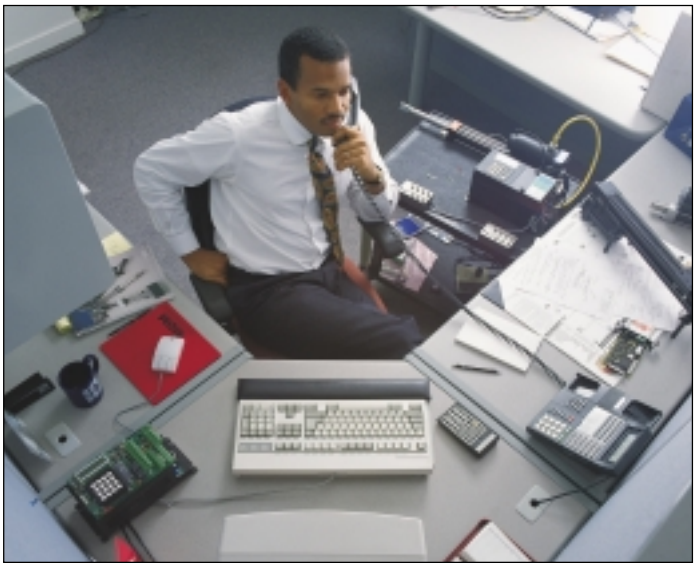
c) Carriage Moment Loads

i) Calculate moment loads on Y-axis carriage to determine whether a secondary Y-axis (Y') is required.

Notes:

- Remember both stopped and moving conditions.
- The X-axis thrust creates a Y-axis Roll Moment load.

ii) Carriage Deflection
Determine carriage surface angular deflection under maximum application loading conditions. See the R3 and R4 sections for these specifications.



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❑ 2) X, X' Axis Actuators

a) Required Actuator Stroke

i) Max. Stroke Available On Each Axis:

X-axis: 108 in

Y-axis: 60 in

ii) Increase Travel Area for Limit Switches

Include 'overtravel distance' to prevent crash into hard-stops when limit switches are triggered.

Use the following formula to estimate stopping distance from a certain speed, with payload for the application:

$x = mv^2 \div 2F$, where

- x = deceleration distance *(inches)*
- m = mass of payload *(lb_f / 386)*
- v = velocity before deceleration *(inches per second)*
- F = force available to decelerate, from performance curve *(lb_f)*

Add twice the X value to your required motion distance, to get required actuator stroke.

Example:

Require 18" movement for longest typical motion cycle. 25 lb payload, moving at 30 in/sec with an actuator capable of 80 lb peak thrust. X calculates with the above formula to be 1.46 inches. So, add 3 inches (two times 1.46 inches) to 18" and order X-axis actuators with a stroke of 21" or greater.

b) Thrust in X and Y Directions

Calculate thrust requirements in both the X and Y axes. Remember that the X axes must move the weight of the Y-axis actuator, besides any Y-axis payloads. Select an appropriate motor and actuator system from section B of the catalog, and de-rate the X-axis thrust by 10 pounds for additional losses in the X' actuator (seal, carriage bearings, pulley bearings, belt, etc.).

Actuator Size, Type
R3S Step Motor
R3B Brushless Servo
R4S Step Motor
R4B Brushless Servo

c) Motor Orientation

Recommended are the -AR and -AL, with the motor *above* the actuator, out of the way of the X-axis actuators. The -BR, -BL, -CR and -CL motor orientations are available as well. Consult the factory to double-check Y-axis/X-axis actuator interference.

d) Actuator Mounting Options

Select an actuator mounting option for both X and Y axes. The -A Angle Brackets often provide the most flexibility.

e) Overall Length of X Actuators

LX (R3 Series) = Stroke + 18.22 in [462.8 mm]
LX (R4 Series) = Stroke + 22.78 in [578.6 mm]

X-Axis: Motor-driven Actuator with Stub Shaft

Base Model		Stub Shaft	Stroke Length	Motor Orientation		Mounting		Options
	—	—	—	—	—	S		
R3B23 **R3B32** **R3P22** **R3S33** **R4B32** **R4B41** **R4S33** **R4S42**	**20T** **30T (R4 only)** **50T** **70T** **100T**	**S** Stub Shaft is always opposite motor.	**nn** (inches)	**AR** Over Right **BR** Behind Right **CR** Under Right **AL** Over Left **BL** Behind Left **CL** Under Left	**A** Angle Brkts **B** T-Nuts **C** Flanges	**S** Single	**E** English **M** Metric	**-GL** Left lube port **-GR** Right lube port **-VL** Left breather vent **-VR** Right breather vent

Cartesian System Selection Checklist

X' Axis Actuator

a) Select actuator mounting options for both X and Y axes. Commonly, -A Angle Brackets provide the most flexibility.

X'- or Y'-Axis: Secondary-driven Actuator with Stub Shaft

Base Model		Stub Shaft	Stroke Length		Mounting		Options
[ ]	— [T] —	[ ]	[ ]	— [ ]	[S]	[ ]	[ ]
R3 **R4**	**T**	**SR*** (right) **SL*** (left)	**nn** (inches)	**A** Angle Brkts **B** T-Nuts **C** Flanges	**S** Single	**E** English **M** Metric	**-GL** Left lube port **-GR** Right lube port **-VL** Left breather vent **-VR** Right breather vent

* Select same shaft side (R or L) as the Motor Orientation option on the X-axis motor-driven actuator.

