

Ultrasonic Ceramic Linear Actuators & Motors

Self Locking, Ultra Stable, High Force, Compact

COMPACT



PRECISE



HIGH FORCE



High-Speed Ultrasonic Actuators - Working Principle

PILine® Ultrasonic Piezomotors

PILine® linear piezomotors are based on a novel, patented ultrasonic drive developed by PI. Ultrasonic oscillations of a piezoceramic actuator are transferred to linear motion along a friction bar, which is attached to the moving part of a mechanical setup.

At the heart of the system is a monolithic piezoceramic plate, segmented by two electrodes. Depending on the desired direction of motion, the left or right electrode of the piezoceramic plate is excited to produce high-frequency eigenmode oscillations at tens to hundreds of kilohertz. An alumina friction tip (pusher) attached to the plate moves along an inclined linear path at the eigenmode frequency.

The pusher is preloaded against the friction bar which is attached to the slider, turntable, etc. Through its oscillations, it provides micro-impulses that drive the moving part forward or backwards.

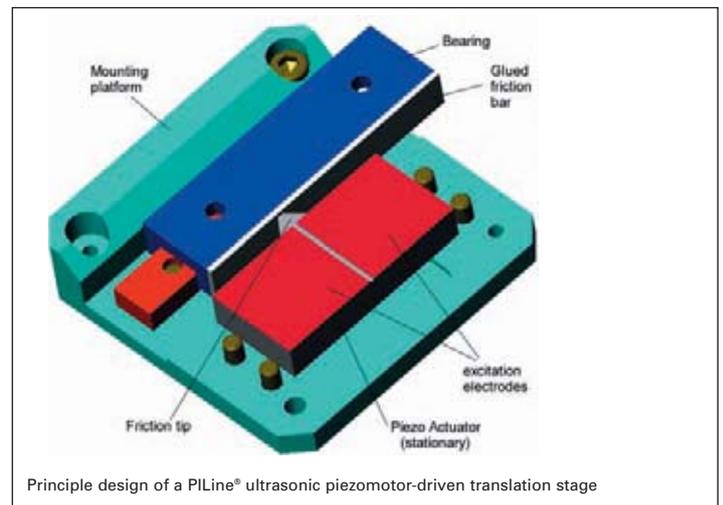
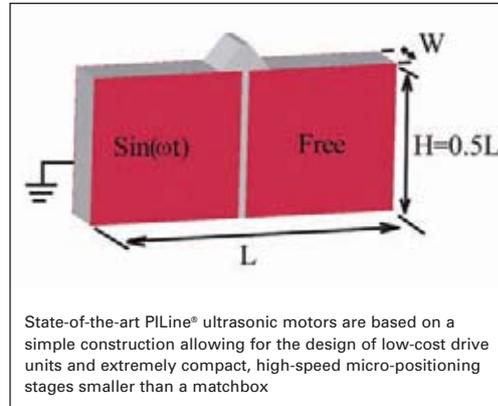
With each oscillatory cycle, the mechanics executes a step of a few nanometers; the macroscopic result is smooth motion with a virtually unlimited travel range. State-of-the-art ultrasonic motors can produce accelerations to 5 g and velocities to 500 mm/s.

Ultrasonic motors cannot provide the unlimited resolution of linear piezo actuators and flexure-guided piezo positioning stages. These motors transfer motion through friction, which is why their repeatability is limited to about 50 nm. Much higher resolution and holding forces can be achieved with PiezoWalk® piezomotors / drives (see p. 1-3 ff).

PILine® Levels of Integration

PILine® ultrasonic drive products are offered in three different levels of integration. The drive electronics and controller can be chosen accordingly.

- P-661 and P-664 OEM motors require the greatest amount of care at the customer's site. Motor and friction bar – the length depends on the desired travel range – have to be integrated into a mechanical setup. Operation requires preload of the motor against the friction bar, guiding and, if necessary, the servo-loop.
- M-674 RodDrives can replace classical drive elements like rotary motor / leadscrew assemblies, or magnetic linear drives integrated into a micropositioner or handling device. Integration requires guiding and – if necessary – the servo-loop.



- Linear positioning stages represent the highest level of manufacturer integration. The piezomotor is integrated completely in a high-quality mechanical setup including the servo-loop with direct-metrology linear encoders.



PILine® levels of integration: OEM motor, RodDrive, linear positioning stage

PILine® Ultrasonic Piezomotors

Features and Advantages of PILine® Ultrasonic Piezomotors

- **Compact Size:** the direct-drive principle allows the design of ultra-compact translation stages. The M-662, for example, provides 20 mm travel in a 28 x 28 x 8 mm package.
- **Low Inertia, High Acceleration, Speed and Resolution:** PILine® drives achieve velocities to 500 mm/s and accelerations to 5 g. They are also very stiff, a prerequisite for their fast step-and-settle times – on the order of a few milliseconds – and provide resolution to 10 nm. The lack
- of a leadscrew means no lubricant flow or material relaxation to cause submicron creep. There is also no rotational inertia to limit acceleration and deceleration.
- **Excellent Power-to-Weight Ratio:** PILine® drives are optimized for high performance in a minimum package. No comparable drive can offer the same combination of acceleration, speed and precision.
- **Safe:** The minimum inertia of the moving platform together with the “slip clutch” effect of the drive provide

better protection of precision fixtures / devices than lead-screw-driven stages. Despite the high speeds and accelerations, there is a much lower risk of pinching fingers or other injuries than with conventional drives. This means users may not need interlocks, light curtains or other measures to keep them safe.

