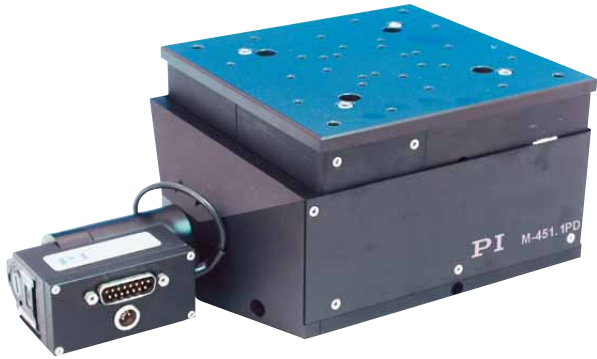


M-451 High-Load Precision Z-Stage

Combinations with Piezo-Nanopositioning Stages Possible



M-451.1PD precision elevation stage

- Encoder Resolution 3 Nanometer
- Min. Incremental Motion to 100 nm
- Travel Range 12.5 mm (1/2")
- Load Capacity up to 12 kg, High Stiffness
- ActiveDrive™ Motor
- Non-contact Limit and Reference Switches
- Mounting Platform for P-500 and PIMars™ Piezo-Nanopositioning Systems
- Self-Locking

The M-451 Z-stage series is ideal for high-precision, high-load vertical positioning tasks. These stages feature a precision-machined base of high-density, stress-relieved aluminum for exceptional stability and minimum weight. Precision-cross-roller guided wedges and low-friction lead-screws provide maintenance-free positioning. The stages are self locking to 12 kg.

ActiveDrive™ for High Dynamics

Model M-451.1PD with Active Drive™ provides incremental motion down to 0.2 μm. 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

High Accuracy with Gearhead/Encoder Combination

Models M-451.1DG are equipped with closed-loop DC-motors with shaft-mounted position encoders and precision gearheads providing 0.1 μm minimum incremental motion and 3 nanometer encoder resolution.

Stepper Motor Version for Open-Loop Operation

Models M-451.12S models feature a cost-effective direct-drive, 2-phase stepper motor, providing very smooth operation and a resolution of 6400 steps/rev. (with the C-663 controller). Minimum incremental motion to 0.2 μm is possible.

Limit and Reference Switches

For the protection of your equipment, non-contact Hall-effect limit and reference switches are installed. The direction-sensing reference

Ordering Information

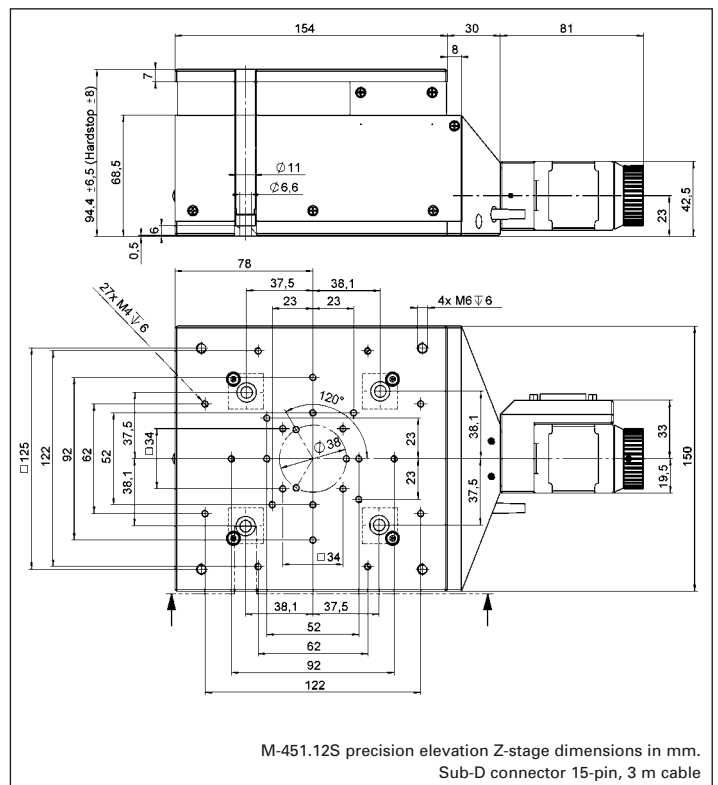
- M-451.1PD**
Vertical Stage, 12.5 mm, ActiveDrive™ DC Motor (includes 24 V power supply)
- M-451.1DG**
Vertical Stage, 12.5 mm, DC Motor Gearhead
- M-451.12S**
Vertical Stage, 12.5 mm, 2-Phase Stepper Motor

Ask about custom designs!

switch supports advanced automation applications with high precision.