Example: *X-axis motor-driven actuator is ordered* with the "–B**R**" motor orientation. Use "–S**R**" shaft option on right side of X'-axis shaft-driven actuator.

X'- or Y'-Axis: Idler Actuator (used when spacing between X and X' is less than 15", instead of drive shaft)

Base Model		Stroke		Mounting		Options
[ ]	— [IDLER] — [ ] —	[ ]	[ ]	[S]	[ ]	[ ]
R3 **R4**	**IDLER**	**nn** (inches)	**A** Angle Brkts **B** T-Nuts **C** Flanges	**S** Single	**E** English **M** Metric	**-GL** Left lube port **-GR** Right lube port **-VL** Left breather vent **-VR** Right breather vent

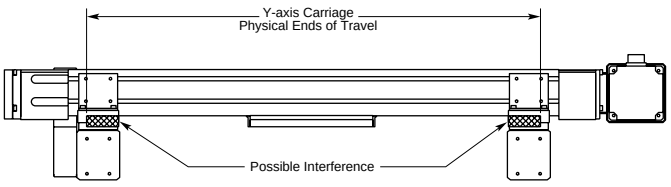
3) Y, Y' Axis Actuators

Select any compatible R3 or R4 Series, belt or screw-driven actuator from the R3 (page B-58) or R4 (page B-102) sections of the catalog. Typically, the -A (side angle brackets) mounting option is used to attach the Y-axis to an X-axis carriage. (No stub shaft option required.)

a) Inverted Y Axis

Is the Y-axis carriage inverted with respect to X-axis carriages? When specifying an inverted Y axis actuator, additional stroke may be required depending on the dimensions of the load and the spacing of the X axis actuators (DBXC). This drawing shows critical dimensions.

Inverted Y Axis Detail



b) Motor Orientation

Recommended are the -AR and -AL, with the motor above the actuator, out of the way of the X-axis actuators. The -BR, -BL, -CR and -CL motor orientations are available as well. Consult the factory to double-check Y-axis/X-axis actuator interference.

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4) Driveshaft

a) Spacing Between X and X' Axes

The distance between the X and X' axes is referred to as *DBXC*.

b) X' Driven By Driveshaft or X' Idler?

i) If DBXC < 15", then you can use an idler, instead of driveshaft.
ii) When using an X' idler, remove the -S option from the X-axis model number, since no stub shaft is required.
iii) Using a driveshaft when DBXC < 15" provides higher stiffness to the system.

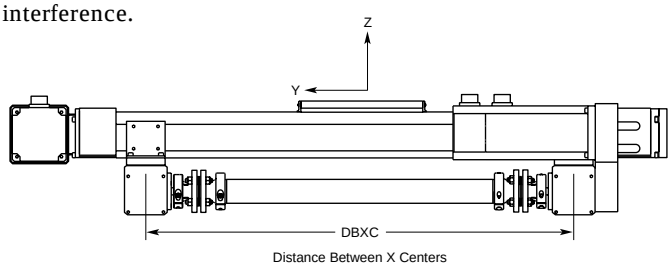
c) Overall Width of X, X' Actuator Pair

WX (R3 Series) = DBXC + 4.03 in [102.4 mm]
WX (R4 Series) = DBXC + 6.13 in [155.7 mm]

X & X' Actuator Spacing Chart

Y Axis	DBXC	
	Minimum	Maximum
R3 Belt	10.63 in	stroke + 7.0 in
R3 Screw *	10.63 in	stroke + 6.4 in
R4 Belt	11.13 in	stroke + 6.1 in
R4 Screw*	11.13 in	stroke + 7.5 in

* When using -P, –PL or –PR mounting, check for motor interference.



Drive Shaft Kit (includes driveshaft, couplings, and hardware)

		Size		DBXC Length
DS	—		—	
DS		**R3** **R4**		**nn.nn** (inches)

DBXC = Distance Between Actuator Centers

Actual driveshaft length is less than the DBXC length, but since it is easier to design for DBXC, we use that for specifying the length of the drive shaft.

5) Mounting Adapters

a) Distance Between Actuator Supports

Evaluate unsupported distance between mounting points of X and Y axes. Adjust as necessary. **Check formulas in R3 or R4 sections for actuator deflection** limits when actuator is supported at two points.

6) Limit Switches

a) Home Limits are used on both the X and Y axis to set the absolute position reference at control startup.

RPS-1 (reed-type) and **RP1** (Hall effect), both normally open switches, are recommended for home inputs.

b) End-Of-Travel Limits are used to indicate when an actuator has been commanded out of safe mechanical range.

RPS-2 (reed-type) and **RP2** (Hall effect), both normally closed switches, are recommended for EOT inputs.

7) Cable Track Kit and Support Tray Kit

Select a cable track kit from the information on page D-16.

a) Which actuator, R3 or R4? This determines which support tray brackets are included in the kit.

b) Enter X-axis Stroke Length as the required "stroke" in the model number for the cable track kit.

c) With –AL, –AR, –CL or –CR X-axis motor orientations, specify the –**A** mounting option. With –BL or –BR motor orientations, use the **–B** mounting option.

NOTE: Standard cable length is 12 ft. Cable lengths up to 50 ft are available.