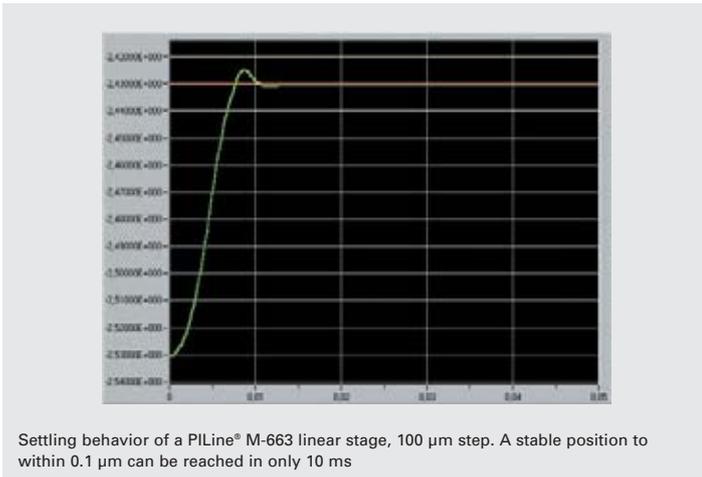
- **Self-Locking Feature:** PILine® drives create a braking force when not energized without the position shift common with conventional mechanical brakes. Other benefits of the self-locking are the elimination of servo dither and steady-state heat dissipation.

Vacuum Compatibility: Vacuum compatible versions of PILine® drives are available.

Negligible EMI: PILine® drives do not create magnetic fields nor are they influenced by them, a decisive advantage in many applications.

- **Custom Solutions / Flexibility for OEMs:** PILine® drives are available in open-loop and closed-loop translation stages and as OEM components. PI develops and manufactures all piezo ceramic components in-house. This gives us the flexibility to provide custom motors (size, force, environmental conditions) for OEM and research applications.

- **Quality, Lifetime, Experience:** Based on PI's 4 decades of experience with piezo nanopositioning technology, PILine® drives offer exceptional precision and reliability with an MTBF of >20,000 hours. Rotating components such as gears, shafts and moving cables that are prone to failure in conventional motion systems, are not part of the PILine® design.



Custom high-force ultrasonic piezo motor



M-272 Linear Actuator / Shaft Motor with Ultrasonic Drive

Fast and Self-Locking with PLine® Piezomotors



Cost-effective combination:
M-272 closed-loop linear pusher and C-867.OE controller card

- Force Generation up to 8 N
- Self Locking at Rest
- Velocity up to 200 mm/s
- 5 μm Encoder Resolution
- Linear Guiding

PLine® piezoceramic ultrasonic drives offer an affordable alternative to motor-leadscrew combinations and electromagnetic linear motors when small dimensions and/or high speed are important. With velocities of up to 200 mm/s, these drives are fast, compact, and are readily integrated. In addition,

PLine® motors are self-locking when at rest with zero heat generation, and doing away with the need for an additional motor brake.

The novel M-272 closed-loop linear drive combines motor, actuator, linear encoder, guiding system and brake functionality in a very compact package. Due to the integrated guiding system a payload can be easily attached to the drive rod of the M-272 drive. The drive can also function as a drop-in-replacement for motor-leadscrew drives facilitating assembly and reducing the number of components significantly. Due to the integrated linear encoder, positioning can be done precisely and repeatably.

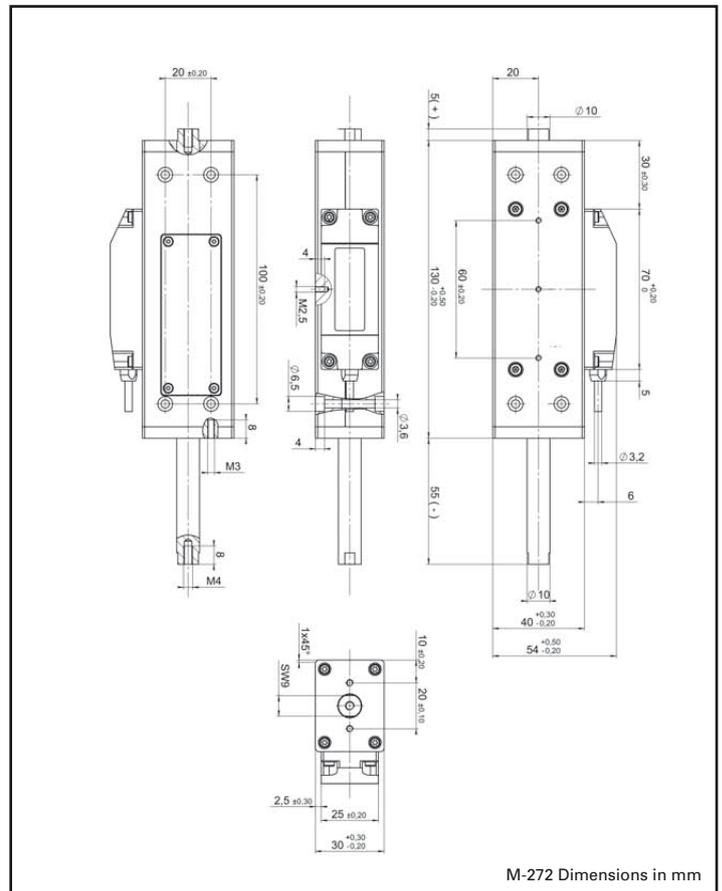
Self-locking Instead of Quiescent Current

