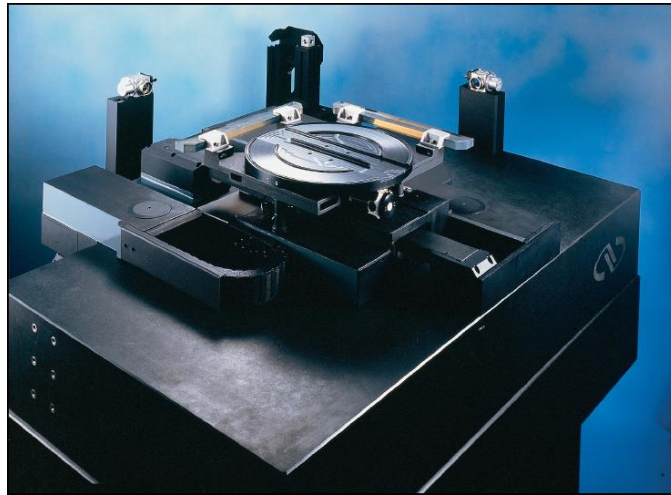


DynamYX 300 Wafer Positioning Stage



Designed for 300mm wafer test, measurement, and processing applications, the DynamXY 300 Wafer Positioning Stage features a simple three-piece architecture in a two motor design that provides a cost effective solution for high accuracy and dynamic performance for step-and-settle and/or scanning applications. It has the smallest footprint in Newport's line of air bearing wafer positioning stages.

DynamYX[®] Family of Air-bearing Stages

With the launch of the 300mm wafer initiative more than a decade ago, DynamYX was designed to provide equipment manufacturers in the semiconductor industry with a tool capable of achieving the highest levels of precision and throughput. DynamYX provides high resolution dynamic positioning of a wafer chuck or other similar substrate in two orthogonal translation axes from a single-plane carriage. A Vertical (Z) axis with Tip Tilt function and a rotary axis for wafer offset correction may be added on the carriage beneath the wafer chuck. Over the years, the form and function of DynamYX has evolved to keep pace with customer requirements. Today The DynamYX family consists of four specific designs each with their own specific features and benefits.

Position Feedback

The positioning loop on DynamYX may be closed using a single linear encoder for each axis. As shown in the adjacent illustration, the encoder measuring positions are closely located to the substrate's surface reducing the already minimal abbey offset affect. For the X-axis, the linear scale is typically mounted to the underside of the bridge structure with the read-head in-line with the system's optical path and affixed to the moving ceramic guide. System architectures that do not allow this configuration can be accommodated by mounting the X-axis scale to a supplementary SiC spar located at the rear side of the system. The Y-axis has its scale mounted to a small SiC bracket on the moving carriage. The read head is fixed to the arm of the L-shape structure. Read-heads which have fixed positions relative to the tool's optical path are beneficial in optimizing precision. With an encoder signal period of 2mm, resolutions down to 0.1nm are possible with Newport's XPS or SPS controllers each with internal 20,000 times interpolation.

Equipped with linear encoders the DynamYX is an extremely accurate and very repeatable platform allowing for very high accuracy through error mapping. The geometric stability of the ceramic elements of these stages results in systems that can be mapped once at our factory then, upon installation, only require a simple length calibration to compensate for uniform thermal expansion. For applications where the accuracy requirements exceed the capabilities of error compensation, or in certain scanning modes where the absolute position of the stage must be the basis of a very precise trigger or latch, linear encoders must yield to laser interferometers which are also part of our offering.

Chuck Interface

The standard mounting interface includes three precision-lapped pads for the direct mounting of a wafer chuck. In the DynamYX 300 and GT stages, these three pads are only 66mm above the granite reference plane maintaining the low-profile nature of the stage. Even with the addition of other accessory components such as a 4-axis Z-Tip-Tilt-Theta stage the height of the wafer plane in the DynamYX GT stage is only 115mm above the granite reference surface. The low profile nature of DynamYX contributes to the system's overall dynamic performance and attenuates the already minimal abbe offset effect of pitch and roll. If Newport is to supply the wafer chuck, the chuck (ideally ceramic), including vacuum lines to the chuck, and wafer lift pins may be supplied as an integrated solution.