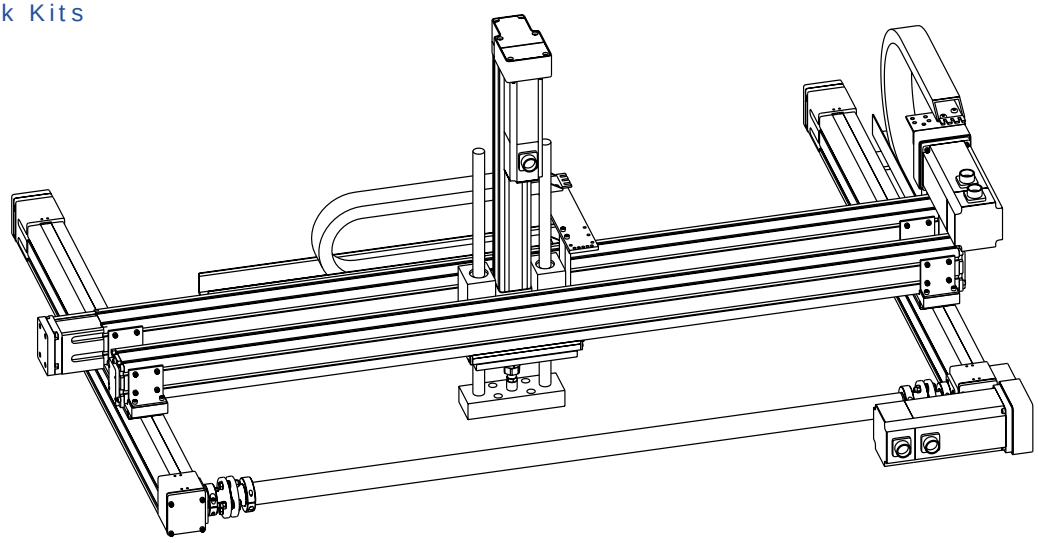
8) Multi-Axis Control

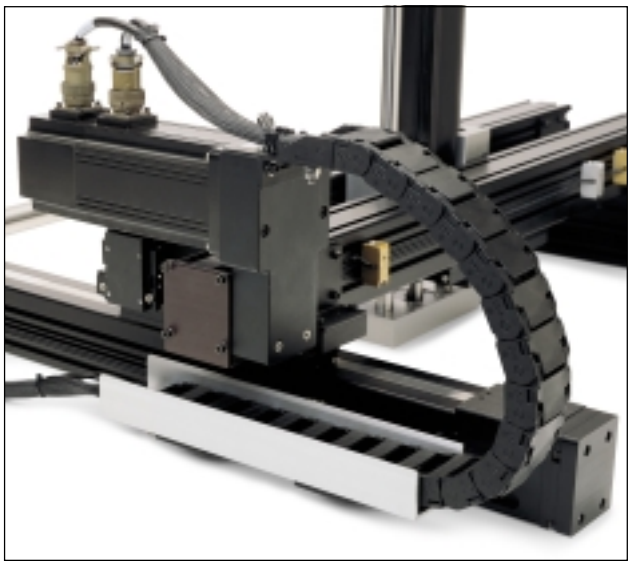
Select a control system to match the motors selected above.

Motor	Programmable Control	Drive Only
Brushless Servo Motors	B8962 (2-axis) 962 Indexer (2-axis, requires drives)	B8001 (1-axis)
Step Motors	S6962 (2-axis) SmartStep (1-axis) 962 Indexer (2-axis, requires drives)	NextStep (1-axis) S6002 (2-axis)

Cartesian System Selection Checklist

Cable Track Kits



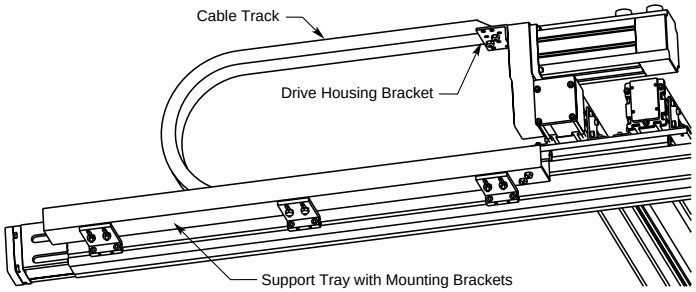


Cable track provides a convenient means of safely routing wiring to Y- and Z-axis moving actuators.

- Power, encoder feedback, and limit switch wires can be routed away from moving components.
- Includes mounting kit for your system

Kits include:

1) Flexible Cable Track
2) Aluminum Support Tray, including actuator mounting hardware
3) Mounting bracket to attach motor end of cable track to actuator



Actual kit sizes

- Actual Length of Cable Track Included: Stroke +9 in [225mm] for both R3 and R4 Cable Track kits.
- Tray Length: (Stroke ÷ 2) + 2 inches [50.8mm].

X- to -Y Cable Track Kit Part Numbers

Example: CT-R3-R3-stroke *(in)* -A

	(From Axis)		(To Axis)		Stroke in *inches*[1]		Mounting Code
CT	– R3	–	R3	–	36	–	A
	R3		R3		*12 to 96*		
	R4		R4				

A: when (To Axis) has motor orientation of -AR, -AL, -CR, -CL

B: when (To Axis) has motor orientation of -BR, -BL

[1] When ordering cable track kits for Y-axis cables, specify the stroke length of the X-axis actuator. This is because the Y-axis cables travel alongside the X-axis actuator. *Consult the factory for Y- to -Z cable track options.*

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Specifications

Cartesian Inertia Data

The following data are used to calculate the combined inertia of the X & X' or Y & Y' components of a multi-axis Cartesian System, including a driveshaft when present.

