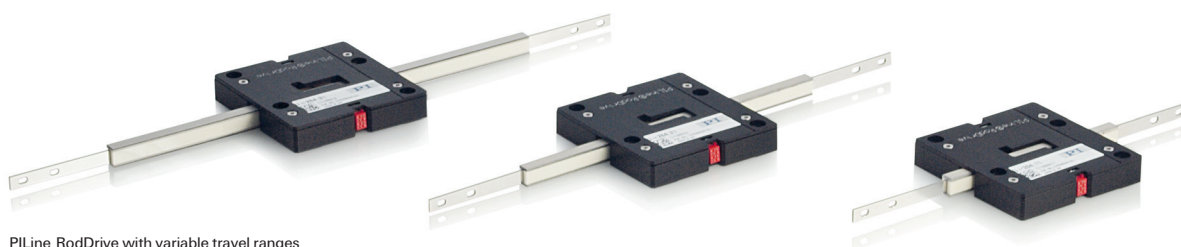


RodDrive Piezomotor Direct Drive

LOW PROFILE, HIGH SPEED, EASY INTEGRATION



PILine RodDrive with variable travel ranges

- Velocity up to 250 mm/s
- Travel ranges up to 150 mm
- Linear drive for integration
- Generated force up to 15 N

Fast OEM linear drive

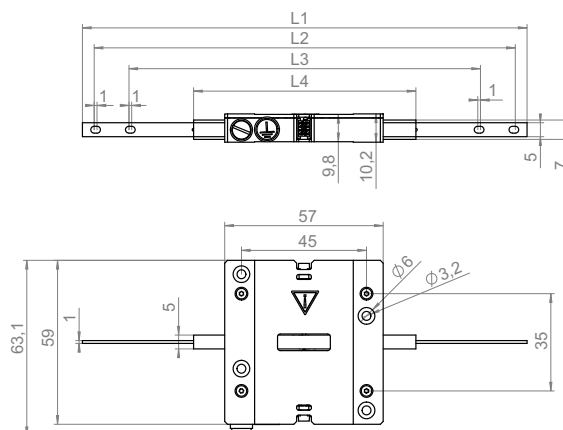
For integration into guided systems

RodDrive direct drive with integrated and preloaded PILine ultrasonic piezo drives

Self-locking, no heat generation at rest. Excellent start/stop dynamics. Easy integration by coupling the rod to a guided payload (e.g. a linear slide)

Application fields

OEM drives for automation. For handling and high-precision positioning systems



	U-264.10/11	U-264.20/21	U-264.30/31
L1	160.0	210.0	260.0
L2	151.5	201.5	251.5
L3	126.5	176.5	226.5
L4	80.0	130.0	180.0

U-264, dimensions in mm

Related Products

M-272 Linear Drive for Automation

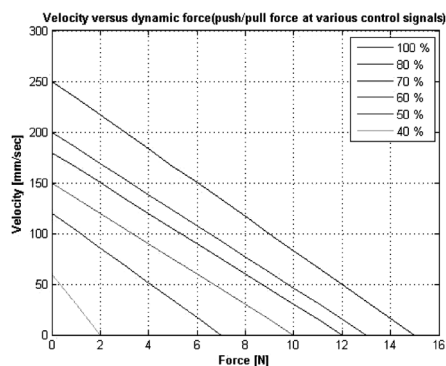
N-310 NEXACT OEM Miniature Linear Motor / Actuator

