M-683 Piezo Motorized Precision Translation Stage

Low-Profile & High-Speed with Ultrasonic Piezomotors, Direct Position Metrology

M-683.2U4 (50 mm) low-profile translation stage with integrated high-speed ceramic linear motors

- **Max. Velocity 350 mm/s**
- **Low Profile: Only 21 mm Height**
- **Compact XY Combination Possible**
- **Up to 6 N Force Generation**
- **Direct Metrology Linear Encoder, 0.1 µm Resolution**
- **Travel Range 50 mm**
- **Excellent Guiding Accuracy Through Crossed Roller Bearings**
- **PILine®: Non-Magnetic and Vacuum-Compatible Working Principle**
- **Self Locking at Rest**

M-683 precision micropositioning stages make use of PILine® ultrasonic piezo linear motors enabling a compact design and low profile. An integrated linear encoder enables closed-loop control with 0.1 µm resolution. The M-683 translation stages use paired crossed-roller bearings mounted on ground-aluminum profiles for better guiding accuracy. Integrated U-164 PILine® linear motors provide push forces to 6 N and a maximum velocity of up to 350 mm/s. A vacuum version is available. The stages can be arranged to form compact XY systems. If an additional Z-axis is required, the M-110 microstage series (see page 4-22) is recommended due to its higher holding force. The M-683 design is scalable and can be extended to provide longer travel ranges to 300 mm.

Application Examples

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

Limit and Reference Switches

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

Advantages of PILine® Micro Positioning Systems

PILine® ultrasonic ceramic drives provide several advantages over classical motors and drivers:

- Higher Acclerations, up to 5 g
- Speeds up to 500 mm/s
- Small Form Factor
- Self-Locking when Powered Down
- No Shafts, Gears or Other Rotating Parts
- No Lubricants
- Non-Magnetic and Vacuum Compatible Operating Principle

Optimized Controller and Drive Electronics

For optimum performance the highly specialized C-867 motion controller (see page 4-116) is recommended. This dedicated piezo motor controller also integrates the drive electronics which PILine® motors require to generate the ultrasonic oscillations for the piezoceramic element.

Furthermore, the controller has a number of special characteristics, including continuous automatic drive frequency adjustment, dynamic parameter switching for optimized high-speed motion and settling behavior and some other features to address the requirements of ultrasonic motors. The broad-band encoder input (50 MHz) supports the outstanding high accelerations and velocities of PILine® drives at high resolutions.

Optionally, for use with third party servo controllers, the C-185 analog drive electronics (stand-alone unit) (see page 1-36) is available. It accepts an analog ±10 V signal to control the motor velocity. For optimum performance the driver must be tuned together with the mechanics and should be ordered at the same time as the motor/stage.

Ordering Information

M-683.2U4
PILine® High-Speed Linear Stage, 50 mm, 6 N

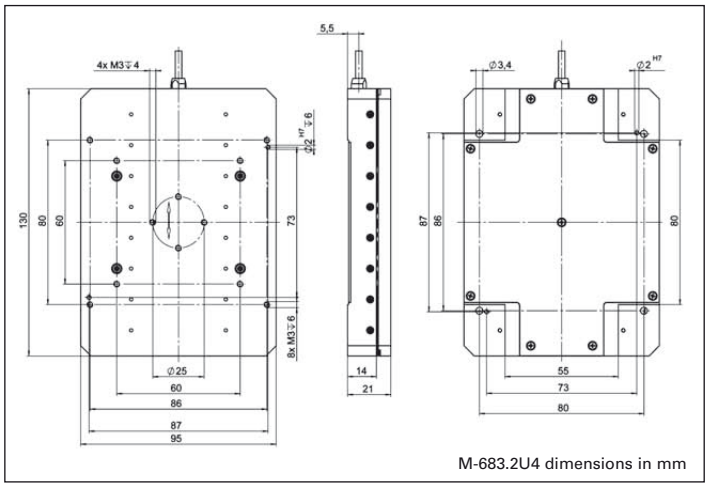
M-683.2V4
PILine® High-Speed Linear Stage, 50 mm, 6 N, Vacuum Compatible to 10^{-6} hPA