PLine® piezo motors are based on a new, patented, ultrasonic drive principle developed by PI. The core piece of the system is a piezoceramic plate, which is excited with high-frequency eigenmode oscillations. A friction tip attached to the plate moves along an inclined linear path at the eigenmode frequency. Through its contact with the friction bar, the moving part of the mechanics drives forward or backwards. With each oscillatory cycle, the mechanics executes a step of a few nanometers; the macroscopic result is smooth motion with a virtually unlimited travel range. The ceramic plate is preloaded against the runner and thus ge-

Ordering Information

M-272
PLine® Linear Actuator with Ultrasonic Motor and Linear Encoder, 50 mm, 8 N

nerates the holding force when the drive is at rest. The products described in this document are in part protected by the following patents:
US Pat. No. 6,765,335
German Patent No. 10154526



Application Examples

- Automation
- Handling
- Micromanipulation
- Metrology

Technical Data (Preliminary Data)

Model	M-272	Tolerance
Active axes	X	
Motion and positioning		
Travel range	50 mm	
Integrated sensor	Linearencoder	
Sensor resolution	5 µm	
Design resolution	5 µm	typ.
Min. incremental motion	10 µm	typ.
Backlash	5 µm	typ.
Unidirectional repeatability	10 µm	typ.
Velocity	200 mm/s	max.
Mechanical properties		
Guiding	Ball bearings	
Push/pull force	8 N	max.
Holding force	8 N	max.
Lateral force	5 N	max.
Drive properties		
Motor type	U-164 PLine® ultrasonic piezomotor	
Current	800 mA	
Reference switch	Hall-effect	
Miscellaneous		
Operating temperature range	-20 to +50 °C	
Material	Aluminum	
Dimensions		
Mass	0.5 kg	± 5%
Cable length	0.5 m	± 10 mm
Connector	MDR, 14-pin	

Recommended controller/driver: C-867.OE

* Power for the motor is supplied by the drive electronics, which requires 12 VDC.

** For drive electronics

RodDrive Ultrasonic Piezo Linear Actuator



Ordering Information

**PILine® RodDrive
Piezo Linear Drive**

For more information, contact us!

vide velocities of up to 0.5 m/s together with high resolution. The ceramic motors are pre-loaded against the rod, thus providing a holding force at rest. The result is a very high position stability, without the heat dissipation common with conventional linear motors. There are no gears, leadscrews or other mechanical components to contribute play or backlash.

- Drive Component for Integration
- Travel Ranges up to 150 mm
- Forces up to 10 N
- Min. Incremental Motion to 50 Nm
- Velocity up to 0.5 m/s
- Self Locking at Rest

Optimized Drive Electronics

PILine® piezo motors require a special drive electronics to generate the ultrasonic oscillations for piezo ceramic elements. The drive electronics is available as low-priced OEM board, stand-alone device or integrated inside a controller and therefore not included in the delivery.

Patented Technology

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

RodDrives may replace classic drive elements like motor / lead-screw assemblies or magnetic linear drives, whereby the ultrasonic piezo linear motors reach significantly higher velocities. They consist of a rod which is preloaded by PILine® piezo linear motors from two sides. Depending on the way of integration, either the rod or the motor block is coupled to the moving platform.

Variable Travel Ranges and Forces

The maximum travel range of the RodDrive is determined by the length of the rod and is basically unlimited. Customized adaptations in terms of operating and holding forces are feasible by varying type and number of the motors used.

RodDrives represent a level of integration between PILine® OEM piezo linear motors such as the U-164 and guided micropositioning systems such as the M-683-series stages (s. p. 4-32).

Advantages of PILine® Micro Positioning Systems

RodDrives employ a patented ultrasonic drive developed by PI. The highly compact, integrated piezo motors can pro-

Application Examples

- System integration for micropositioning products
- Automation
- Handling
- Micromanipulation
- Biotechnology
- Metrology



The M-674 integrated into a micropositioning stage

P-661 PLine® Ultrasonic Piezo Linear Drive

Fast, Compact OEM Ultrasonic Linear Motor



PLine® P-661 OEM piezo linear motor

- Patented Principle Features with High Forces in Small Space
- Max. Velocity 500 mm/s
- Acceleration to 5 g
- Min. Incremental Motion to 0.05 µm
- Self-Locking to 1.5 N
- No Electro-Magnetic Fields
- MTBF 20,000 h
- Integrated Actuators & Positioning Systems Also Available

PLine® Linear Motors – Small, Fast, Highly Effective

Despite their small size, PLine® linear motors generate high driving and holding forces.

