

Micropositioning Actuators

FAST



NON-MAGNETIC



HIGH FORCE

Micropositioning Actuators



Non-Magnetic Linear Actuators



High Speed Linear Piezo Motor Actuator for Automation



Piezo Stepper / Micro-Manipulator



PiezoWalk Motor Actuator



Low-Cost Precision Stepper-Motor Actuators



High Precision Servo & Stepper Motor Actuators



Compact, High Precision Actuator



Closed-Loop Highly Precise Folded Actuator Shown with M-106 Stage



High Force & Precision Actuators



High Force & Precision Actuator w/ Linear Encoders



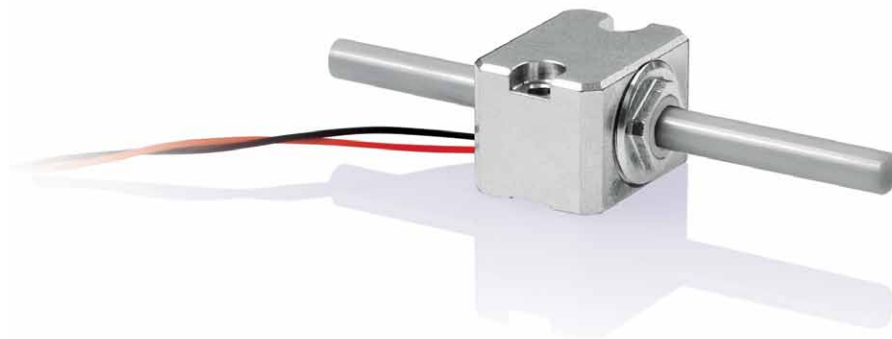
High Resolution Stepper Motors



High Resolution Actuators w/ Servo Motors

Linear Actuator with PIShift Piezomotor

COST-EFFECTIVE AND EASY TO INTEGRATE



N-412 • N-422

- Simple integration: Two mounting versions
- Quiet: Drive frequency >20 kHz
- Velocity over 5 mm/s
- Sub-micron resolution
- Holding force to 10 N

Piezomotor-based direct drive

OEM actuator without position sensor. Continuous motion with step frequencies in the ultrasound range. Easy integration, the housing can either be bolted to a level surface (N-412) or mounted via a threaded flange (N-422)

PIShift inertia drive

Self-locking, no heat generation at rest. Noiseless drive with operating frequencies beyond 20 kHz. Resolution in step mode approx. 300 nm, open-loop

Fields of application

Research and industry. Alignment of optical elements, micromanipulation, biotechnology, cell manipulation, medical technology

Recommended controller / amplifier

E-870 PIShift drive electronics



PIShift drives mounted in a cardanic N-412.50 for mounting via the threaded flange mirror for aligning the tilting angles

Related products

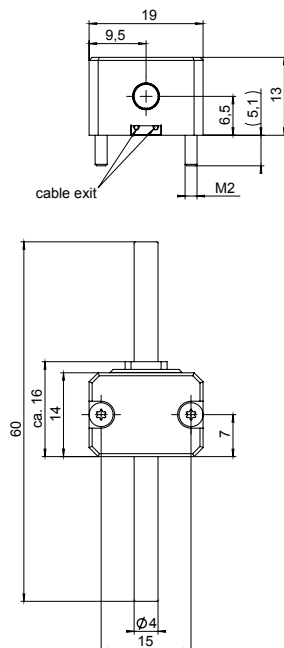
- N-310 NEXACT® OEM miniature linear motor/actuator
- N-381 NEXACT® linear actuator, manipulator, piezo stepper
- U-264 RodDrive piezomotor direct drive
- M-272 ceramic linear drive for automation

Perliminary Data	N-412.50	N-422.50	Unit	Tolerance
Active axes	X	X		
Motion and positioning				
Travel range	30	40	mm	
Step frequency*	>20	>20	kHz	max.
Max. velocity*	5	5	mm/s	min.
Mechanical properties				
Stiffness in motion direction	>4	>4	N/ μ m	$\pm 20\%$
Push / pull force (active)	5	7	N	max.
Max. holding force (passive)	10	10	N	min.
Drive properties				
Drive type	PIShift inertia drive	PIShift inertia drive		
Operating voltage	48	48	V _{pp}	max.
Power consumption	15 W (actuator) 30 W (drive input)	15 W (actuator) 30 W (drive input)	W	nominal
Miscellaneous				
Operating temperature range	0 to 50	0 to 50	$^{\circ}$ C	
Material**	Stainless steel	Stainless steel		
Dimensions	\varnothing 18 mm, length 26 mm + rod	21,5 mm \times 18 mm \times 13 mm + rod		
Mass	25	25	g	$\pm 5\%$
Cable length	1,5	1,5	m	± 10 mm
Connector	DIN 4-pin	DIN 4-pin		
Recommended controller / driver	E-870 PIShift drive electronics	E-870 PIShift drive electronics		

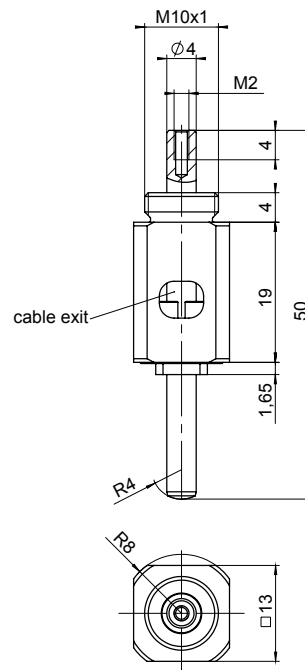
Ask about custom designs!