Y-axis and Z-axis actuator inertia can be found in the Rodless Actuator section of the catalog, for single-axis components.

X or Y with X'/Y' Idler

Equations Rotary Inertia (reflected to the motor) = A + B × (stroke, in) + C × (load, lbf) + E
Linear Inertia (reflected to the carriage) = [A + B × (stroke, in) + E]/C + (load, lbf)

R3 Idler Models	Motor Ratio	Belt/Screw Ratio	A (lb-in-s²)	B (lb-in-s²/in)	C (lb-in-s²/lb)
R3...-20T with idler	2:1	Belt Drive	2.82 E-03	4.82 E-06	5.78 E-04
R3...-50T with idler	5:1	6.000 in/rev	5.81 E-04	7.61 E-07	9.12 E-05
R3...-70T with idler	7:1		3.47 E-04	3.96 E-07	4.71 E-05
R3...-102B with idler	1:1	2B Ballscrew	5.29 E-03	7.12 E-05	1.64 E-05
R3...-152B with idler	1.5:1	0.5 in/rev	2.35 E-03	3.17 E-05	7.29 E-06
R3...-202B with idler	2:1		1.33 E-03	1.78 E-05	4.10 E-06
R3...-502B with idler	5:1		3.44 E-04	2.80 E-06	6.48 E-07
R3...-702B with idler	7:1		2.25 E-04	1.45 E-06	3.30 E-07
R3...-105B with idler	1:1	5B Ballscrew	5.25 E-03	7.12 E-05	2.62 E-06
R3...-155B with idler	1.5:1	0.2 in/rev	2.34 E-03	3.17 E-05	1.17 E-06
R3...-205B with idler	2:1		1.32 E-03	1.78 E-05	6.64 E-07
R3...-505B with idler	5:1		3.42 E-04	2.80 E-06	9.71 E-08
R3...-705B with idler	7:1		2.24 E-04	1.45 E-06	6.61 E-08
R3...-105A with idler	1:1	5A Acme screw	5.25 E-03	7.12 E-05	2.62 E-06
R3...-155A with idler	1.5:1	0.2 in/rev	2.34 E-03	3.17 E-05	1.17 E-06
R3...-205A with idler	2:1		1.32 E-03	1.78 E-05	6.64 E-07
R3...-505A with idler	5:1		3.42 E-04	2.80 E-06	9.71 E-08
R3...-705A with idler	7:1		2.24 E-04	1.45 E-06	6.61 E-08
R4 Idler Models					
R4...-20T with idler	2:1	Belt Drive	9.44 E-03	1.06 E-05	9.02 E-04
R4...-30T with idler	3:1	7.421 in/rev	3.82 E-03	4.71 E-06	4.01 E-04
R4...-50T with idler	5:1		1.61 E-03	1.62 E-06	1.38 E-04
R4...-100T with idler	10:1		5.75 E-04	4.21 E-07	3.60 E-05
R4...-101B with idler	1:1	1B Ballscrew	1.57 E-02	7.12 E-05	6.56 E-05
R4...-151B with idler	1.5:1	1.0 in/rev	7.05 E-03	3.17 E-05	2.92 E-05
R4...-201B with idler	2:1		4.04 E-03	1.78 E-05	1.64 E-05
R4...-501B with idler	5:1		9.73 E-04	2.72 E-06	2.51 E-06
R4...-1001B with idler	10:1		4.10 E-04	7.12 E-07	6.48 E-07
R4...-104B with idler	1:1	4B Ballscrew	1.53 E-02	7.12 E-05	4.10 E-06
R4...-154B with idler	1.5:1	0.25 in/rev	6.91 E-03	3.17 E-05	1.83 E-06
R4...-204B with idler	2:1		3.96 E-03	1.78 E-05	1.02 E-06
R4...-504B with idler	5:1		9.61 E-04	2.72 E-06	1.62 E-07
R4...-1004B with idler	10:1		4.07 E-04	7.12 E-07	4.86 E-08

Motor	E (lb-in-s²)
D	1.13 E-03
H	3.06 E-03
H4	1.25 E-02
S23	3.11 E-04
S33	1.66 E-03
S42	7.13 E-03
B23	1.19 E-04
B32	1.00 E-03
B41	2.60 E-03

Metric Conversions:
1 mm = 0.03937 in
1 kg = 2.205 lb
1 lb-in-s² = 1129 kg-cm²
= 1.152 kg-cm-s²

X with Driveshaft and Driven X' Actuator

Equations Rotary Inertia (reflected to the motor) = A + B × (stroke, in) + C × (load, lbf) + D × (DBXC, in) + E
Linear Inertia (reflected to the carriage) = [A + B × (stroke, in) + D × (DBXC, in) + E]/C + (load, lbf)

R3 Driveshaft Models	Motor Ratio	Belt/Screw Ratio	A (lb-in-s²)	B (lb-in-s²/in)	C (lb-in-s²/lbf)	D (lb-in-s²/in)
R3...-20T with driveshaft	2:1	6.000 in/rev	4.33 E-03	9.64 E-06	5.78 E-04	2.85 E-05
R3...-50T with driveshaft	5:1		9.49 E-04	1.52 E-06	9.12 E-05	4.56 E-06
R3...-70T with driveshaft	7:1		5.84 E-04	7.92 E-07	4.72 E-05	2.33 E-06
R4 Driveshaft Models						
R4...-20T with driveshaft	2:1	7.421 in/rev	1.16 E-02	2.12 E-05	9.02 E-04	2.85 E-05
R4...-30T with driveshaft	3:1		4.34 E-03	9.42 E-06	4.01 E-04	1.27 E-05
R4...-50T with driveshaft	5:1		1.90 E-03	3.24 E-06	1.38 E-04	4.56 E-06
R4...-100T with driveshaft	10:1		6.57 E-04	8.42 E-07	3.60 E-05	1.14 E-06

Cartesian Selection Worksheet

For selection assistance, fax to your local IDC Distributor, or directly to IDC. An Application Engineer will call to discuss the application and assist in recommending a solution.

