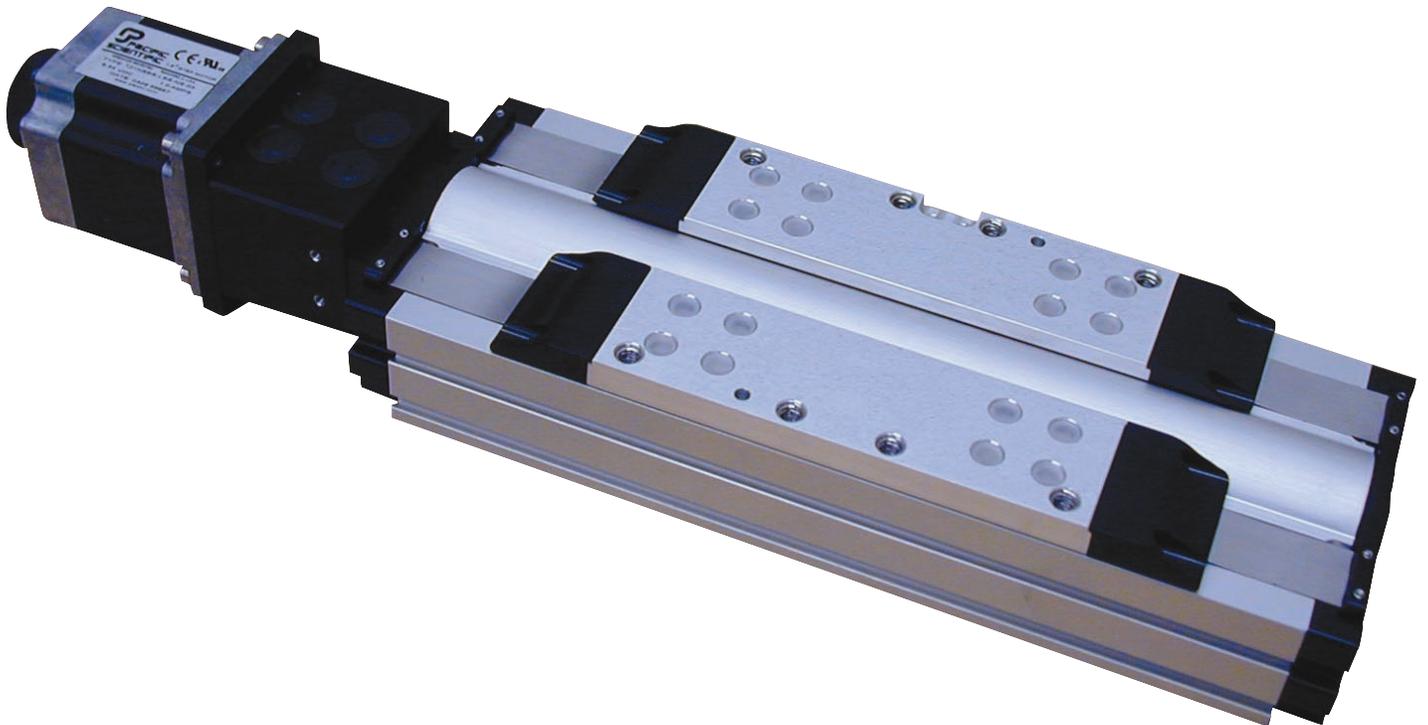


# DS4 Series

## Ballscrew Positioning Tables

## User's Manual





## Record of Manual Revisions

<b>REV NO.</b>	<b>DATE</b>	<b>BRIEF DESCRIPTION OF REVISION</b>
1.0	8/25/03	Initial release
1.1	1/09/04	Revised with IDC14 as standard brushless servo motor

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## Important User Safety Instructions

Only qualified personnel are permitted to transport, assemble, commission, and perform maintenance on this equipment. Properly qualified personnel are persons who are familiar with the transport, assembly, installation, commissioning and operation of positioning tables and motors, and who have the appropriate qualifications for their jobs. The qualified personnel must know and observe the following guidelines:

- Read all available documentation before assembly and commissioning. Incorrect handling of products in this manual can result in injury and damage to persons and machinery. Strictly adhere to the technical information on the installation requirements.
- DO fully support the positioning table body when lifting it.
- DO make certain to remove shipping locks prior to table operation.
- DO make sure that the mounting surface is sufficiently flat.
- DO NOT allow the carriage to collide with hard stops at end of travel.
- DO make certain that the installation area provides sufficient space for full carriage travel.
- DO NOT drill holes into the carriage or base without consulting IDC. Metal chips may contaminate the drive screw and bearings, and holes and fasteners may interfere with the table mechanisms. Please contact IDC if such modifications are desired.
- DO NOT disassemble the positioning table. Unauthorized modifications and adjustments will void product warranty and potentially affect safety and performance of the unit
- DO NOT immerse the positioning table in liquids or store or operate it in condensing atmospheres. Liquids or condensate may dissolve lubricants or cause corrosion of the components.
- DO inspect the table mechanism regularly and clean and lubricate it as required.
- DO use common sense by keeping fingers, hair, clothing, etc. away from any moving parts.
- DO secure the carriage whenever transporting or shipping the table.
- DO NOT disassemble multi axis configurations unless your system was purchased with the dowel pin assembly option. The user cannot restore unpinned configurations to precise orthogonality.
- In vertical orientations, depending on the ballscrew lead and the load applied to the positioning table, the shuttle carriage may backdrive in a power loss situation. To prevent potential damage or personal injury, an electro-mechanical power-off brake should be considered.
- All electrical components must be strain relieved to prevent component failure and possible personal injury. This includes motors, brakes, limit/home sensors and encoders.



Prior to operating any positioning table, check to be certain that your installation allows sufficient space for unobstructed travel.

Overtravel excursions, resulting in carriage collisions with the hard stops, are potentially damaging to the positioning table and must be avoided. Damage incurred as a result of over travel is not covered by IDC's Product Warranty. Limit switches are recommended for all DS4 tables. The locations of any limit switches are adjustable and should be installed in accordance with the guidelines provided.

Limit switches alone do not guarantee overtravel protection since load, speed and the resulting momentum of the user's move profile will affect necessary stopping distance. Brakes or over travel allowances sufficient to stop the carriage prior to hard stop contact are the responsibility of the user.





<b>1.</b>	<b>PRODUCT OVERVIEW</b>	<b>7</b>
	DS4 Series Features	7
	DS4 Series Specifications	8
	DS4 Positioning Table Construction	8
	Unpacking & Handling	8
	Shipping Locks	9
	Transporting the Table	9
<b>2.</b>	<b>PART NUMBERS – IDENTIFYING/CONFIGURING A DS4</b>	<b>10</b>
	Location & Use of the Identification Label	10
	Part Number Example	11
	Identify Your DS4 Table	11
	Complete Standard Configuration Guide	12
<b>3.</b>	<b>DS4 SERIES SPECIFICATION</b>	<b>15</b>
	General Specifications	15
	DS4 Dimensional Drawing (Base Unit)	16
	Motor Mount Information – Inline Versions	17
	Motor Mount Information – Parallel Versions	19
	Engineering Reference	20
	Loading Calculations for DS4	20
	Load/Life Chart	27
	Ball screw Technical Data	28
<b>4.</b>	<b>MOUNTING YOUR DS4 POSITIONING TABLE</b>	<b>29</b>
	Mounting Considerations	29
	Base Mounting of the DS4	29
<b>5.</b>	<b>MOUNTING OF MOTORS, OPTIONS, ACCESSORIES</b>	<b>35</b>
	Mounting/Adjusting Limit & Home Sensors	35
	Brake Mounting	37
	Rotary Encoder Mounting	38
	Linear Encoder Index Adjustment	41
	Installing a Vent Tube Fitting	42
<b>6.</b>	<b>OPTIONAL EQUIPMENT - SPECIFICATIONS, DIMENSIONS, AND WIRING</b>	<b>44</b>
	Limit and Home Sensor Options	44
	Brake on Ballscrew Option (-BS)	48
	Rotary Encoder On Ballscrew Option (-ES)	50
	Linear Encoder Option (-E1, -E2, -E3)	52
	Motor Couplings	54



**7. MOTOR SPECIFICATIONS & MOUNTING .....57**  
     Specification of IDC-supplied motors .....57  
     Mounting a customer-supplied motor .....62  
     Motor Attachment or Replacement Inline Motor Mounting .....63  
     Motor Attachment or Replacement Parallel Motor Mounting .....66

**8. SERVICE & ROUTINE MAINTENANCE .....70**  
     Performing Inspections and Routine Maintenance .....70  
     Internal Access Procedure .....70  
     Lubricating Ways (Square Rail Bearings) .....75  
     Lubricating the Ballscrew .....76

**9. WARRANTY AND SERVICE COVERAGE .....78**

**APPENDICES .....80**  
     Cleanroom Prep .....81  
     Pinning .....82  
     Multi-axis Configurations .....83



## SECTION 1: Product Overview

IDC's DS4 Series Ballscrew Positioning Tables are designed for use in a wide variety of industrial, scientific, and commercial applications requiring precise control of position, speed or linear thrust. This manual will help you install, operate, and maintain your DS4 Table.

### DS4 Series Features

The DS4 is IDC's most versatile and modular line of positioning tables. Following are several features that make the DS4 the positioning table of choice for the most demanding applications:

- Precision-machined extruded high-strength aluminum base minimize angular positioning errors.
- Square rail linear bearings, featuring long modules on stainless steel rails, provide rigidity, stable accuracy, and smooth, precise motion.
- Precision ballscrew drive, with 5mm and 10mm leads, offer high speed and efficiency, excellent repeatability and accuracy, and mechanical advantage. The DS4's ballscrews can be driven at up to 80 rps, translating into speeds (with the 10mm lead) of up to 800 mm/s.
- Travels lengths from 50 to 600mm cover a wide range of applications.
- Proven magnetic stainless steel seal strip technology effectively seals the internal components of the DS4, protecting the ballscrew and ways from contaminants. This feature also contains ballscrew and way lubrication grease within the DS4.
- Unique IDEAL-SEAL magnetic cover strip locking device.
- Prevents stretching of the stainless steel bands, increasing life of the strips.
- Allows easy access to interior of the DS4, for mounting and maintenance.
- No small hardware or springs to lose, and no exposure to the sharp ends of the strips, which are problems for similar seal end-cap designs.
- Low profile shuttle carriage accepts direct mounting of another DS4 for XY configurations.
- Easily configurable modular design and option set including a variety of motor mounting orientations, motor sizes and type, ballscrew leads, coupling types and sizes, encoder feedback options, limit/home sensor types, and shaft brakes allow the DS4 to be customized to meet your specific requirements.
- Metric dimensions - Meets the needs of customers who manufacture for the international marketplace.

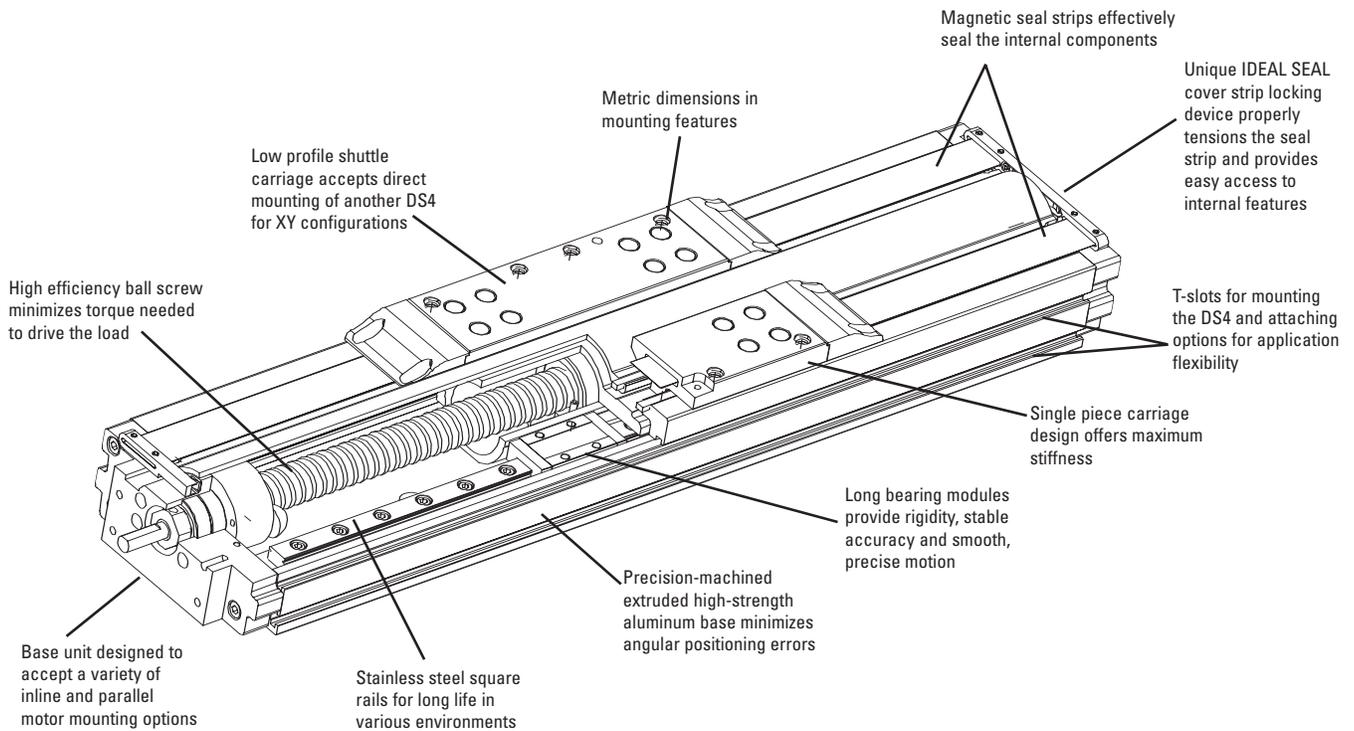


## DS4 Series Specifications

Specifications for each DS4 will vary based upon the travel, configuration and options selected. Please refer to Section 3, DS4 Series Specifications and Configuration Reference for specifications parameters and configurations.

## DS4 Positioning Table Construction (Typical)

This diagram of a DS4 Table is provided to illustrate the typical components of a DS4. Refer to Section 10, Parts List and Exploded Parts Diagram, for a more detailed breakdown of the DS4.



## Unpacking & Handling

Remove the positioning system from the shipping container being careful to fully support the base structure during lifting operations. Gently lay the positioning system on a clean, sturdy and flat surface. Never allow the system to “drop” into place. If the system was shipped in a crate, retain it for future transportation of the system. Next, carefully separate the packing material from the positioning table. Thoroughly inspect the container for loose items that may have shipped with the table (examples: Documentation CD, ancillary items). Examine the table for any evidence of damage.

**Any shipping damages to either the positioning system or the container should be reported to IDC or to the distributor from which it was purchased.**

## Shipping Locks

DS4 positioning tables and multi axis systems configured with DS4's include shipping locks to restrict carriage movement during transit. The locks are red aluminum plates that fasten the carriage to the base with socket head cap screws. Special multi axis table configurations may employ supplemental restraining devices to immobilize the system. In either case the **restraining elements must be removed prior to table operation.**

**Adhere to all user safety instructions provided on page 2.**

## Transporting the Table

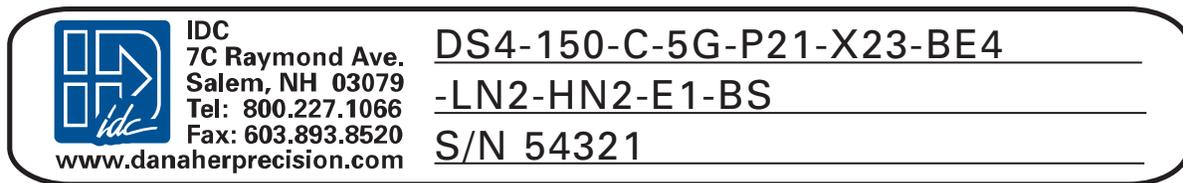
When moving, transporting or shipping DS4 positioning tables, the shipping locks and restraining materials included in the original packaging should be re-installed to immobilize the carriage. Failure to properly immobilize the carriage may result in damages to the positioning table that are not covered under warranty.



## SECTION 2: Part Numbers – Identifying/Configuring a DS4

### Location & Use of the DS4 Identification Label

Your new DS4 Positioning Table will arrive with an IDC factory labels attached as shown below. The factory label provides a detailed breakdown of the table model with all of its mechanical characteristics.



The identification label is located at two locations on each DS4. One is located externally on the side of the base of the DS4. The other label is located on the moving carriage of the DS4, and can be accessed by removing the curved ballscrew cover.

The identification label can be used to:

- (1) Identify the serial number of your particular DS4.
- (2) Identify a table's mechanical characteristics or configuration.
- (3) Order a new DS4 table with the same or different mechanical characteristics.

### DS4 Part Number Example

DS4 positioning tables are described by a modular part number that identifies the basic model as well as the component options supplied with the system. DS4 tables are described in the following example:

Sample Part # DS4-150-C-5G-X23-BE4-LN2-HN2-BS-E1

<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>
DS4	150	C	5G	P21	X23	BE4	LN2	HN2	BS	E1	

- Model .DS4
- Travel (mm) ..150
- Grade .....C
- Ballscrew Lead .....5G
- Motor .....P21
- Motor Mount .....X23
- Coupling (inline)/Orientation & Pulley (parallel) .....BE4
- Limit Switches .....LN2
- Home Switch .....HN2
- Shaft End Option (brake or rotary encoder) .....BS
- Linear Encoder .....E1
- Additional Options ..... xxx

### Identify Your DS4 Positioning Table

This fill-in-the-box section is provided for users who want to identify an existing DS4 Table or perhaps order a new DS4 Table. To identify the mechanical characteristics of an existing DS4 Table, print or photocopy this page and transcribe the model number from the factory label to boxes 2 through 12. To reconfigure or order a new DS4, fill in boxes 2 - 12 with codes for the new table. Refer to the DS4 Table Standard Configuration Guide on the following pages for boxes 2 - 12.

	Travel	Grade	Ballscrew Load	Motor	Motor Mount	Coupling/ Orientation and Pulley	Limits	Home	Shaft Option	Linear Encoder	Additional Options
DS4	-	-	-	-	-	-	-	-	-	-	-
1	2	3	4	5	6	7	8	9	10	11	12

See IDC's latest brochure or the DS4 web page ([www.DanaherMotion.com/ds4](http://www.DanaherMotion.com/ds4)).



### Complete Standard Configuration Guide

**1. Base Unit**

<b>DS4</b>
------------

**2. Travel**

<b>50mm to 600mm in 50mm increments</b>
---

**3. Grade**

<b>C</b>	Commercial Grade
<b>P</b>	Precision Grade

**4. Ballscrew Lead**

<b>5G</b>	5mm Lead
<b>10G</b>	10mm Lead

**5. Motor**

<b>P21</b>	Stepper, NEMA 23, 130 oz-in, 200 step
<b>IDC14</b>	Brushless Servo, NEMA 23
(Blank if no motor selected)	

**6. Motor Mounts**

<b>X16</b>	1.6" mount
<b>X17</b>	NEMA 17 mount
<b>X23</b>	NEMA 23 mount*
<b>X34</b>	NEMA 34 mount**
<b>X70</b>	70 mm**
* default for P21 and IDC14 motors	
** not available with parallel motor mounts	



**7A. Couplings (inline models)**

<b>OE3</b>	Oldham style, 3/16" bore
<b>OE4</b>	Oldham style, 1/4" bore*
<b>OE5</b>	Oldham style, 5/16" bore
<b>OE6</b>	Oldham style, 3/8" bore**
<b>OE8</b>	Oldham style, 1/2" bore
<b>OM5</b>	Oldham style, 5mm bore
<b>OM8</b>	Oldham style, 8mm bore
<b>OM9</b>	Oldham style, 9mm bore
<b>OM11</b>	Oldham style, 11mm bore
<b>BE3</b>	Bellows style, 3/16" bore
<b>BE4</b>	Bellows style, 1/4" bore*
<b>BE5</b>	Bellows style, 5/16" bore
<b>BE6</b>	Bellows style, 3/8" bore**
<b>BE8</b>	Bellows style, 1/2" bore
<b>BM5</b>	Bellows style, 5mm bore
<b>BM8</b>	Bellows style, 8mm bore
<b>BM9</b>	Bellows style, 9mm bore
<b>BM11</b>	Bellows style, 11mm bore
* Select a 1/4" bore coupling for P21 motor	
**Select a 3/8" bore coupling for IDR26 motor	

**7B. Motor Orientation & Pulley Bore (parallel models)**

<b>PRxx*</b>	Parallel Right Motor Mount
<b>PLxx*</b>	Parallel Left Motor Mount
<b>PUxx*</b>	Parallel Under Motor Mount
*select pulley bore diameter below	
<b>xx3E</b>	3/16" pulley bore diameter
<b>xx4E</b>	1/4" pulley bore diameter
<b>xx5E</b>	5/16" pulley bore diameter
<b>xx6E</b>	3/8" pulley bore diameter
<b>xx5M</b>	5mm pulley bore diameter
<b>xx8M</b>	8mm pulley bore diameter
<b>xx9M</b>	9mm pulley bore diameter

**8. Limit Sensors (2)**

<b>LO</b>	No End-of-Travel Limits
<b>LN1</b>	Limits, NPN type Normal Open
<b>LN2</b>	Limits, NPN type Normal Closed
<b>LP1</b>	Limits, PNP type Normal Open
<b>LP2</b>	Limits, PNP type Normal Closed



**9. Home Switch**

<b>HO</b>	No Home Sensor
<b>HN1</b>	Home, NPN type Normal Open
<b>HN2</b>	Home, NPN type Normal Closed
<b>HP1</b>	Home, PNP type Normal Open
<b>HP2</b>	Home, PNP type Normal Closed

**10. Shaft End Options**

<b>BS</b>	Brake on ballscrew, 24VDC Power-off
<b>ES</b>	Rotary encoder on ballscrew, 1250 line
<b>Note:</b> Shaft brake and rotary encoder options can not be used in conjunction with each other.	

