

Ultra-Precision Linear Motor Stages

X M SERIES



The XM ultra-precision linear stages provide high sensitivity and outstanding trajectory accuracy in a compact, robust and cost effective package. They are an excellent, ultra high-performance solution for applications such as semiconductor wafer inspection, sensor test and calibration, laser machining and ultra-precision assembly.

XM stages are machined from stress-relieved 7075 aluminum, ensuring long-term strength and stability. All critical stage surfaces undergo multiple machining processes and precision grinding under stringent temperature and quality control to further improve overall performance and accuracy. The T-shaped carriage used on the XM provides the optimum solution for precision XY assemblies without impacting the stage preload. It is also more robust and is more tolerant to non-ideal mounting conditions than stages with a C-shaped carriage design.

To ensure the most accurate trajectory control, XM stages feature matched pairs of best-in-class anti-creep crossed roller bearings, leading to outstanding ripple-free motion adequate for the most demanding scanning and inspection systems. Moreover, geared retainers prevent bearing cage migration, which can occur with other linear bearing products.

Unlike screw driven stages, the XM employs a center-driven, ironless linear motor as the driving element. Since the linear motor is a frictionless direct drive device, there is no backlash or hysteresis, wind-up or stiction limiting performance. The linear motor drive also has the advantage of higher speed, acceleration and system responsiveness with no wear to motor brushes or drive screws. The extra-large, ironless motor coil ensures zero cogging for ultra smooth velocity control and provides higher efficiency compared to other stage designs. This results in significantly less heat generation, which is generally the main limit for ultra-precision motion applications. To further improve thermal management and its effect on stage performance, the XM also has the benefit of a sophisticated length decoupling of the magnetic track from the stage carriage

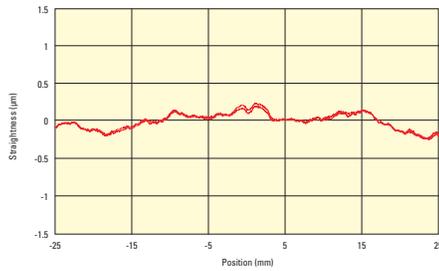
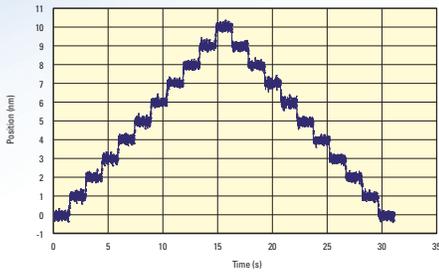


- Ultra-high performance with Minimum Incremental Motion of 1 nm
- Non-contact, direct-drive system ensures ultra-precision motion with high dynamics and reliability
- Sub-nm, high precision glass scale encoder provides accurate position feedback with 80 nm repeatability
- Extra-large, ironless, high-efficiency linear motor minimizes heat generation
- Ultra-quiet anti-creep crossed roller bearings assure ripple-free motion without cage migration

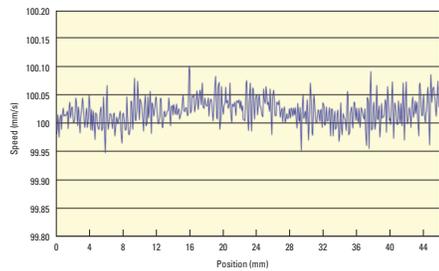
Precision position feedback is supplied by a high accuracy LIF 481 Heidenhain Linear Scale. The precision alignment and mounting of this low thermal expansion scale in the center of the stage minimizes the impact of temperature changes on stage repeatability and accuracy. The encoder signals are interpolated by Newport's XPS motion controller with sub-nm resolution and less than 10 nm noise for outstanding position sensitivity and stability. Absolute home position and limit signals are incorporated on the same scale without further electronics or mechanics for improved reliability and accuracy. In general, all electronics are attached to the stationary base, so there are no moving cables inside the stage. This results in an extremely compact design with exceptional reliability and safety. The space-saving, fixed read head design eliminates any moving cables inside the stage and underscores the robustness and reliability of the XM stages, exemplified by an MTBF of 20,000 hours.

XM stages are also compatible with the GTS30V vertical stage, GTS series ultra-precision linear stages, URS and RGV100BL rotation stages, VP-25X precision compact linear stages and VP-5ZA vertical lift stages. XM stages are shipped with a test certificate at no additional charge.