Prepared By: _____

Name _____
Company _____
E-mail _____
Phone _____
Fax _____

Prepared For: _____

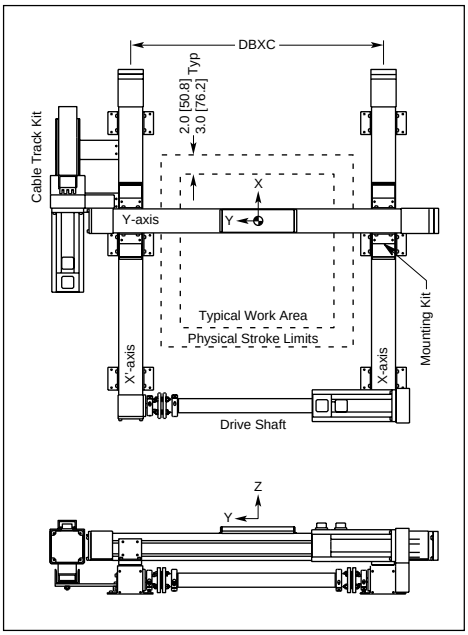
Name _____
Company _____
E-mail _____
Phone _____
Fax _____

Payload

Weight _____ lbs Payload Dimensions: X= _____ inches, Y= _____ inches, Z= _____ inches

Motion Information

	X Axis	Y Axis	Z Axis
Travel			
Dist. Between Actuator Centers	DBXC:	DBYC:	
Horizontal or Vertical?	☐ H ☐ V	☐ H ☐ V	☐ H ☐ V
Thrust Force			
Maximum Acceleration			
Maximum Speed			
Position Repeatability			
Position Accuracy			
Straightness / Flatness			
Duty Cycle			
Required Life			
Limit Switches			



Duty Cycle/Life

Duty Cycle

Total Cycle Time _____sec Extend/Retract Cycles per day _____

Sum of Move Times _____sec Move Distance per cycle _____

Please attach Move Profile Chart (speed vs. time) for each axis.

Required Life

Units ☐ Inches ☐ Meters ☐ Cycles ☐ Months ☐ Years

Minimum Life _____

Maintenance/Lube Interval _____

Environment

Operating Temperature

☐ Normal 32-140°F [0-60°C]
☐ High Temp _____°F/°C
☐ Low Temp _____°F/°C

Contaminants (Check all that apply)

Solid _____
☐ Non-abrasive ☐ Coarse Chips
☐ Abrasive ☐ Fine Dust

Liquid _____
☐ Dripping ☐ Non-corrosive
☐ Mist/Spray ☐ Corrosive
☐ Splashing
☐ High Pressure

Conditions

☐ Washdown ☐ Outdoor ☐ Vacuum ☐ Cleanroom

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How To Order

There are two methods for selecting and ordering Cartesian systems. You can either use IDC's assistance or you can select your own components. These two methods are described here.

IDC Assistance with Selecting your System

1) **Application Data Form**
Fill out the Cartesian Selection Worksheet form, and fax to the Applications department (see previous page). The checklist below is provided as guide when selecting a system, however it is strongly recommended that IDC take part in the selection process.

2) **Preliminary Price Estimate–Budgetary Pricing**
An applications engineer will evaluate your needs, and prepare a "Preliminary Price Estimate," including pricing for the system which best meets the requirements described in the Application Data Form. This estimate will document all required components, and is used to verify pricing before completely engineering the system.

3) **IDC System Design and Drawing**
An IDC design engineer will integrate the components selected in the Preliminary Price Estimate, using a 3-D CAD package, and ensure all motion requirements and space constraints are met. Secondary review of motion and precision requirements will be done, and any required modifications will be documented. A multi-view CAD drawing will be produced, showing the dimensions and work area of your exact system. Also, a single part number will be assigned for the complete system, to make ordering easier.

4) **Formal Quote**
Returned with the system CAD drawing will be a formal "Cartesian System Quote," which includes finalized system pricing following thorough engineering review. Also, if you desire your system arrive fully assembled, charges for system assembly and crating will be included.

Select your own System

The checklist is intended as a selection aid for 'do-it-yourselfers' when selecting components for Cartesian Actuator Systems. Without reviewing the application, it is difficult to guarantee that this list will be appropriate in every application, but it is hoped that the checklist will list the required components for most applications.

Please contact our Applications Engineering department with any questions at (800) 747-0064.