**11. Linear Encoders**

<b>EO</b>	No linear encoder
<b>E1</b>	1 micron resolution linear encoder
<b>E2</b>	0.5 micron resolution linear encoder
<b>E3</b>	0.1 micron resolution linear encoder

**12. Additional Options**

<b>P1</b>	Standard Pinning of x-axis carriage
<b>P2</b>	Precision Pinning of x-axis carriage, matched to y-axis or z-axis base
<b>P3</b>	Precision Pinning of y-axis base, matched to x-axis carriage
<b>P4</b>	Precision Pinning of z-axis base, matched to x-axis carriage
<b>CLN</b>	Cleanroom Prep – Class 100

**Accessories**

Toe Clamps, Riser Plates, and Multi-Axis Brackets are accessory items which are ordered separately from the configured DS4.

**Note:** Riser Plates may be necessary for mounting of a single axis, or for the lower axis of a multi-axis assembly. Check the motor and flange dimensions with respect to the base plane of the DS4.



## SECTION 3: DS4 Series Specification

GENERAL SPECIFICATIONS													
Travel (mm)	50	100	150	200	250	300	350	400	450	500	550	600	
Overall Height (mm)	47												
Width (mm)	95												
Positional Accuracy (microns)													
Commercial Grade	12	12	14	20	22	24	26	26	28	34	36	40	
Precision Grade	8	8	10	12	12	14	14	16	19	21	23	25	
Straightness & Flatness (microns)	6	6	9	12	12	14	18	21	23	23	25	25	
Bi-directional Repeatability, open loop													
Commercial Grade (microns)	+/- 3												
Precision Grade (microns)	+/- 1.3												
Pitch / Yaw (arc-sec)													
Commercial Grade	20	24	28	36	40	44	47	53	56	61	64	68	
Precision Grade	12	14	17	22	25	27	29	33	35	38	40	42	
Load Capacity, Normal (kg) (max)	170												
Axial Load Capacity (kg)	95												
Acceleration (max) (m/sec <sup>2</sup> )	20												
Moving Mass (kg)	0.75												
Total Mass (kg)	2.7	3.0	3.3	3.6	3.9	4.1	4.4	4.7	5.0	5.3	5.6	5.9	
Ballscrew Diameter (mm)	16												
Duty Cycle (%)	100												
Ballscrew Efficiency (%)	90												
Max. Breakaway Torque (oz-in)	18												
Max. Running Torque (oz-in)	16												
Ballscrew Lead Available (mm)	5, 10												
Input Inertia (x10 <sup>-5</sup> kg-m <sup>2</sup> )	1.17	1.24	1.67	1.93	2.18	2.43	2.68	2.93	3.19	3.44	3.69	3.94	
Max. Ballscrew Speed (rev/sec)	80						60		55	50			

All performance specifications are based upon proper mounting procedures, with the DS4 fully supported on a flat surface (flat within 0.008mm/300mm). See Section 4 of this manual for proper mounting procedures.

Positional accuracy and repeatability specifications are for inline motor mount models only. Contact the factory for specification of parallel mount configurations.

Above specifications are measured 37.5mm directly above the center of the carriage.

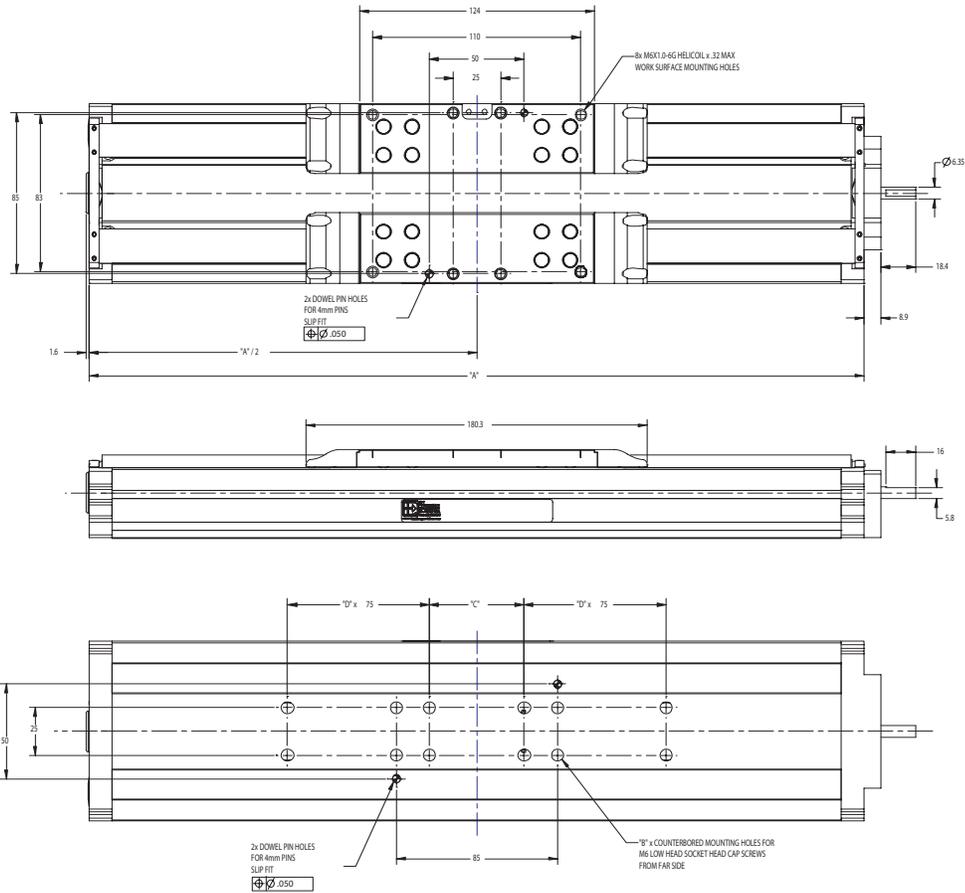
Specifications are based upon ideal operation at 20° C. Although the DS4 will operate between 5° and 70° C, no performance guarantee is made with respect to the above specifications. Contact IDC to discuss your low- and high-temperature applications

The maximum speed of screw driven positioning tables is limited by the critical speed (also known as the natural resonant speed) of the drive screw. This speed is a function of table travel and screw diameter. Operation at or above the rated speed limit can cause the drive screw to whip, resulting in poor performance and degraded life.

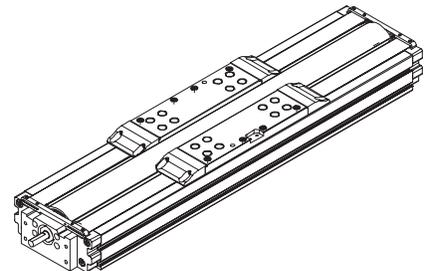
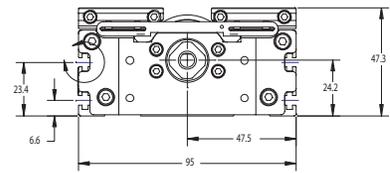
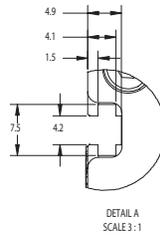
DS4 positioning tables are rated for normal loads (load vector directed down onto the surface of the carriage), for axial loads (load vector directed in the direction of travel), and for moment loads (torsional loads caused by loads with an offset center of gravity). The moment loading limits are based on the maximum moment in pitch, roll or yaw including any dynamic components that are move profile dependent.



DS4 Dimensional Drawing (Base Unit)



Model#	Travel	A	B	C	D
DS4-050	50	259.1	8	150	0
DS4-100	100	309.1	12	50	1
DS4-150	150	359.1	12	50	1
DS4-200	200	409.1	12	50	1
DS4-250	250	459.1	16	50	2
DS4-300	300	509.1	16	50	2
DS4-350	350	559.1	16	50	2
DS4-400	400	609.1	20	50	3
DS4-450	450	659.1	20	50	3
DS4-500	500	709.1	20	50	3
DS4-550	550	759.1	24	50	4
DS4-600	600	809.1	24	50	4

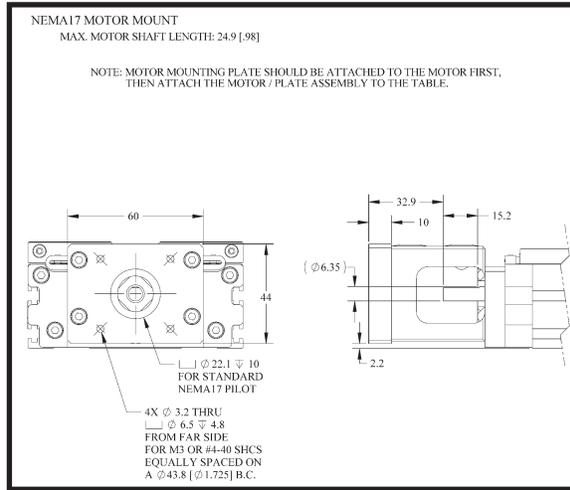


## Motor Mounting Dimensions

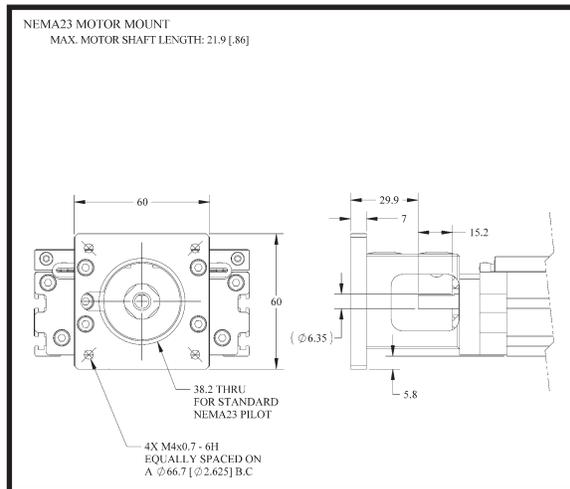
### Inline Motor Mounts

The motor is mounted directly to the ballscrew with the appropriate motor coupling.

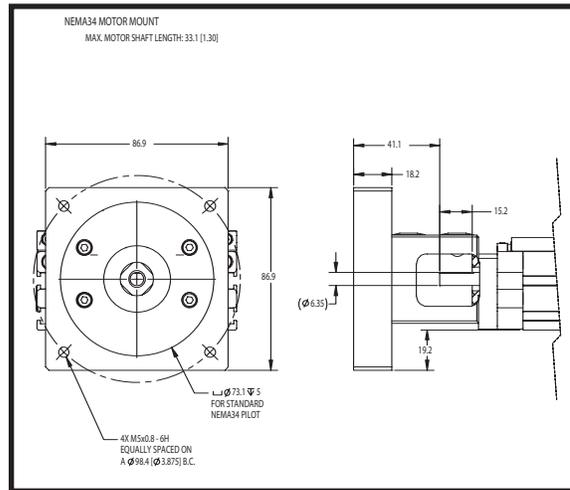
#### NEMA 17



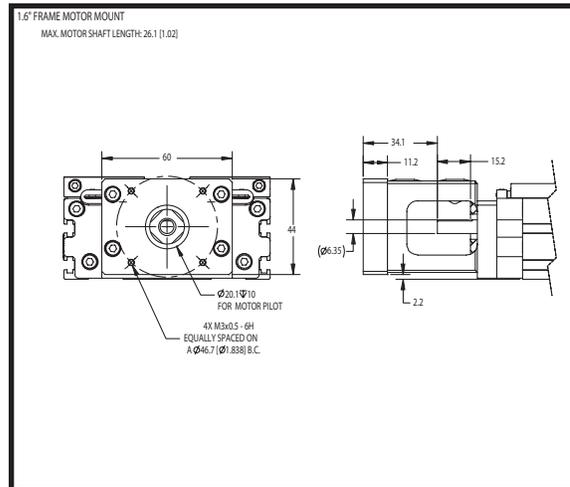
#### NEMA 23



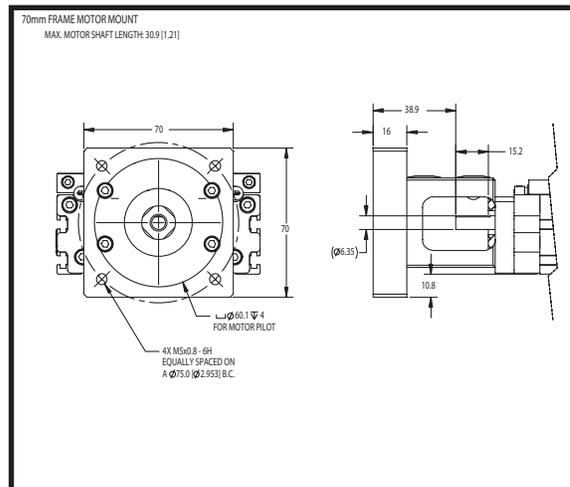
**NEMA 34**



**1.6" FRAME**



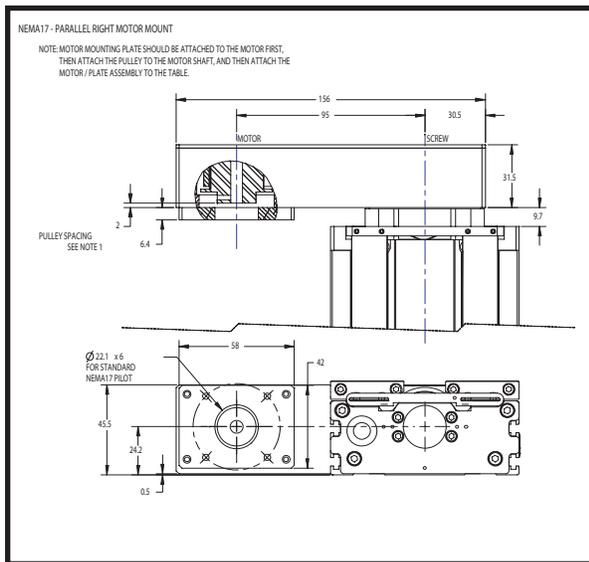
**70 mm FRAME**



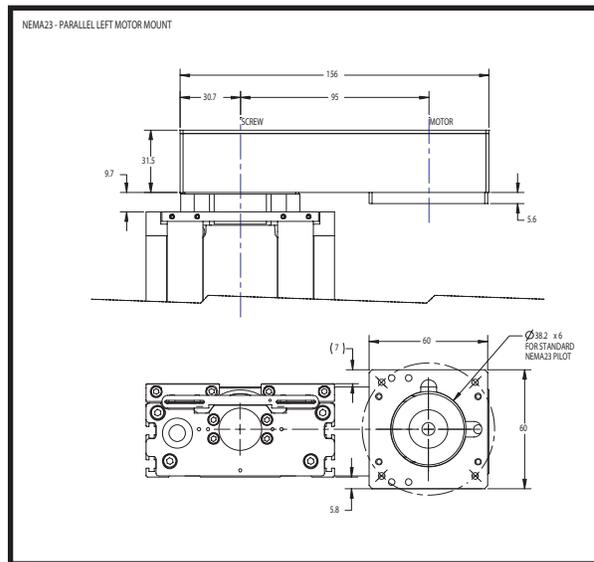
### Parallel Motor Mounts

Utilize a 1:1 belt drive arrangement to provide an shorter overall unit length. Three motor orientations are available, as are several motor mounting flanges.

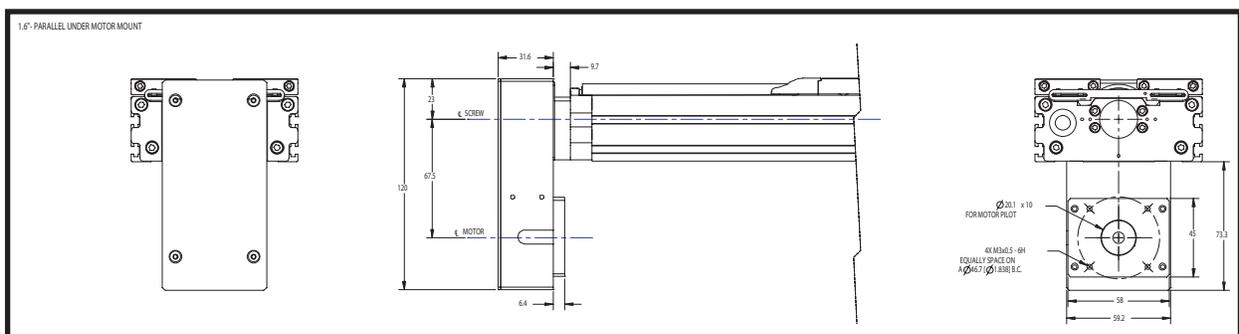
Parallel Right shown with NEMA 17



Parallel Left shown with NEMA 23



Parallel Under shown with 1.6" Frame



**Note:** When utilizing a parallel motor mount be aware that unit travel direction is opposite of an inline unit. For example, a “+” direction command to an inline unit will move the carriage away from the motor mount. For a parallel unit, the same “+” direction command will move the carriage toward the motor mount



## Engineering Reference for the DS4 Product Line

The following calculations and examples provide the basis for calculating the permissible loading and resultant life of the DS4. The forces acting on the DS4 include both the static weight of the load and the dynamic loading due to the acceleration and deceleration of that load. When the DS4 is used in a multi-axis configuration, the lowest stage in the stack usually has the highest loads, and therefore is the limiting factor in the loading calculations. Great care should be taken when analyzing the loading of this lower DS4, to take into account not only the workload, but also the resulting load from the additional axes mounted upon it.