Accessories:

M-110.05
Adapter bracket for vertical mount of M-110 stages on M-683 stages

Patent Protection

The products described in this document are in part protected by the following patents:
US Pat. No. 6,765,335
German Patent No. 10154526



M-683.2U4 dimensions in mm

Technical Data

Model	M-683.2U4	Tolerance
Active axes	X	
Motion and positioning		
Travel range	50 mm	
Integrated sensor	Linear encoder	
Sensor resolution	0.1 µm	
Min. incremental motion	0.3 µm	typ.
Bidirectional repeatability	±1 µm	typ.
Unidirectional repeatability	0.2 µm	typ.
Pitch	±150 µrad	typ.
Yaw	±50 µrad	typ.
Max. velocity	350 mm/s	
Reference switch repeatability	1 µm	typ.
Mechanical properties		
Max. load capacity	50 N	
Max. push / pull force	6 N	
Max. holding force	6 N	
Drive properties		
Motor type	2 x U-164 PILine® ultrasonic piezo drive	
Operating Voltage	60 V_{rms}*	
Electrical power	15 W**	nominal
Power consumption	1.5 A**	
Reference Switch	optical	
Limit Switches	Hall-effect	
Miscellaneous		
Operating temperature range	0 to +50 °C	
Material	Al (black anodized)	
Dimensions	130 x 95 x 21 mm	
Mass	0.65 kg	±5 %
Cable length	1.5 m	±10 mm
Connector	MDR, 14-pin	
Recommended controller	C-867 PILine® controller incl. drive electronics	

*Power to the motor is supplied by the drive electronics, which runs on 12 V DC, or by the controller (24 V).
**For drive electronics
Data for vacuum version may differ. M-683.2V4: Delivery includes 1 m cable (vacuum), feedthrough an 1.5 m cable (air).

N-661 Miniature Linear Slide with NEXACT® Drive

- Travel Range 20 mm
- Self Locking at Rest, no Heat Generation, no Servo Dither
- Compact Design: 70 x 50 x 20 mm
- Zero-Wear Piezo Stepping Drive, Ideal for Micro- and Nano-Manipulation
- Integrated Linear Encoder Option for Highest Accuracy with 20 nm Resolution
- Two Operating Modes: Continuous Stepping Mode and Continuously Variable, High-Dynamics Analog Mode for 30 pm Resolution
- Up to 10 N Force Generation

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- Low Profile: Only 21 mm Height
- Compact XY Combination Possible
- Up to 6 N Force Generation
- Direct Metrology Linear Encoder, 0.1 µm Resolution
- Travel Range 50 mm
- Excellent Guiding Accuracy Through Crossed Roller Bearings
- PILine®: Non-Magnetic and Vacuum-Compatible Working Principle
- Self Locking at Rest

M-664 PILine® Linear Motor Stage

- Travel Range 25 mm
- Max. Velocity 400 mm/s
- Ultra-Low Profile, 15 mm
- Direct Metrology Linear Encoder with 0.1 µm Resolution
- High Guiding Accuracy with Crossed Roller Bearings
- Compact XY Combinations
- Piezo Linear Motor with 4 N Drive Force
- Self Locking at Rest

M-605.2DD high precision translation stage

- **Integrated 0.1 µm Linear Encoder for Highest Accuracy**
- **Travel Ranges 25 mm (1“) and 50 mm (2“)**
- **Max. Velocity 50 mm/s with ActiveDrive Motor**
- **High Load Capacity up to 30 kg**
- **Zero-Backlash Recirculating Ballscrews**
- **Non-contact Limit and Reference Switches**
- **Stress-Relieved Aluminum Base for Highest Stability**
- **Flexible Bellows Protects the Mechanics from Dust and Spray**
- **XY & XYZ Combinations Possible**
- **MTBF >20,000 h**

