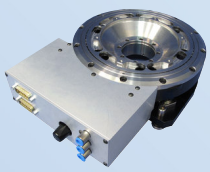
Motorized Vertical Stage Selection Guide

Motorized vertical stages add the 3rd dimension to orient objects in 3D space. Newport's precision vertical stages range from the high load, long travel IMS family to the high accuracy XMS100V. Typical applications include focusing and imaging, metrology, inspection, laser writing, etc. Vertical stages can be selected based on load capacity, travel, Minimum Incremental Motion and repeatability.

Series	Travel Range (mm)	Minimum Incremental Motion (μm)	Bi-directional Repeatability (μm)	Accuracy (μm)	Maximum Speed (mm/s)	Centeredl Load Capacity (Cz)(N)
 **XMS-V** Ultra-high Precision Vertical Linear Stage see page 79	50-100	0.05	0.1	1.5	300	100
 **VP-5ZA** Precision Vertical Linear Stage see page 81	4.8	0.06	0.5	3.0	5	50
 **GTS30V** High-Precision Vertical Linear Stage see page 83	30	0.1	0.2	1.5	10	40
 **IDL280-Z20** Industrial Vertical Stage see page 85	20	0.1	1.2	4.0	5	500
 **IMS-V Series** High-Load Vertical Linear Stages see page 87	100, 300	0.3	1.0	4.0 - 10.0	20	400
 **UZ Series** Vertical Linear Stages see page 89	4.5, 9	0.2	0.8-5.5	0.7 - 8.0	0.1 - 4.0	30 - 300
 **ZVR Series** Integrated Vertical and Rotation Stage see page 91	10	0.05	4.0	4.0	10	100

XMS-V Series

Ultra-high Precision Direct Drive Vertical Linear Stage

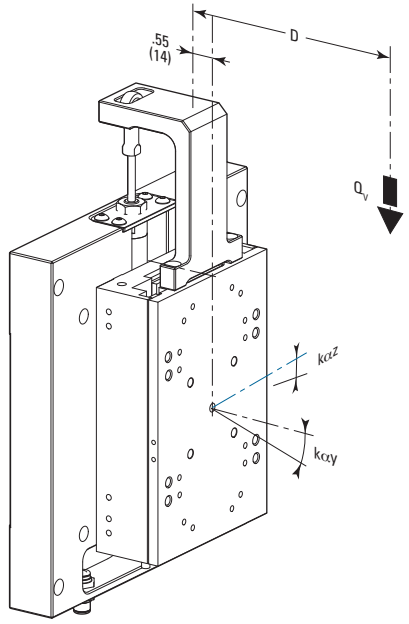
- Ultra-high performance vertical stage with suprerior accuracy, repeatability and MIM
- Non-contact, direct-drive system with counterbalance for ultra-precision, high dynamic motion and reliable operation
- Extra-large, ironless, high-efficiency linear motor minimizes heat generation
- Ultra-quiet anti-creep crossed roller bearings assure ripple-free motion without cage migration
- Highest maximum speed at 300 mm/s
- Two types of counterbalances available: pneumatic or fail-safe, magnetic

The XMS100V stage is a standard XMS100 ultra-precision linear stage mounted vertically on a high flatness plate with a pneumatic counterbalance. The air cylinder valve is used to achieve a perfect balance of the load while enabling a controlled descent of the carriage in a vertical setup. Innovative and compact, XM stages provide robust, repeatable motion with outstanding accuracy on the most complex trajectories. Features include precision position feedback with a linear scale encoder and a frictionless direct drive with ironless linear motor for high speed, high acceleration and excellent ripple-free motion. Typical applications include focusing, sensor test and calibration, direct laser lithography, fiber alignment, ultra-precision assembly and more.

Specifications

	XMS50V	XMS100V
Travel Range	50 mm	100 mm
Maximum Speed	300 mm/s	
Centered Load Capacity	100 N	
Minimum Incremental Motion	0.05 µm	
Accuracy, Guaranteed	± 0.75 µm	
Bi-directional Repeatability, Guaranteed	± 0.05 µm	
Limit Switches	Optical, fiducial on ncoder	
Origin	Optical, at center of travel, including mechanical zero signal	
Cable Length	5 m	
Straightness, Flatness	± 0.75 µm	
Weight	2.5 kg	3.5 kg
MTBF	20,000 h	

Load Characteristics



Model	XMS100V
Kαx, Compliance in roll (µrad/Nm)	2.0
Kαy, Compliance in pitch (µrad/Nm)	2.5
Kαz, Compliance in yaw (µrad/Nm)	3.5
Q_v	Off-center load, $Q_v \leq 100N/(1 + D/109)$
D	Cantilever distance in mm between the center of mass of the load and the bearing center
Distance between top surface and the bearing center	14 mm

XM Series Models

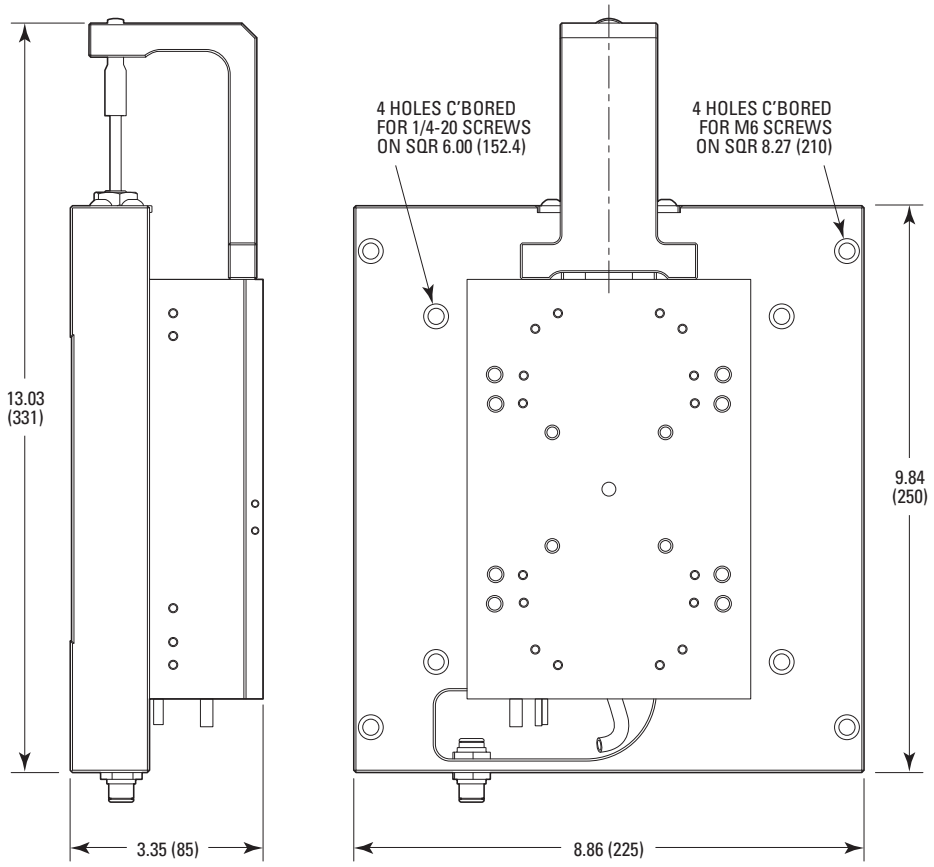
Model	Description
XMS100V	Ultra-Precision Vertical Linear Motor Stage, 100 mm Travel, XMS-V Series

