

## System Specifications and Features

### Description

- ◆ UHV construction — only metal parts are exposed to the vacuum.
- ◆ Rare earth magnet performance.
  - High linear force — 26 lb (117 N).
  - Tight linear compliance — 0.0025 in/lb (0.014 mm/N).
  - Rotary torque — 15 in-lb (160 Ncms).
  - Rotary compliance — 2 degrees/in-lb.
- ◆ Nonrotating square main shaft.
- ◆ Low droop — spring constant =  $(XX)^3/10^6$  where spring constant is the displacement in inches per pound of load and XX is the stroke length in inches.
  - 0.002"/lb for a 12" stroke.
  - 0.014"/lb for a 24" stroke.
  - 0.047"/lb for a 36" stroke.
  - 0.110"/lb for a 48" stroke.
- ◆ Separate rotation shaft.
  - 0.25" precision shaft.
  - Separate drive magnets allow truly independent rotary motion.
- ◆ Low maintenance — all bearings are easily field replaceable.
- ◆ Bake temperature — 200°C (with magnet carriage removed).

### Dimensions

- ◆ Mounts to a 2.75" OD CFF.
- ◆ Length —  $(XX) + 9"$ .

- ◆ Minimum protrusion — 1.5" (minimum protrusion can be longer if specified on order).
- ◆ Weight ~15 pounds.

### Accessories

- ◆ External drive — allows knob controls to be placed near the front flange. Allows motor drives to be attached.
- ◆ Rho-theta stage — available for DBLRP-XX and DBLRM-XX models only.
- ◆ KLAMP — a pincher mechanism for picking up wafers or trays.

### Prices

DBROP price quoted upon request.

DBLOP-XX = \$2,600 + \$5 per inch stroke.\*

DBLOM-XX = \$2,800 + \$5 per inch stroke.\*

DBLRP-XX = \$3,600 + \$6 per inch stroke.\*

DBLRM-XX = \$4,800 + \$6 per inch stroke.\*

\* If over 40 inches, add an additional \$200.

Prices for accessories upon request.

Prices and specifications subject to change.

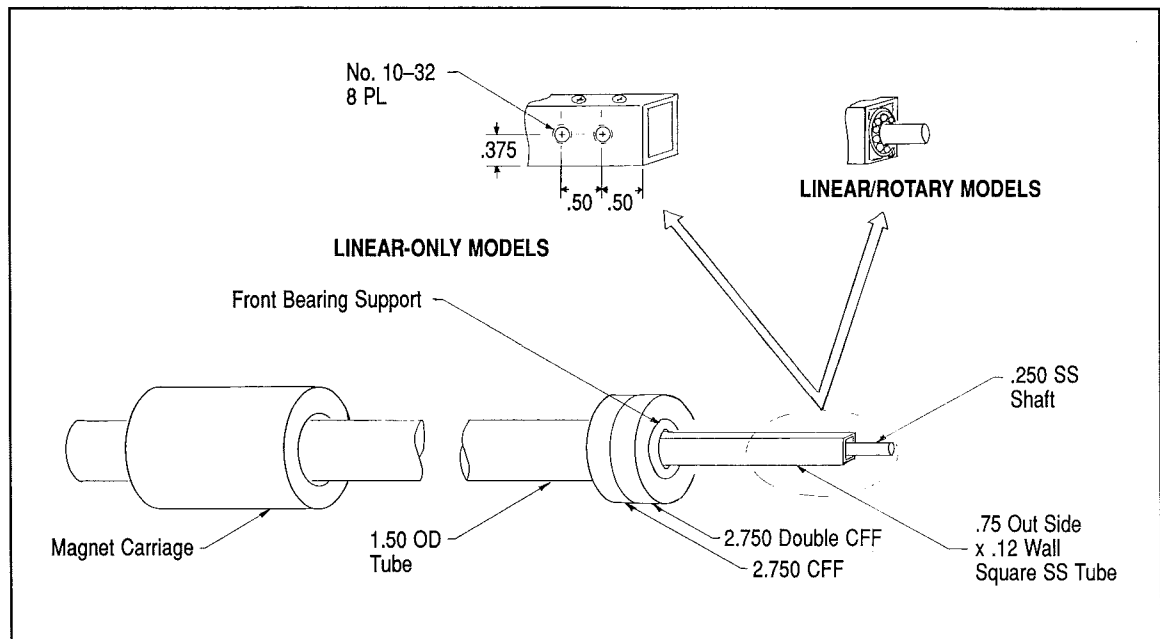
DBROP = DB rotary-only with external polymeric bearings.