Checklist Summary

X-Axis

Actuators
- ☐ Motor-driven X
- ☐ Driveshaft-driven X' or Idler non-driven X'

Mounting Brackets
- ☐ X/X' to Alum. Framing (optional, used when mounting to Bosch, 80/20, Item, etc. framing)

Driveshaft
- ☐ Driveshaft kit (also requires that both X and X' actuators include the -S stub shaft option)

Limit Switches
(switches for X or X', not both)
- ☐ Home Limit Switch (1)
- ☐ End-of-travel Limit Switches (2)

Cable Track
- ☐ Cable track kit for Y-axis cables (ordered to match X-axis stroke)

Y-Axis

Actuators
- ☐ Motor-driven Y
- ☐ Idler non-driven Y' (optional)

Mounting Brackets
- ☐ Y to X Mounting Brackets
  Needed when:
  - Ys are inverted
  - Two parallel Ys (Y' Idler)
  - Y is R3 size, and X is R4

Limit Switches
- ☐ Home Limit Switch (1)
- ☐ End-of-travel Limit Switches (2)

Cable Track
- ☐ Cable track kit for Z-axis cables–ordered to match Y-axis stroke. (optional)

Z-axis

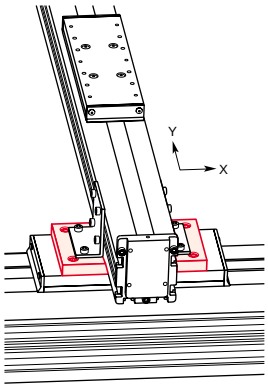
Actuators
- ☐ Motor-driven Actuator

Mounting Brackets
- ☐ Z to Y Mounting Brackets

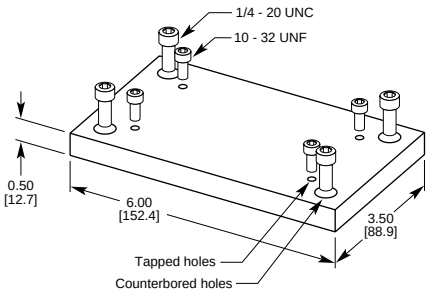
Limit Switches
- ☐ Home Limit Switch (1)
- ☐ End-of-travel Limit Switches (2)

Mounting Brackets

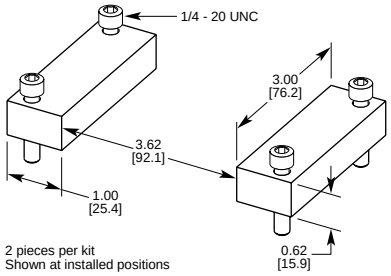
Single Y-Axis Actuator to X-Axis Carriage



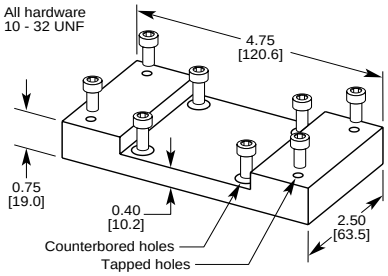
MB-R3-R4
Mounts R3 to R4 carriage.



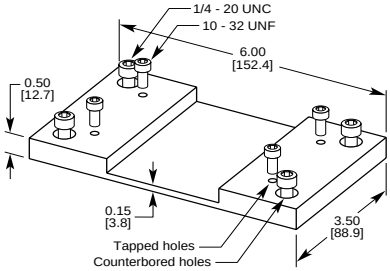
MB-R4INV-R4
Mounts inverted R4 to R4 carriage.



MB-R3INV-R3
Mounts inverted R3 to R3 carriage.

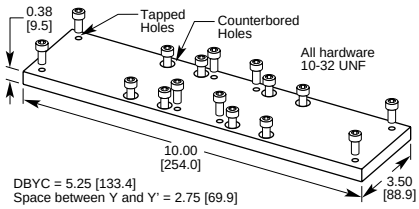


MB-R3INV-R4
Mounts inverted R3 to R4 carriage.

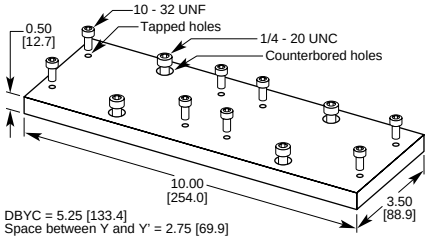


Dual Y-Axis Actuators to X-Axis Carriage

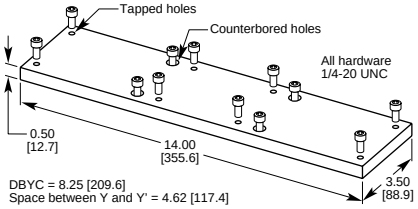
MB-2R3-R3
Mounts two R3s to R3 carriage.



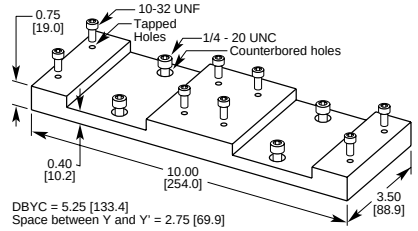
MB-2R3-R4
Mounts two R3s to R4 carriage.



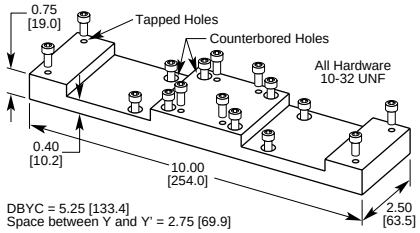
MB-2R4-R4
Mounts two R4s to R4 carriage.



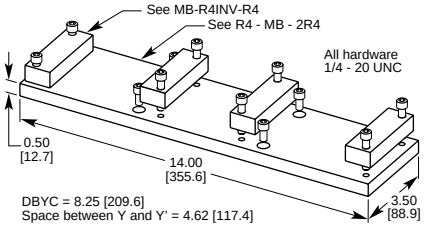
MB-2R3INV-R4
Mounts two inverted R3s to R4 carriage.