PILine® M-663 micropositioning stages with integrated linear encoder

- **Smallest Translation Stage with Closed-Loop Linear Motor and Encoder**
- **Travel Range 19 mm**
- **Max. Velocity 400 mm/s**
- **Acceleration up to 10 g**
- **Direct Metrology Linear Encoder**
- **0.1 µm Resolution**
- **XY Combination Possible**
- **Vacuum-Compatible Versions Available**

Reference-class translation stage with linear motor

N-664

- Travel range 30 mm
- Encoder resolution 0.5 nm
- Minimal incremental motion 2 nm
- Excellent guiding accuracy
- Max. velocity 10 mm/s

M-116.DG micro rotary stage

- Compact Design
- Continuous Rotation Range
- Encoder Resolution 2.5 µrad
- Clear Aperture
- Max. Velocity 20 degrees/second
- Preloaded Worm Drive for Zero Backlash
- Fits Directly on M-110 Micro Translation Stages
- Non-Contact Reference Switch
- Repeatability to ±10 µrad

M-060.PD, M-061.PD and M-062.PD

- Continuous Rotation Range
- Ultra-High Resolution
- Max. Velocity 90 deg/sec
- Preloaded Worm Drive for Zero Backlash
- ActiveDrive DC-Servo, Stepper-Motor and Manual Drives
- Direction-Sensing Reference Switch

M-660 PILine® Rotation Stage

- Unlimited Travel Range
- Max. Velocity 720 °/s
- Low Profile: Only 14 mm in Height
- Self-Locking Ceramic Direct Drive: Energy Saving & High Position Stability
- Direct Metrology Linear Encoder, up to 4 µrad Resolution
- PILine® Direct Drive: Non-Magnetic and Vacuum-Compatible Working Principle
- Compact Combinations with Linear Stages

M-112.2DG, M-111.2DG, M-110.2DG
25 mm, 15 mm and 5 mm travel range

- **Travel Ranges 5, 15 and 25 mm**
- **Very Cost Effective**
- **Min. Incremental Motion to 50 nm**
- **Max. Velocity 2 mm/s**
- **Closed-Loop DC Motors and Stepper Motors**
- **Non-Contact Limit and Reference Switches**
- **Optional Recirculating Ball Screw Drives Provide High Speeds & Long Lifetimes**
- **Vacuum-Compatible Versions Available to 10^{-6} hPa**

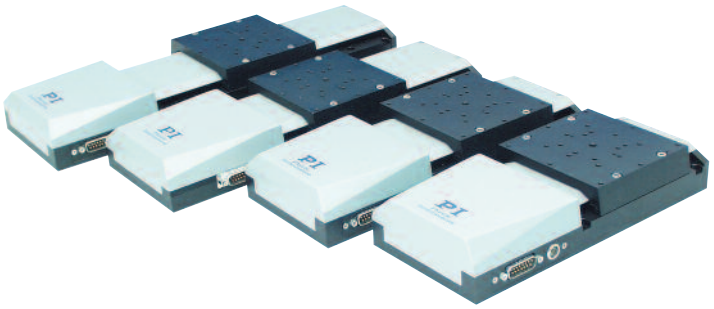
M-122 Precision Micro-Translation Stage

- **Travel Range 25 mm**
- **0.1 µm Optical Linear Encoder for Highest Accuracy & Repeatability**
- **Min. Incremental Motion to 0.2 µm**
- **Max. Velocity 20 mm/s**
- **Cross-Roll Bearings**
- **Recirculating Ball Screw Drives Provide High Speeds & Long Lifetimes**