Compatible with Nanopositioning/Scanning Stages

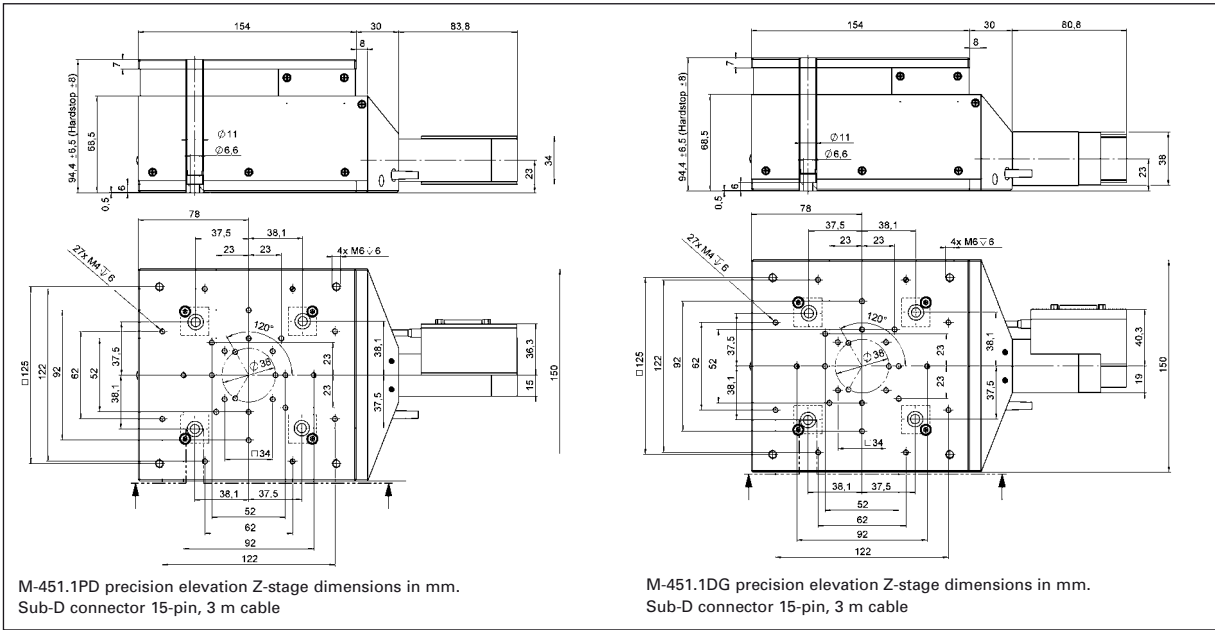
M-451 is designed to work with a variety of PI piezo nanopositioning stages such as the P-527 series and P-561 PIMars™ series. These piezo-driven positioning and scanning stages provide sub-nanometer resolution and accuracy and very high scanning speed.



M-451.12S precision elevation Z-stage dimensions in mm. Sub-D connector 15-pin, 3 m cable

Application Examples

- R&D
- Semiconductor technology
- Mass storage device testing
- Metrology



Technical Data

Model	M-451.1PD	M-451.1DG	M-451.12S	Unit
Active axes	Z	Z	Z	
Motion and positioning				
Travel range	12.5	12.5	12.5	mm
Integrated sensor	Rotary encoder	Rotary encoder	-	
Sensor resolution	4000	2000	-	cts./rev.
Design resolution	0.042	0.0028	0.026	µm
Min. incremental motion	0.2	0.1	0.2	µm
Backlash	1	1	1	µm
Unidirectional repeatability	0.3	0.3	0.3	µm
Pitch/Yaw	±75	±75	±75	µrad
Straightness	1	1	1	µm
Flatness	1	1	1	µm
Max. velocity	3	0.5	0.8	mm/s
Origin repeatability	1	1	1	µm
Mechanical properties				
Drive screw	Leadscrew	Leadscrew	Leadscrew	
Thread pitch	0.5	0.5	0.5	mm
Gear ratio	-	29.6:1	-	
Motor resolution*	-	-	6,400*	steps/rev.
Max. load (self-locking)	120	120	120	N
Drive properties				
Motor type	ActiveDrive™ DC Motor	DC Motor, gearhead	2-phase stepper motor*	
Operating voltage	24	0 to ±12	24	V
Electrical power	25	4	4.8	W
Limit and reference switches	Hall-effect	Hall-effect	Hall-effect	
Miscellaneous				
Operating temperature range	-20 to +50	-20 to +50	-20 to +50	°C
Material	Al (black anodized)	Al (black anodized)	Al (black anodized)	
Mass	5	5	5	kg
Recommended controller/driver	C-863 (single-axis) C-843 PCI board (up to 4 axes)	C-863 (single-axis, p. 4-114) C-843 PCI board (up to 4 axes, p. 4-120)	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