MB-2R3INV-R3
Mounts two inverted R3s to R3 carriage.



MB-2R4INV-R4
Mounts two inverted R4s to R4 carriage.



Mounting Bracket Part Number

Example: MR-2R3-R3

		(Base Axis)				(Attached Axis)
MB	–	2R3			–	R3
		R3	2R3	R3INV		
		R4	2R4	R4INV		

Notes:
- When connecting a single Y-axis actuator to an X or X' carriage of the same size (i.e. R3 to R3), no adapter is required when the Y-axis has the -A mounting option.
- Consult the factory for mounting brackets not listed herein.

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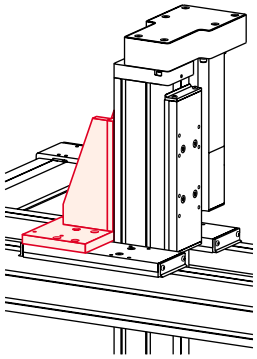
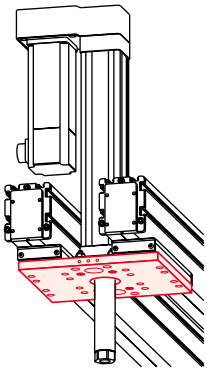
Mounting Brackets

Z-Axis Actuator to Dual Y-Axis Carriages

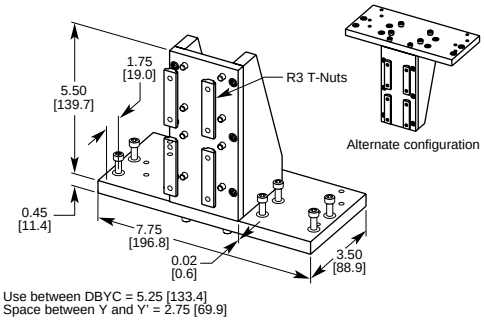
R3 Rodless Z-Axis



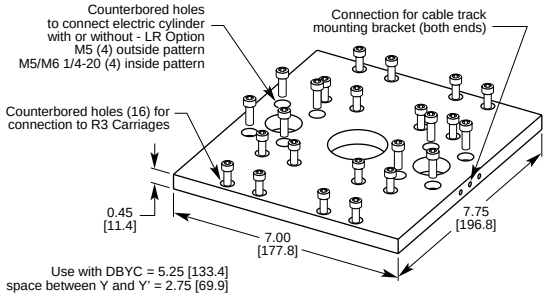
EC2 Rod-Type Z-Axis



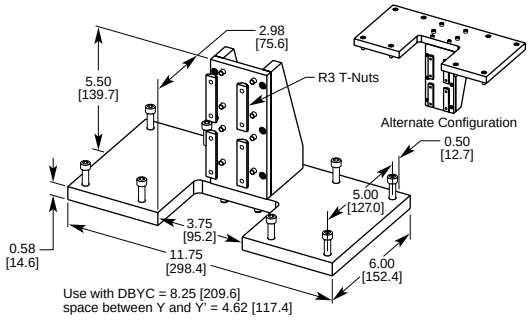
MB-Z-R3-2R3 – Mounts R3 to two R3 carriages.



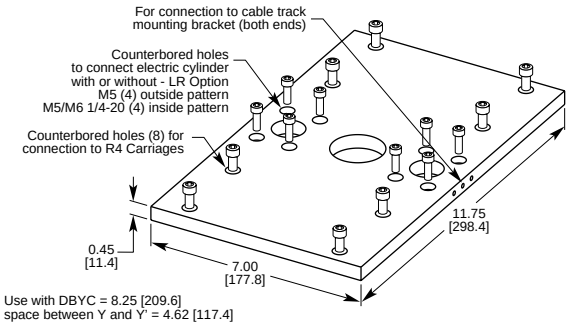
MB-Z-EC2-2R3 – Mounts EC2 to two R3 carriages.
* Requires EC2 to have MF1 or -LR.



MB-Z-R3-2R4 – Mounts R3 to two R4 carriages.

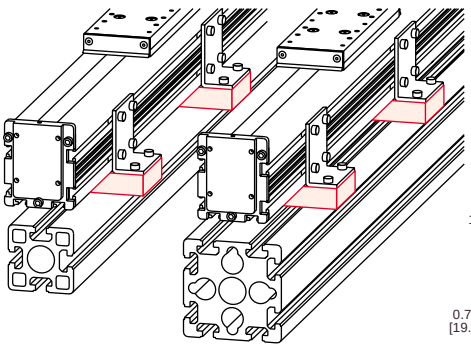


MB-Z-EC2-2R4 – Mounts EC2 to two R4 carriages.
* Requires EC2 to have MF1 or -LR.