PLine® motors have a new, patented, ultrasonic drive developed by PI. The core piece of the system is a piezoceramic plate, which is excited to produce high-frequency eigenmode oscillations. A friction tip attached to the plate moves along an inclined linear path at the eigenmode frequency. Through its contact with the friction bar, the moving part of the mechanics drives forward or backwards. With each oscillatory cycle, the mechanics executes a step of a few nanometers; the macroscopic result is smooth motion with a virtually unlimited travel range.

High Speed and Acceleration

PLine® piezomotor drives can provide accelerations of up to 5 g and speeds of up to 500 mm/s, together with high resolution and high holding

force. Because the ceramic stator is pressed against the slider, holding forces are generated when the motor is powered down. The result is very high position stability without the heat dissipation common in conventional linear motors.

Accessories for Easy Integration

PLine® piezomotors require a special drive electronics to generate the ultrasonic oscillations for the piezoceramic element. The drive electronics is available as OEM board, stand-alone device or integrated controller and therefore not included in the delivery. PI offers friction bars with different lengths.

Long Lifetime

PI has over 30 years experience with piezo technology and nanopositioning. PLine® drives offer high precision and reliability, with over 20,000 hours MTBF. This is because PLine® piezo linear motor drives have no mechanical components such as shafts and gears which can cause failures in conventional motors.

Ordering Information

P-661.P01

PLine® Miniature Linear Piezomotor, 2 N

Accessories:

P-661.B01

Friction Bar for P-661 PLine® Miniature Linear Piezomotor, 15 mm

P-661.B02

Friction Bar for P-661 PLine® Miniature Linear Piezomotor, 25 mm

P-661.B05

Friction Bar for P-661 PLine® Miniature Linear Piezomotor, 55 mm

C-184.161

Analog OEM Driver Board for PLine® P-661 Motors

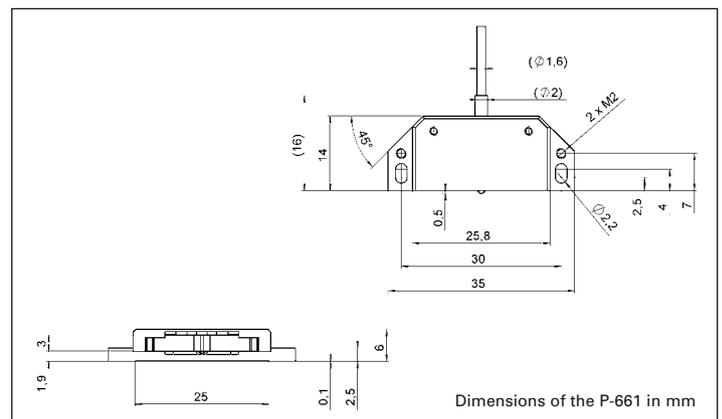
C-185.161

Analog Stand-Alone Drive Electronics with Power Supply for PLine® P-661 Motors

Controller for closed-loop operation are available as C-867 s. p. 4-116.

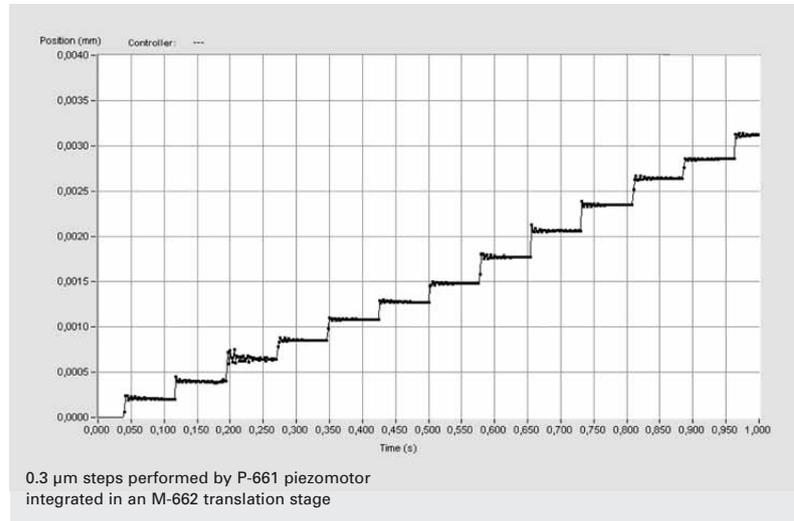
Application Examples

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



Note

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



Technical Data

Model	P-661.P01	Units	Tolerance
Motion and positioning			
Travel range	No limit*	mm	
Minimum incremental motion, open-loop	0.05**	μm	typ.
Max. velocity	500	mm/s ²	
Mechanical properties			
Stiffness when powered down	0.7	N/μm	±10%
Holding force when powered down	1.5	N	max.
Push / pull force	2	N	max.
Preload on friction bar	9	N	±10%
Drive properties			
Resonant frequency	210	kHz	typ.
Motor voltage range	120 (peak-peak) 42 (RMS)	V	
Operating voltage drive electronics	12	V	
Electrical power drive electronics	5	W	
Miscellaneous			
Operating temperature range	-20 to +50	°C	
Body material	Al (black anodized)		
Mass	0.01	kg	±5%
Cable length	1.6	m	±10 mm
Connector	Open leads		
Recommended controller/driver	C-184.161 OEM board C-185.161 in box		
Dimensions	14 x 35 x 6	mm	
MTBF	>20,000	h	

* The travel range of piezo linear motors is virtually unlimited and depends on the length of the friction bar, which is available separately.