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

Linear Actuators & Motors

Nanopositioning / Piezoelectrics

Nanometrology

Micropositioning

Hexapod 6-Axis Systems / Parallel Kinematics

Linear Stages

Translation (X)

Vertical (Y)

Multi-Axis

Rotary & Tilt Stages

Accessories

Servo & Stepper Motor Controllers

Single-Channel

Hybrid

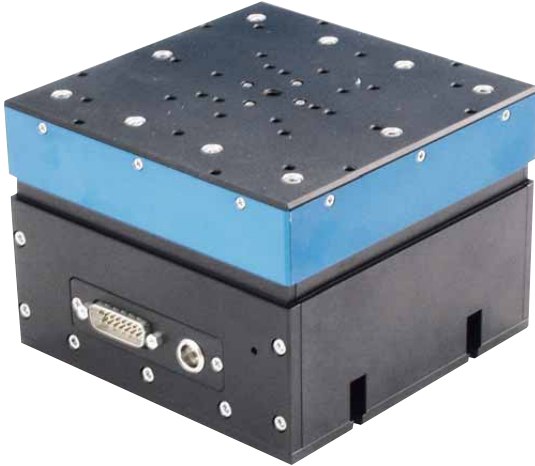
Multi-Channel

Micropositioning Fundamentals

Index

M-501 Precision Vertical Stage

Compact XYZ Combinations with M-511 Translation Stage Series



M-501.1PD vertical stage

- Travel Range 12.5 mm (1/2")
- Ultra-High-Resolution Encoder
- ActiveDrive™ Motor
- Zero-Backlash Recirculating Ballscrews
- Non-Contact Limit and Reference Switches
- Stress-Relieved Aluminum Base for Highest Stability
- MTBF >20,000 h
- Self Locking to 10 kg

The M-501 Z-stage is the latest family member of the M-500 series of translation stages. It is ideal for forming compact XYZ combinations together with the low-profile M-511, M-521 and M-531 translation stages. M-501 vertical stages feature a precision-machined base of high-density, stress-relieved aluminum for exceptional

stability and minimum weight. Precision-ground recirculating ball screws with preloaded nuts provide low-friction, maintenance-free and backlash-free positioning.

Two DC-motor drives are currently available:

M-501.1PD with ActiveDrive™ for High Velocity

This model features an ultra-high-resolution ballscrew-mounted encoder (40 960 counts/rev!) and provides a minimum incremental motion of better than 100 nanometers (design resolution 24 nm).

For superior dynamic performance the ActiveDrive™ motor is integrated. The ActiveDrive™ design, developed by PI, fea-

tures 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

M-501.1DG with Gearhead

These versions feature closed-loop DC motors with shaft-mounted position encoders and precision gearheads providing a minimum incremental motion to 0.1 μm and 5 nanometer encoder resolution.

The gearhead version can hold loads to 10 kg in power-off mode.

Ordering Information

M-501.1PD

Vertical Stage, 12.5 mm, ActiveDrive™ DC Motor (includes 24 V power supply)

M-501.1DG

Vertical Stage, 12.5 mm, DC Motor Gearhead

Ask about custom designs!

Limit and Reference Switches

For the protection of your equipment, non-contact Hall-effect limit and reference switches are installed. The direction-sensing reference switch supports advanced automation applications with high precision.