Recommended Motion Controllers

XPS-D see page 148
XPS-RL see page 153

Driver cards and cable kits to be ordered separately. Please refer to Stage to Controller compatibility chart on page 146.

Dimensions



MODEL SHOWN: XMS100V
DIMENSIONS IN INCHES (AND MILLIMETERS)

NOTE:
FOR DIMENSIONS AND HOLES PATTERN
OF THE STAGE, SEE XMS100 DRAWING.

Optional bracket for XYZ mounting is available

VP-5ZA

Precision Vertical Linear Stages

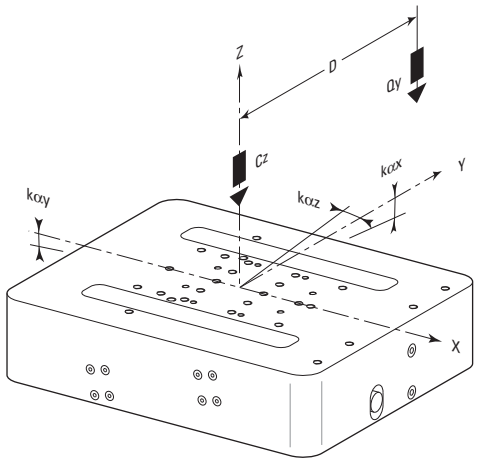
- 4.8 mm of precision vertical motion with unique inclined plane concept
- Ultra-low profile design for compact XYZ configurations
- Unobstructed access to the moving platform from any direction
- Highly repeatable and accurate motion with integrated linear encoder
- Excellent 60 nm minimum incremental motion
- Plug and play ESP compatibility

The VP-5ZA vertical stage is an ultra-low profile, precision vertical stage with minimum incremental motion capability of 60 nm, high-responsiveness and perfectly straight trajectory over 4.8 mm travel. Features include: an innovative inclined-plane design; a cool running, high torque DC motor with a precision preloaded, long-life, ball screw ensuring high speed motion with minimum settling time; a high-resolution linear scale directly attached to the moving rail, eliminating all drive-train induced motion errors; and two pairs of vertically mounted double-row linear ball bearing slides resulting in pure vertical motion. A standard 3-point mounting interface for a wafer chuck is provided as well. Manual vertical adjustments can be made using a flat screw driver for convenience. Typical applications include: semiconductor wafer inspection, photonics test and packaging, micro-assembly, precision metrology, and surface inspection systems. The VP-5ZA is compatible with the VP-25X linear stages and other Newport positioning products. For mounting to optical tables or to the ILS linear stages, use the optional base plate VP-BP.

Specifications

	VP-5ZA
Travel Range	4.8 mm
Minimum Incremental Motion	60 nm
Maximum Speed	5 mm/s
Centered Load Capacity	50 N
Accuracy, Typical	±0.6 µm
Accuracy, Guaranteed	±1.5 µm
Bi-directional Repeatability, Typical	±0.10 µm
Bi-directional Repeatability, Guaranteed	±0.25 µm
Uni-directional Repeatability, Typical	±0.06 µm
Uni-directional Repeatability, Guaranteed	±0.15 µm
Origin Repeatability	±0.1 µm
Cable Length	1.5 m
Pitch, Typical	±30 µrad
Pitch, Guaranteed	±50 µrad
Roll, Typical	±30 µrad
Roll, Guaranteed	±100 µrad
Yaw, Typical	±30 µrad
Yaw, Guaranteed	±50 µrad
Weight	2.4 kg
MTBF	20,000 h (25% load, 10% duty cycle)
CE	Compliant

Load Characteristics and Stiffness

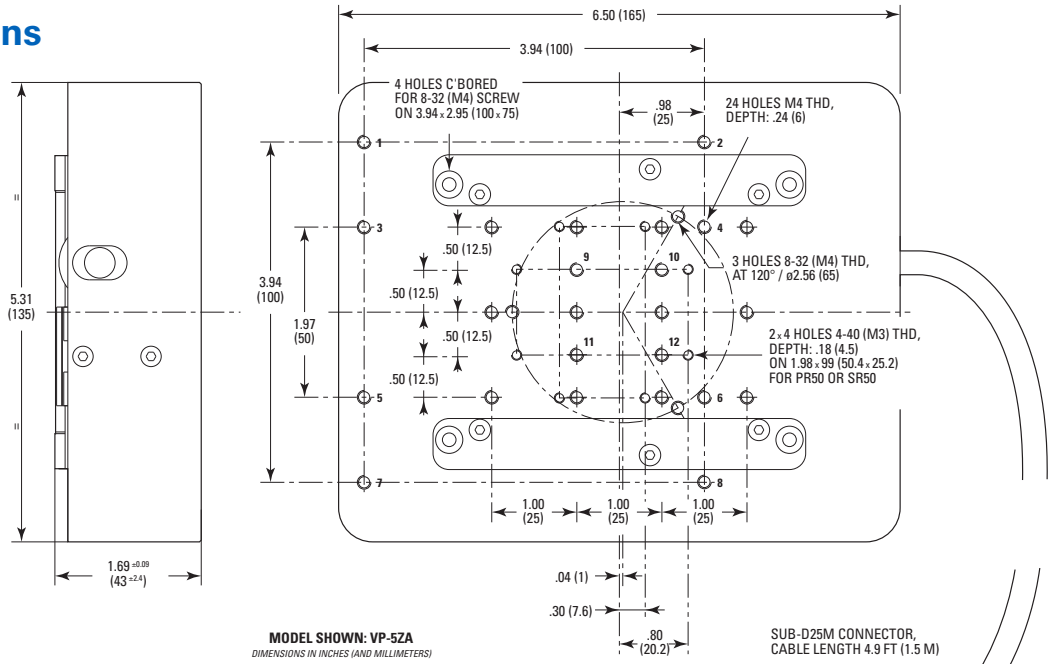


Cz, Normal centered load capacity	50 N
kαx, Compliance in roll	50 µrad/N.m
kαy, Compliance in pitch	45 µrad/N.m
kαz, Compliance in yaw	10 µrad/N.m
Q, Off-center load	Qx, Qy ≤ Cz / (1+D/30)
Where D = Cantilever distance in mm	