XM SERIES



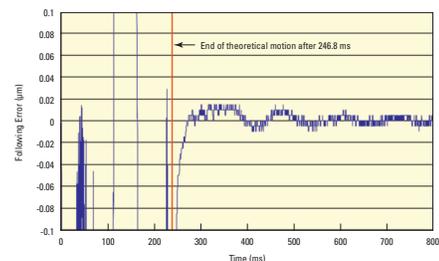
XM stages deliver ripple-free motion as required by many precision scanning and wafer inspection processes. Shown is the straightness of an XMS50 during one forward and return cycle, measured with an interferometer.



XM stages provide exceptional speed stability in continuous scanning or laser machining applications. Shown is the speed of an XMS50 gathered at a rate of 1 kHz using an interferometer.



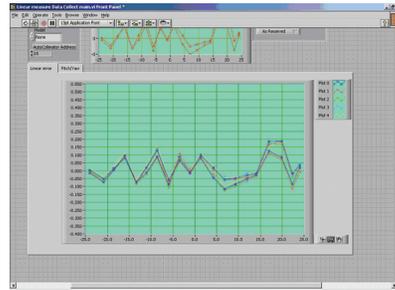
Accuracy of a XMS50 stage after linear error correction. The data was taken dynamically at a rate of 10 kHz while the stage was moving at a speed of 100 mm/s. Both the encoder and the interferometer positions were acquired by an XPS motion controller with a latency of less than 50 ns between the different signals



The high responsiveness and stiffness of the XM stages result in very short settling times that improve the performance and throughput of many stepping processes.

Need Accuracy to 1 µm?

Contact Newport to learn about our micropositioning calibration services needed for critical positioning applications. Upon request, we will create, implement and verify an electronic compensation routine to improve the absolute position accuracy of XM stages to 1 µm/100 mm when used with our XPS advanced motion control system. A certificate of calibration along with measured error maps is included.



Accuracy of an XMS50 stage with linear error compensation and error mapping. The data was taken one day after the calibration and at different positions. The plot shows error readings over five cycles of back and forth motion. The accuracy is 0.3 µm peak-to-peak.

DESIGN DETAILS

Base material	High-strength 7075 Aluminum
Bearings	Anti-creep crossed roller bearings
Drive mechanism	3-phase synchronous ironless linear motor (without Hall effect sensors)
Motor initialization	Utilizes XPS controller patented feature that avoids large motions during initialization, without using Hall effect sensors
Motor commutation	Done by the XPS controller using encoder signals
Feedback	Heidenhain LIF 481 scale, 1 Vpp, 4 µm signal period, 32768-fold signal subdivision when used with XPS controller
Limit switches	Optical, on encoder's fiducial track
Origin	Optical, at center of travel, including mechanical zero signal
Drive type	Brushless DC Servo
Cable	5 m included

SPECIFICATIONS

	XMS	XML
Travel range (mm)	50, 100, 160	210, 350
Minimum Incremental Motion, linear ⁽⁴⁾⁽⁵⁾ (with XPS-DRV02 Drive)		0.01
Minimum Incremental Motion, linear ⁽⁴⁾⁽⁵⁾ (with XPS-DRV02P Drive Module)		0.003
Minimum Incremental Motion, linear ⁽⁴⁾⁽⁵⁾ (with XPS-DRV02L Drive Module)		0.001
Uni-directional repeatability, guaranteed ⁽¹⁾⁽⁴⁾ (µm)		0.05
Bi-directional repeatability, guaranteed ⁽¹⁾⁽⁴⁾ (µm)		0.08 or ±0.04
On-axis accuracy, guaranteed ⁽¹⁾⁽⁴⁾ (µm)	1.5 or ±0.75	3 or ±1.5
Maximum speed ⁽⁵⁾ (mm/s)		300
Maximum acceleration ⁽⁵⁾ (m/s ²)		5
Max. force (cont.) ⁽⁵⁾ (N)	16	37
Load capacity, horizontal (N)	100	300
Straightness, flatness, guaranteed ⁽¹⁾⁽²⁾ (µm)	1.5 or ±0.75	3 or ±1.5
Pitch, guaranteed ⁽¹⁾⁽²⁾⁽⁴⁾ (µrad) ⁽³⁾	50 or ±25	100 or ±50
Yaw, guaranteed ⁽¹⁾⁽²⁾⁽⁴⁾ (µrad) ⁽³⁾	50 or ±25	100 or ±50
MTBF (h)		20,000

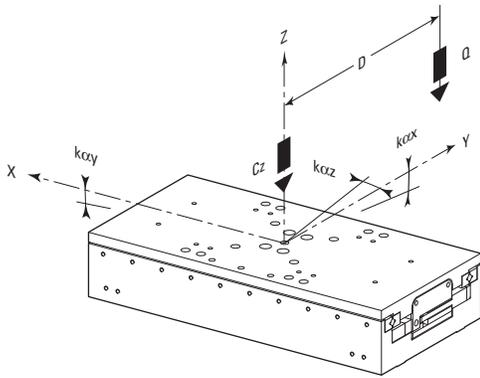
¹⁾ Shown are peak to peak, guaranteed specifications or ±half the value as sometimes shown. For the definition of typical specifications which are about 2X better than the guaranteed values, visit www.newport.com for the Motion Control Metrology Primer.