** The minimum incremental motion is a typical value that can be achieved in the open-loop mode of a piezomotor stage. To reach the specs it is important to follow the mounting guidelines of the OEM-motors.

Miniature Ultrasonic Motorized Linear Positioning Stage

With Ultrasonic Piezo Linear Drives



PILine® M-662 (left side) and M-661 stages are the smallest piezo-motor-driven translation stages available on the market that achieve speeds of up to 500 mm/s

- **Smallest Translation Stages with Linear Motor Drive**
- **Travel Ranges to 20 mm**
- **Max. Velocity 500 mm/s**
- **Acceleration to 5 g**
- **Incremental Motion to 50 nm**
- **Self Locking at Rest**
- **XY-Combination Possible**
- **MTBF 20.000 h**
- **Vacuum Versions to 10⁻⁷ hPa**

M-661 and M-662 PILINE® translation stages offer accelerations to 5 g with millisecond response and velocities to 500 mm/sec in an extremely compact package. Providing travel ranges to 20 mm, they

are among the smallest motorized translation stages currently on the market. Both models are designed for open-loop operation (a similar closed-loop stage with linear encoder is available as model M-663). The M-662, with its square footprint, is also suitable for use in XY configurations. For applications where the smallest dimensions are essential, the P-652 micro stage is offered.

Working Principle

PILine® piezo motors use a new, patented, ultrasonic drive developed by PI. At the heart of the system is a piezo ceramic plate, which is excited with high-frequency eigenmode oscillations. A friction tip attached to the plate moves

along an inclined linear path at the eigenmode frequency. Through its contact with the friction bar, the moving part of the mechanics drives forward or backwards. With each oscillatory cycle, the mechanics execute a step of a few nanometers; the macroscopic result is smooth motion with a virtually unlimited travel range.

Advantages of PILINE® Micropositioning Systems

The ultrasonic piezoceramic drives used in PILINE® micropositioners have a number of advantages over classical drives:

- Higher Accelerations, 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
- Non-Magnetic and Vacuum-Compatible Drive Principle

Choice of Drive Electronics

Special driver electronics are required to create the ultrasonic oscillations for PILINE® piezo-

Ordering Information

M-661.370
PILINE® Translation Stage, 18 mm, Open-Loop

M-662.470
PILINE® Translation Stage, 20 mm, Open-Loop, XY Mountable

Accessories:

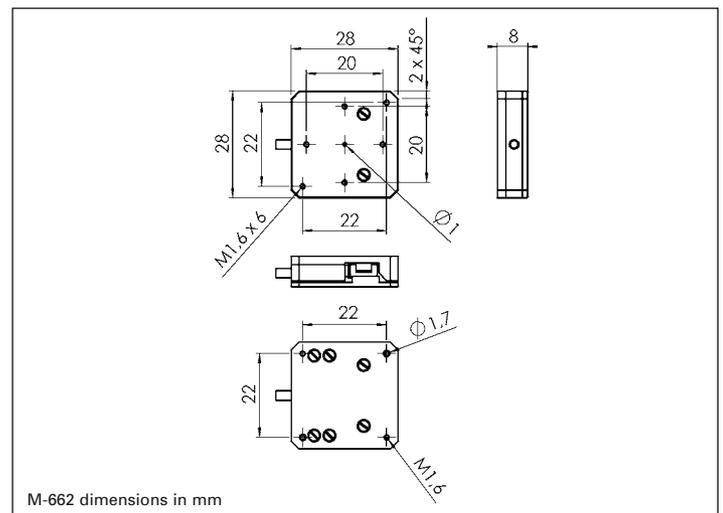
C-184.161
Analog OEM Driver Board for PILINE® P-661 Motors

C-185.161
Analog Stand-Alone Drive Electronics with Power Supply for PILINE® P-661 Motors

motors. The driver controls the motor speed as a function of an analog ± 10 V signal. The driver is not included, as it is available in different versions, from the low-priced C-184.161 OEM-board to the C-185.161 bench-top unit. The stage and the driver electronics, however, must be ordered together, so that they can be tuned to one-another for optimum performance.