DBLOP = DB linear-only with external polymeric bearings.

DBLOM = DB linear-only with external metal bearings.

DBLRP = DB linear-rotation with external polymeric bearings.

DBLRM = DB linear-rotation with external metal bearings.



*Linear/Rotary Feedthrough*

**INSTRUCTIONS FOR THE INSTALLATION  
AND OPERATION OF THE DBLRP-XX  
LINEAR / ROTARY AND DBLOP-XX LINEAR ONLY  
MAGNETICALLY COUPLED MANIPULATORS**

## **TABLE OF CONTENTS**

1. Description of DBLRP/DBLOP-XX Magnetic Manipulators .....	1
2. Assembly and Alignment .....	2
3. Removal of Carriage .....	3
4. Installation of Carriage .....	4
5. Bake-out .....	4
6. Maintenance .....	5
7. Shipping Instructions.....	5
8. Other Cautions .....	6

## **TABLE OF FIGURES**

1. Figure 1 - Linear / Rotary Manipulator Diagram .....	8
2. Figure 2 - Flange Orientation Diagram .....	9
3. Figure 3 - Front Bearing Assembly Diagram .....	10

This set of instructions provides information necessary for the alignment, installation, and bakeout for the linear/rotary and linear only manipulators. Some precautions are also included.

## DESCRIPTION

The magnetic manipulator consists of four assemblies: the carriage assembly, the tube assembly, the front bearing assembly, and the follower assembly. See Figure 1 for the location of each assembly and its relationship to the other assemblies.

The carriage assembly is the device that the user moves to obtain the translation or rotation desired within the vacuum system. The carriage for the linear/rotary manipulator contains six strong magnets and the carriage for the linear only manipulator contains two. These magnets interact with magnetic materials inside the tube assembly. The carriage rides along the tube assembly on teflon sleeve bearings which might eventually need some adjustment. This is covered in the MAINTENANCE section of this manual.

The tube assembly consists of a 1.5" O.D. stainless steel tube of moderately thin wall thickness and high tolerance that is welded to a 2.75" O.D. CFF.

The front bearing assembly attaches to the tube assembly and provides support and centering for the follower assembly. This assembly is shipped set up for a particular bolt hole pattern which is discussed in the ASSEMBLY AND ALIGNMENT section below.

The follower assembly is the assembly which is magnetically coupled to the carriage assembly through the tube. It consists of a square tube attached to two iron rings which provides the linear motion, and a round rod which is attached to another magnetic piece to provide the rotary motion. These two independent systems both travel the length of the tube on preloaded stainless steel bearings.

## ASSEMBLY AND ALIGNMENT

The manipulator will arrive with the carriage assembly decoupled from the follower and removed from the tube. The follower assembly will be isolated and centered within the front bearing assembly by two sheet metal brackets which should be removed when the unit is ready to be installed.

**NOTE:** Please do not disregard these brackets when they are removed since they might be used again later if the loader is shipped to a different location or back to the factory. See the SHIPPING INSTRUCTIONS section of this manual for information on shipping.

The carriage can be installed and coupled before the entire unit is installed onto the vacuum system, or the carriage can be coupled later if desired. If the carriage is to be coupled before mounting the manipulator onto the vacuum system, be sure to mount it as described in the CARRIAGE INSTALLATION section of this manual. The unit will arrive with new copper gaskets in place and will be ready to have fixtures added to the .250 " rotation shaft or (10-32) tapped linear (square) tube, as the user desires.