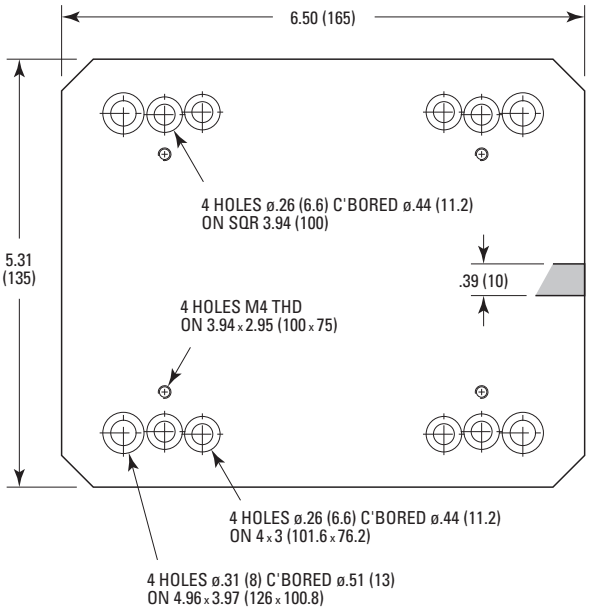
Ordering Information

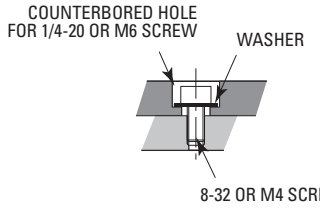
Model (Metric)	Description
VP-5ZA (M-VP-5ZA)	Compact Precision Vertical Stage, 4.8 mm Travel, DC Servo Motor with Tachometer, Metric
VP-BP	Universal Base Plate

Dimensions

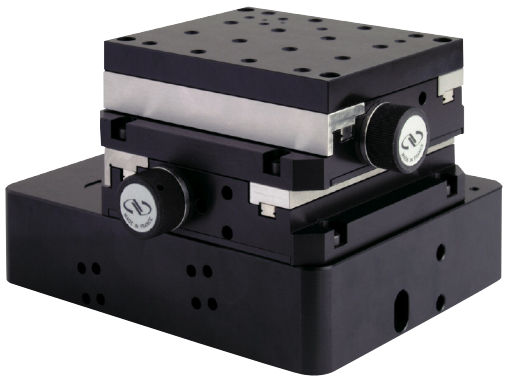


MODEL SHOWN: VP-5ZA
DIMENSIONS IN INCHES (AND MILLIMETERS)





Components with counterbored holes for 1/4-20 (M6) screws can be attached to the top plate of the VP-5ZA (M-VP-5ZA) using 8-32 (M4) screws and the washers supplied with each stage.



Ultra low-profile precision XYZ system consisting of two VP-25XA linear stages and one VP-5ZA vertical translation stage. Compared to traditional stacks of stages, this solution offers a lower-profile alternative with easy access to the load from any side.

Recommended Motion Controllers:

XPS-D see page 148
XPS-RL see page 153
ESP301 see page 157
SMC100CC see page 159

Driver cards to be ordered separately. Please refer to Stage to Controller compatibility chart on page 146.

GTS30V

High-Precision Vertical Linear Stage

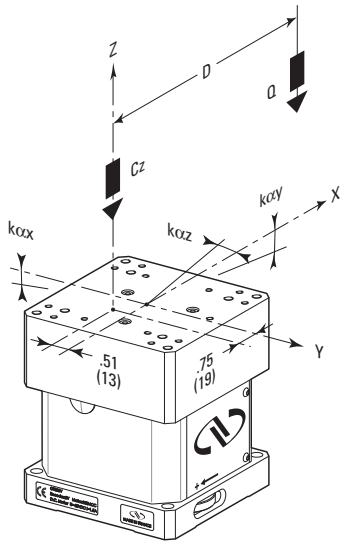
- 30 mm of precision vertical travel in a compact unit
- Unobstructed access to the payload from any side
- Ripple-free motion and outstanding trajectory accuracy with vertical anti-creep crossed roller bearings
- High sensitivity, excellent repeatability and high accuracy motion from integrated linear encoder

The GTS30V is a compact, vertical stage that combines outstanding trajectory accuracy with fine adjustment capability of 0.1 µm Minimum Incremental Motion with a travel range of 30 mm. Features include: a vertical guide system composed of matched pairs of anti-creep crossed roller bearings resulting in high-precision, ripple-free motion, a folded DC motor with a precision ground and a low-friction lead screw designed to deliver ultra-smooth motion. The GTS30V also does not back drive even with heavy loads, offering excellent in-position stability. A reduction belt between the motor and lead screw increases available output torque and robustness for servo loop sensitivity. The GTS30V is ideal for applications such as semiconductor wafer inspection, scanning, microscopy, laser machining, automated device alignment, metrology, quality control and applications requiring long travel vertical motion of 30 mm.

Specifications

	GTS30V
Travel Range	30 mm
Minimum Incremental Motion	0.1 µm
Maximum Speed	10 mm/s
Centered Load Capacity	40 N
Accuracy, Typical	±0.37 µm
Accuracy, Guaranteed	±0.75 µm
Bi-directional Repeatability, Typical	±0.07 µm
Bi-directional Repeatability, Guaranteed	±0.1 µm
Origin Repeatability	±0.05 µm
Cable Length	3 m
Pitch, Typical	±20 µrad
Pitch, Guaranteed	±25 µrad
Roll, Typical	±12 µrad
Roll, Guaranteed	±25 µrad
Weight	3.3 kg
MTBF	20,000 h (25% load, 10% duty cycle)
CE	Compliant

Load Characteristics and Stiffness



Cz, Normal centered load capacity	40 N
Kαx, Compliance in roll	40 µrad/Nm
Kαy, Compliance in pitch	40 µrad/Nm
Kαz, Compliance in yaw	25 µrad/Nm
Qx, Qy, Off-center load	Q ≤ Cz/(1+D/30)
D max, Cantilever distance	100 mm