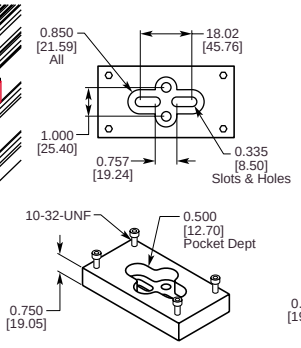


X, X'-axis Actuator to Aluminum Framing

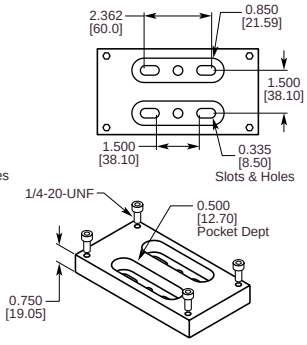
X, X'-axis Stroke	Total Required for X & X'
6-18"	4
19-36"	6
37-48"	8
49-72"	10
73-108"	12



R3 Series
p/n: MB-R3-AF1



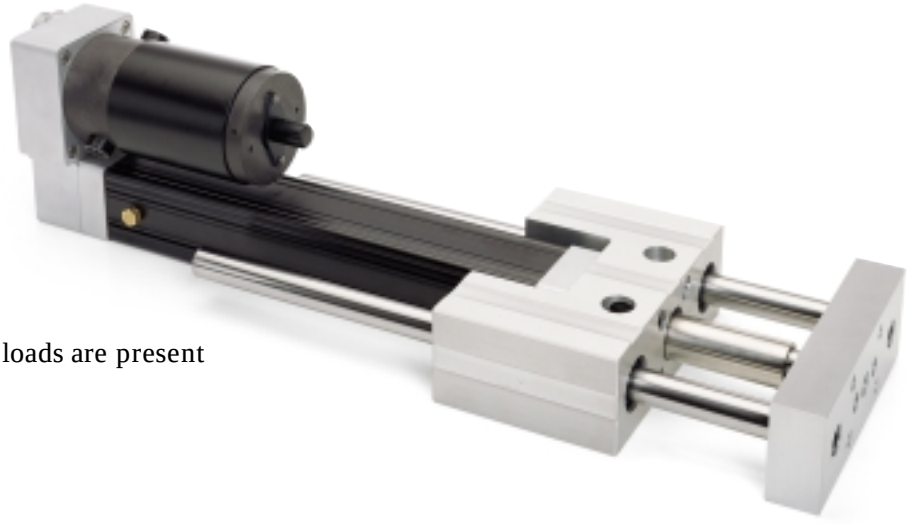
R4 Series
p/n: MB-R4-AF1



Linear Rod Bearing Option

-LR Linear Rod Bearing Option

The -LR linear rod bearing option is used in applications where side loads are present, or when the load is not externally supported.



Reasons for using the -LR Linear Rod Bearing are:

- Increased side load capacity
- Anti-rotation–reduces any rotational motion of the moving load
- Higher actuator efficiency when side loads are present
- Lower thrust tube runout

-LR available with:

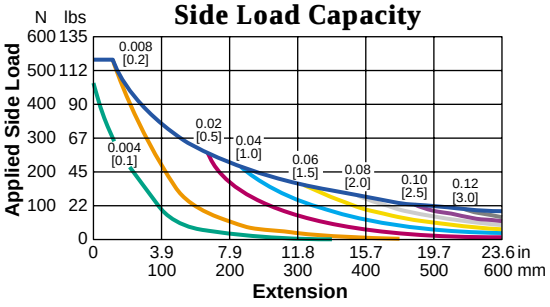
- EC2

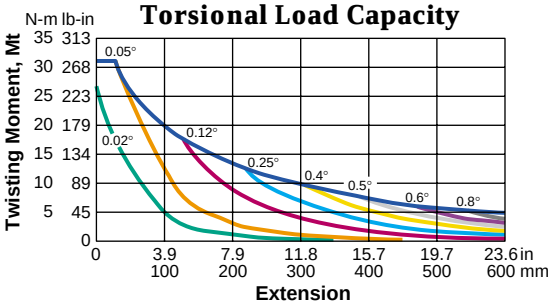
-LR not available with:

- MS2 Side lug mounting option

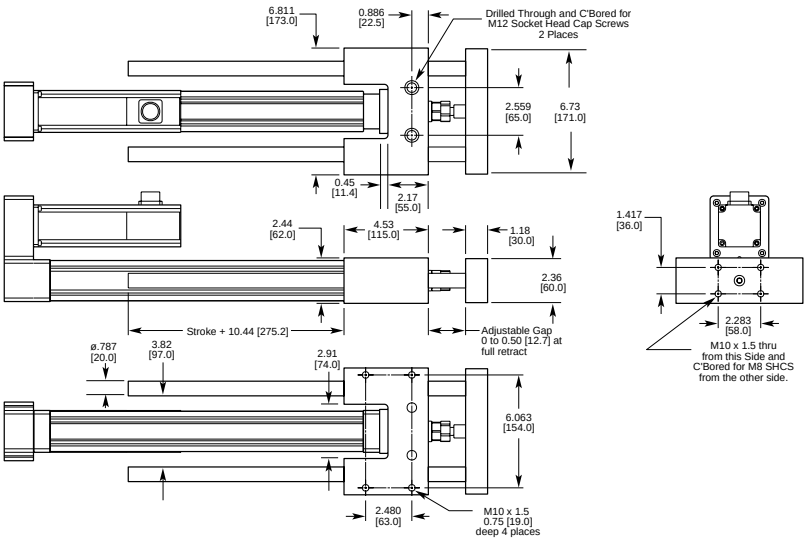
Weight calculation:

Weight (lb_f) = 0.0147 stroke (mm) + 7.6 lb_f





Dimensions in [mm]



To order the Linear Rod Bearing as a separate component:

Linear Rod Bearing Part Number

Example: LR-EC2-0200-A

LR	—	EC2	—	0200	—	A
LR		EC2		Stroke in mm		Revision

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