C-872 Driver for PILine® Ultrasonic Piezomotors

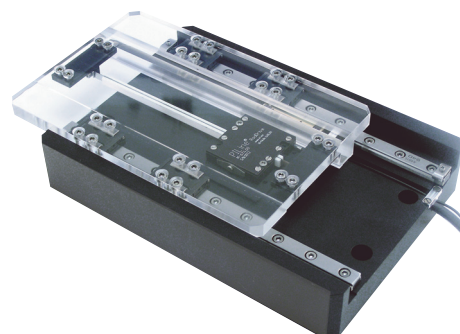
	U-264.10/20/30	U-264.11/21/31	Units	Tolerance
Motion and positioning				
Travel range	50 / 100 / 150	50 / 100 / 150	mm	
Open-loop step size	0.1*	2*	μm	typ.
Open-loop velocity	250	200	mm/sec	max.
Mechanical properties				
Stiffness when powered down	1.5	1.5	N/μm	±10 %
Holding force when powered down	8	15	N	max.
Push/pull force	7 (at 50 mm/s) 2 (at 250 mm/s)	12 (at 50 mm/s) 3 (at 200 mm/s)	N	max.
Drive properties				
Resonant frequency	158	159	kHz	±2 kHz
Motor voltage	200 V _{pp} 65 V _{rms}	200 V _{pp} 65 V _{rms}		
Input impedance	40 to 80**	50 to 100**	Ω	
Miscellaneous				
Operating temperature range	0 to 40	0 to 40	°C	
Material case	Al (black anodized)	Al (black anodized)		
Mass	0.08 / 0.09 / 0.1	0.08 / 0.09 / 0.1	kg	±5 %
Connector	D-Sub 15 (m)	D-Sub 15 (m)		
Recommended controller/driver	C-872.160 driver, C-867 motion controller/driver	C-872.160 driver, C-867 motion controller/driver		
Dimensions	57 x 63 x 10.2 plus rod	57 x 63 x 10.2 plus rod	mm	

* pulsed operation, 1 msec ON time, 50 % duty cycle

** at resonant frequency



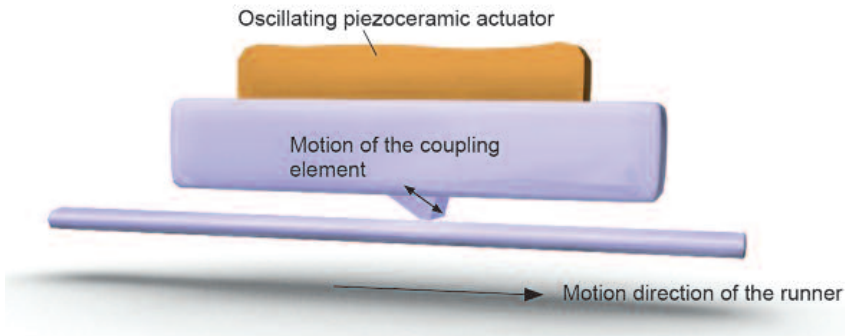
U-264.11/21/31, velocity (open-loop) vs. dynamic force (push/pull force) at various drive signal amplitudes



RodDrive integrated in a micro stage

PILine® Ultrasonic Piezo Motors

COMPACT DRIVES, FAST AND SELF-LOCKING



The piezoceramic actuator is excited with a high frequency electric signal (100 to 200 kHz). The deformation of the actuator leads to a periodic diagonal motion of the coupling element to the runner. The created feed is roughly 10 nm per cycle; the high frequencies lead to the high velocities

- Integration levels from economical OEM motors to multi-axis positioning systems
- Excellent dynamic properties, fast step & settle
- Basically unlimited travel ranges
- Easy mechanical integration
- Self-locking at rest
- Holding force up to 15 N
- Velocity up to 500 mm/sec
- Resolution to 0.05 μm (50 nm)

Direct-driven PILine® linear motors

These linear drives dispense with the mechanical complexity of classical rotary motor/gear/leadscrew combinations. These components can be very susceptible to wear, especially in miniaturized systems.

The simplicity of the ultrasonic linear motor promotes its precision, reliability and cost efficiency. An integral part of the ultrasonic piezo motor is a piezo ceramic that is preloaded against a moving runner with a coupling

element. The piezo element is electrically excited to produce high-frequency oscillations that cause the runner to move.

Piezo motors are self-locking

The preload of the piezoceramic actuator against the runner ensures that the drive self-locks at rest and when powered down. As a result, it does not consume any power, it does not heat up and keeps the position stable mechanically. Applications with a short duty cycle, that are battery-operated or heat-sensitive benefit from these characteristics.

Lifetime and reliability

The motion of the piezoceramic actuator is based on crystalline effects and is not subject to any wear. The coupling to the runner, on the other hand, is subject to friction effects. Depending on the operating mode, running distances over 2000 km or a MTBF of 20000 hours are achieved.