Ordering Information

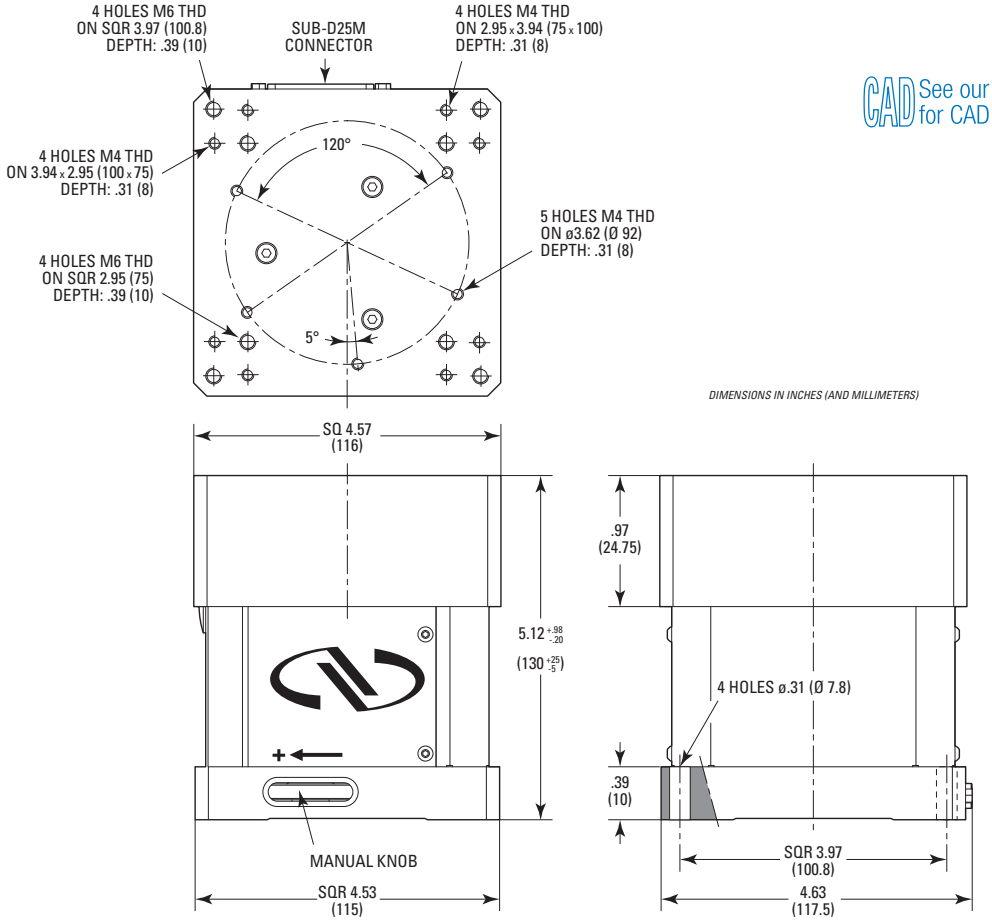
Model	Description
GTS30V	High Precision Vertical Stage, 30 mm Travel, GTS Series

Recommended Motion Controllers:

XPS-D see page 148
XPS-RI see page 153
ESP301 see page 157
SMC100CC see page 159

Driver cards to be ordered separately. Please refer to Stage to Controller compatibility chart on page 146.

Dimensions



CAD See our website for CAD files

A typical assembly with an ILS250 linear stage, a GTS30V vertical stage and a URS100 rotation stage.

A compact XYZ assembly consisting of a GTS150 linear stage, a GTS70 linear stage and a GTS30V vertical stage.

IDL280-Z20 Industrial Vertical Stage

- Built for industrial applications
- Up to 500 N load capacity
- Stiff construction
- Fine positioning

The IDL280-20Z Industrial Grade Vertical Stage offers 20 mm travel and 500N load capacity. Specifically designed for high load industrial applications, it can directly be mounted on any IDL280 series Industrial Linear Stages for easy XZ or XYZ assemblies.

Specifications

Travel Range	20 mm
Minimum Incremental Motion	0.10 µm
Maximum Speed	5 mm/s
Centered Load Capacity	500 N
Accuracy, Typical	2.0 µm
Bi-directional Repeatability	±0.6 µm
Uni-directional Repeatability, Guaranteed	±0.1 µm
Origin Repeatability	±0.5 µm
Cable Length	3 m
Pitch, Guaranteed	±50 µrad
Compliance in Pitch	10 µrad/ Nm
Compliance in Roll	10 µrad/ Nm
Yaw, Guaranteed	±50 µrad
Compliance in Yaw	10 µrad/ Nm
Weight	14.5 kg
MTBF	20,000 h (25% load, 30% duty cycle)
CE	Compliant

Ordering Information

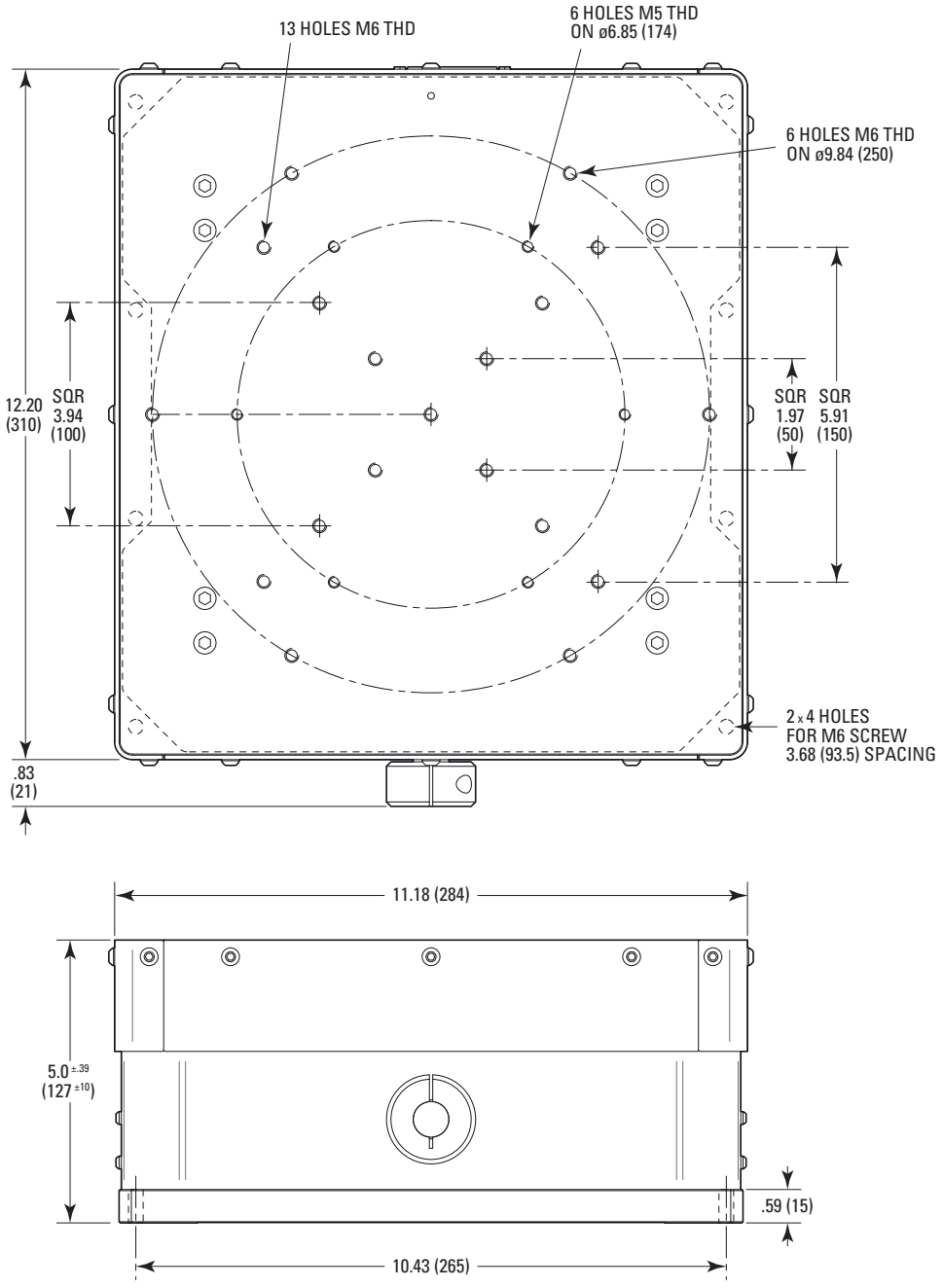
Model	Description
IDL280-Z20	Industrial Grade Vertical Stage, 20 mm Travel