### Loading Calculations for DS4 Product Line

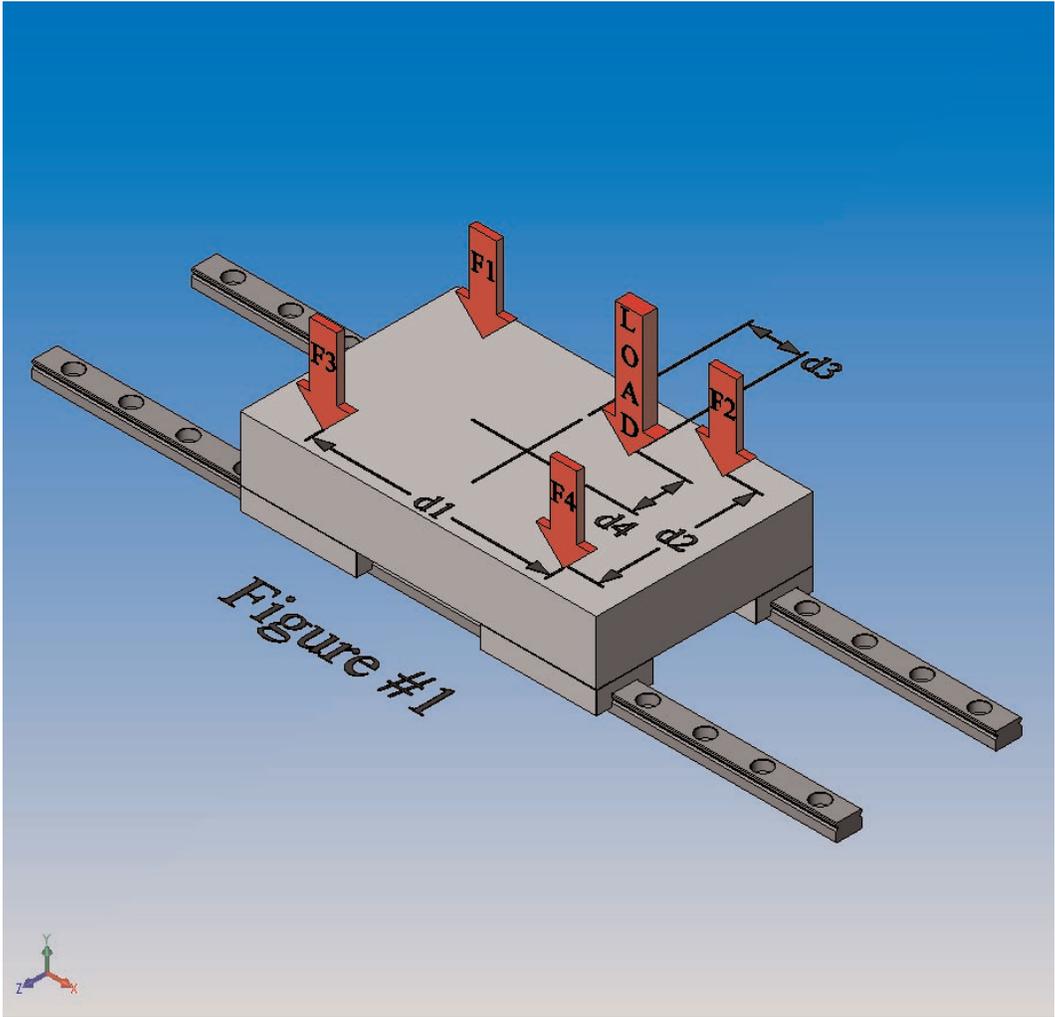
*QUICKER RESULTS: Use our online DS4 life-load tool, found at [www.DanaherMotion.com/ds4](http://www.DanaherMotion.com/ds4).*

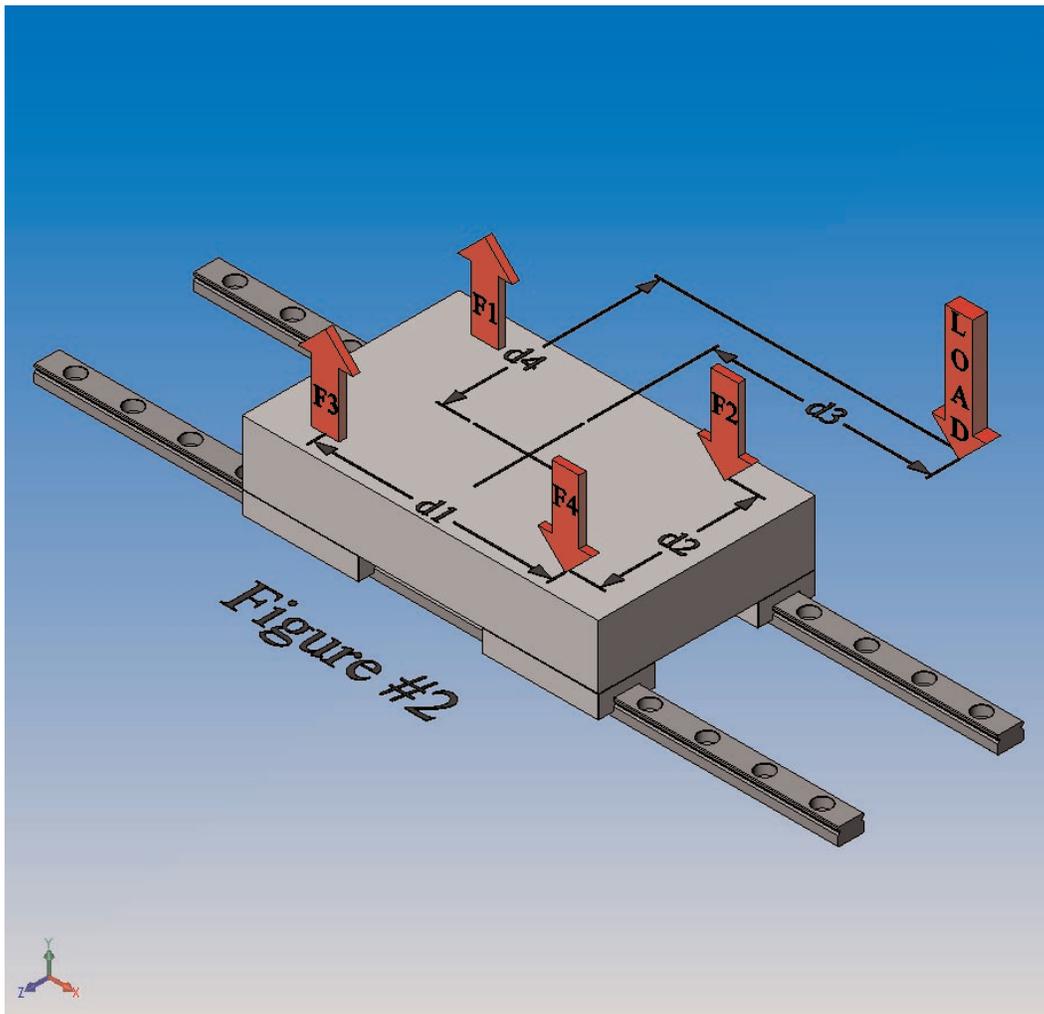
Listed below are the calculations and examples for determining the load on each linear bearing module in the table of the DS4. The load on each linear bearing module is a combination of the following forces, the workload, the moment load generated by the workload, the acceleration and deceleration of that load, also any additional stacked multi-axis configurations. In stacked multi-axis configurations it is imperative that the masses of the additional axes are taken into account. Also, these calculations should be performed with the upper axes of the multi-axis configuration in their extremes of travel to properly account for the highest potential loading condition. The basic construction of this line of actuators uses four re-circulating ball modules on linear rails. The distances between these modules, and their respective position to the applied load, and the magnitude of the applied load, determines the force on each module. The life of the stage will be limited by the life of the highest loaded module. These dimensions are as follows:

- d1** = Module spacing along axis travel
- d2** = Module spacing across axis travel
- d3** = Load distance from center of table to load location, along axis of travel
- d4** = Load distance from center of table to load location, across axis of travel
- d5** = Load distance off top of the table
- d6** = Distance from table mounting surface to modules
- L** = Load Center of Gravity

The simplest loading condition is when the stage is mounted horizontally so that the table is parallel to the floor. In this orientation, the following formulas can be used. These formulas apply whether the CG of the load is above the tabletop, as shown in Figure #1, or outside the tabletop mounting area, as shown in Figure #2.







### Horizontal Travel with Normal Load (Figures #1 & #2)

$$F1 = (L/4) - [(L/2)*(d3/d1)] + [(L/2)*(d4/d2)]$$

$$F2 = (L/4) + [(L/2)*(d3/d1)] + [(L/2)*(d4/d2)]$$

$$F3 = (L/4) - [(L/2)*(d3/d1)] - [(L/2)*(d4/d2)]$$

$$F4 = (L/4) + [(L/2)*(d3/d1)] - [(L/2)*(d4/d2)]$$

$$\text{Where } d1 = 3.289\text{in.} / 83.54\text{mm}$$

$$\text{Where } d2 = 2.187\text{in.} / 55.55\text{mm}$$

$$\text{Where } L = \text{Applied Load}$$

Where F1 = the force acting on module #1, F2 = the force acting on module #2, F3 = the force acting on module #3, and F4 = the force acting on module #4. These forces can be either positive (compressive force) or negative (tensile force), with the most positive or most negative number indicating the highest loaded module. The highest loaded module will have the shortest life. It is important to note that these calculations apply to the forces acting on the modules when it is stationary or moving at a constant velocity. The forces due to acceleration and deceleration must be taken into account when calculating the dynamic forces that act upon the system.

**Horizontal Travel with Perpendicular Load (Figure #3)**

$$F1 = F2 = (L/2) * [(d5+d6)/d2]$$

$$F3 = F4 = -(L/2) * [(d5+d6)/d2]$$

$$F1S = F3S = (L/4) + [(L/2) * (d3/d1)]$$

$$F2S = F4S = (L/4) - [(L/2) * (d3/d1)]$$

$$\text{Where } d1 = 3.289\text{in.} / 83.54\text{mm}$$

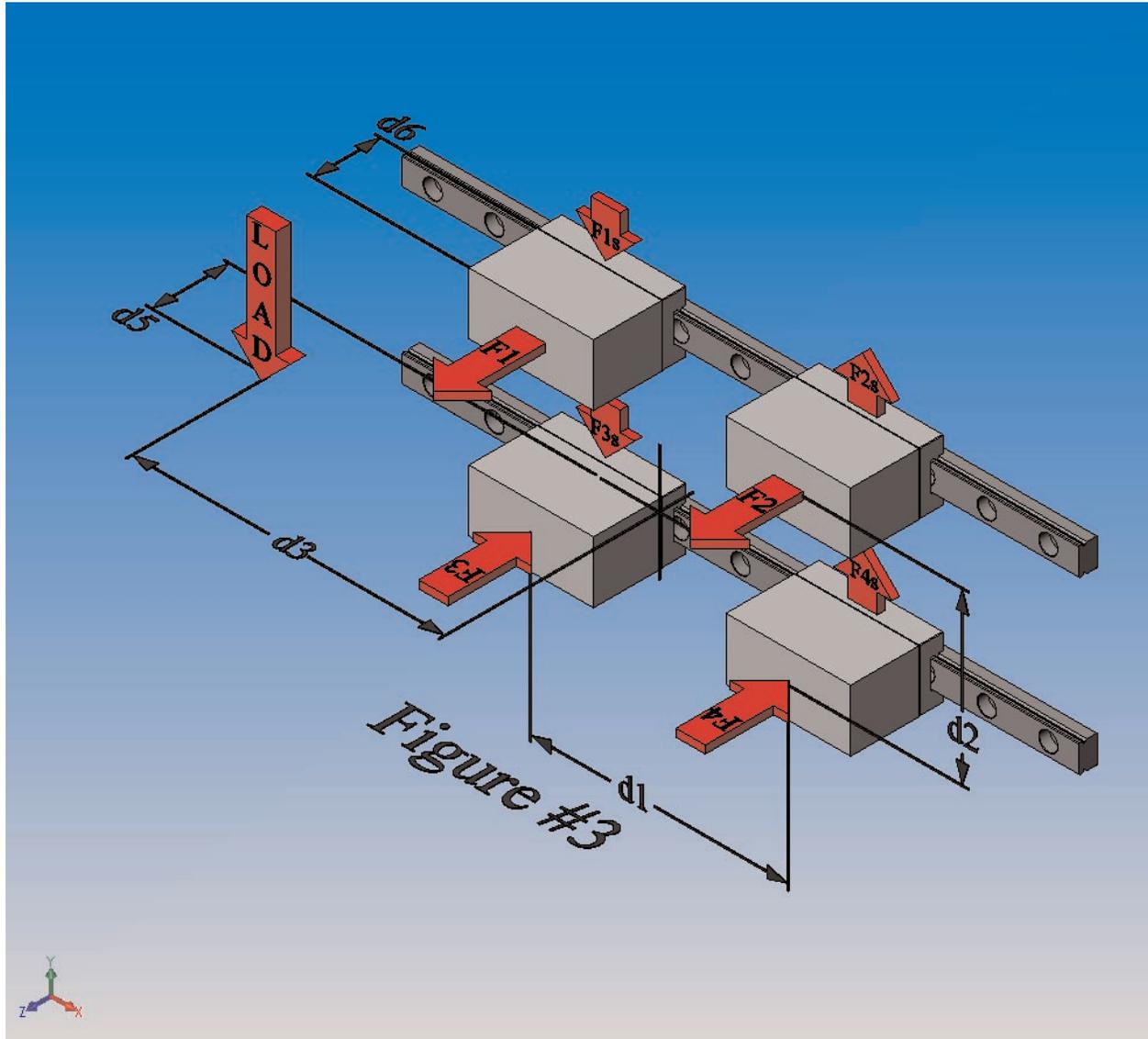
$$\text{Where } d2 = 2.187\text{in.} / 55.55\text{mm}$$

$$\text{Where } d6 = 0.876\text{in.} / 22.25\text{mm}$$

$$\text{Where } L = \text{Applied Load}$$

Where F1 = the force acting on module #1, F2 = the force acting on module #2, F3 = the force acting on module #3, F4 = the force acting on module #4, F1S is the perpendicular side load acting on module #1, F2S is the perpendicular side load acting on module #2, F3S is the perpendicular side load acting on module #3, and F4S is the perpendicular side load acting on module #4. These forces can be either positive (compressive force) or negative (tensile force), with the most positive or most negative number indicating the highest loaded module. The highest loaded module will have the shortest life. It is important to note that these calculations apply to the forces acting on the modules when it is stationary or moving at a constant velocity. The forces due to acceleration and deceleration must be take into account when calculating the dynamic forces that act upon the system.





**Vertical Travel (Figure #4)**

$$F1 = F3 = (L/2) * [(d5+d6)/d1]$$

$$F2 = F4 = -(L/2) * [(d5+d6)/d1]$$

$$F1S = F3S = (L/2) * [(d5+d6)/d2]$$

$$F2S = F4S = -(L/2) * [(d5+d6)/d2]$$

$$\text{Where } d1 = 3.289\text{in.} / 83.54\text{mm}$$

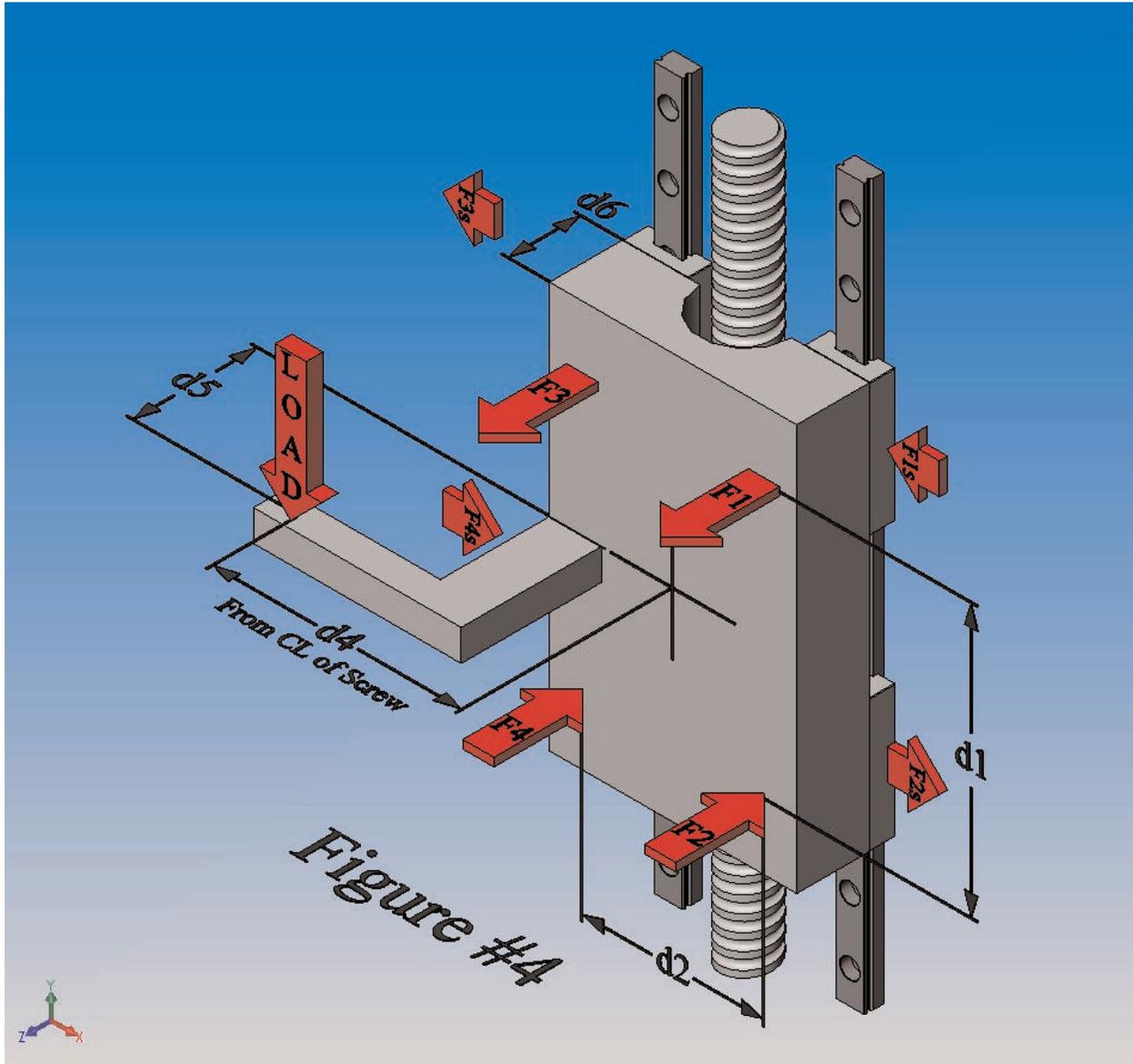
$$\text{Where } d2 = 2.187\text{in.} / 55.55\text{mm}$$

$$\text{Where } d6 = 0.876\text{in.} / 22.25\text{mm}$$

$$\text{Where } L = \text{Applied Load}$$

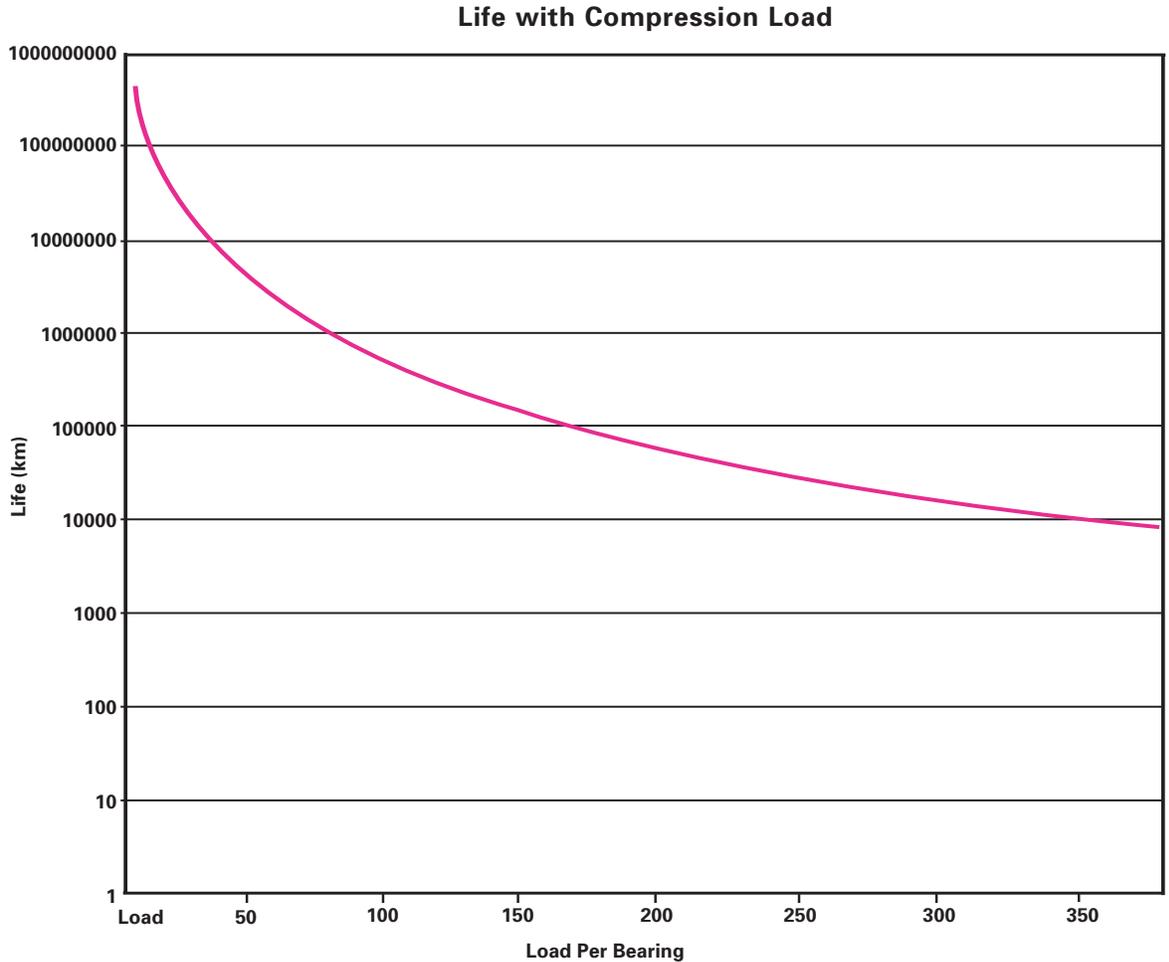
Where F1 = the force acting on module #1, F2 = the force acting on module #2, F3 = the force acting on module #3, F4 = the force acting on module #4, F1S is the perpendicular side load acting on module #1, F2S is the perpendicular side load acting on module #2, F3S is the perpendicular side load acting on module #3, and F4S is the perpendicular side load acting on module #4. These forces can be either positive (compressive force) or negative (tensile force), with the most positive or most negative number indicating the highest loaded module. The highest loaded module will have the shortest life. It is important to note that these calculations apply to the forces acting on the modules when it is stationary or moving at a constant velocity. The forces due to acceleration and deceleration must be take into account when calculating the dynamic forces that act upon the system.