Notes

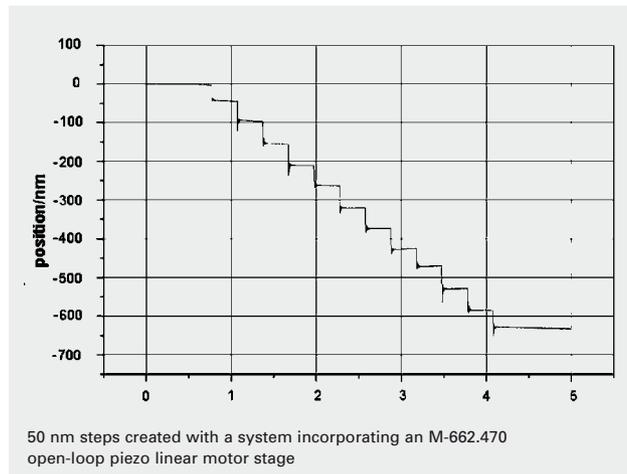
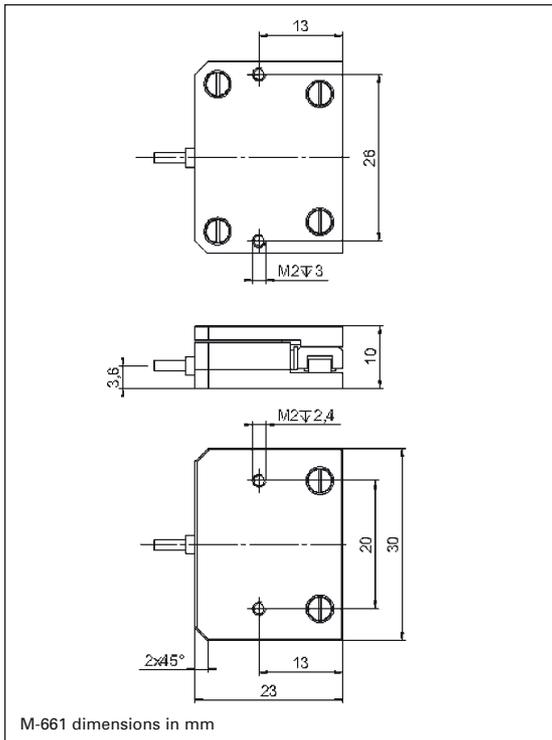
The products described in this document are in part protected by the following patents: US Pat. No. 6,765,335
German Patent No. 10154526



M-662 dimensions in mm

Application Examples

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



Technical Data

Model	M-661.370	M-662.470	Units	Tolerance
Motion and positioning				
Travel range	18	20	mm	
Min. incremental motion	0.05*	0.05*	µm	typ.
Max. velocity	500	500	mm/s	
Mechanical properties				
Max. load	5	5	N	
Max. push/pull force	1	1	N	
Max. holding force	2	2	N	
Drive properties				
Motor type	P-661 PLine® ultrasonic piezomotor drive	P-661 PLine® ultrasonic piezomotor drive		
Operating voltage	120 (Peak-Peak)**	120 (Peak-Peak)**	V	
Electrical power	42 (RMS)**	42 (RMS)**	W	nominal
Current	400***	400***	mA	
Miscellaneous				
Operating temperature range	-20 to +50	-20 to +50	°C	
Material	Al (black anodized)	Al (black anodized)		
Dimensions	30 x 23 x 10	28 x 28 x 8		
Mass	0.03	0.03	kg	±5%
Cable length	1.5	1.5	m	±10 mm
Connector	LEMO connector	LEMO connector		
Recommended controller/driver	C-184.161 OEM board C-185.161 Bench-top	C-184.161 OEM board C-185.161 Bench-top (p. 1-36)		

*The minimum incremental motion is a typical value that can be achieved in the open-loop mode of a piezomotor stage.

To obtain it, it is important to follow the mounting guidelines in the motor documentation.

**The stage supply power is drawn from the drive electronics, which runs on 12 VDC.

***For drive electronics.

M-663 Closed-Loop Ultrasonic Linear Motor-Driven Stage

Compact, Fast, with Ultrasonic Piezo Linear Drives, Direct Position Measurement



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**

PILine® M-663 micropositioning systems offer high velocities of up to 400 mm/s and travel ranges of 19 mm in a compact package. The M-663 is the smallest closed-loop trans-

lation stage with piezomotor drives currently on the market. Its square footprint makes it suitable for use in compact XY configurations.

Application Examples

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

Working Principle

PILine® motors have a new, patented, ultrasonic drive developed by PI. The core piece of the system is a piezoceramic plate, which is excited to produce high-frequency eigenmode oscillations. A friction tip attached to the plate moves along an inclined linear path at the eigenmode frequency. Through its contact with the friction bar, the moving part of the mechanics drives forward or backwards.

With each oscillatory cycle, the mechanics executes a step of a few nanometers; the macroscopic result is smooth motion with a virtually unlimited travel range.

Advantages of PILine® Micropositioning Systems

The ultrasonic piezoceramic drives used in PILine® micropositioners have a number of advantages over classical drives:

- Higher Accelerations, 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
- Non-Magnetic and Vacuum-Compatible Drive Principle

Optimized Controller and Drive Electronics

PILine® motors require a special drive electronics to generate the ultrasonic oscillations for piezoceramic element. For optimum performance the highly specialized C-867 (see p. 4-116) motion controller is recommended. This sophisticated controller also integrates the drive electronics. Furthermore, the controller has a number of special features, including dynamic parameter switching for an optimized high-speed motion and settling behavior to take into account the motion characteristics typical of piezomotors. 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) is available. It controls the motor speed by an analog ±10 V signal. For

Ordering Information

- M-663.465**
PILine® Translation Stage, 19 mm, Linear Encoder, 0.1 μm Resolution
- M-663.Y65**
PILine® Translation Stage, 19 mm, Linear Encoder, 0.1 μm Resolution, turned cable outlet, XY mountable
- M-663.46V**
PILine® Translation Stage, 19 mm, Linear Encoder, 0.1 μm Resolution, Vacuum Compatible to 10⁻⁶ hPa