Linear Motor Drives

The original DynamYX 300 and DynamYX RS "Reticle Stage" tables are driven by only two Ironless linear motors; one in the X-axis and one for the Y-axis. The rating of each motor is carefully considered based on the intended duty cycle/throughput requirements as to minimize the power dissipation of the system. For even higher throughput requirements, the DynamYX GT and all-new DynamYX Datum incorporate a second X axis linear motor which is driven in open loop mode. Unlike H-bridge air bearing designs which rely on a synchronized servo loop for positioning and stiffness, the monolithic ceramic guide found in all four designs defines the positioning reference and overall stiffness of the positioning elements. Controlling any of the four DynamYX stages is very much like controlling a conventional XY stack with one control signal for X and one for Y. For the GT and Datum stages, a single X-axis control signal is split and fed into two amplifier channels where the output force is biased according to the linear motor ratings and total payload.

Most linear motors on the market were designed without focusing on the real needs of precision motion control applications where mass limits and efficiency are most critical. Newport air bearing stages benefit from our commitment to providing the highest possible performance by incorporating motors developed in-house that are optimized for the products and applications they address. Newport's linear motors have outstanding performance in the areas heat dissipation, time constant, force ripple, and structural integrity. From an efficiency standpoint, the performance of our motors is measured as the steepness per given motor volume where steepness is defined at the heat dissipated by a motor when delivering a given force (F2/W) and volume is simply the motor cross-section multiplied by the coil length. In situations where the rms acceleration values are extremely high and any heat loss is a problem, our motors feature sealed-forced air or recirculating water methods of cooling.

Design Details	DynamYX 300
Stage Architecture	Single Plane XY Air Bearing, L-Shape Configuration
Material	Ceramic (SiC), Granite
Drive Mechanism	Brushless linear servo motors (one motor each for X and Y)
Position Feedback	Non-contact optical linear encoders - Heidenhain LIF, Zerodur scale with 2 μm signal period - Heidenhain LIF, glass scale with 4 μm signal period
Bearings	Integrated Pressure-Vacuum Air Bearing
Cable Management	Fully integrated, clean-room compatible, single point exit/entry, minimal external force

General Specifications	
Travel Range (standard, encoder or interferometer)	310 mm X-axis , 340 mm Y-axis
Travel Range (maximum, encoder)	520 mm X-axis , 340 mm Y-axis
Footprint (without bridge pillars, standard travel)	965 mm x 815 mm
Rated Payload (maintains dynamic specifications)	5 kg
Maximum Load Capacity	15 kg
Maximum Velocity (rated payload)	400 mm/sec X-axis , 400 mm/sec Y-axis
Peak Acceleration (rated payload)	0.75 G X-axis , 1.5 G Y-axis
RMS Acceleration (rated payload)	0.25 G X-axis , 0.5 G Y-axis
Granite Base Thickness (standard travel)	250 mm
Total Weight	530 kg
Stiffness, First Natural Frequency (rated payload)	230 Hz
MTBF	20,000 hrs.

Performance Specifications	
Pitch, Yaw, Roll (300 mm by 300 mm travel)	<15 μrad
XY Straightness & Flatness (300 mm circle)	0.6 μm TIR
XY Straightness & Flatness (25 mm circle)	0.1 μm TIR
XYZ Position Stability (on-air)	± 10 nm
Position Stability Is Highly Dependant On Vibration Isolation and Overall Environmental Conditions	
XYZ Position Stability (clamped)	+/-1 nm
XY Orthogonality	< 5 μrad
Speed Stability (velocity ripple sampled at 2kHz and 400mm/sec)	0.1%
XY Accuracy with Zerodur Scale, TIR, XY error compensation, 0.1 degree C temperature stability (300 mm circle)	0.4 μm
XY Accuracy with Agilent Interferometer, Newport SiC Replica Mirrors, XY mapping (300 mm circle)	NA
SiC Replica Mirror Flatness	NA
XY Bi-Directional Repeatability (long term, short or long displacement)	± 50 nm
XY Bi-Directional Repeatability (short term, short or long displacement)	± 10 nm
Step-and-Settle Times (using Newport ND40 Passive Isolators)	Settling into ± 0.1 μm window
300 mm step	< 950 msec X-axis , < 900 msec Y-axis
100 mm step	< 450 msec X-axis , < 400 msec Y-axis
25 mm step	< 300 msec X-axis , < 250 msec Y-axis