M-126.CG1 translation stage with compact DC motor/gearhead

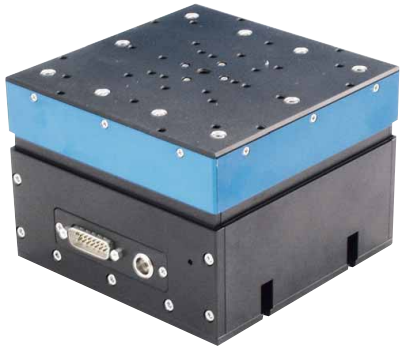
- **Min. Incremental Motion to 0.1 µm (3.5 nm Resolution)**
- **Repeatability to 0.1 µm**
- **Velocity to 50 mm/s**
- **Travel Ranges 20 and 25 mm**
- **Manual, DC-Servo and Stepper-Motor Drives**
- **ActiveDrive™ Option**
- **Crossed Roller Bearings**
- **Ballscrew and Leadscrew Versions**
- **XY and XYZ Combinations**
- **Direction-Sensing Reference Switch**
- **Variety of Cost-Effective Motion Controllers**

M-505 translation stages with ballscrew drives



- Travel Ranges to 150 mm (6")
- Velocity up to 50 mm/sec.
- ActiveDrive™ Motors
- Compatible with Leading Industrial Motion Controllers
- Stress-Relieved Aluminum Stage Base for Highest Stability
- Zero-Backlash Recirculating Ballscrews
- Non-Contact Direction-Sensing Origin Switch
- Non-Contact Limit Switches
- Load Capacity 100 kg
- >20,000 Hours MTBF

M-501.1PD vertical stage

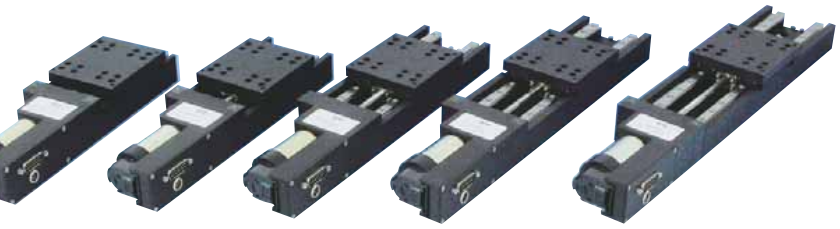


- Travel Range 12.5 mm (1/2")
- Ultra-High-Resolution Encoder
- ActiveDrive™ Motor
- Zero-Backlash Recirculating Ballscrews
- Non-Contact Limit and Reference Switches
- Stress-Relieved Aluminum Base for Highest Stability
- MTBF >20,000 h
- Self Locking to 10 kg

M-511.HD hybrid nanopostioner

- Simultaneous Control of
  Piezo-Flexure Drives & DC-Servo/Ballscrew Drives
- 100 mm Travel Range, 50 mm/sec Max. Velocity
- Reliable Execution of Nanometer Level Increments
- 2 nm Linear Encoder Resolution
- Millisecond Settling Time to Nanometer Precision
- Frictionless Piezo Drive and Flexure-Decoupled Ballscrew
- Active Compensation of Backlash and Stick/Slip Effects
- Excellent Velocity Control

M-403 linear stage versions (from left) M-403.1PD, M-403.2PD, M-403.4PD, M-403.6PD und M-403.8PD provide travel ranges from 25 to 200 mm



- For Cost-Sensitive Precision Positioning Applications
- Travel Ranges 25 to 200 mm
- Resolution to 0.012 µm
- Min. Incremental Motion to 0.1 µm
- Preloaded Precision Leadscrew or Recirculating Ball Screw Drives Provide High Speeds & Long Lifetimes
- Stress-Relieved Aluminum Base for Highest Stability
- Vacuum-Compatible Versions Available
- M-413 and M-414 Versions for Higher Load Requirements

M-405.DG, M-410.DG and M-415.PD high-precision translation stages

- Travel Ranges up to 150 mm
- Stress-Relieved Aluminum Base for Highest Stability
- Crossed Roller Bearings
- Manual, DC-Servo and Stepper-Motor Drives
- Knob for Convenient Manual Position Adjustment
- Direction-Sensing Reference Switch

M-531.DD, M-521.DD, M-511.DD and M-505.2DG heavy duty translation stages with recirculating ballscrew drive (bottom to top)

- 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