Accessories:

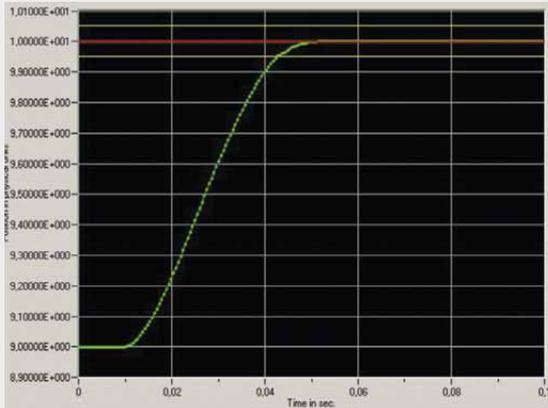
- C-867.161**
Piezomotor Controller with Drive Electronics, 1 Channel, for PILine® Systems with P-661 Motors

Driver for use with separate controller:
- C-185.161**
Analog Stand-Alone Drive Electronics with Power Supply for PILine® P-661 Motors

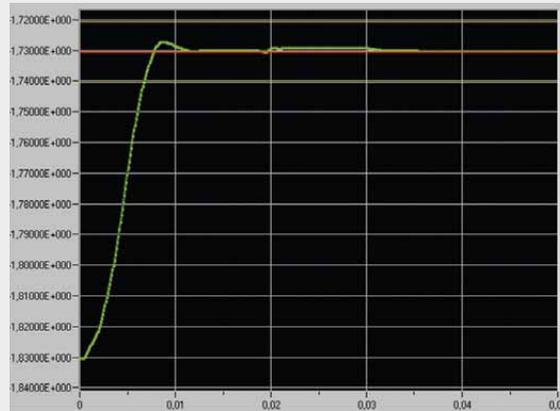
optimum performance the driver must be tuned together with the mechanics and should be ordered at the same time as the motor/stage.

Note

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German Patent No. 10154526



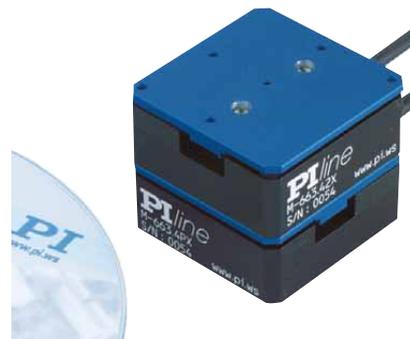
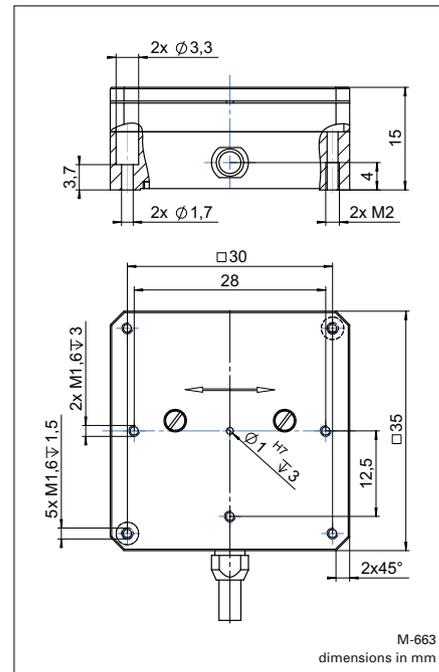
A 1 mm step performed by an M-663 stage with 300 g load controlled by a C-867 controller/driver reaches the end position in less than 40 ms



An M-663 with 100 g load settles to 0.1 µm accuracy in 10 ms after a 100 µm step, measured with C-867 controller/driver

Technical Data

Model	M-663.465	Units	Tolerance
Active axes	X		
Motion and positioning			
Travel range	19	mm	
Integrated sensor	Linear encoder		
Sensor resolution	0.1	µm	
Min. incremental motion	0.3	µm	typ.
Bidirectional repeatability	±0.3	µm	typ.
Unidirectional repeatability	0.2	µm	typ.
Pitch	300	µrad	typ.
Yaw	300	µrad	typ.
Max. velocity	400	mm/s	
Reference switch repeatability	1	µm	typ.
Mechanical properties			
Max. load	5	N	
Max. push/pull force	2	N	
Max. holding force	2	N	
Drive properties			
Motor type	P-661 PiLine® ultrasonic piezomotor		
Motor voltage range	120 (peak-peak)* 42 (RMS)*	V	
Electrical power	5**	W	nominal
Current	400**	mA	
Reference switch	Hall-effect		
Miscellaneous			
Operating temperature range	-20 to +50	°C	
Material	Al (black anodized)		
Dimensions	35 x 35 x 15	mm	
Mass	40	g	±5 %
Cable length	1.5	m	±10 mm
Connector	MDR, 14-pin		
Recommended controller/driver	C-867.161 Single-axis controller/driver (p. 4-116) C-185.161 Drive electronics (p. 1-36)		



XY combination of two M-663s; CD for size comparison

*Power is supplied by the drive electronics which runs on 12 V DC

**For drive electronics

M-664 Closed-Loop Ultrasonic Linear Motor-Driven Stage Low-Profile High-Speed with Ultrasonic Piezo Linear Drives & Direct Position Measurement



Fast and compact M-664 piezo translation stage with linear encoder

- 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-664 micropositioning systems are low-profile, high-accuracy translation stages with linear encoders. The M-664 stage is next-larger in the series of piezomotor-driven stages of which the M-663 (see p. 4-28) is the smallest. For

improved guiding accuracy, the M-664 uses two crossed roller bearings mounted on ground aluminum profiles. The integrated P-664 PLine[®] linear motor can generate forces up to 4 N and maximum closed-loop velocities to 400 mm/s over a 25 mm travel range.