Dynamics in use

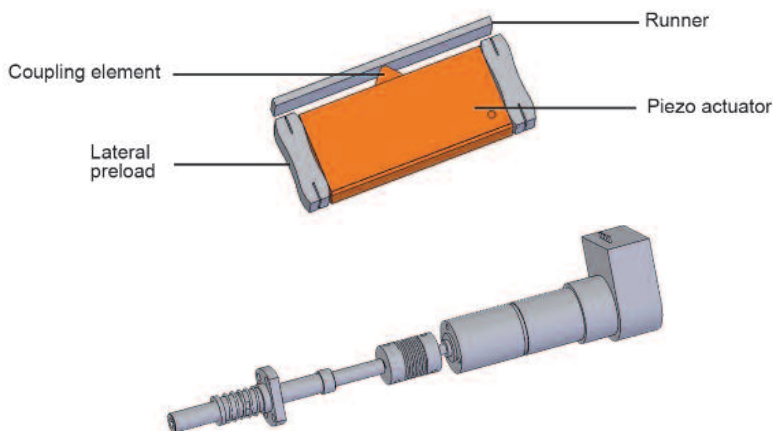
The stiff design, direct coupling and fast response of the piezo ceramics to electric inputs allows for very fast start / stop behavior and velocities to hundreds of mm/sec.

Patented technology

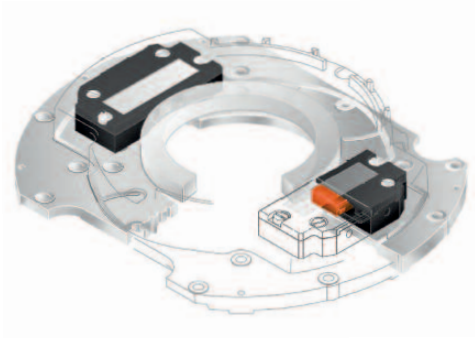
The products described in this document are in part protected by the following patents:

US Pat. No. 6,765,335B2

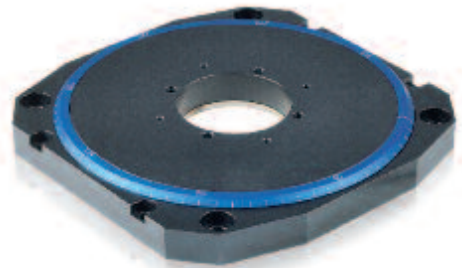
European Patent No. 1267425B1



Motor-leadscrew combinations (above) transform the rotational motion of the motor into linear motion. Due to play in the mechanical components responsiveness is limited. Linear motors such as PILine® generate linear motion directly and provide much faster response and better stability



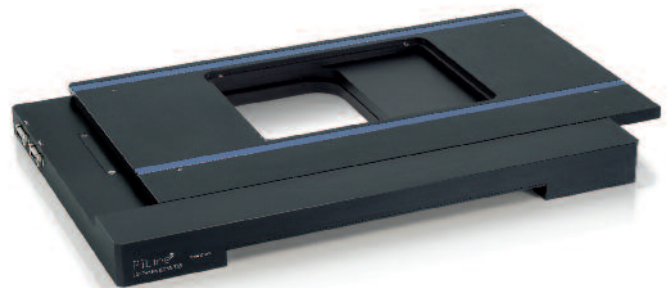
Implementation of rotary motion: PILine® motors act on a ring-shaped runner



The benefit of the low profile PILine® drives becomes apparent with positioning systems such as the M-660 rotation stage (left, 14 mm high) or the M-687 microscopy XY stage (right, 25 mm high): a consistently flat design without lead screw ducts or flanged motors

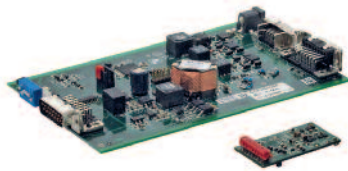
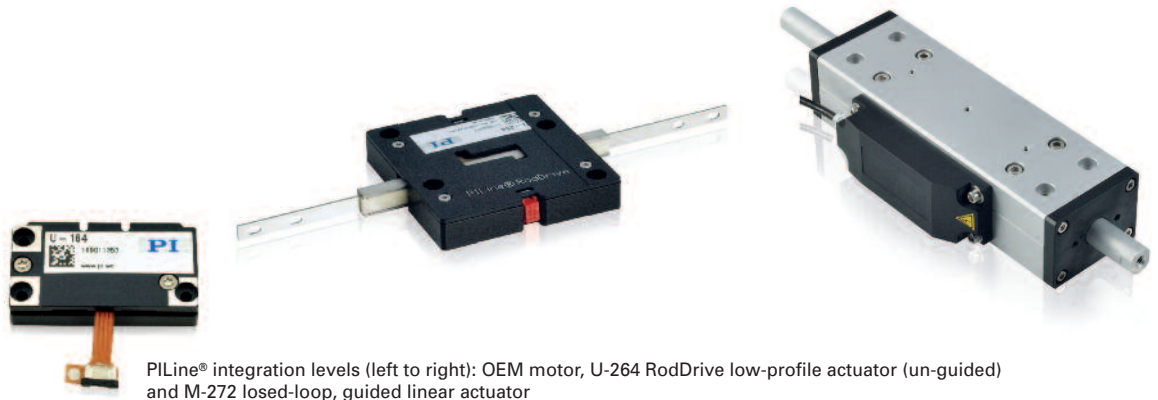
Piezo motors for all applications – e. g. in vacuum environments and strong magnetic fields

