

M-500 Micropositioner: XY & XYZ Stage Combinations

High-Precision Linear Guiding, Long Travel, Direct Position Measurement



XYZ combination with two M-511.DD linear stages and an M-501.1PD precision vertical stage



P-562.3CD PIMars™ XYZ piezo-nanopositioning & scanning system (200 μm x 200 μm x 200 μm) mounted on an M-451.1PD elevation stage

- **Travel Ranges 102, 204 and 306 mm (4", 8", 12")**
- **Max. Velocity 125 mm/s with ActiveDrive™ Motors**
- **Optional 0.1 μm Linear Encoder for Highest Accuracy**
- **Load Capacity of 100 kg**
- **Stress-Relieved Aluminum Base for Highest Stability**
- **Zero-Backlash Recirculating Ballscrews**
- **Non-contact Limit and Reference Switches**
- **XY & XYZ Combinations (Special Z-Stages Available)**
- **MTBF >20,000 h**

M-5x1-series translation stages are designed to meet the most demanding positioning requirements and are available in a number of different models. They boast an extremely low profile design to allow multiaxis combinations (see also page 4-58 and page 4-60) and feature

a precision-machined base of high-density, stress-relieved aluminum for exceptional stability and minimum weight.

Heavy Duty and Maintenance Free

The stages are equipped with high-precision linear guiding rails with recirculating ball bearings to guarantee 1 μm/100 mm straightness and flatness. Precision-ground recirculating ball screws with preloaded nuts provide low-friction, maintenance-free and backlash-free positioning. This equipment provides high load capacity and guiding accuracy with long lifetime.

Four Drive Options

Maximum dynamic performance is possible with versions featuring the highly efficient ActiveDrive™ direct-drive sys-

tem, which can achieve speeds of up to 125 mm/s.

The ActiveDrive™ design, developed by PI, features a high-efficiency PWM (pulse width modulation) servo-amplifier mounted side-by-side with the DC motor and offers several advantages:

- **Increased efficiency, by eliminating power losses between the amplifier and motor**
- **Reduced cost of ownership and improved reliability, because no external driver is required**
- **Elimination of PWM amplifier noise radiation, by mounting the amplifier and motor together in a single, electrically shielded case**

The M-5x1.PD version provides velocities up to 125 mm/sec. It is equipped with an ActiveDrive™ DC motor and rotary encoder.

The M-5x1.DD models provide superior repeatability of only 0.2 μm by means of integrated optical linear encoders. A motor brake which assures maintenance of the stage position after power-down is also available.

The M-5x1.DG versions feature

closed-loop DC motors with shaft-mounted position encoders and precision gearheads providing minimum incremental motion to 0.1 μm with velocities up to 6 mm/s.

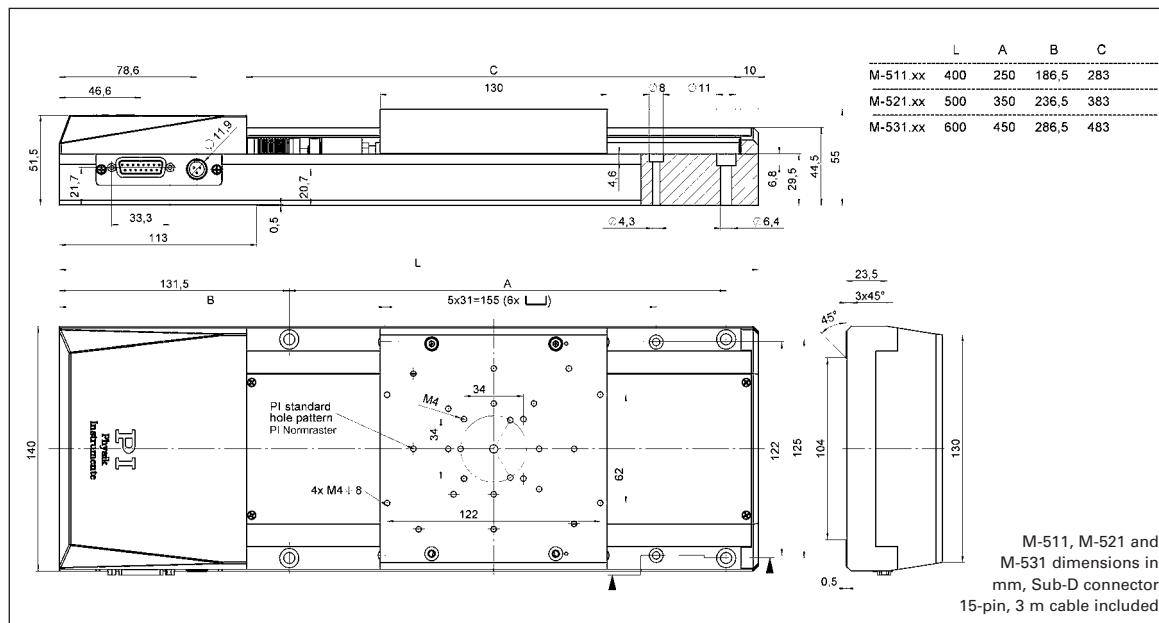
The M-5x1.2S versions models feature a cost-effective direct-drive, 2-phase stepper motor, providing very smooth operation and a resolution of 0.1 μm.