**IMPORTANT:** The manipulator has a definite "top" and "bottom" and the unit must be mounted in the correct orientation to insure proper performance. The outer edge of the front bearing assembly (see diagram 3) will have a "T" inscribed on the top of the assembly to show the correct orientation.

If the manipulator is to be mounted to a rotatable 2.75" CFF, with the mounting bolts still loosely in place, rotate the flange until the "T" is on the uppermost part of the flange.

For nonrotatable flanges, the manipulator can be easily changed to fit two different flange orientations. These orientations are shown in Figure 2 as pattern A and pattern B. The system will arrive set up for pattern A, but the several easy steps that follow will allow the user to change the orientation to the 30° rotated version, pattern B. Decouple the carriage before starting this procedure.

- 1) With a gloved hand, pull the follower assembly to the fully extended position.
- 2) Remove the front bearing assembly and follower from the tube assembly by removing the 4-40 x .625 socket head screws that hold the front bearing assembly to the tube flange.

- 3) Note the orientation of the follower with respect to the front bearing assembly to be sure these are in the same orientation when the unit is put back together. The single spring loaded bearing in the follower assembly will line up with the dual bearings in the front bearing assembly. Slide the front bearing assembly off the end of the follower bar and place it on a clean workbench or tabletop with the 'inside' side of the assembly face up. Notice that with the front bearing assembly installed, the bottom of the assembly contains two support bearings, where the top and sides contain only one.
- 4) Loosen the three socket head screws and remove the front bearing frame assembly that is inside. See Figure 3 for the locations of these screws. Notice the three spacers that are between the flange and frame assembly for venting purposes. These must be placed over the holes which are 30° clockwise to the holes they are over now. The front bearing frame assembly may now be put back in place, rotated clockwise 30°, and the screws put back in.
- 5) The front bearing assembly must now be slid back over the follower in the same orientation that it was in prior to being removed. After sliding a new copper gasket in place, attach these two assemblies to the tube using the two screws removed earlier.

The manipulator can now be mounted onto a bolt hole pattern similar to pattern B.

Some alignment of the fully extended manipulator can be made by applying force on the end of the tube. Only a small amount of deviation should be expected from this type of adjustment. Also, care must be taken not to use too much force as this could break the tube-flange weld.

### REMOVAL OF CARRIAGE

To remove the carriage from the tube assembly, the carriage must first be pulled as far away from the front bearing assembly as possible without restriction. The follower is now in contact with the end of the tube and the linear/rotary carriage should be about 1" from the end of the tube or the linear only carriage will be right up flush with the end of the tube. To uncouple the carriage from the tube, pull the carriage off the end of the tube assembly. Uncoupling the carriage from the follower takes a force of approximately 30 pounds.

## INSTALLATION OF CARRIAGE

Installation of the carriage assembly involves sliding the carriage onto the tube assembly and then coupling the carriage to the follower. The carriage will fit snugly onto the tube with only a small amount of play. It should be installed so that if the front bearing assembly is to the left as the user faces the manipulator, the Surface/Interface logo can be read correctly when the carriage is in place. Inversely, with the front bearing assembly to the right as the user faces the manipulator, with the carriage on the tube, the logo should appear upside-down to the user. Another way to approach this installation is to look inside the carriage assembly for the end with the two toroidal shaped magnets. This end is the first end to go onto the tube.

After sliding the carriage onto the tube, the carriage must be coupled in the correct position with respect to the follower (inside the tube). The linear only units have three locking positions. The carriage on the linear/rotary units have several positions, and the correct operating position has the most firmly locking position. To get into the operating position, the follower must be able to push up against something solid, like the back end of a main chamber or a solid gate (not a bellows-type valve). This operating position is the most solid of the locking positions, and is easily recognizable once the user gets the feel of the follower locking into it. With the linear/rotary coupled correctly and the manipulator fully retracted, the carriage will be about 1" from the end of the tube and on the linear only units the carriage will be flush with the end of the tube.