²⁾ Middle 80% of travel.

³⁾ To obtain arcsec units, divide µrad value by 4.8.

⁴⁾ Requires operation in a controlled environment to achieve specification.

⁵⁾ Maximum value is driver dependent. Contact Newport for additional information.



LOAD CHARACTERISTICS AND STIFFNESS

	XMS50	XMS100	XMS160	XML210	XML350
Cz, Normal centered load capacity (N)	100	100	100	300	300
k _{cx} , Compliance in roll (μrad/Nm)	3.5	2.0	1.5	0.5	0.1
k _{cy} , Compliance in pitch (μrad/Nm)	3.5	2.0	1.5	0.5	0.1
k _{cz} , Compliance in yaw (μrad/Nm)	3.5	2.0	1.5	0.5	0.1
a, Construction parameter (mm)	109	109	109	155	155
Q, Off-center load	$Q \leq C_z \div (1 + D/a)$				
where D = Cantilever distance in mm					

RECOMMENDED MOTION CONTROLLERS/DRIVERS

XM Series ultra precision linear stages are compatible with the XPS universal high-performance motion controller/driver using XPS-DRV02.

Model	Description
XPS-Qx	Universal controller/driver, Ethernet
XPS-DRV02	PWM drive module for brushless motors, 5 A/44 Vpp max.
XPS-DRV02L	1 nm MIM. low noise drive module for brushless motors, 2 A/44 Vpp max.
XPS-DRV02P	3 nm MIM. low noise drive module for brushless motors, 7 A/44 Vpp max.



A typical assembly using XML210, XMS50 and a GTS30V vertical stage.

ORDERING INFORMATION

Model	Description
XMS50	Ultra-precision linear motor stage, 50 mm travel
XMS100	Ultra-precision linear motor stage, 100 mm travel
XMS160	Ultra-precision linear motor stage, 160 mm travel
XML210	Ultra-precision linear motor stage, 210 mm travel
XML350	Ultra-precision linear motor stage, 350 mm travel

ACCESSORIES

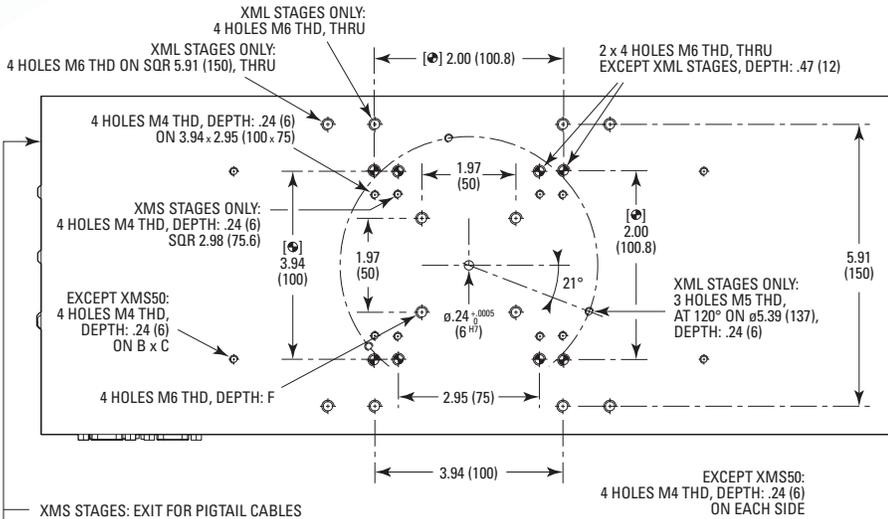
The flatness of the surface is often a major factor in the positioning accuracy and repeatability of a motion system. The polished granite surfaces are among the flattest and commercially available structures. Granite's tight flatness tolerance and extreme hardness make it an attractive option to complement Newport's ultra-precision linear motor XM series stage. The GB series granite base plates feature 3 point mounting, to make-up for non-flat tables. Edge handles facilitate handling and locating the base plate on the work surface.

Model	Description
GB50	Granite base for XMS50
GB100	Granite base for XMS100
GB160	Granite base for XMS160
GB210	Granite base for XML210
GB350	Granite base for XML350



GB160 granite base plate with XMS160 stage.