### Load/Life Chart

After calculating load on each bearing, compare your results against the chart provided below. Note again that the single bearing with the highest load is the life-limiting component.

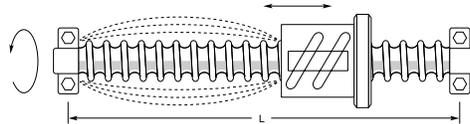


**QUICKER RESULTS:** Use our online DS4 life-load tool, found at [www.DanaherMotion.com/ds4](http://www.DanaherMotion.com/ds4).



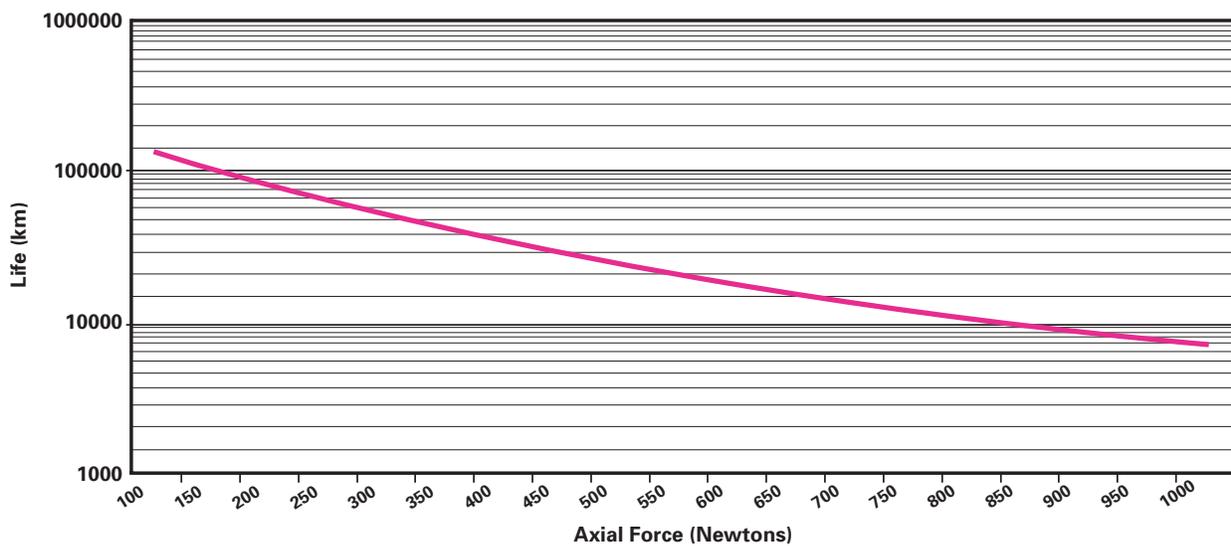
### Ballscrew Technical Data

All screw-driven systems have a critical speed at which harmonic vibrations begin to occur. Sustained operation beyond this critical speed limit (see table below) may cause the ballscrew to vibrate or whip violently, eventually bending or warping the screw (see illustration). Useful life of the DS4 is dependent upon the forces acting upon it. Moment loading forces were discussed in the previous section. Life of the ballscrew based upon the axial force applied must also be considered.



MODEL / SPECIFICATION												
	DS4-50	DS4-100	DS4-150	DS4-200	DS4-250	DS4-300	DS4-350	DS4-400	DS4-450	DS4-500	DS4-550	DS4-600
Travel (mm)	50	100	150	200	250	300	350	400	450	500	550	600
Max Ballscrew Speed (rev/sec)	80						60		55	50		
Ballscrew Lead Available (mm)	5, 10											
Ballscrew Diameter	16											
Max Breakaway Torque (oz-in)	16											
Max Running Torque (oz-in)	14											
Input Inertia (10 <sup>-5</sup> kg-m <sup>2</sup> )	1.17	1.24	1.67	1.93	2.18	2.43	2.68	2.93	3.19	3.44	3.69	3.94

### Ballscrew Life



## SECTION 4: Mounting Your DS4 Positioning Table

### Mounting Considerations

The bases of DS4 positioning tables are precision-machined surfaces. To operate within the design specifications, DS4 positioning tables must be mounted on a precision surface that fully supports the base of the table using all internal precision mounting holes. The surface should be flat to within 0.008mm per 300mm. The surface to which the positioner mounts may be shimmed or scraped to meet the required flatness.

Attachment of the positioning table to the mounting surface requires a minimum of four (4) screws at symmetric locations in the base of the table. To ensure catalog specifications, the DS4 must be bolted along its entire length using the table's internal mounting holes.

Portions of any table which are overhung, whether in a single- or multi-axis configuration, may not meet the stated specification over that portion of the table.

Holes in the carriage top for payload attachment feature steel thread inserts. Inserts reduce the possibility of stripping out threads when attaching the payload to the aluminum carriage.

Please contact IDC concerning non-uniform, dynamic, cantilevered or points loads or multi axis operations.

The low profile of the DS4 will require the use of riser plates in many instances to allow for the selected motor, or otherwise require a cutout in the surface, to accommodate the motor, as the lower plane of the motor may be below the lower plane of the motor mount/flange. Riser plates are available from IDC and should be installed according to the directions provided below.

### Base Mounting of the DS4

The DS4 can be mounted to a surface or another positioning axis in two manners:

- (1) Using the counterbored holes in the base of the DS4. Mounting the DS4 in this manner and in accordance with the above guidelines will offer optimal performance of the positioning table.
- (2) Using the accessory "toe clamps". This method offers flexibility in mounting hole position.

#### Mounting with the counterbored holes in the base of the DS4:

This procedure describes mounting the DS4 positioning table utilizing the counterbored holes in the base of the DS4. This is useful for the most precise mounting, and is required for many multi-axis configurations include standard XY mounting.

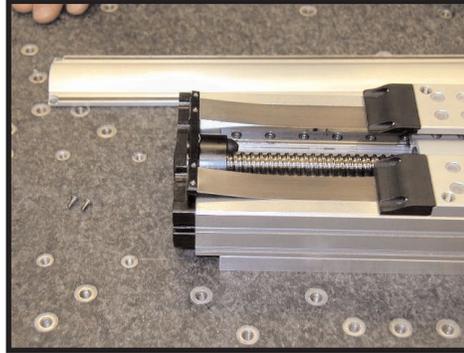
**Tools required:**

- 2mm Allen wrench and a small flat-blade screwdriver (for internal access)
- M6 low head cap screws (provided with each DS4)
- 4mm Allen wrench

**Note:** Use only M6 Low Head cap screws to prevent damage to the DS4.



- (1) The extruded ballscrew cover must be removed. Follow the “Internal Access” procedure as detailed in Section 8 of this manual (2mm Allen wrench and flat-blade screwdriver required).



- (2) Locate each pair of counterbored holes.



- (3) Use the M6 low-head cap screws through the counterbored holes to mount the DS4 to the surface or lower axis. A 4mm Allen wrench is required.



- (4) Replace the extruded ballscrew cover in the manner detailed in Section 8 of this manual.

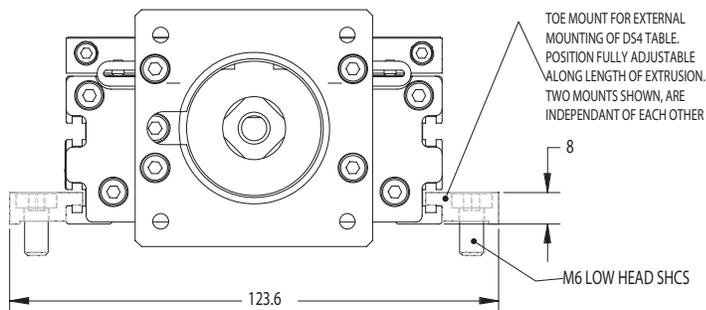
## Mounting the base of the DS4 with Toe Clamps

This procedure describes mounting the DS4 positioning table utilizing the accessory external Toe Clamps.

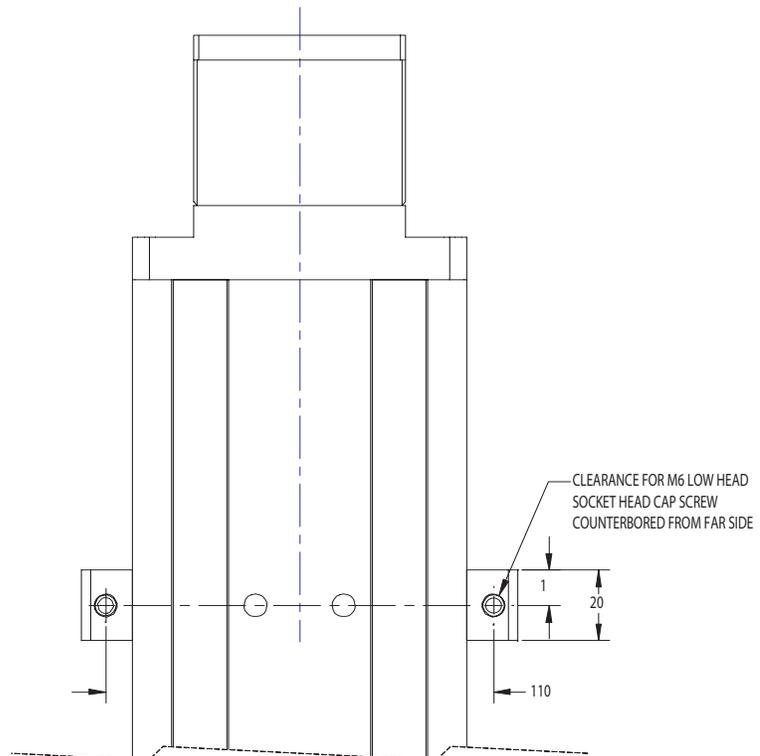
**Tools required:**

- Sufficient number of Toe Clamps (refer to chart below)
- M6 low head cap screws
- 4mm Allen wrench

- (1) Insert lip of the Toe Clamps into the lower T-slot in the DS4 on both sides of the base.
- (2) Insert an M6 Low Head Cap Screw into the counterbored hole in each of the Toe Clamps, and securely fasten to the surface using a 4mm Allen wrench.



**Note:** It is recommended that Toe Clamp spacing not exceed 150mm center-to-center. See the chart below for the number of Toe Clamps recommended for each specific model of DS4.



Mounting accessories are ordered separately from the configured DS4.

	Toe Clamp Sets*	Wide Riser Blocks*	Narrow Riser Blocks*
<b>PART NO:</b>	<b>12-0129</b>	<b>12-0130</b>	<b>12-0131</b>
<b>DS4-50</b>	2	2	2
<b>DS4-100</b>	3	3	4
<b>DS4-150</b>	3	3	4
<b>DS4-200</b>	4	4	4
<b>DS4-250</b>	4	4	6
<b>DS4-300</b>	5	5	6
<b>DS4-350</b>	5	5	6
<b>DS4-400</b>	6	6	8
<b>DS4-450</b>	6	6	8
<b>DS4-500</b>	7	7	8
<b>DS4-550</b>	7	7	10
<b>DS4-600</b>	8	8	10

\* Each set includes necessary hardware.



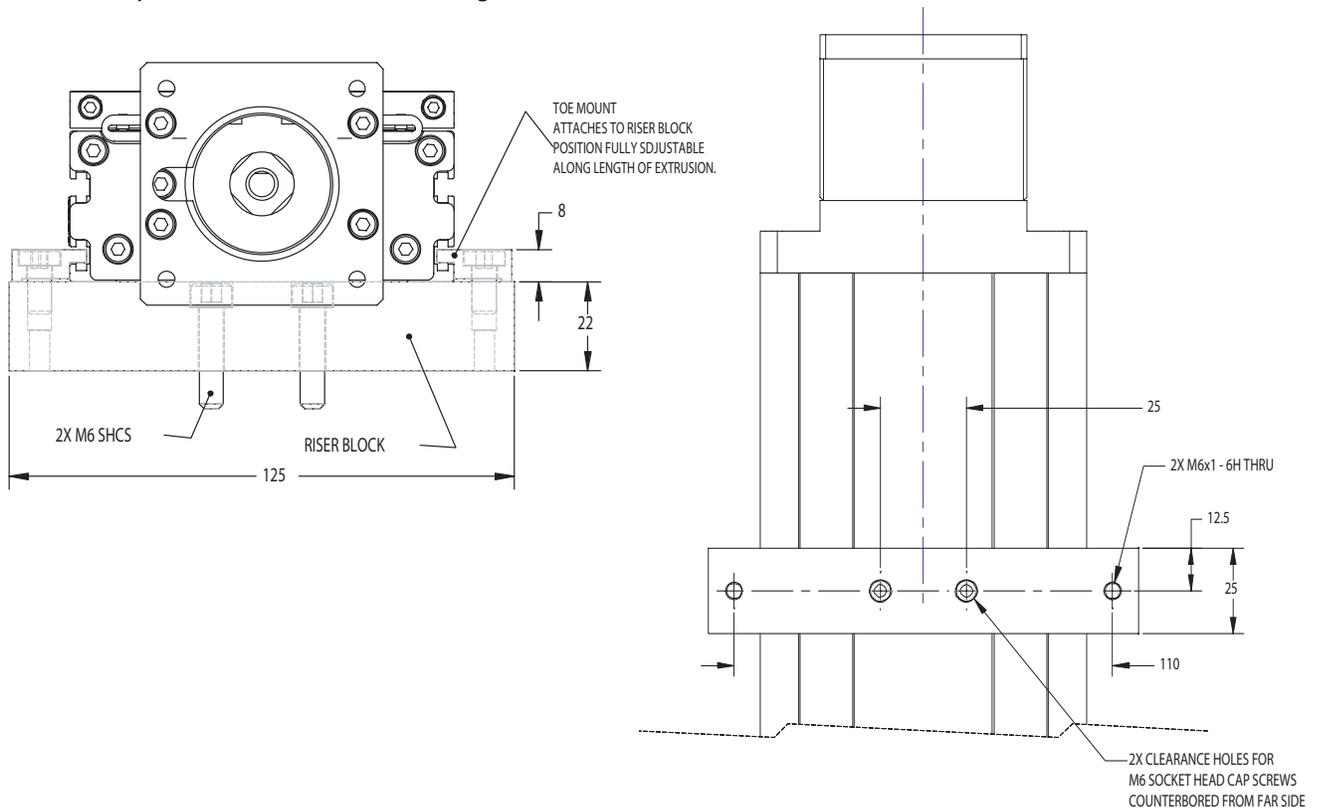
## Mounting the base of the DS4 with Wide Riser Block Option:

This procedure describes mounting the DS4 positioning table utilizing the accessory Wide Riser Blocks in conjunction with Toe Clamps.

**Tools required:**

- Sufficient number of Wide Riser Blocks (refer to chart in Toe Clamp instructions above)
- Sufficient number of Toe Clamp (refer to chart in Toe Clamp instructions above)
- M6 Socket Head Cap Screws (provided with Wide Riser Blocks)
- M6 Low Head Cap Screws (provided with Toe Clamps)
- M4 and M5 Allen wrenches

- (1) Position a sufficient number of Wide Riser Blocks on the mounting surface, and fasten securely using M5 wrench for the M6 socket head cap screws.
- (2) Position the DS4 on the Wide Riser Blocks.
- (3) Insert lip of the Toe Clamps, over the Wide Riser Blocks, and into the lower T-slot in the DS4 on both sides of the base.
- (4) Insert a M6 Low Head Cap Screw into the counterbored hole in each of the Toe Clamps, and securely fasten to the surface using an M4 Allen wrench.



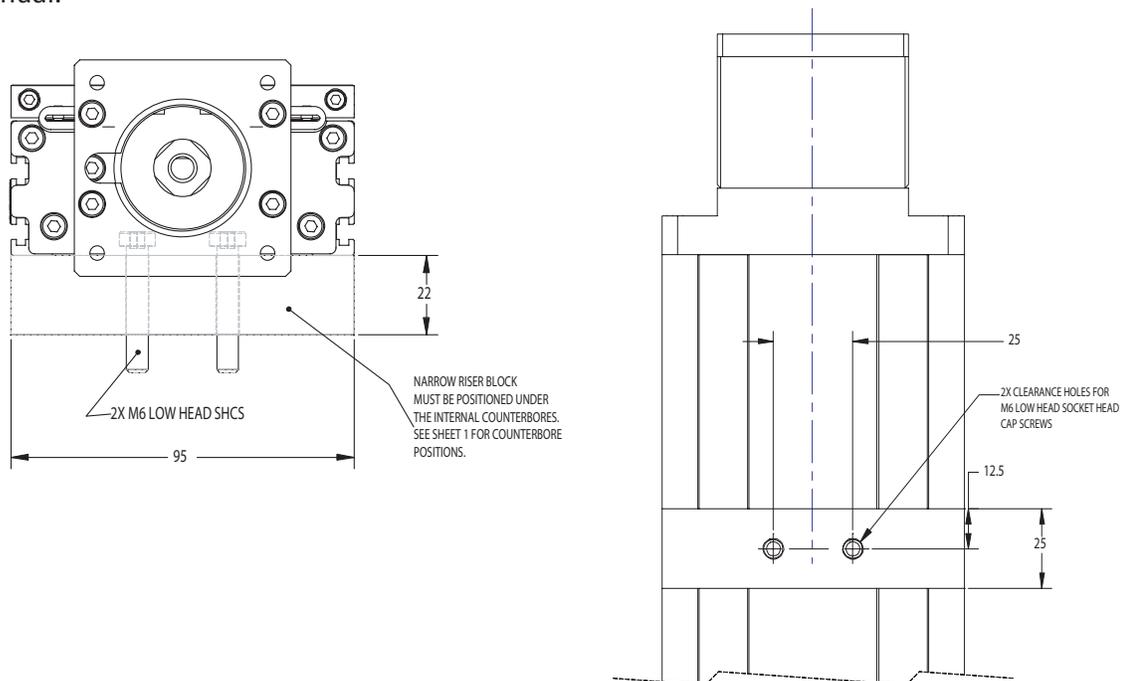
## Mounting the base of the DS4 with Narrow Riser Block Option:

This procedure describes mounting the DS4 positioning table utilizing the accessory Narrow Riser Blocks.