Notes

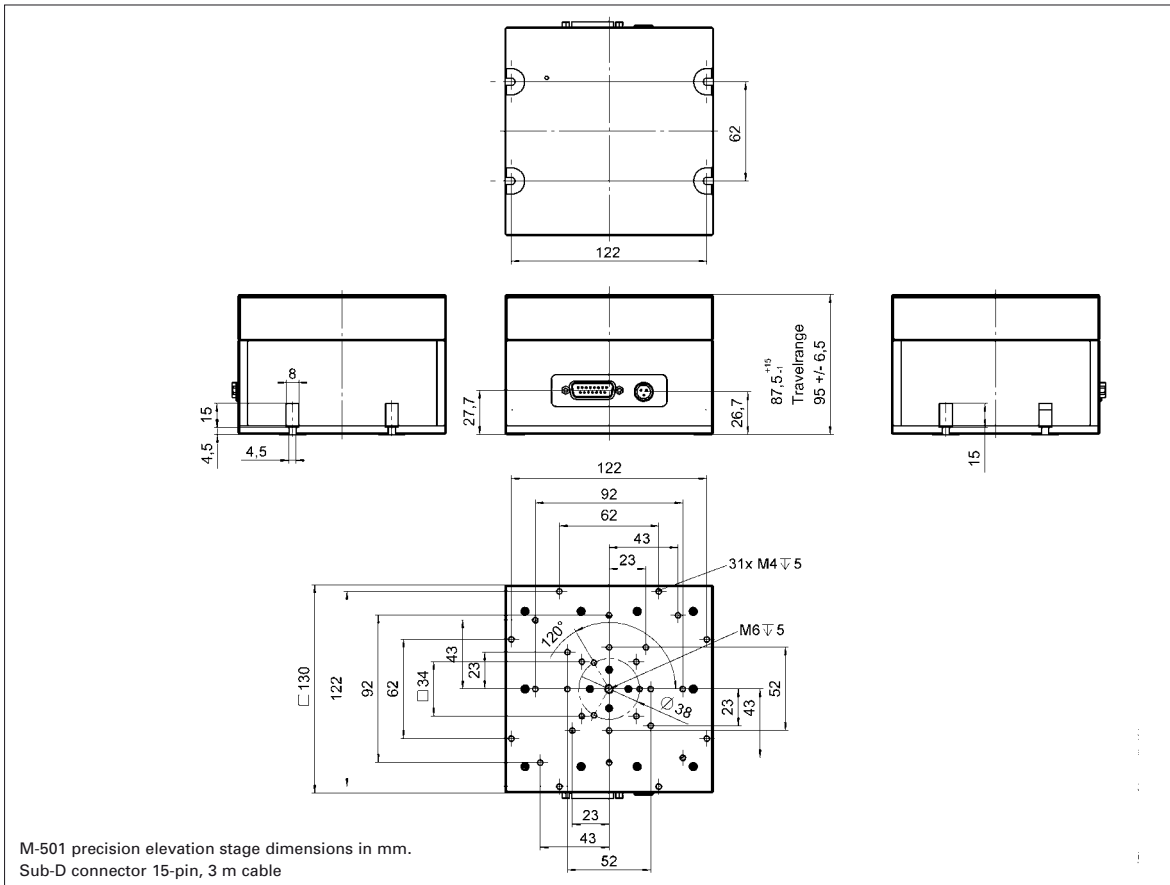
For adapters, bracket, etc. (see p. 4-90).



XYZ combination of M-521.DD (204 mm), M-511.DD (102 mm) and M-501.1PD vertical stage

Application Examples

- R&D
- Semiconductor testing
- Mass storage device testing
- Metrology
- Photonics packaging
- Quality assurance testing



Technical Data

Model	M-501.1PD	M-501.1DG	Units
Active axes	Z	Z	
Motion and positioning			
Travel range	12.5	12.5	mm
Integrated sensor	Rotary encoder	Rotary encoder	
Sensor resolution	40,960	2048	Cts./rev.
Design resolution	0.024	0.005	μm
Min. incremental motion	<0.1	<0.1	μm
Unidirectional repeatability	0.1	0.1	μm
Pitch/Yaw	±15	±15	μrad
Max. velocity	3	1	mm/s
Origin repeatability	1	1	μm
Mechanical properties			
Spindle pitch	1	1	mm
Gear ratio	80/26 (belt drive)	80/26 (belt drive); (28/12):1 ~ 29,6:1 gearhead	
Max. Load	50	100	N
Max. Holding force	20	100	N
Drive properties			
Motor type	ActiveDrive™ DC Motor	DC Motor, gearhead	
Operating voltage	24 (PWM)	0 to ±12	V
Electrical power	17	4	W
Limit and reference switches	Hall-effect	Hall-effect	
Miscellaneous			
Operating temperature range	-20 to +50	-20 to +50	°C
Material	Al (black anodized)	Al (black anodized)	
Recommended controller/driver	C-863 (single-axis), C-843 PCI board (up to 4 axes)	C-863 (single-axis, p. 4-114), C-843 PCI board (up to 4 axes, p. 4-120)	

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Index