Piezo motors from PI are intrinsically vacuum-compatible and suitable for operation in strong magnetic fields. Special versions are offered for this purpose. Nanometer resolution or forces up to several 100 N can be achieved with PiezoWalk® linear motors.



PILine® Ultrasonic Piezo Motors

OEM MOTORS, TECHNICAL DATA



Drive electronics create the ultrasonic oscillations in the piezo-ceramic actuator of the PILine® drive. PI offers universal drives for all actuator sizes – as well as specialized, compact boards

Different integration levels offer flexibility

PILine® allow the design of positioning systems with higher dynamics and smaller dimensions. PI offers various integration levels of PILine® drives for easier integration into customer designs:

- Complete positioning stages with integrated PILine® motors are available in custom designs for OEMs,
- Linear actuators move the load via a guided rod. Position feedback is available as an option,

- RodDrives are unguided and open-loop linear drives that replace motor-leadscrew combinations. They can easily be coupled to a guided positioning platform,
- The integration of OEM motors requires more experience and technical knowledge because the optimal preload between runner and actuator has to be set-up by the customer.

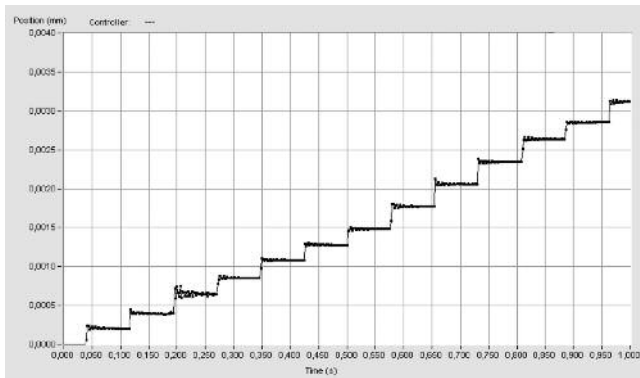
Drive electronics

To produce the ultrasonic oscillations in the piezo actuator, special drive electronics are required that are also provided by PI. These range from OEM boards to integrated servo controllers for closed-loop systems.

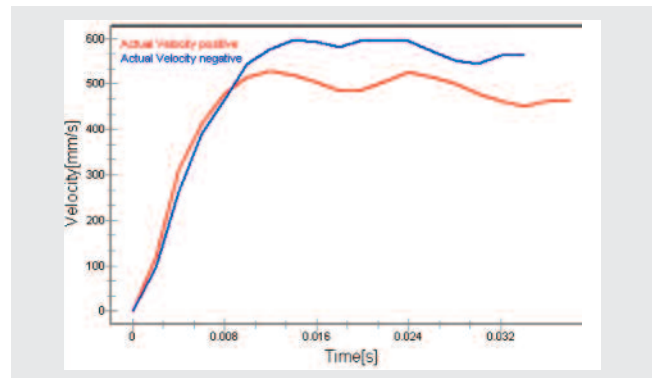
PILine® Piezo Linear Drive	P-661	U-164	Unit	Tolerance
Motion and positioning				
Travel range*	No limit	No limit	mm	
Min. incremental motion, open-loop**	0.05	0.05	µm	typ.
Open-loop velocity	500	500	mm/s	max.
Mechanical properties				
Stiffness, de-energized	0.7	3	N/µm	±10 %
Holding force, de-energized	1.5	3	N	max.
Push / pull force	2	4	N	max.
Optimum preload on runner	9	18	N	±10 %
Drive properties				
Resonant frequency	210	155	kHz	±2 kHz
Motor voltage	42 V _{rms} (120 V _{pp})	60 V _{rms} (170 V _{pp})		
Miscellaneous				
Operating temperature range	-20 to +50	-20 to +50	°C	
Casing material	Al (black anodized)	Al (black anodized)		
Mass	10	20	g	±5 %