**Tools required:**

- Sufficient number of Narrow Riser Blocks (refer to chart in Toe Clamp instructions above)
- M6 Low Head Cap Screws (provided with Toe Clamps)
- 4mm Allen wrench

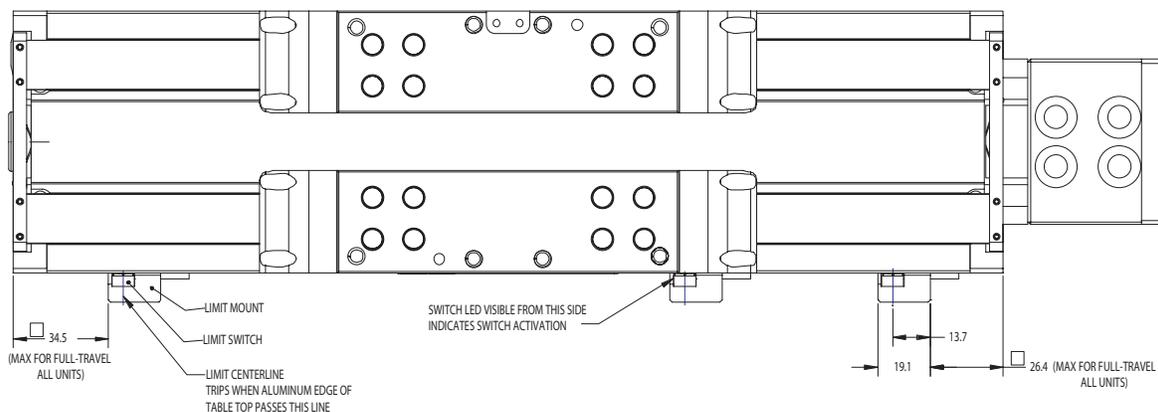
- (1) Position a sufficient number of Narrow Riser Blocks on the mounting surface, in position to line up the through holes of the Narrow Riser Blocks with the base mounting holes of the DS4 (refer to DS4 dimensional drawing in Section 3 of this manual). NOTE: This mounting option is dependent on the internal counterbore positions of the DS4 base. Locate one riser plate at each counterbore location, with the exception of the four in the center of the DS4 base.
- (2) Position the DS4 on the Narrow Riser Blocks.
- (3) Follow the procedure outlined in Section 8 to gain access to the inside of the DS4 (peeling back the seal strips and removing the extruded ballscrew cover).
- (4) Insert a M6 Low Head Cap Screw into the counterbored hole in the base of the DS4 and through the thru-holes in the Narrow Riser Blocks, and securely fasten to the surface using a 4mm Allen wrench.
- (5) Replace the extruded ballscrew cover and attach the seal strips as outlined in Section 8 of this manual.



## SECTION 5: Mounting of Motors, Options, Accessories

### Mounting/Adjusting Limit & Home Sensors

End-of-travel position sensors (a.k.a. limit switches) are required to prevent potentially damaging collisions with the internal hard-stops of the DS4. If the motor is accidentally commanded to move toward a hard stop, position sensors can signal a stop before a collision occurs. To work properly, position sensors must be positioned inward from the hard-stop (see drawing below), and wired correctly to the motor controller.



**Note:** Using the physical limits (hard-stops) of the DS4 will reduce table life and can cause premature component failure.

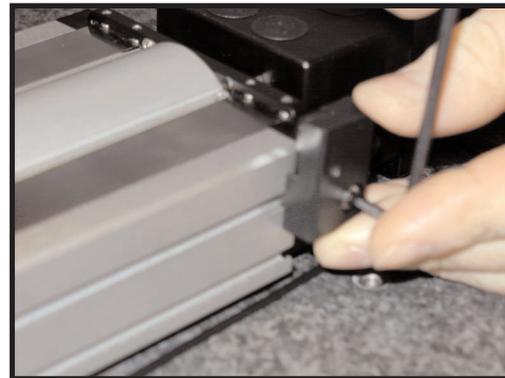
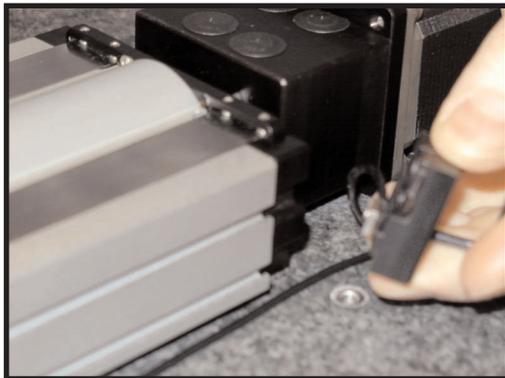
The limit switches can also be positioned to reduce travel of a given positioning table, a method sometimes used to prevent collision with external objects. The location of the DS4's external limit sensors are adjustable throughout the entire range of travel. Limit Sensors are configured in sets of two (2).

**Tools required:** - 3mm Allen wrench

- (1) To adjust position of a limit sensor, loosen the limit mount using a 3mm Allen wrench, adjust the position of the limit mount by sliding the limit mount along the T-slot, and re-tighten the socket head cap screw with the 3mm Allen wrench.



- (2) If it is necessary to add/replace a sensor, the limit mount attaches to the upper T-slot in the DS4 base, which is accessible from both ends of the positioning table.



Sometimes an additional Home sensor is requested to indicate that the DS4 is in a particular location along its travel. This is also referred to as an “index” mark. Home sensors can be the same, or different, electronic “flavor” as the Limit Sensors. Home Sensors are configured as individual (qty 1) items. Adjustment procedures for Home Sensors is identical to that of Limit Sensors.

Please refer to Section 6 for the specifications of limit and home sensors.

## Brake Mounting

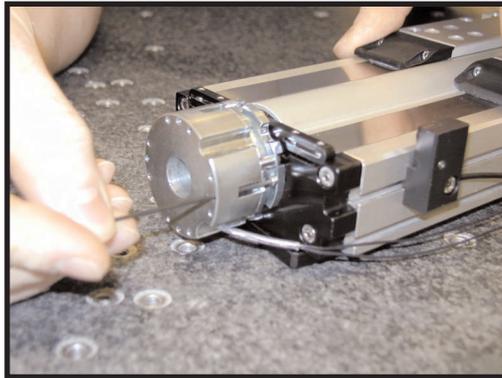
DS4 positioning tables ordered with the option shaft brake will be shipped from the factory with that option mounted to the DS4. If it is necessary to remove or replace the brake, follow this procedure.

**Tools required:** - 1.5mm Allen wrench.

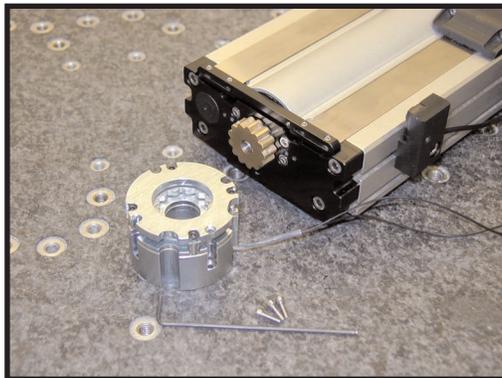
Note: Power to brake must be turned OFF prior to performing this activity.

Removal of brake assembly:

- (1) Locate the three (3) M2x8mm socket head cap screws which attach the brake to the end of the DS4. Using a 1.5mm Allen wrench, loosen and remove the three screws.



- (2) Remove the brake by pulling the brake assembly directly outward from the base of the DS4.  
**Note:** It is not necessary in most cases to remove the gear which is attached to the shaft extension of the ballscrew.



To mount the brake, reverse the procedure describe above. To verify brake operation, apply 24VDC to the brake (to “deactivate” it) and traverse the carriage to ensure free movement and no changes in noise or torque. Activate the brake by removing the power, and verify that the ballscrew is not able to rotate freely.

## Rotary Encoder Mounting

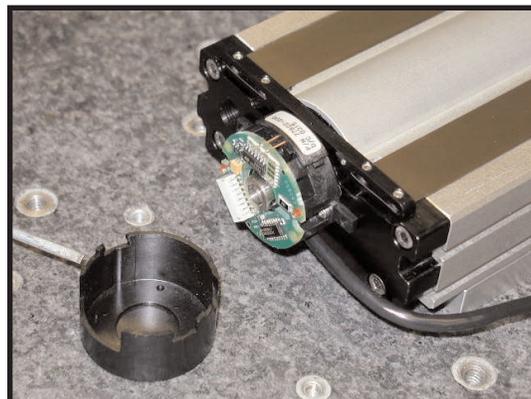
DS4 positioning tables ordered with the optional shaft-mounted rotary encoder will be shipped from the factory with that option mounted to the DS4. If it is necessary to remove or replace the rotary encoder, follow this procedure.

**Tools required:**

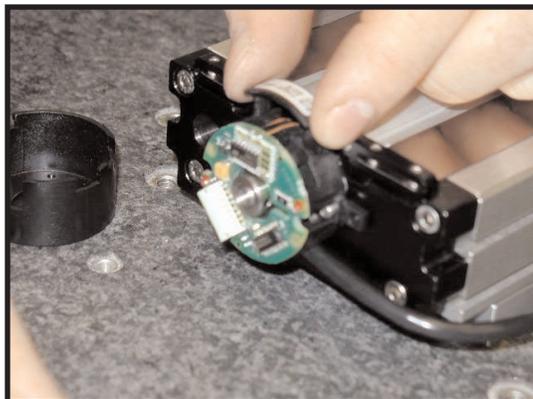
- Small flathead screwdriver
- 1.5mm Allen wrench
- 0.050" Allen wrench

**Note:** Power to the rotary encoder must be turned OFF prior to performing this activity.

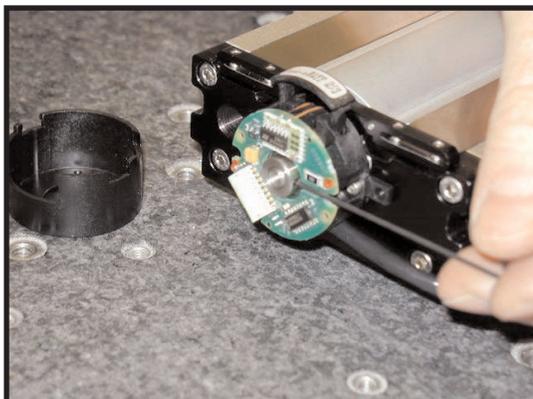
- (1) Using a flathead screwdriver, gently pry off the protective cover by locating and using the two screwdriver slots, which are located one on each side of the cover.



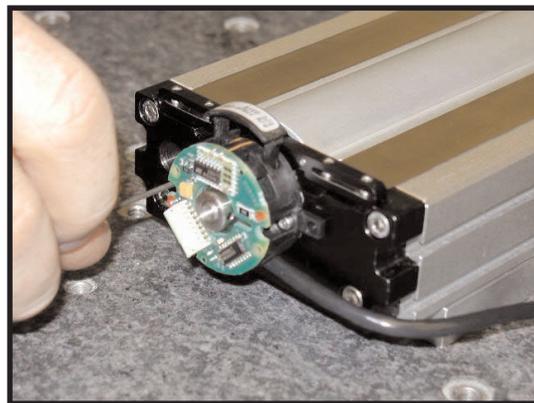
(2) Lift the shaft alignment lock upward.



(3) Using a 0.050" Allen wrench, loosen the set screw which connects the rotary encoder to the ballscrew shaft extension.



(4) With a 1.5mm Allen wrench, remove the two M2 x 8mm long mounting screws which attach the encoder to the base of the DS4.



(5) Remove the encoder by pulling it straight outward.



(6) To replace the existing encoder, or to install a new encoder, perform step 1 to 5 above in reverse order.

## Linear Encoder Index Adjustment

DS4 positioning tables as is an optional linear rotary encoder will be shipped from the factory with that option mounted to the DS4. The index mark for the linear encoder will be mounted at the factory in the center of the DS4's travel, unless otherwise specified. Because the index mount resides in the lower T-slot of the DS4, it is possible to adjust the position of the index in the field. Follow this procedure.

**Tools required:** - 2.5mm Allen wrench.

**Note:** Power to the encoder must be turned OFF prior to performing this activity.

- (1) Loosen the two (2) M4x6mm button head cap screws using a 2.5mm Allen wrench, adjust the position of the index in the T-slot, and re-tighten the screws.



**Note:** The green light should flash red as the encoder readhead passes over the index mark.

## Installing a Vent Tube Fitting

A plastic vent tube fitting is included separately with each DS4. The vent tube fitting would typically be installed to provide a small amount (2-3 psi) of positive air pressure to help prevent contamination of the DS4 by minute particles.

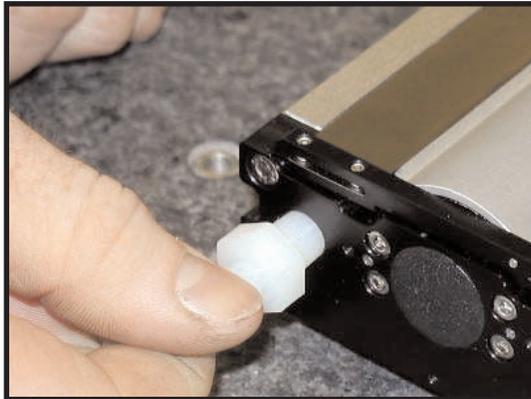
**Materials required:**

- 1/8" NPT vent tube fitting (one is supplied with each DS4)
- 5/8" open end wrench
- 1/4" (inner) diameter plastic tubing
- small flat bladed screwdriver

- (1) Remove the plastic cap at the end of the DS4 with flat blade screw driver to expose the threaded hole for the vent tube fitting.



(2) Thread the NPT vent tube fitting into hole clockwise.



(3) Tighten the vent fitting with a 5/8" wrench.



(4) Attach the 1/4" diameter tubing to the barbed end of the vent tube fitting.

## SECTION 6: Optional Equipment - Specifications, Dimensions, and Wiring

### Limit (-Lxx) & Home (-Hxx) Sensors Options

End-of-travel position sensors (a.k.a. limit switches) are required to prevent potentially damaging collisions with the internal hard-stops of the DS4. If the motor is accidentally commanded to move toward a hard stop, position sensors can signal a stop before a collision occurs. To work properly, position sensors must be positioned inward from the hard-stop, and wired correctly to the motor controller.

**Note:** Using the physical limits (hard-stops) of the DS4 will reduce table life and can cause premature component failure.

The limit switches can also be positioned to reduce travel of a given positioning table, a method sometimes used to prevent collision with external objects. The location of the DS4's external limit sensors are adjustable throughout the entire range of travel. Limit Sensors are configured in sets of two (2).

Sometimes an additional Home sensor is requested to indicate that the DS4 is in a particular location along its travel. This is also referred to as an "index" mark. Home sensors can be the same, or different, electronic "flavor" as the Limit Sensors. Home Sensors are configured as individual (qty 1) items.

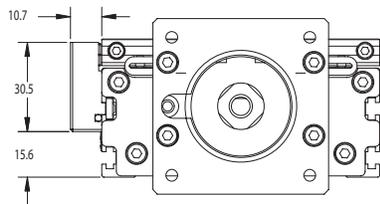
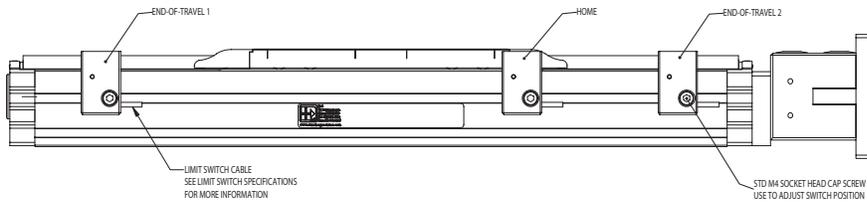
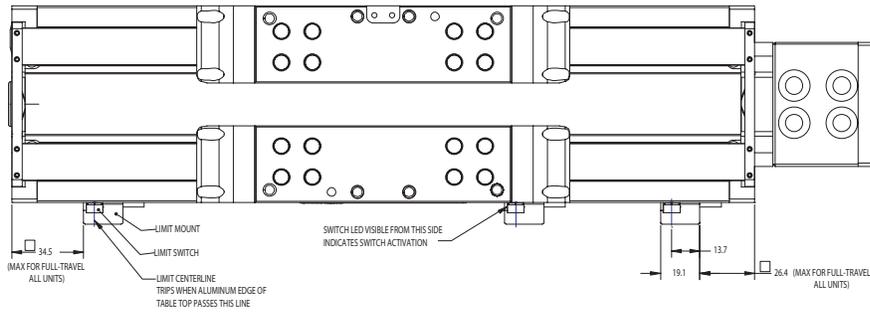
Please refer to Section 5 for information on the adjustment of limit and home sensors.



LIMIT SENSOR / HOME SENSOR SPECIFICATIONS								
	LN1	LN2	LP1	LP2	HN1	HN2	HP1	HP2
<b>Sensor Type</b>	Inductive Proximity Sensor							
<b>Output Type</b>	NPN, Sinking, Open collector	NPN, Sinking, Open collector	PNP Sourcing	PNP Sourcing	NPN, Sinking, Open collector	NPN, Sinking, Open collector	PNP Sourcing	PNP Sourcing
<b>Connection</b>	Normally Open	Normally Closed	Normally Open	Normally Closed	Normally Open	Normally Closed	Normally Open	Normally Closed
<b>Quantity</b>	2	2	2	2	1	1	1	1
<b>Repeatability</b>	+/- 8 microns							
<b>Power Supply</b>	5 to 30 VDC							
<b>Current Consumption</b>	<=10mA							
<b>Current Capacity</b>	100mA							
<b>Temperature Range</b>	-20C to +70C							
<b>Sealing</b>	IP67							
<b>LED Color</b>	red							
<b>Cable</b>	5m Cable w/ 3 x 28AWG conductors and flying leads							



### Limit Sensor / Home Sensor Dimensions



**Limit Sensor / Home Sensor Electrical Connections**

LIMIT/HOME WIRING COLORS	
+VDC	Brown
Ground	Blue
Signal	Black



### Brake on Ballscrew Option (-BS)

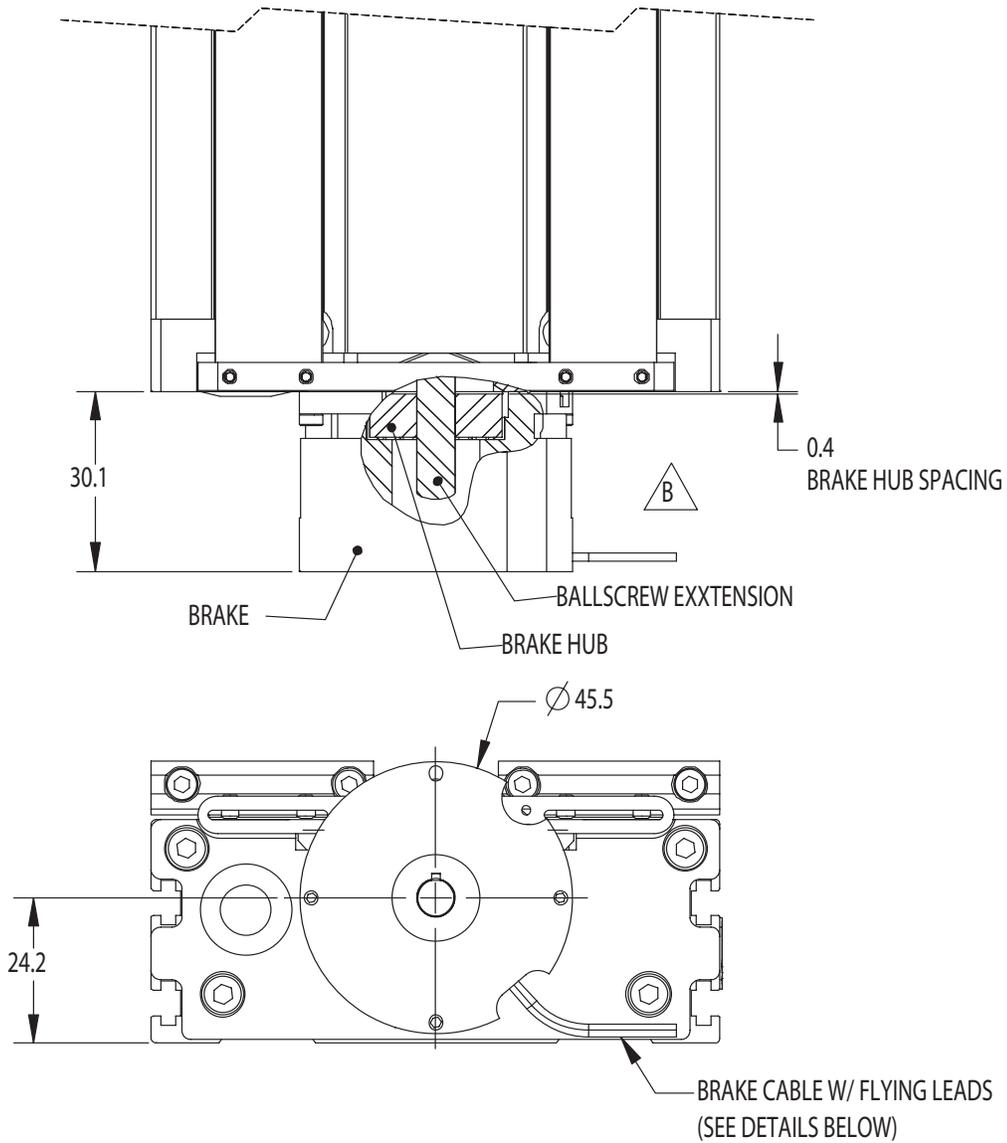
This brake option provides a spring-set, electrically-released friction brake mounted to an extension of the leadscrew. It prevents backdriving when the unit is at rest, or in case of power failure. The brake is engaged when power is not applied. Applying power releases the brake, allowing motion to occur.