Recommended Motion Controllers

XPS-D4 see page 148
XPS-RL2 see page153

Driver cards to be ordered separately. Please refer to Stage to Controller compatibility chart on page 146.

Specifications



IMS-V Series

High-Load Vertical Linear Stages

- Highest vertical load capacity (400 N) and longest travel range (300 mm)
- Self-locking lead screw ensures best position stability even with power off
- FEM-optimized aluminum body allows for high stiffness and minimizes bi-metal bending
- Proprietary nut design minimizes wear
- Direct position feedback provides superior accuracy and repeatability with minimum hysteresis
- Recirculating ball bearings offer support for high loads and counteract moment loads

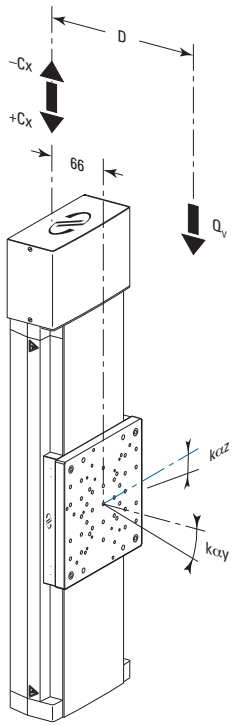
IMS-V Series stages are long travel vertical stages offering high performance in a cost effective package. They are an ideal solution for both precision industrial and laboratory applications requiring precise vertical motion with 0.3 µm MIM for loads up to 400 N and 300 mm travel. Features include: four-way equal load ball bearings to provide superior cantilevered loading characteristics, caged recirculating ball bearings to ensure maintenance-free operation without cage migration, self-locking lead screw to ensure superior in-position stability with no change of position at power off, and a direct-read to encoder provide superior accuracy and minimum hysteresis. Available in IMS300V and IMS100V models. Ideal for a wide range of precision industrial and research applications.

Specifications

	IMS100V	IMS300V
Travel Range.	100 mm	300 mm
Maximum Speed	20 mm/s	
Centered Load Capacity	400 N	
Minimum Incremental Motion	0.30 µm	
Accuracy, Typical	±0.6 µm	±3.5 µm
Accuracy, Guaranteed	±2 µm	±5 µm
Bi-directional Repeatability, Typical	±0.15 µm	±0.20 µm
Bi-directional Repeatability, Guaranteed	±0.5µm	
Uni-directional Repeatability, Typical	±0.10 µm	±0.12 µm
Uni-directional Repeatability, Guaranteed	±0.25µm	
Origin Repeatability	±0.1 µm	
Cable Length	5 m	
Pitch, Typical	±15 µrad	±35 µrad
Yaw, Typical	±10 µrad	±20 µrad
Weight	13.6 kg	17 kg
MTBF	20,000 h (300 N load, 10% duty cycle)	
CE	Compliant	

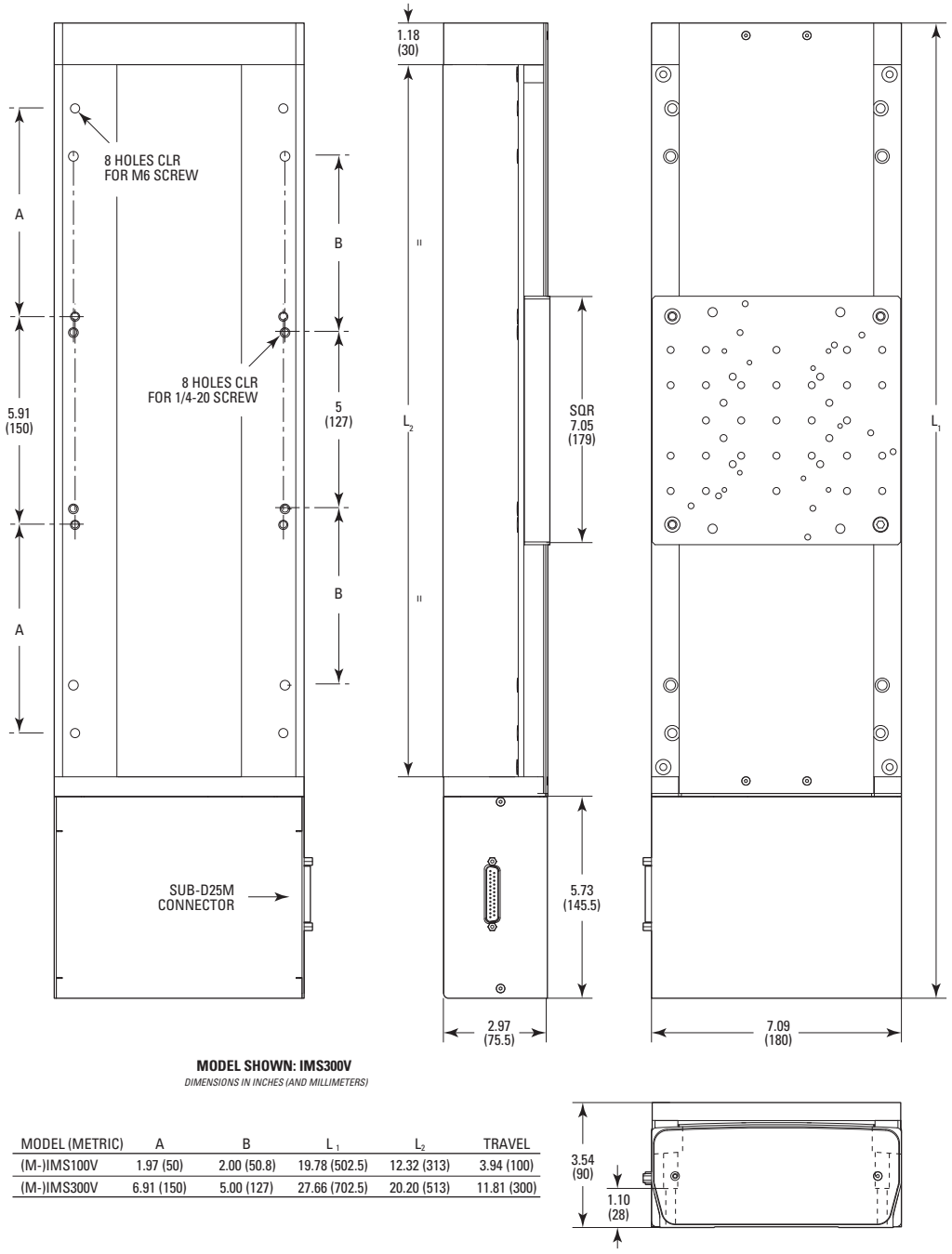
Note: Also available in metric version, p/n M-