* The travel range of piezo linear motors is practically unlimited and it only depends on the length of the runner

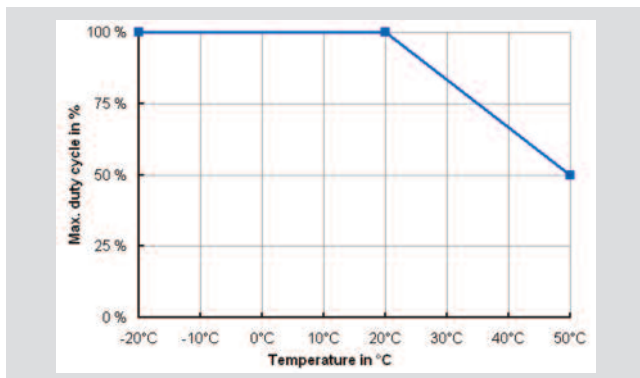
** The minimum incremental motion is a typical value which can be reached in open-loop operation. However, it is important to follow the installation guidelines for the motors



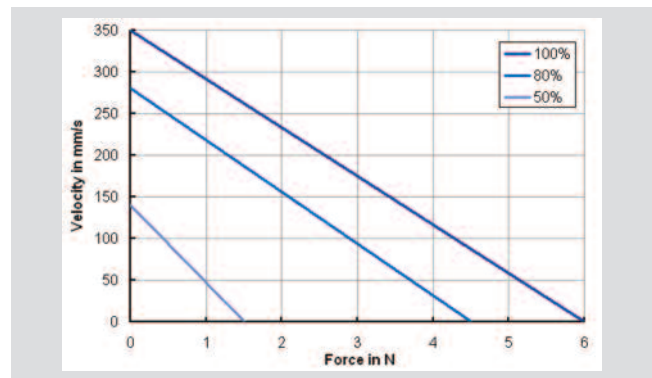
Open-loop step sequence of a PLine® based translation stage. Steps of approx. 300 nm shown. For repeatable increments closed-loop operation is recommended, because the step size depends on the force applied from outside



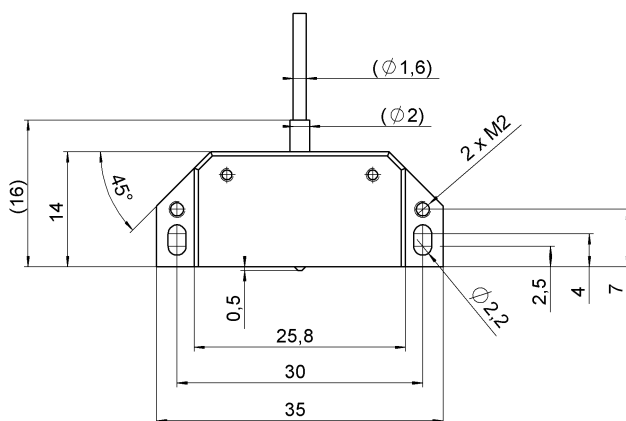
PLine® ultrasonic linear motors provide excellent dynamic properties. They provide acceleration to several g and can achieve step and settle of a few 10 msecs for small distances



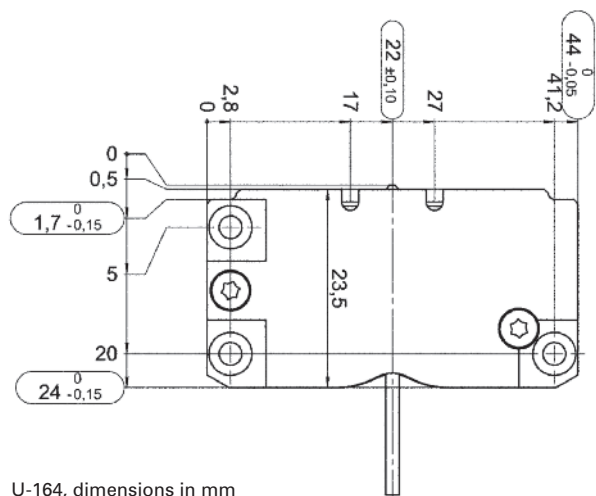
Maximum duty cycle depending on the ambient temperature with a control signal level of 100 %



Force / velocity motor characteristic of a U-164 PLine® motor. The percentages refer to the control signal level, which denotes the coupling of the electric power of the actuator



P-661, dimensions in mm



U-164, dimensions in mm