**Application Note:** This option is used only for *in-position* holding, it should not be used for stopping a moving load.

BRAKE SPECIFICATIONS		
	TYPE	ELECTROMAGNETIC POWER-OFF
ELECTRICAL	Coil Voltage	24 VDC
	Resistance	640 Ohms (nominal)
	Current	125mA
	Power	10W max
MECHANICAL	Holding Torque	1.13Nm
	Weight	300g
	Inertia	0.211 g-cm <sup>2</sup>
	Armature Engagement	30ms
	Armature Disengagement	10ms
	Max Operating Temperature	180C
	Cable length	300mm min
	Cable type	2 x 28 gauge conductors with PVC insulation



### Brake Dimensions



### Brake Electrical Connection

The power-off brake is a two (2) wire device. Either of the wires can be connected to the source 24 VDC, while the other is connected to ground.



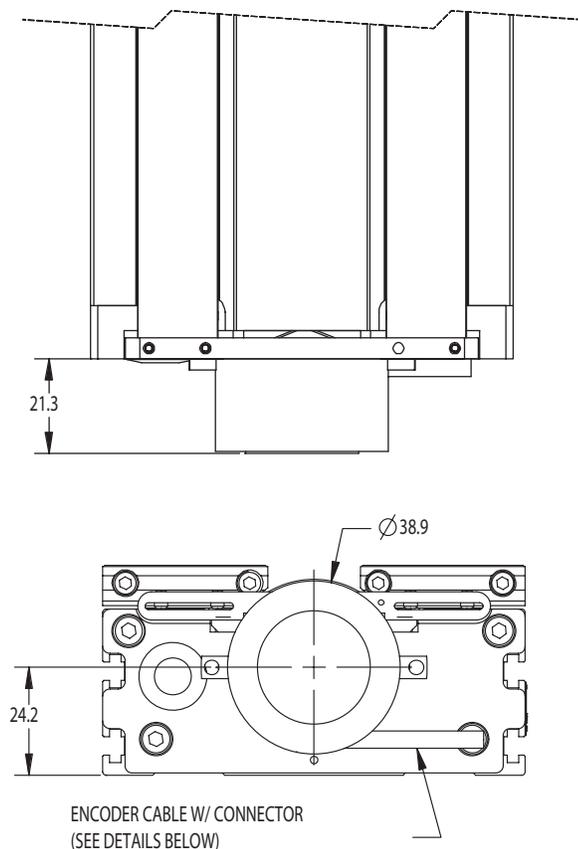
## Rotary Encoder on Ballscrew Option (-ES)

The -ES encoder is an industry-standard, 1250-line count encoder. The digital pulse output is used to provide position feedback to external devices such as motor controllers, counters, or PLC's. When used in conjunction with a 5mm lead ballscrew (option -5G) the 1250 line encoder provides 1 micron of linear resolution after TTL quadrature output.

ROTARY ENCODER SPECIFICATIONS		
	TYPE	MODULAR INCREMENTAL
ELECTRICAL	Output Format	Square-Wave, Two-Channel quadrature with index
	Resolution	1250 lines/rev (5000ppr post quadrature, one index line)
	Supply Voltage	5 VDC +/-5%
	Current Requirements	135mA
	Output Frequency	200kHz max
MECHANICAL	Weight	57g max
	Inertia	5.16 g-cm <sup>2</sup>
	Cover Material	Glass-filled polycarbonate
ENVIRONMENT	Operating Temperature	-10C to +100C
	Storage Temperature	-30C to +110C
	Humidity	90% relative (non-condensing)
	IP Rating	IP40
	Shock	50Gs for 11ms duration
	Vibration	5-2000Hz @ 10G's
CABLE	Cable Length	457mm +/- 26mm
	Cable Type	8 x 28 gauge conductors with PVC insulation, polyester foil shield with drain wire, in PVC cable jacket
	Connector	AMP P/N 103971-7 or equivalent
	Mating Connector	Any 0.635mm non-polarized single row header (2.54mm centers) or may be installed into single row latching shroud (AMP p/n 103680-5)



### Rotary Encoder Dimensions



### Rotary Brake Electrical Connection

ELECTRICAL CONNECTION		
PIN	FUNCTION	WIRE COLOR
1	+VCC	Red
2	GRD	Black
3	CH A	White
4	CH A NOT	Yellow
5	CH B	Green
6	CH B NOT	Blue
7	INDEX	Orange
8	INDEX NOT	Brown
-	SHIELD	Drain



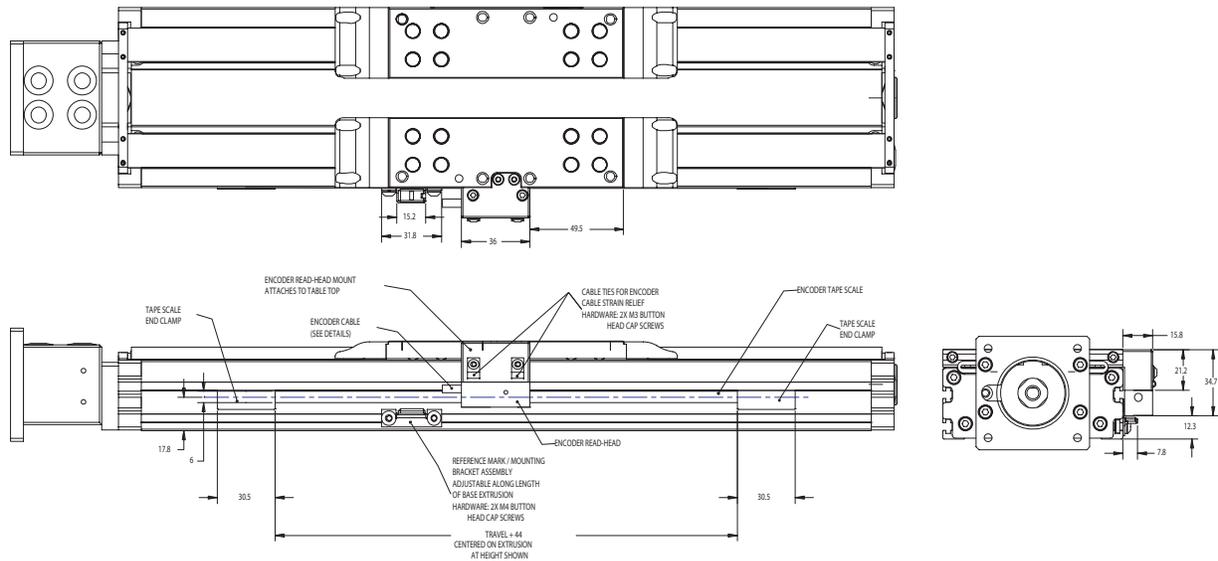
## Linear Encoder Options (-E1, -E2, -E3)

Linear encoders can be added to DS4 Positioning Tables to improve positioning performance. Repeatabilities up to one encoder count may be possible depending on application conditions. Because the linear encoder read head is directly attached to the carriage, a motion controller can benefit from directly measuring the carriage position. Directly measuring the carriage position can improve positioning results by compensating for the positional errors caused by thermal expansion of the drive screw, lost rotary encoder counts, mechanical backlash and other system hysteresis (e.g. coupling wind up).

LINEAR ENCODER SPECIFICATIONS			
	-E1	-E2	-E3
Resolution	1 micron	0.5 micron	0.1 micron
Type	Incremental		
Signal	Square wave differential line driver; Two channel quadrature		
Power Supply	5VDC +/- 5%, 120mA		5VDC +/- 5%, 120mA
Operating Temperature	0C to +55C		
Storage Temperature	-20C to +70C		
Humidity	10-90% relative (non-condensing)		
Sealing	IP40		
Acceleration	30G (operating)		
Shock	100G for 11ms duration (non-operating)		
Vibration	10G at 55-2000Hz (operating)		
Accuracy	+/-3 microns/m with linear compensation (slope correction)		
Linearity	+/- 1 micron/60mm; +/- 3 microns/m (slope collected)		
Cable Type	1.5m long x 4.2mm $\phi$ diameter integral double shielded cable with 9-pin D-type plug		
Cable Flex Life	>20 million cycles at 20mm bend radius		
Velocity, Maximum	3 m/s	1.5 m/s	0.3 m/s



### Linear Encoder Dimensions



### Linear Encoder Electrical Connection

LINEAR ENCODER WIRING CONNECTIONS (D9 MALE CONNECTOR)		
PIN	FUNCTION	WIRE COLOR
1	0VDC	White
2	CH A	Green
3	CH Z	Pink
4	CH B	Blue
5	+5VDC	Brown
6	CH A NOT	Yellow
7	CH Z NOT	Grey
8	CH B NOT	Red
9	Inner Shield	-
-	Outer Shield	-



### Motor Couplings

DS4 positioning tables (inline versions) are normally supplied with flexible shaft couplings as indicated in the modular part number. Improperly selected couplings with poor torsional stiffness can cause wind up errors, unwanted resonance problems and long settling times. The chart below provides the available coupling options and replacement part numbers that are available for the DS4.

OLDHAM STYLE COUPLINGS (COMMERCIAL GRADE)								
Coupling Code	Bore Diameter (Motor Side)	Outside Diameter (mm)	Length (mm)	Rated Torque (Nm)	Break Torque (Nm)	Torsional Stiffness (Nm/degree)	Misalignment Specification Parallel (mm)	Axial Motion (mm)
OE3	3/16"	25.4	31.8	4.75	19	3.43	0.2	0.1
OE4	1/4"							
OE5	5/16"							
OE6	3/8"							
OE8	1/2"							
OM5	5mm							
OM8	8mm							
OM9	9mm							
OM11	11mm							

BELLOWS STYLE COUPLINGS (PRECISION GRADE)									
Coupling Code	Bore Diameter (Motor Side)	Outside Diameter (mm)	Length (mm)	Rated Torque Static (Nm)	Rated Torque Dynamic (Nm)	Torsional Stiffness (Nm/degree)	Misalignment Specification		Axial Motion (mm)
							Parallel (mm)	Angular (deg)	
BE3	3/16"	25	33	6.8	3.4	32	0.1	1.5	0.3
BE4	1/4"								
BE5	5/16"								
BE6	3/8"								
BE8	1/2"								
BM5	5mm								
BM8	8mm								
BM9	9mm								
BM11	11mm								

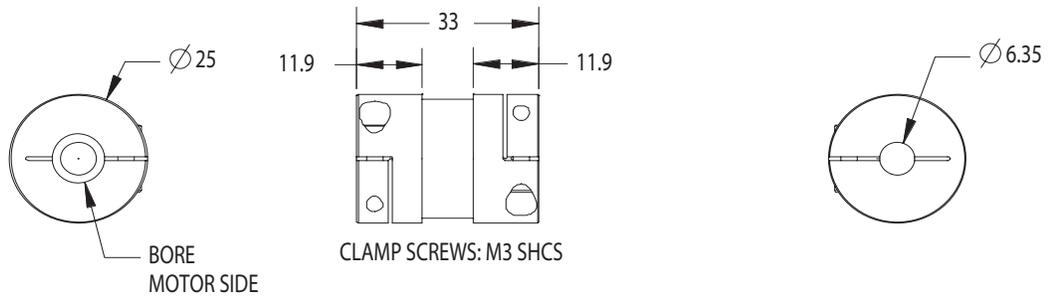


STYLE	REPLACEMENT PART NUMBER	BORE DIAMETER (MOTOR SIDE)	BORE DIAMETER (DS4 SIDE)	OUTSIDE DIAMETER (MM)
Oldham	12-0132	3/16"	6.3mm (0.25")	25.4
Oldham	12-0133	1/4"		
Oldham	12-0134	5/16"		
Oldham	12-0135	3/8"		
Oldham	12-0136	1/2"		
Oldham	12-0137	5mm		
Oldham	12-0138	8mm		
Oldham	12-0139	9mm		
Oldham	12-0140	11mm		
Bellows	61-0059	3/16"		
Bellows	61-0055	1/4"		
Bellows	61-0117	5/16"		
Bellows	61-0057	3/8"		
Bellows	61-0058	1/2"		
Bellows	61-0063	5mm		
Bellows	61-0064	8mm		
Bellows	61-0062	9mm		
Bellows	61-0060	11mm		

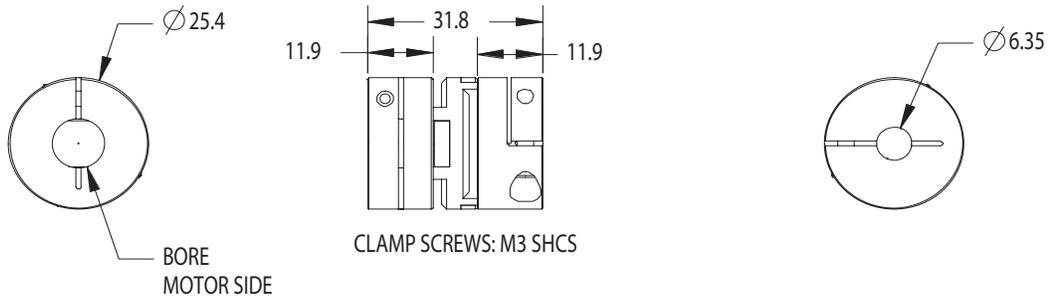


### Motor Coupling Dimensions

BELLOWS STYLE



OLDHAM STYLE



## SECTION 7: Motor Specifications & Mounting

### Specifications of IDC-Supplied Motors

A DS4 positioning table may be purchased with a standard IDC motor mounted to the table. In this case, the IDC motor code appears in the motor mount field of the part number.

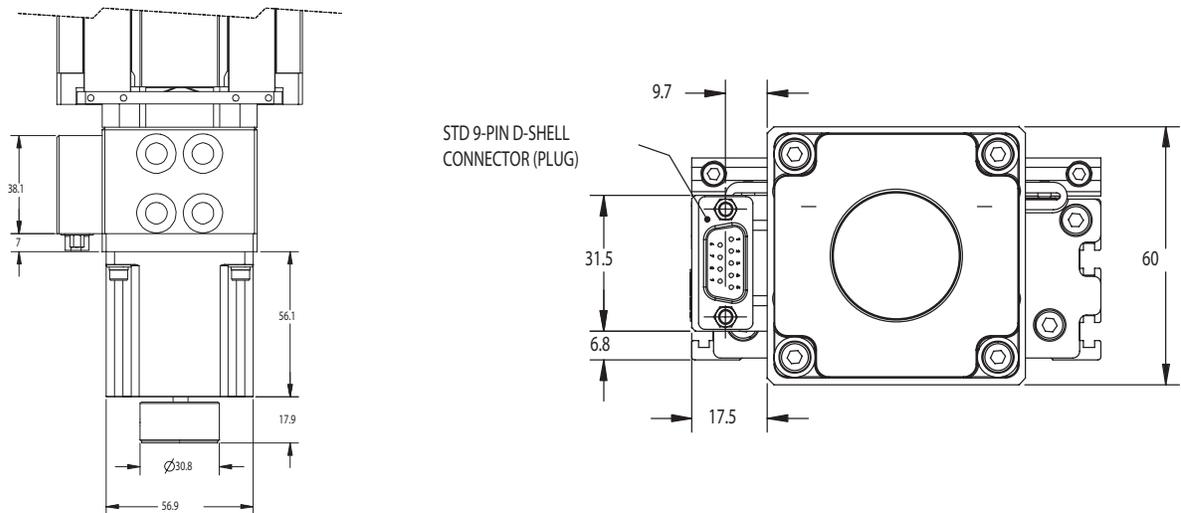
*Example: In the DS4 configuration string of **DS4-150-C-5G-P21-OE4-LN2-HN2-BS-E1**, the "P21" indicates the selection of our standard single-stack 200 step/rev stepper motor.*

Specification for our current offering of stepper and servo motors is provided here.

### Stepper Motor Option (-P21)

P21 MOTOR PARAMETERS		
Holding Torque	0.69 N-m	126 oz-in
Rated Continuous Current / Phase	0.95A	
Phase Inductance (+/-20%)	16.9mH	
Weight	0.703 kg	1.55 pounds
Rotor Inertia	$0.0248 \times 10^{-3} \text{ kg-m}^2$	0.0034 oz-in-sec <sup>2</sup>

### P21 Stepper Motor Dimensions



<b>P21 STEPPER MOTOR WIRING CONNECTION</b>		
<b>Motor Connection Pin #</b>	<b>Stepper</b>	<b>Mating Cable Wire Color</b>
1	A+	Red
2	A-	Orange
3	N/C	White
4	B+	Green
5	B-	Blue
6	A Center	Black
7	N/C	Violet
8	N/C	Yellow
9	B Center	Brown
<b>Metal Hood</b>		Ground



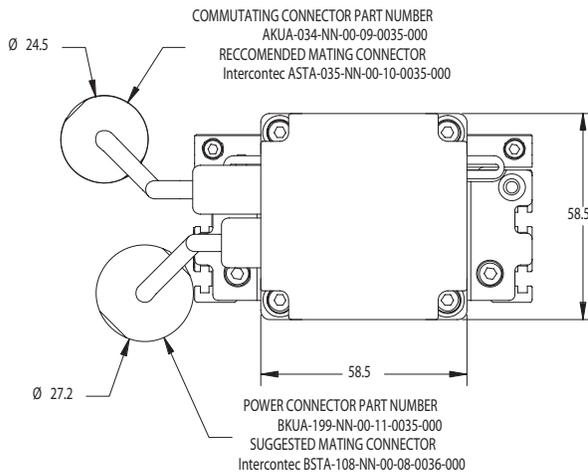
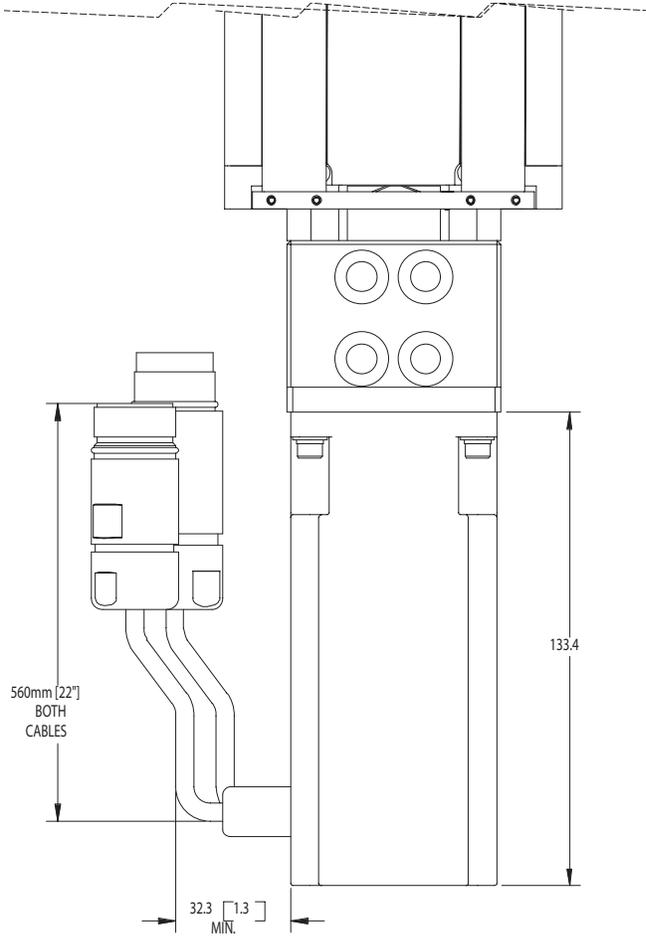
When the IDC-supplied motor needs to be removed and/or replaced, follow the instructions provided later in this section to mount the motor back on the DS4.