## BAKEOUT

**WARNING:** Maximum bakeout temperature is 200° C.

Remove the carriage assembly during bakeout and do not replace it until the tube has completely cooled to room temperature. Misalignment of the carriage assembly and loss of optimum performance of the manipulator could occur from overheating. Loss of some magnetic properties could also occur if the carriage is left on the tube during bakeout. If practical, the follower assembly should be backed all the way against the end of the tube during bakeout and cool down. This will occur automatically when the carriage is removed from the end of the tube, as described in the **CARRIAGE REMOVAL** section of this manual.

**WARNING:** The manipulator should be allowed to cool a minimum of 24 hours. The follower assembly cools at a very slow rate inside the vacuum. If the tube and follower are at a different temperature differential, expansion of the follower assembly will cause it to drag against the tube.

## **MAINTENANCE**

As the carriage teflon sleeve bearings wear, some adjustment of them will be necessary. To tighten these down, remove one of the screws that holds the end caps to the carriage case, insert a .050" allen wrench into the threaded hole, and remove the first of the two set screws in each hole. Then tighten the remaining set screw to take some of the play out of the bearing. Install the set screw previously removed to lock down the adjusting screw, and insert the screw that holds the end cap to the case.

**CAUTION:** The end closest to the front bearing assembly contains two very strong ring magnets which are held by the end cap with like poles facing each other. If more than one of the screws holding this end cap in place are removed, the magnet farthest out will try to pop out, and care must be taken when putting it back in.

Be sure to adjust all three screws at each end of the magnet carriage equally to keep the case centered on the tube assembly. Misalignment will result in dragging of the magnets on the tube assembly.

If friction between the carriage and tube seems excessive, a lubricant such as WD-40 can be used on the outside of the tube. The use of a lubricant will allow the carriage to slide more freely along the tube. Be sure to clean this lubricant off before any bakeout is to take place.

## **SHIPPING INSTRUCTIONS**

The magnetic manipulator is a delicate instrument which must be carefully packaged for any shipment. If possible, it is a good idea to use the box and foam that the manipulator arrives in, or if that is not available, the loader should be packaged in a manner similar to the way it came from the factory. This means that the manipulator should be surrounded in foam at least 3-4 inches thick, with the carriage assembly pulled off of the tube, and the follower assembly centered and isolated with the two shipping brackets that the loader arrived with. These brackets prevent damage to the front



bearing assembly and follower assembly caused by rough handling during shipment. If these instructions are followed the unit can be shipped safely.

### OTHER CAUTIONS

The carriage assembly contains several extremely strong magnets which can cause damage to any devices sensitive to strong magnetic fields, i.e. computer hard disk drives, monitors, floppy disks, and magnetized credit cards. Care must be taken in regard to where the carriage is placed when it is taken off the unit. Magnetic fields at the carriage assembly are on the order of 20-30 gauss. At one foot the field drops to the order of one gauss.

The tube assembly is made of a relatively thin walled stainless steel tubing which could be damaged if any unnecessary pressure or torques are placed on it. This includes squeezing or leaning on the tube. The internal assemblies should be kept free of dust or other substances which might contaminate the vacuum. Also, keep the internal assemblies free of small particles which could destroy the moving parts inside the assembly.

Please call Surface/Interface Inc. at (415) 965-8205 with any questions or comments concerning the performance or procedures stated above.

## **WARNING**

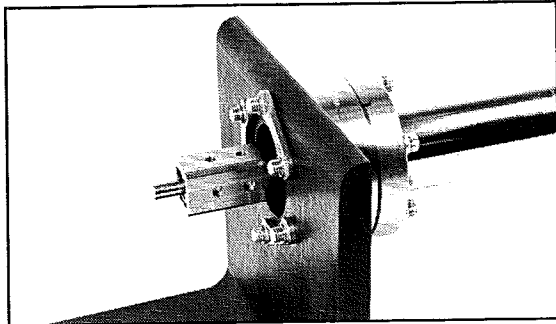
The precision magnetic manipulator contains several extremely strong magnets which could be dangerous if they are removed from the carriage assembly (see Figure 1). The magnets strongly attract each other and other magnetic materials and can cause injury if they are not handled carefully. The magnetic field produced by the magnets can damage or destroy magnetically sensitive materials.