Load Characteristics and Stiffness



Min. -Cx; +Cx	40 N
Max. -Cx; +Cx	400 N with XPS 100 N with ESP301 or SMC100CC
kαy, Compliance in pitch	0.2 µrad/N.m
kαz, Compliance in yaw	1 µrad/N.m
Q, Off-center load	$Q_y \leq 1500N/(1 + D/90)$, but not greater than Cx Max
D, Cantilever distance in mm between the center of mass of the load and the bearings center.	
Distance between mounting surface and the bearings center	66 mm

Dimensions



MODEL SHOWN: IMS300V

DIMENSIONS IN INCHES (AND MILLIMETERS)

MODEL (METRIC)	A	B	L_1	L_2	TRAVEL
(M-)IMS100V	1.97 (50)	2.00 (50.8)	19.78 (502.5)	12.32 (313)	3.94 (100)
(M-)IMS300V	6.91 (150)	5.00 (127)	27.66 (702.5)	20.20 (513)	11.81 (300)

CAD See our website for CAD files

Ordering Information

Model (Metric)	Description
(M-)IMS100V	Vertical Stage, 100 mm Travel, DC motor, IMS-V Series
(M-)IMS300V	Vertical Stage, 300 mm Travel, DC motor, IMS-V Series

Recommended Motion Controllers/Drivers

XPS-D see page 148	(max. 400 N payload, 0.3 µm MIM)
XPS-RL see page 153	(max. 400 N payload, 0.3 µm MIM)
ESP301 see page 157	(max. 100 N payload, 0.6 µm MIM)
SMC100 see page 159	(max. 100 N payload, 0.6 µm MIM)

Driver cards to be ordered separately. Please refer to Stage to Controller compatibility chart on page 146.

UZ Series

Vertical Linear Stages

- All steel construction offers high stiffness, thermal stability, repeatable positioning and overall durability
- Screw mounted rotary encoder produces sub-micron MIM
- Unobstructed access to moving platform from any direction
- Plug and Play - ESP compatible

UZ Series vertical stages offer high precision vertical translation for space-limited applications requiring sub-micron sensitivity. They are available in two sizes, the UZS80 and the UZM160. The UZS80CC DC motor version provides high speed adjustments and accurate bi-directional positioning capabilities and features a high resolution encoder directly attached to the drive spindle, eliminating most error sources associated with indirect feedback devices. The UZS80PP stepper motor version is a more economical model for less demanding applications. The UZM160 is specifically designed for high load applications, capable of bearing loads up to 300N, and is available with a DC-motor drive, a full step motor drive, or a mini-step motor drive. In addition, the stages utilize a 2,000 cts/rev. rotary encoder to ensure consistent operation under high loads. UZ Series stages feature a center home position and are available in vacuum versions as well.

Ordering Information

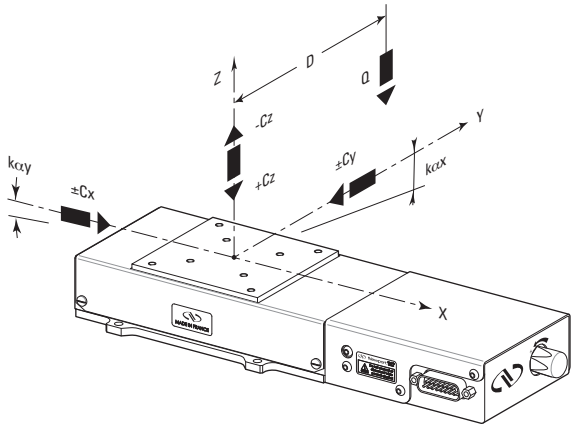
Model (Metric)	Description
UZS80CC	UZS80 vertical stage, DC motor
UZS80PP	UZS80 vertical stage, stepper motor
UZM160CC.05 (M-UZM160CC.05)	UZM160 vertical stage, DC drive
UZM160PE.05 (M-UZM160PE.05)	UZM160 vertical stage, full-step drive
UZM160PE.05V6 (M-UZM160PE.05V6)	UZM160PE.05 vertical stage, vacuum compatible to 10^{-6} hPa
UZM160PP.05 (M-UZM160PP.05)	UZM160 vertical stage, micro-step drive
M-CAP-M41	4 Captive screws for mounting UZS80 on top of UTS linear stages
M-CAP-M61	4 Captive screw for mounting MTM linear stages on top of UZM160
M-PBN12	Base plate for UZS80
UTS-TP	UZS80 top plate with English holes

Specifications

	UZS80CC	UZS80PP	UZM160CC.05	UZM160PP.05	UZM160PE.05
Travel Range	4.5 mm		9 mm		
Maximum Speed	4 mm/s	2 mm/s	1 mm/s		0.1 mm/s
Centered Load Capacity	30 N		300 N		
Minimum Incremental Motion	0.20 µm				
Accuracy, Typical	±0.35 µm		±4.0 µm		
Bi-directional Repeatability, Typical	±0.4 µm	±0.5 µm	±2.75 µm		
Uni-directional Repeatability, Typical	±0.25 µm				
Origin Repeatability	±1 µm	±2 µm	±0.25 µm		
Cable Length	3 m				
Pitch, Typical	±37 µrad		±50 µrad		
Yaw, Typical	NA	NA	±100 µrad		
Weight	2.8 kg		22 kg		
MTBF	20,000 h (25% load, 10% duty cycle)				
CE	Compliant				

M- versions have M6 threaded mounting holes.