DIMENSIONS

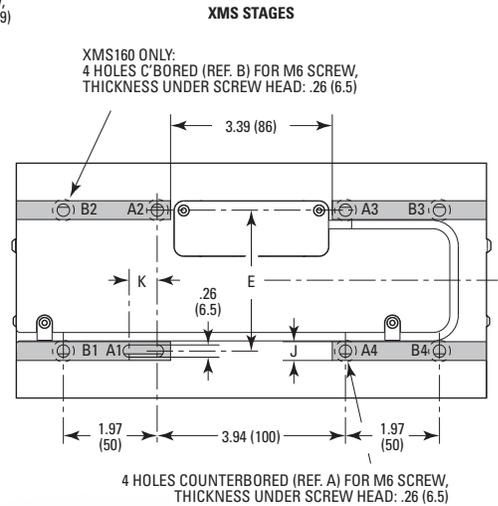
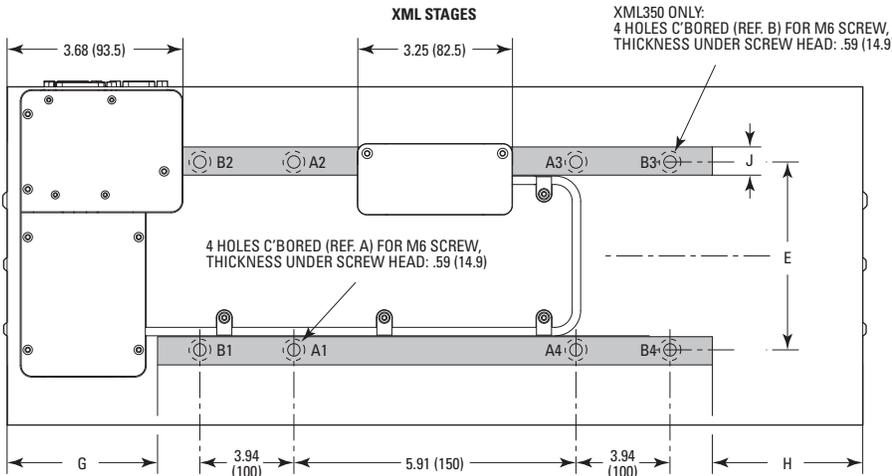
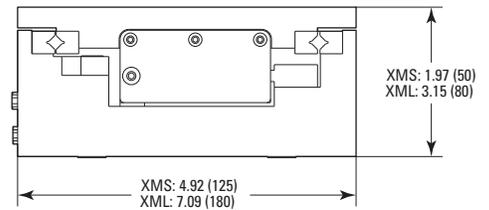
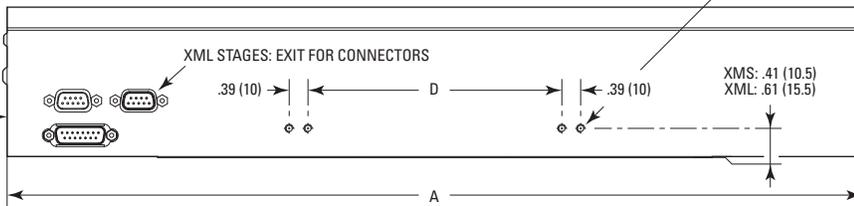


DIMENSIONS IN INCHES (AND MILLIMETERS)

	A	B	C	D	E
XMS50	4.92 (125)	-	-	-	2.95 (75)
XMS100	7.28 (185)	6.10 (155)	1.77 (45)	5.31 (135)	2.95 (75)
XMS160	9.84 (250)	7.28 (185)	1.77 (45)	7.87 (200)	2.95 (75)
XML210	13.98 (355)	9.84 (250)	3.94 (100)	5.31 (135)	3.94 (100)
XML350	21.85 (555)	9.84 (250)	3.94 (100)	13.19 (335)	3.94 (100)

	F	G	H	J	K
XMS50	.28 (7)	-	-	.39 (10)	.28 (7)
XMS100	.28 (7)	-	-	.39 (10)	.59 (15)
XMS160	.28 (7)	-	-	.39 (10)	.59 (15)
XML210	.47 (12)	2.91 (74)	2.66 (67.5)	.59 (15)	-
XML350	.47 (12)	3.15 (80)	3.15 (80)	.59 (15)	-

XMS & XML STAGE CONNECTORS:
 SUB-D9M FOR MOTOR
 SUB-D9F FOR END-OF-RUNS & THERMISTANCE
 SUB-D15M FOR ENCODER



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