### Brushless Servo Motor Option (-IDC14)

IDC14 MOTOR PARAMETERS		
Continuous Stall Torque	1.16 N-m	164.3 oz-in
Peak Torque	3.84 N-m	543.8 oz-in
Torque Sensitivity (+/-10%)	0.52 N-m/A rms	73.6 oz-in/A rms
Back EMF (+/-10%)	33.8 V rms / krpm	
Maximum Speed	8000 rpm	
Weight	1.38 kg	3.04 pounds
Rotor Inertia	0.22 kg-cm <sup>2</sup>	1.9 x 10 <sup>-4</sup> lb-in-sec <sup>2</sup>



### IDC14 Brushless Servo Dimensions



## IDC14 Brushless Servo Motor Wiring Connections

MOTOR PHASE WIRING (8-PIN CONNECTOR)	
SIGNAL	PIN
PHASE "C"	1
GROUND	2
PHASE "A"	3
PHASE "B"	4
BRAKE +	A
BRAKE -	B
N/C	C
N/C	D

HALL SENSOR WIRING (17-PIN CONNECTOR)	
SIGNAL	PIN
B	1
B-	2
A	3
A-	4
Z	5
Z-	6
GND	7
THERMAL SENSOR	8
THERMAL SENSOR	9
VCC	10
N/C	11
U-	12
V-	13
W-	14
U	15
V	16
W	17



## Mounting a Customer-Supplied Motor

### Motor Compatibility

When purchased from the factory without a motor, DS4 positioning tables include a motor mounting block to accept the particular motor that was selected for your application. Several standard motor mounting blocks are available, in both inline and parallel mount versions (see Section 2). In this case the IDC motor mount code appears in the appropriate configuration field.

*Example: In the DS4 configuration string of DS4-150-C-5G-X23-OE4-LN2-HN2-BS-E1, the "X23" indicates the selection of flange to accept a NEMA 23 motor flange. The "OE4" indicates which coupling has been selected to connect the 1/4" diameter motor shaft to the ballscrew.*

An IDC Applications Engineer must approve all non-standard motors to ensure desired performance of the positioning table.

A system configured by your distributor or integrator may incorporate a gearhead or other motor blocks and couplings. Please contact an IDC Applications Engineer or your distributor for answers to motor mounting questions.

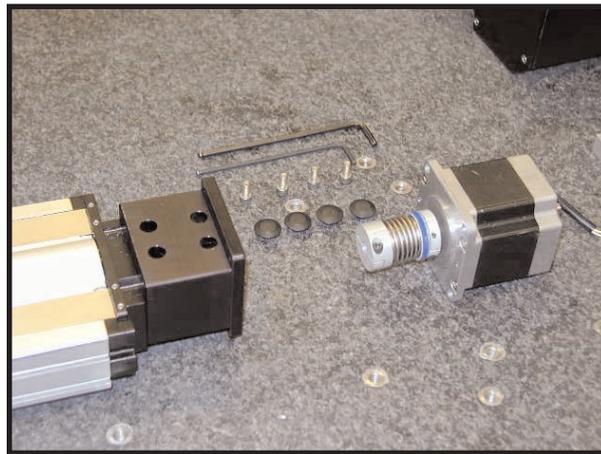
MOTOR MOUNTING HARDWARE	
Motor Size	SHCS Size
1.6" Frame	M3
NEMA 17 Frame	M3 or 4-40 (mfr. dependent)
NEMA 23	M4
NEMA 34	M5
70mm	M5



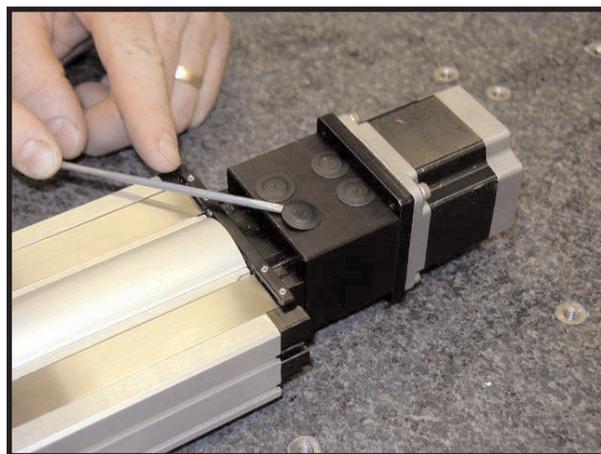
## Motor Attachment or Changing – Inline Motor Mounting

A flexible shaft coupling is required to connect the drive motor shaft to the table's drive screw. Most DS4 positioning tables are ordered with a coupling. Motor attachment proceeds as follows.

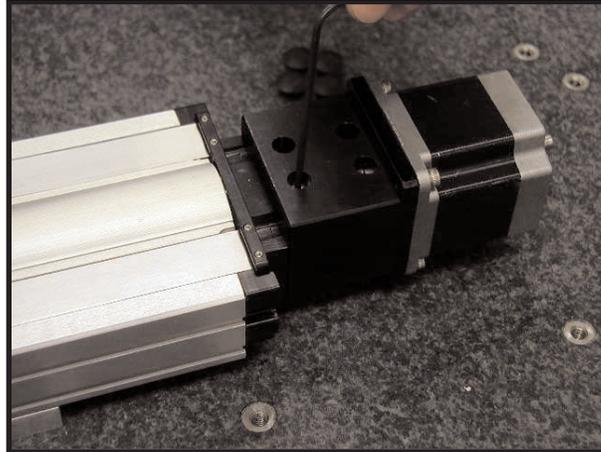
- Materials required:**
- Small flat-blade screwdriver
  - Allen wrenches for appropriate coupling and motor mounting hardware (see chart above)
  - Flexible motor coupling
  - Motor



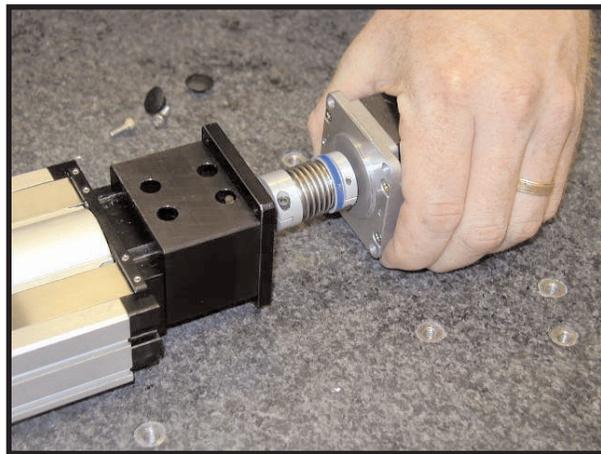
- (1) First, remove the plastic caps in the top of the coupling housing by prying all four pieces upward.



- (2) Proceed to remove the coupling from the drive screw shaft by loosening the coupling set screw or cap screw. It may be necessary to rotate the coupling to allow access to the screw via the port in the end block. If changing/removing the motor, loosen the four (4) socket head cap screws holding the motor to the mounting flange.

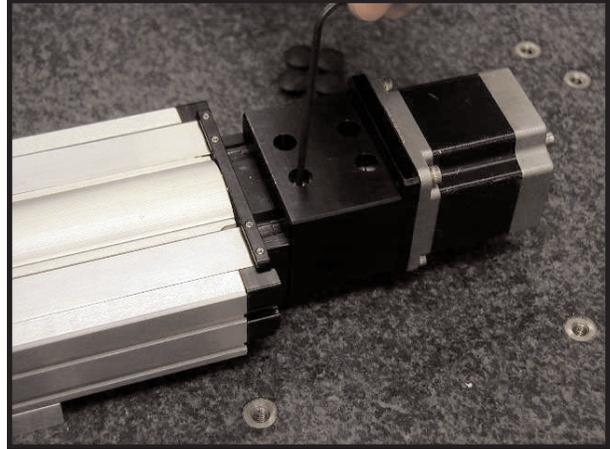
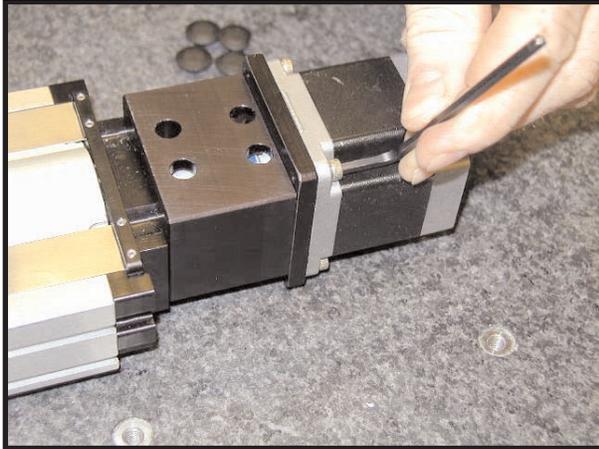


- (3) **With the motor power OFF**, attach the coupling to the motor shaft with the appropriate Allen wrench. Position the motor on the block such that the power cables will not interfere with free movement of the carriage.

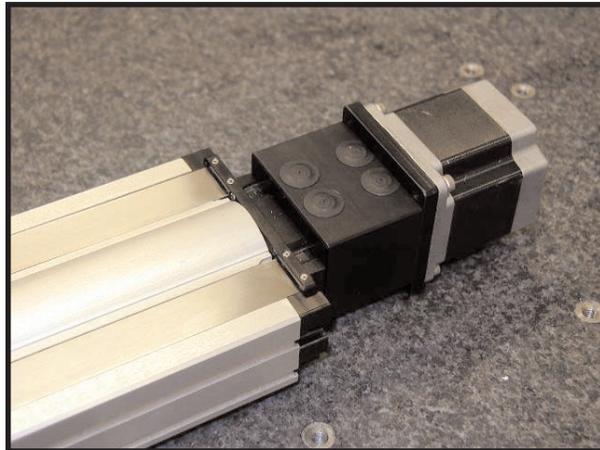


**Note:** Clamp screws used to attach the couplings to the motor shaft and ballscrew shaft should be tightened to 2.1 Nm (297 in/ozf).

- (4) Insert and tighten the four (4) attachment screws. Re-attach the coupling to the table drive screw. User supplied motors should be checked for shaft interference. **Direct contact between the ends of the drive and motor shafts is not acceptable.** For tables purchased with motors attached, simply verify that the coupling is properly secured to both shafts.



- (5) Replace the four plastic caps.

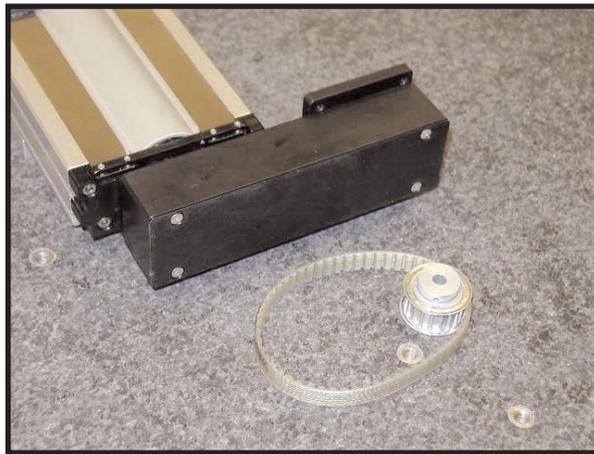


## Motor Attachment or Replacement – Parallel Motor Mounting

Two pulleys and a belt are required to connect the drive motor shaft to the table's drive screw. When ordered with a parallel motor mount, your DS4 positioning table will be supplied with the appropriate pulleys and belt. Motor attachment proceeds as follows.

**Materials required:**

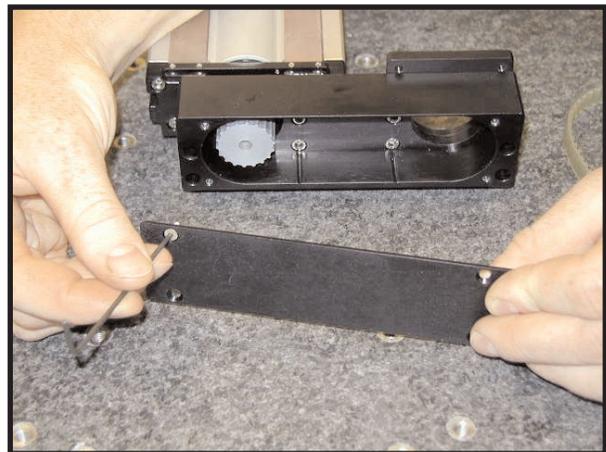
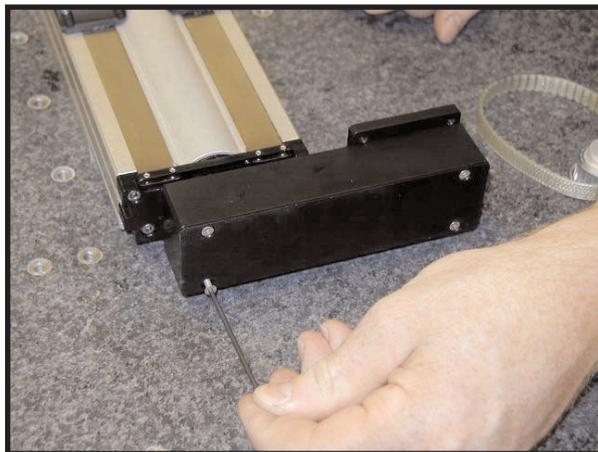
- Allen wrenches: 8mm, 3mm, 2mm, 1.5mm (and those for the appropriate motor mounting hardware (see chart above))
- Pulleys
- Belt
- Motor



**Note:** The ballscrew shaft pulley will be mounted at the factory.

**Note:** Three parallel motor mounting orientations are available: Parallel Right, Parallel Left, and Parallel Under. The procedures are identical for all three orientations.

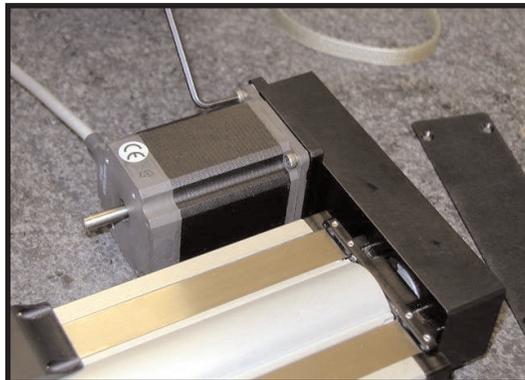
(1) Remove the parallel motor mount cover by first removing the four (4) M3 flat-head cap screws with a 2mm Allen wrench.



- (2) Attach the motor pulley to the motor shaft with the two (2) set screws using a 1.5mm Allen wrench. The tightening torque on the set screws should be 0.92 Nm (130 in/ozf).



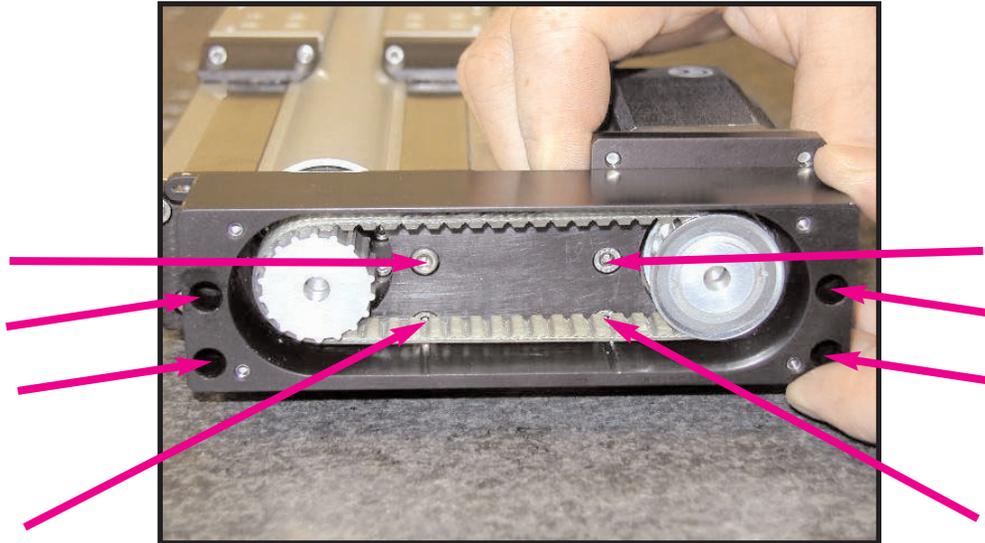
- (3) Position the motor on the motor mounting flange. Select the appropriate socket head cap screws and firmly attach the motor to the flange.



- (4) Wrap the belt, first over the motor pulley and then over the ballscrew shaft pulley. It may be necessary to loosen the mount in order to attach the belt over both pulleys. See step 5 below.



- (5) There are a total of eight (8) M4 screws which both mount the parallel motor mount to the positioning table and motor, as well as providing means to adjust the tension of the belt. All eight of these screws may be loosened and re-tightened with a 3mm Allen wrench to increase the tension of the belt.



- (6) Once belt is fully aligned and meshed with both pulleys, tension the belt by firmly pulling the motor away from the DS4 (applying approximately 7-14 pounds of side force) and re-tightening the eight M4 cap screws



- (7) Replace the parallel motor mount cover with the four (4) flat head caps screws using a 2mm Allen wrench.



## SECTION 8: Service & Routine Maintenance

In order to ensure a long life expectancy and reliable functionality, the DS4 must be serviced according to the directions found in this manual. Lubricants and replacement parts should be by the same manufacturer as the original, and of the same type as the original, or be among those approved by IDC. Never use parts which will work improperly or appear to be damaged.

Be sure to read, understand and follow all of the “**Important User Safety Instructions**” located in the beginning of this manual. The User should be capable of performing routine maintenance by following the instructions presented here. If additional assistance or factory repair is required, please contact the factory, making sure to have the full part number and serial number of your DS4 handy. Maintenance beyond what is covered in this manual should only be performed with the aid of, or by an IDC technician.

Follow recommended service intervals. Replace defective parts immediately.

Check the unit at least one a month, particularly the seal strips and the mounting hardware connections. Be attentive to changes in level of noise. Replace, repair, or adjust the unit if any of these conditions occur.

Keep the DS4 clean. Wipe it off as required, particularly the seal strip. If cleaning fluid is required, use small amounts and see to it that none gets into the unit. Do not use strong cleaning agents. Dry the unit completely.

Never mix different types of grease/lubricants.

Power and compressed air connected to the DS4 must be turned OFF prior to mounting or performing maintenance on the positioning table.

### Internal Access

The procedure addressed here allows access to internal components of the DS4. This is useful for access to the mounting holes in the base of the DS4, as well as for routine lubrication of the ballscrew and square rail linear bearings.

**Tools required:**

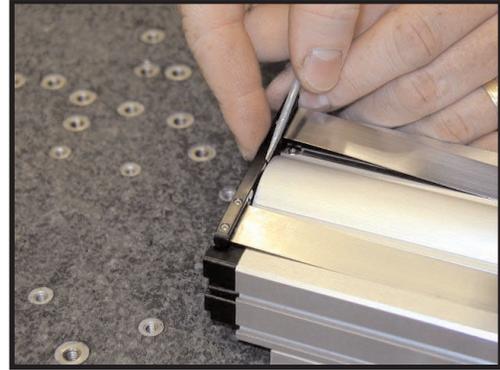
- Small flat-blade screwdriver.
- 2mm Allen wrench.

**Note:** The dual seal strip bands and (2) spring-loaded seal strip retainers are assembled at the factory. It is not necessary to disassemble the bands from the seal strip retainers.

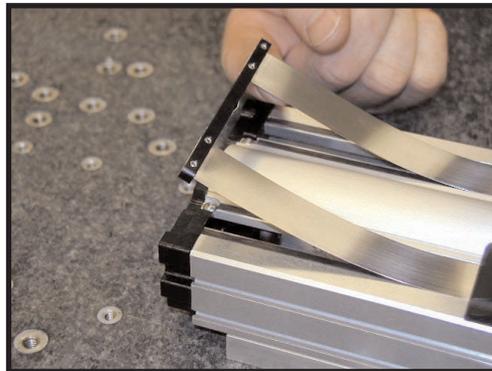
**Note:** It is usually helpful to position the carriage of the DS4 roughly in the center of its travel range.



- (1) Starting at the end of the DS4 away from the motor, insert the blade of a small screwdriver between the seal strip retainer and the ballscrew cover to depress the flat spring into the seal strip retainer.