Load Characteristics



	UZS80	UZM160
Cz, Normal centered load capacity	±30 N	-200 N, +300 N
Cx, Cy	±150 N	±200 N
kαx, Compliance in roll	100 µrad/Nm	0.13 µrad/Nm
kαy, Compliance in pitch	100 µrad/Nm	0.65 µrad/Nm
Max torque (Q x D)	0.75 Nm	20 Nm
Q, Off-center load		
D, Cantilever distance in m		

Recommended Motion Controllers:

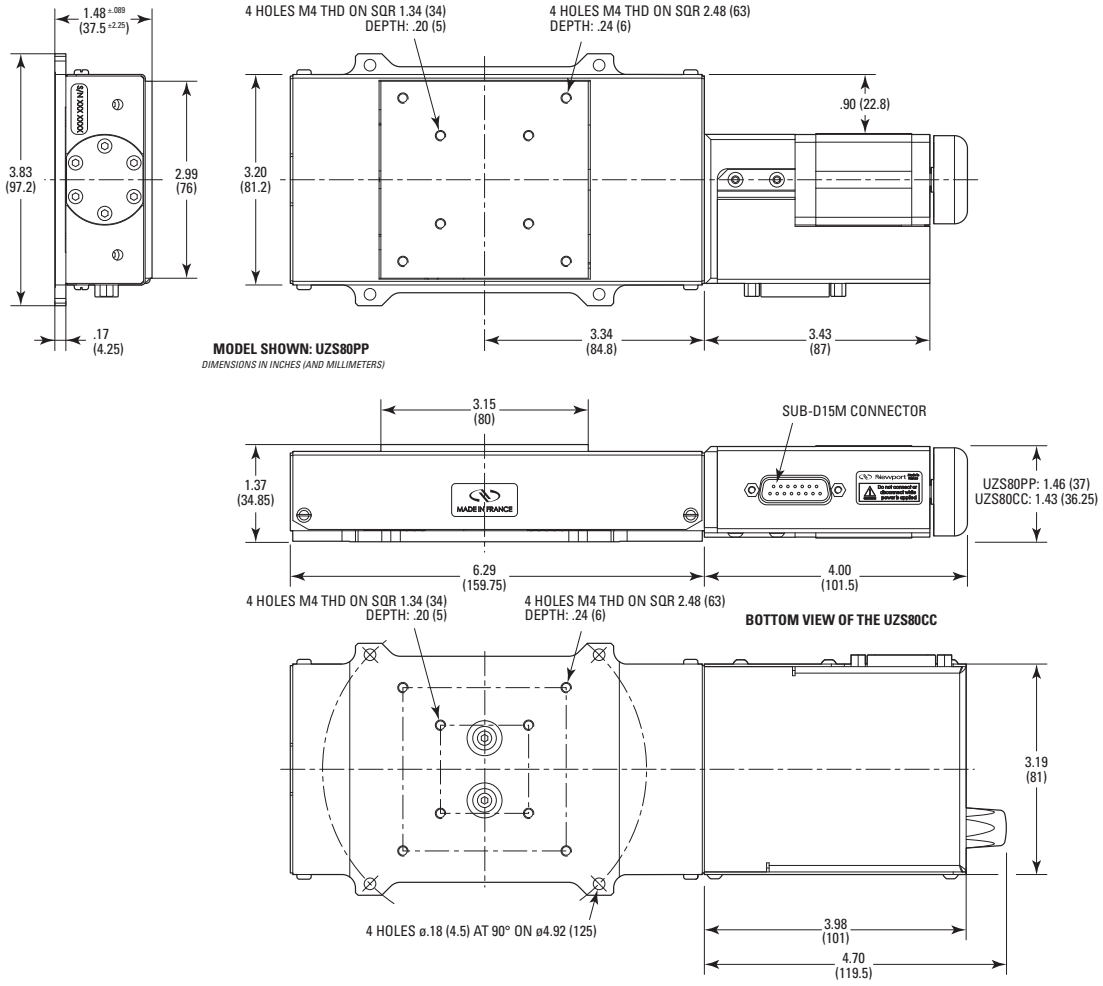
XPS-D see page 148	
XPS-RL see page 153	
ESP301 see page 157	
SMC100CC see page 159	UZS80CC only
SMC100PP see page 159	UZS80PP and UZM160PP.05 only

Driver cards to be ordered separately. Please refer to Stage to Controller compatibility chart on page 146.

A BGS80CC stage mounted on top of an UZS80CC stage

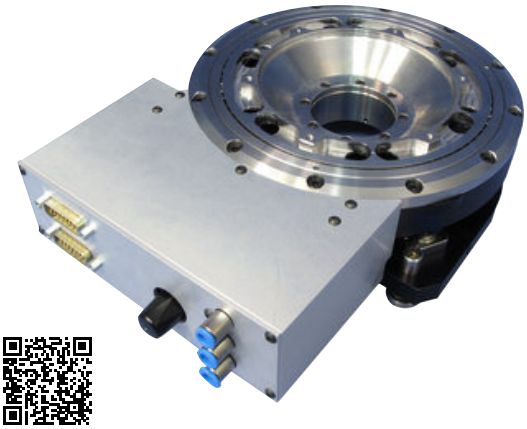
CAD See our website for CAD files

Dimensions



ZVR Series

Integrated Vertical and Rotation Stage for Wafer Positioning



scan QR code
to watch video

- Precise 10 mm vertical and continuous 360 degree angular travel in a very low profile design
- Three-point bottom interface for stable mounting to any XY stage or other platfor
- Large center aperture simplifies vacuum and electrical cable management
- Low mass and a high natural frequency enable rapid step-and-settle applications
- Stainless steel recirculating ball bearings
- Plug and Play - ESP compatible

Newport's ZVR-PP and ZVR-PC are integrated Z-vertical and Theta-rotation positioning stages designed to precisely elevate and rotate 200 mm and/or 300 mm diameter wafer chucks. The ZVR stages rigidly support and drive the payload at three points (seperated by 120 degrees) along the outer circumference of the stage. Newport's three point design has advantages for applications that have slight to extreme unbalanced loading such as wafer probing, which can have vertical forces applied at locations along the outer edges of the chuck. Angular deflections due to these off-centre loads are minimized and binding during vertical motion is eliminated. The ZVR's unique design also permits the center of the stage to remain open down through the bottom plate. Guiding the stage through its vertical trajectory are three miniature, ultraquiet, recirculating bearing guides. The ZVR is also equipped with a hardware origin allowing the stage to be returned to an absolute reference (home) position and a limit switch enabling the user to set the upper limit for vertical travel.