Precision Assembly

The stages are individually tested and optimized using a laser interferometer.

Application Examples

- R&D
- Semiconductor testing
- Mass storage device testing
- Metrology
- Photonics packaging
- Quality assurance testing
- Precision Linear Motion Control



Technical Data

Model	M-511.DD / M-521.DD / M-531.DD	M-511.PD / M-521.PD / M-531.PD	M-511.DG / M-521.DG / M-531.DG	M-511.2S / M-521.2S / M-531.2S	Unit
Motion and positioning					
Travel range	102 / 204 / 306	102 / 204 / 306	102 / 204 / 306	102 / 204 / 306	mm
Integrated sensor	Linear encoder	Rotary encoder	Rotary encoder	–	
Sensor resolution	0.1 µm	4000	2048	–	cts./rev.
Design resolution	0.1	0.5	0.033	0.31	µm
Min. incremental motion	0.1	0.5	0.1	0.1	µm
Unidirectional repeatability	±0.1	±0.5	±0.2	±0.2	µm
Bidirectional repeatability	±0.2	–	–	–	µm
Backlash	–	1	1	1	µm
Accuracy per 50 mm	0.2	2	2	2	µm
Pitch/Yaw	±25 / ±35 / ±50	±25 / ±35 / ±50	±25 / ±35 / ±50	±25 / ±35 / ±50	µrad
Straightness/Flatness per 100 mm	1	1	1	1	µm
Max. velocity	50	125	6	20	mm/s
Mechanical properties					
Thread pitch	2	2	2	2	mm
Gear ratio	–	–	(28/12) ⁴ : 1 ≈ 29.6:1	–	
Motor resolution*	–	–	–	6400*	steps/rev.
Max. load	1000	1000	1000	1000	N
Max. push/pull force	80 / 80	80 / 80	80 / 80	80 / 80	N
Max. lateral force	200	200	200	200	N
Drive properties					
Motor type	ActiveDrive™ DC Motor	ActiveDrive™ DC Motor	DC-motor, gearhead	2-phase stepper motor*	
Operating voltage	24 (PWM)	24 (PWM)	0 to ±12	24	V
Electrical power	30	30	3		W
Limit and reference switches	Hall-effect	Hall-effect	Hall-effect	Hall-effect	
Miscellaneous					
Operating temperature range	-20 to +65	-20 to +65	-20 to +65	-20 to +65	°C
Material	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	
Mass	5 / 6.1 / 7.2	5 / 6.1 / 7.2	4.9 / 6 / 7.1	4.9 / 6 / 7.1	kg
Recommended controller/driver	C-863 (single-axis) C-843 PCI board (up to 4 axes)	C-863 (single-axis) C-843 PCI board (up to 4 axes)	C-863 (single-axis, p. 4-1149) C-843 PCI board (p. 4-120) (up to 4 axes)	C-663 (single-axis) (p. 4-112)	

* 2-phase stepper motor, 24 V chopper voltage, max. 0.8 A/phase, 400 full steps/rev., motor resolution with C-663 stepper motor controller