Application Examples

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

Advantages of PLine[®] Micro-positioning Systems

The ultrasonic piezoceramic drives used in PLine[®] micro-positioners have a number of advantages over classical drives:

- Higher Accelerations, 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

- Non-Magnetic and Vacuum-Compatible Drive Principle

Optimized Controller and Drive Electronics

PLine[®] motors require a special drive electronics to generate the ultrasonic oscillations for the piezoceramic element. For optimum performance the highly specialized C-867 motion controller (see p. 4-116) is recommended. This sophisticated controller also integrates the drive electronics. Furthermore, the controller has a number of special features, including dynamic parameter switching for an optimized high-speed motion and settling behavior to take into account the motion characteristics typical of piezomotors. The broad-band encoder input (50 MHz) supports the outstanding high accelerations and velocities of PLine[®] drives at high resolutions.

Ordering Information

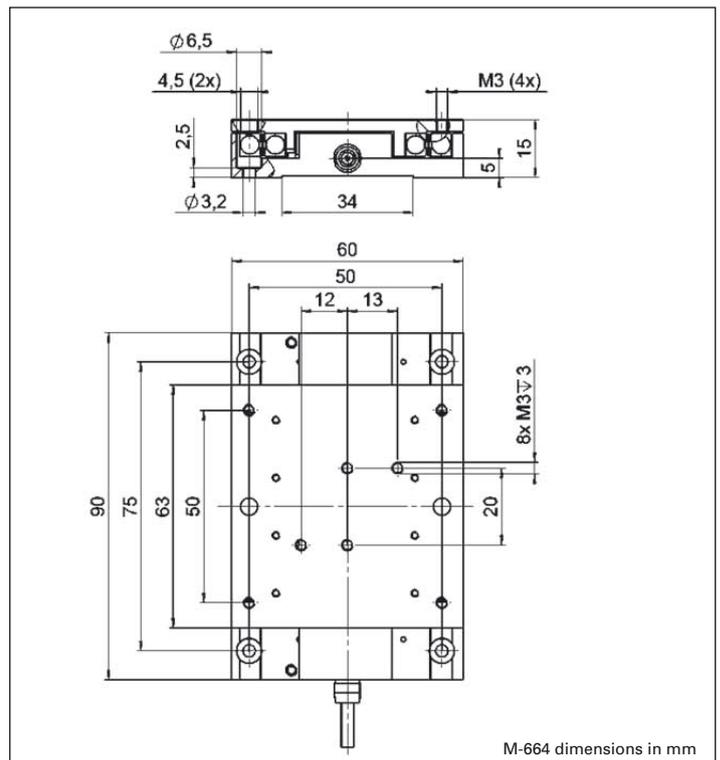
- M-664.164**
PLine[®] Micro Positioning Stage with P-664 Piezo Linear Motor, 25 mm, 4 N
- M-664.AP1**
Adapter plate for XY-mounting of M-664, 4 mm high

Ask about custom designs!

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

Notes

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-664 dimensions in mm



PILine® Micropositioning stages: M-682, M-664 and M-663 (from left)

Technical Data

Model	M-664.164	Tolerance
Active axes	X	
Motion and positioning		
Travel range	25 mm	
Integrated sensor	Linear encoder	
Sensor resolution	0.1 μm	
Min. incremental motion	0.3 μm	typ.
Bidirectional repeatability	0.2 μm	typ.
Unidirectional repeatability	0.2 μm	typ.
Pitch	$\pm 50 \mu\text{rad}$	typ.
Yaw	$\pm 50 \mu\text{rad}$	typ.
Max. velocity	400 mm/s	
Reference switch repeatability	1 μm	typ.
Mechanical properties		
Max. load	25 N	
Max. push/pull force	4 N	
Max. holding force	3 N	
Drive properties		
Motor type	P-664 PILine® ultrasonic piezo drive	
Operating voltage	168 V (peak-to-peak) * 60 V (RMS) *	
Electrical power	10 W **	nominal
Current	800 mA **	
Limit and reference switches	Hall-effect	
Miscellaneous		
Operating temperature range	-20 to +50 °C	
Material	Al (black anodized)	
Dimensions	90 x 60 x 15 mm	
Mass	0.190 kg	$\pm 5\%$
Cable length	1.5 m	$\pm 10 \text{ mm}$
Connector	MDR, 14-pin	
Recommended controller/driver	C-867.164 single-axis controller/driver C-185.164 drive electronics	

*The stage supply power is drawn from the drive electronics, which runs on 12 V.

**For drive electronics

Program Overview

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