Specifications

	ZVR-PC	ZVR-PP
Angular Range	360°	
Travel Range	10 mm	
Maximum Speed	80°/s	40°/s
Maximum Linear Speed	10 mm/s	
Centered Load Capacity	100 N	
Aperture Diameter	50 mm	
Minimum Incremental Motion, Rotary	2 mdeg	
Minimum Incremental Motion, Linear	0.05 µm	
Bi-directional Repeatability, Typical	Rotary: ±1.3 mdeg ; Linear: ±1.2 µm	Rotary : ±3.0 mdeg ; Linear: ±1.2 µm
Bi-directional Repeatability, Rotary, Guaranteed	Rotary: ± 3.0 mdeg ; Linear: ±2.0 µm	Rotary : ± 6.0 mdeg; Linear: ± 2.0 µm
Uni-directional Repeatability, Typical	Rotary: ±0.5 mdeg ; Linear: ±0.2 µm	Rotary: ±1.0 mdeg, Linear: ±0.1 µm
Uni-directional Repeatability, Guaranteed	Rotary: ±1.5 mdeg ; Linear: ±1.0 µm	Rotary: ±1.5 mdeg, Linear: ±1.0 µm
Accuracy, Typical	Rotary: ±10 mdeg , Linear: ±0.5 µm	
Accuracy, Guaranteed	Rotary: ±15 mdeg , Linear: ±2.0 µm	Rotary: ±17 mdeg , Linear: ±2.0 µm
Origin Repeatability (rotary)	Rotary: ±7.5 mdeg	Rotary: ±20 mdeg
Origin repeatability(linear)	Linear: ±2.5 µm	
Cable Length	3 m	
MTBF	20,000 h (25% load, 10% duty cycle)	
CE	Compliant	

Ordering Information

Model	Description
ZVR-PP	Integrated Vertical and Stepper Motor Rotation Stage for Wafer Positioning
ZVR-PC	Integrated Vertical and DC Rotation Stage for Wafer Positioning

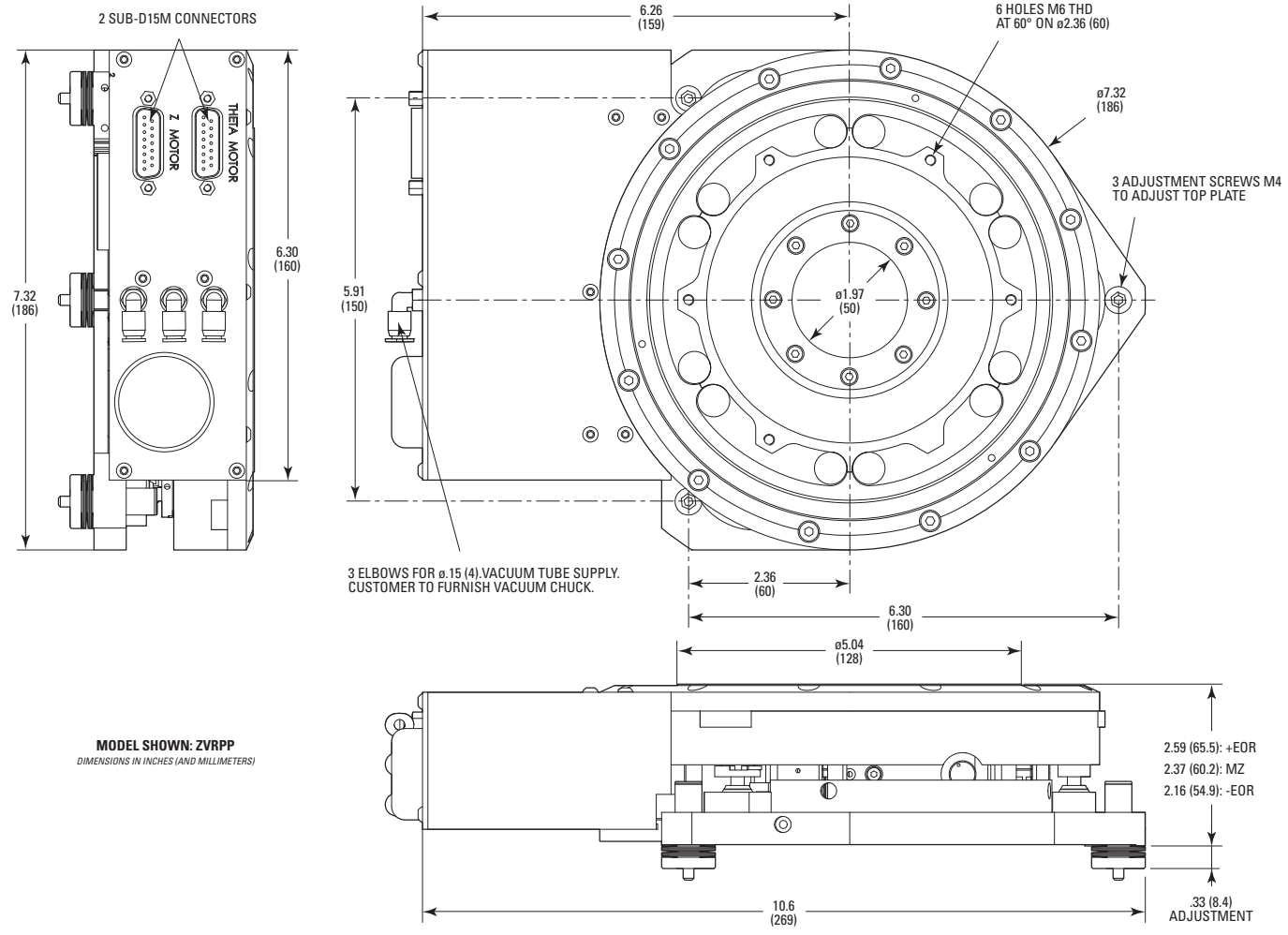
For a vertical only version, please contact Newport.

Recommended Motion Controllers/Drivers:

XPS-D see page 148
XPS-RL see page 153
ESP301 see page 157
SMC100CC see page 159
SMC100PP see page 159

Driver cards to be ordered separately. Please refer to Stage to Controller compatibility chart on page 146.

Dimensions



MODEL SHOWN: ZVRPP
DIMENSIONS IN INCHES (AND MILLIMETERS)