- (2) Peel the seal strip retainer upward.



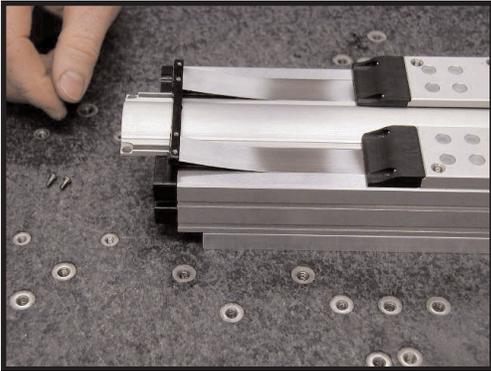
- (3) Slide the entire seal strip assembly slightly toward the motor end of the DS4.



- (4) Locate the four button head cap screws (2 at each end) which secure the extruded ballscrew cover to the base of the DS4. Use a 2mm Allen wrench to remove the four screws.



- (5) Remove the extruded ballscrew cover by sliding it out through the carriage, sliding the cover away from the motor end of the DS4.



## Re-assembly of the Ballscrew Cover and Seal Strip

- (1) Insert the extruded ballscrew cover by sliding it under the stainless steel bands and through the carriage. Please note that the end of the cover with the slotted holes goes in toward the motor.



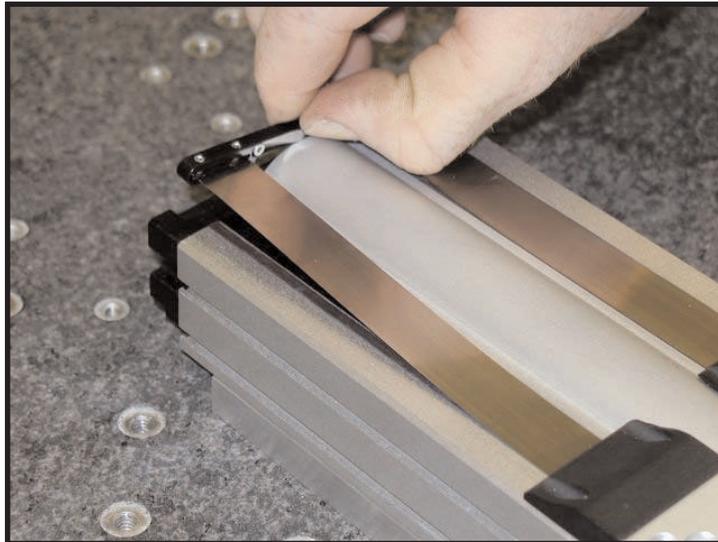
- (2) Replace the four (4) button head cap screws with a 2mm Allen wrench.



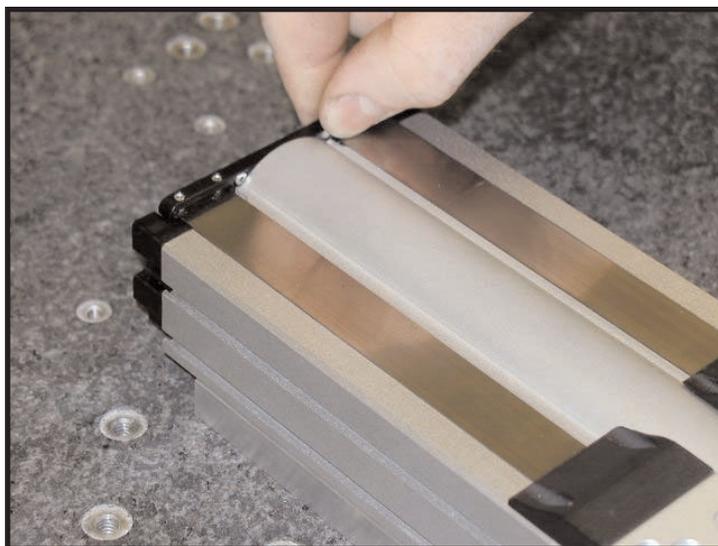
- (3) Reposition the seal strip assembly so that one flat spring is seated firmly in the slot on the end of the DS4.



- (4) Depress the flat spring on the other end of the seal strip assembly, and slip over the end of the DS4 until the flat spring is seated in its slot.



**Note:** Make certain that each end of the seal strip assembly is seated in its slot by applying a light upward pulling action.



## Lubricating Ways (Square Rail Linear Bearings)

The DS4 is lubricated at the factory prior to final inspection and shipment. As the quality of any grease will gradually deteriorate as operating time passes, periodic relubrication is necessary. The re-lubrication interval varies depending on the operating conditions of the rolling guides. A six month interval (or 1000 hours of usage) is generally recommended, and, if the machine operation consists of reciprocating motions with many cycles and long strokes, re-lubrication every three months may be required.

Use only a Lubriplate DS-ES lithium soap, mineral oil supplied by IDC, or an approved equivalent, for standard DS4 positioning tables (designed for Cleanroom Class 1000 operation). If your DS4 is prepared for Cleanroom 100/10 operation, use only a cleanroom compatible lubricant.

A 6cc syringe of way lubricant is provided with each DS4.

**Materials required:**

- 2mm Allen wrench and a small flat-blade screwdriver (for internal access)
- Lint free lean cloth
- Syringe of way lubricant

- (1) Use the procedures presented above to gain access to the internal components of the DS4.
- (2) Position the carriage of the DS4 roughly in the center of travel.
- (3) Using a clean cloth, wipe down the square rails to remove any existing excess or old grease.
- (4) With the syringe of way lubricant, place a small bead of lubricant on each side of the square rail, roughly over the bearing raceway. Each bead should be approximately 1" (25mm) long.



- (5) Repeat the process by applying lubrication to each square rail on the other side of the carriage.
- (6) Traverse the carriage over the full length of the travel 7 to 10 times to disperse the grease lubricant.
- (7) Remove any excess accumulations of grease with a clean cloth.
- (8) Re-assemble the ballscrew cover and seal strip assembly by following the instructions presented earlier in this section.

### Lubricating the Ballscrew

The DS4 is lubricated at the factory prior to final inspection and shipment. As the quality of any lubricant will gradually deteriorate as operating time passes, periodic re-lubrication is necessary. The re-lubrication interval varies depending on the operating conditions of the rolling guides. A six month interval (or 1000 hours of usage) is generally recommended, and, if the machine operation consists of reciprocating motions with many cycles and long strokes, re-lubrication every three months may be required.

Use only a Shell Alvania type 2 grease supplied by IDC, or an approved equivalent, for standard DS4 positioning tables (designed for Cleanroom Class 1000 operation). If your DS4 is prepared for Cleanroom 100/10 operation, use only an approved cleanroom compatible lubricant.

A 6cc syringe of way lubricant is provided with each DS4.

**Materials required:**

- 2mm Allen wrench and a small flat-blade screwdriver (for internal access)
- Clean cloth
- Syringe of ballscrew lubricant

- (1) Use the procedures presented above to gain access to the internal components of the DS4.
- (2) Position the carriage of the DS4 roughly in the center of travel.
- (3) Using a clean cloth, wipe down the ballscrew to remove any existing excess or old grease.



- (4) With the syringe of way lubricant, apply a small bead of lubricant directly to the ballscrew. The bead should be approximately 1" (25mm) long.



- (5) Repeat the process by applying lubrication to the ballscrew on the other side of the carriage.
- (6) Traverse the carriage over the full length of the travel 7 to 10 times to disperse the lubricant.
- (7) Remove any excess grease with a clean cloth.
- (8) Re-assemble the ballscrew cover and seal strip assembly by following the instructions presented earlier in this section.

## SECTION 9: Warranty, Technical & Service Support

### Technical Support

IDC provides product technical support through its network of factory trained and authorized distributors. IDC is also available through factory based Applications Engineering and Customer Service departments. Routine technical information is available through IDC's web site at [www.idcmotion.com](http://www.idcmotion.com). If application issues arise or product failures occur, please contact your local IDC distributor. IDC can also be contacted directly at (815) 226-2222 or by fax at (815) 226-3080.

### Product Returns

All IDC service for precision positioning systems is performed at our factory located in Salem, NH. Before shipping any positioning system to IDC for evaluation or repair (under warranty or for paid service), it is first necessary to obtain a return authorization number. A Return Material Authorization (RMA) number can be obtained from IDC's Application Engineering or Customer Service Departments. Please contact your local distributor or IDC at (815) 226-2222 by phone or (815) 226-3080 by fax to make the necessary arrangements. When requesting an RMA number, it is necessary to provide the following:

ORIGINAL IDC ORDER NUMBER  
DISTRIBUTOR IDENTITY AND ORDER NUMBER  
PRODUCT SERIAL NUMBER  
CONTACT INFORMATION  
DETAILED DESCRIPTION OF THE PROBLEM

Pack the product securely, preferably in the original shipping carton. The IDC positioning system must be wrapped or bagged to separate it from cushioning packing materials. Foam in place urethane or other high density, cushioning foam blocks are recommended. Styrofoam packing chips should be avoided if possible. Failure to protect the mechanism from packing chips and dust and to securely package the positioning system may result in damages that will not be covered under IDC's warranty terms.

**The RMA number should be printed prominently on the packing carton exterior and referenced on all shipping documents. Ship the positioning system prepaid to:**

IDC  
7C Raymond Avenue  
Salem, NH 03079  
Attn: RMA # \_\_\_\_\_

A minimum charge applies for inspection and repair of a returned positioning table. Contact IDC



for the current minimum charge and service rates. This charge applies to all paid (non-warranty) repairs and to tables within their warranty period if no problem is found with the positioning system.

While IDC makes every effort to address both warranty and non-warranty repairs as rapidly as possible, turn around time will depend upon the availability of resources (both internal and external). Delivery will be quoted by phone or fax after an evaluation by IDC technicians.

## Warranty Terms

Unless otherwise specified, IDC warrants its precision positioning systems to be free from defects in materials and workmanship when handled and operated in accordance with the terms stated in this manual. IDC will repair or replace, at no charge, positioning systems that are defective in materials or workmanship, provided that such defects are declared in writing within 12 months after the original shipment date. **IDC's obligation under this warranty is limited to the repair or replacement of the apparatus at IDC's factory. The decision to replace or repair a table is reserved to IDC.** Repairs or replacements made under warranty terms will be shipped prepaid to the user.



## Appendix A – Clean Room Preparation

DS4 Positioning Tables can be ordered with special preparation for clean room environments. With vast experience of applying positioning tables into applications where particle generation must be minimized, we have reviewed all aspects of the materials and design of products subject to this environment.

Our approach is to address particles which are generated both actively (by sliding surfaces such as bearings, ballscrews, and seal strips) and passively (the shedding of surface particles from materials including lubricants, and the outgassing of foreign materials trapped on surfaces).

Several obvious, and some less obvious steps are taken to prepare the DS4 for operation in a Clean Room. These include removal of the seal strips, seal strip magnets, and the four plastic table endcaps, as well as the use of special lubricants.

The standard clean room option for the DS4 prepares the positioning table for operation in a Class 100 Clean Room\*. Depending on the application and orientation of the DS4 with respect to the particle counter and the laminar flow within the chamber, the DS4 Clean Room option may provide a positioning table suitable for a Class 10 Clean Room.

FED STD 209E CLEAN ROOM STANDARDS						
CLASS	Number of Particles per Cubic Foot by Micrometer Size					
	0.1 um	0.2 um	0.3 um	0.5 um	1 um	5 um
Class 1	35	7	3	1		
Class 10	350	75	30	10	1	
Class 100		750	300	100	10	1
Class 1000				1000	100	10
Class 10000				10000	1000	100
Class 100000				100000	10000	1000

\* Clean Room ratings are per FED STD 209E Standard



## Appendix B – Multi-axis Pinning

Dowel pin holes are located in the base and carriage of each DS4 to provide simple and repeatable mounting of DS4 tables together, or for the attachment of tooling and/or the payload.

A Standard Pinning option is utilizes these existing pin holes for XY configurations, and provides orthogonality of 2 arc-minutes or less.

Precision Pinning options are also available for applications requiring precise XY or XZ orthogonality. The resulting multi-axis configuration will be shipped assembled from the factory as a single unit with orthogonality set to 30 arc-seconds or less.

Contact an IDC Application Engineer to discuss specific orthogonality requirements.

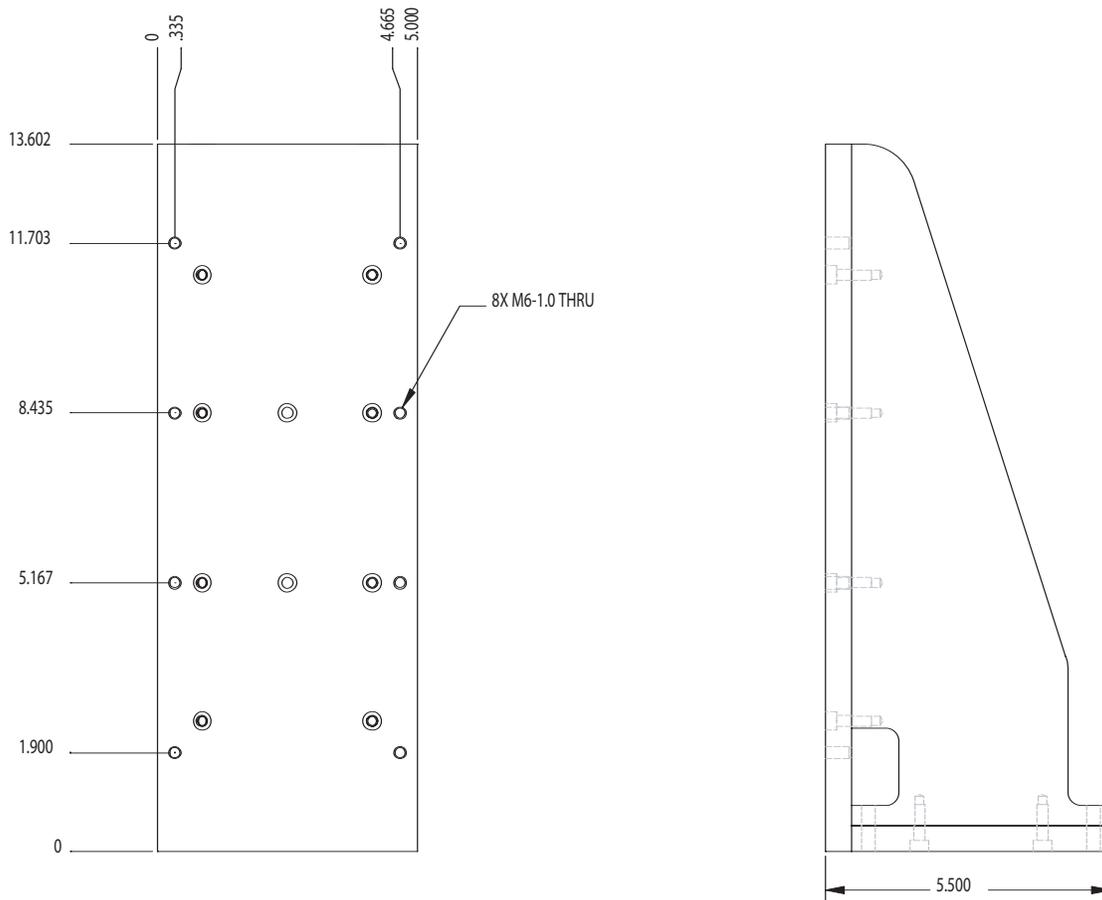


## Appendix C – Multi-axis Brackets & Adaptor Plates

DS4's can be ordered from the factory in a variety of multi-axis configurations including XY, XZ, and Cartesian arrangements.

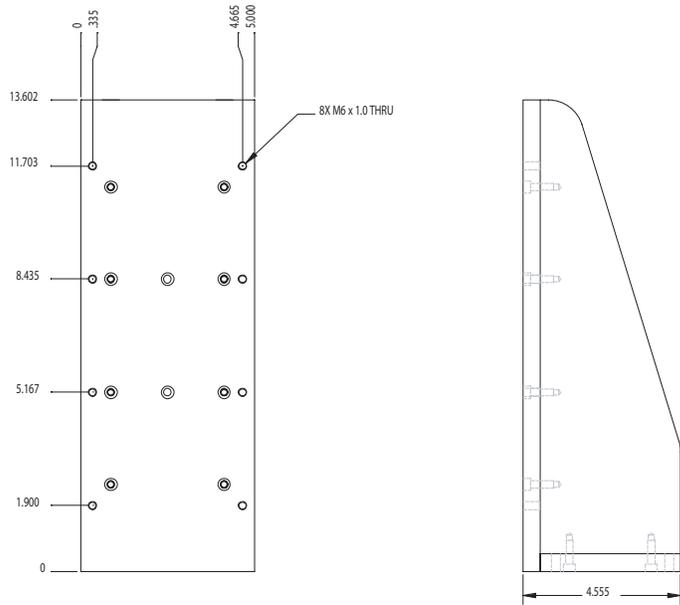
The carriages and bases of all DS4s include mounting features for direct bolting of two units in a standard XY configuration without modification or additional components.

Standard multi-axis brackets are also available for both factory-assembly, as well as for building two- and three-axis systems in the field. Consult IDC applications engineering for your standard and custom configurations.

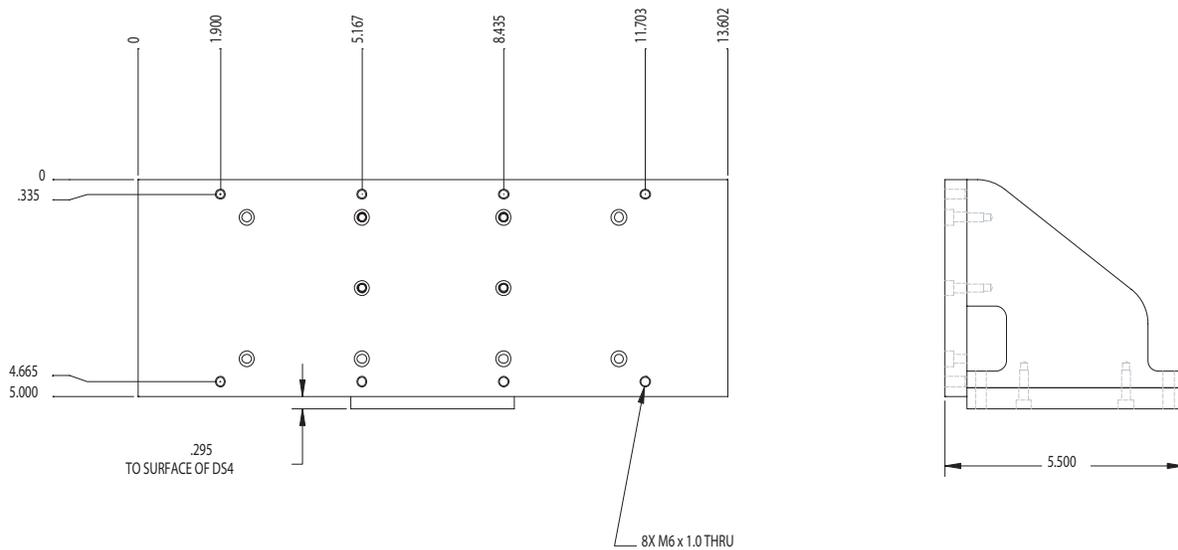


Part Number 11-0017 - Z Bracket (DS4 to DS4)



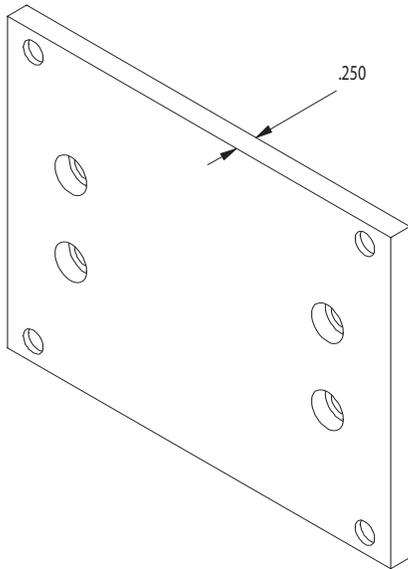


Part Number 11-0018 - Z Bracket, 90 degree (DS4 to DS4)



Part Number 11-0019 - Cartesian Bracket (DS4 to DS4)





**Part Number 81-0073 - Carriage-to-Carriage Mounting Plate (DS4 to DS4)**