Prior to disassembly of the carriage assembly, call Surface/Interface Inc. at (415) 965-8205 for instructions and precautions.

# Precision Magnetic Manipulators

*For many people, the phrase "precision magnetic manipulator" is a contradiction in terms. Admittedly, that's been the case in the past — but no longer.*

Surface/Interface Inc. (S/I) now offers a family of precise magnetically-operated linear, rotary, and linear/rotation sample manipulation systems for operation in UHV.



*The independence of linear and rotational motion is the key to versatility in these systems.*

These systems handle more axial force and torque and exhibit better compliance and load carrying capability than typically expected from a magnetically-coupled feedthrough. This increase in force and torque results in lower stiction, lower backlash, and greater ability to overcome friction. Modern rare earth magnets and some highly evolved CAD programs are used to achieve this unusually high performance.

Independence of linear and rotational motion is the key to versatility in these systems. The round rotary shaft is contained within the outer square linear motion shaft and is com-

pletely independent of it. Thus, rotation motion and linear motion can be used in combination or separately, providing numerous potential combinations of sample movement. Examples include locking devices for sample transfer and a precision rho-theta stage for access to every location on a wafer.

The precision magnetic manipulators are manufactured as linear-only, linear/rotation, or rotary-only models.

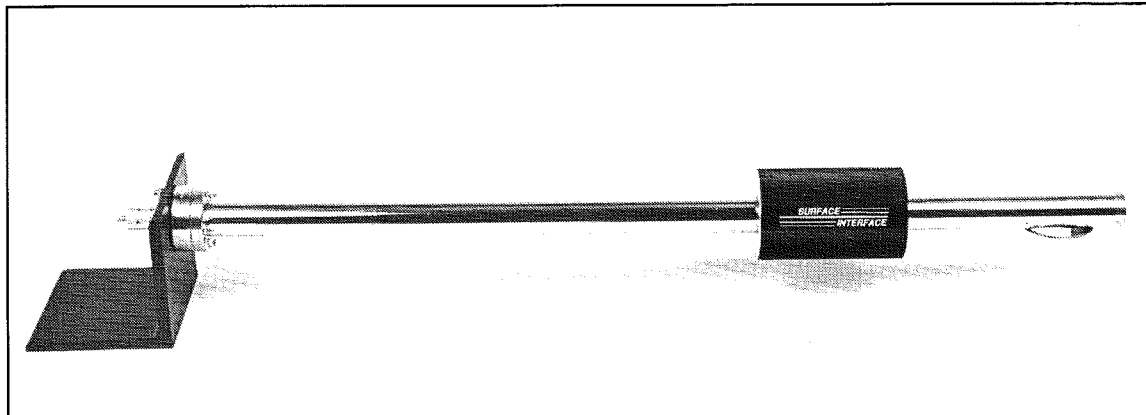
## All Models with UHV All-Metal Internal Construction

Altogether, there are five models available. Two are linear-only models, DBLOM-XX and DBLOP-XX (XX is the stroke length in inches). Two are linear/rotation models, DBLRM-XX and DBLRP-XX. The rotary-only model, DBROP, has no stroke length. All five models use UHV all-metal internal construction.

Models DBLOP-XX, DBLRP-XX, and DBROP use polymeric bearings outside the vacuum, and as a result, have a slightly higher stiction than the metal bearing units. They are intended for sample transferring and similar functions, where the slight amount of stiction is acceptable. This construction is less expensive; and hence, these units are lower in price.

Models DBLOM-XX and DBLRM-XX use all metal construction throughout, and as a result, have very low stiction. These models are intended for manipulator applications where very good tactical feedback is desired. They are slightly more expensive.

*continued ...*



*The Model DBLRP-XX Precision Magnetic Manipulator.*

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**INTERFACE**

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