* Depending on drive electronics.

** Ceramic rod.



N-422.50, dimensions in mm. Version for mounting on an even surface vertical to the direction of motion



N-412.50, dimensions in mm. Version for mounting on the front via the M10 threaded flange

Nonmagnetic Micropositioning Actuator

Long Travel, High Resolution, for Operation in Strong Magnetic Fields



The N-900C001 actuator is based on PI's patented NEXACT® piezo linear motor technology and is built exclusively from non-magnetic components.

Ordering Information

N-900C001
Nonmagnetic Piezo Motor Actuator

E-861
PiezoWalk® Motor Controller/Driver, Desktop

E-862
PiezoWalk® Motor Controller/Driver, OEM

Application Examples

- Medical Technology
- MRI
- High Energy Physics

- **Non-Magnetic Working Principle**
- **For Operation in Strong Magnetic Fields, such as MRI**
- **Patented PiezoWalk® Motor**
- **Travel Range to 70 mm**
- **Self-Aligning Design**
- **Sub-Micrometer Step Size**
- **5 N Force**
- **Self-Locking at Rest, No Heat Generation**
- **Custom Designs Available**



Controllers for PiezoWalk® motors.
E-861 desktop version left and E-862 OEM version (right)

PiezoWalk® Working Principle

PiezoWalk® technology overcomes the limitations of conventional piezo drives and combines virtually unlimited travel ranges with high stiffness in a very small package. NEXACT® actuators provide piezo-class resolution and millisecond responsiveness. The special drive design reduces the operating voltage to 45 V and below.

Non Magnetic Design

The N-900C001 is a customized PiezoWalk® linear actuator for applications in very strong magnetic fields, such as encountered in MRI systems. All components and materials employed in the actuator are non-magnetic and non-magnetizable.

Preliminary Data

Models	N-900C001	Units	Tolerance
Active axes	X		
Drive type	NEXACT® linear drive		
Travel Range	70	mm	
*Step size (in step mode)	10 nm to 5 µm		
Travel range in analog operation	7	µm	max.
Push/pull force	5	N	typ.
Step frequency	1.0	kHz*	max.
Recommended operating temperature	10 to 40 °C	°C	
Material	PZT, ceramic, AL, 300 series stainless steel		
Mass	30	g	±5%
Cable length	2	m	±0.1 m

*Depends on drive electronics.

Linear Motor Micropositioning Actuator for Automation

Fast and Self-Locking with PLine® Piezomotors



The M-272 linear drive for automation offers a travel range of 50 mm

- 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-lead screw 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-lead screw drives facilitating assembly and reducing the number of components significantly. Due to the integrated linear encoder, positioning can be done precisely and repeatably.

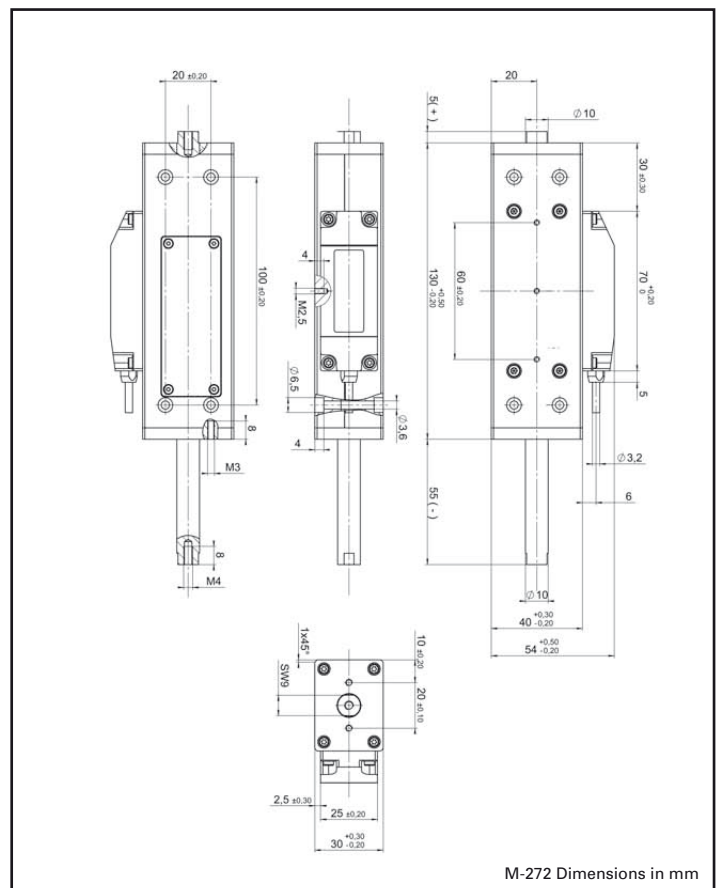
Self-locking Instead of Quiescent Current

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

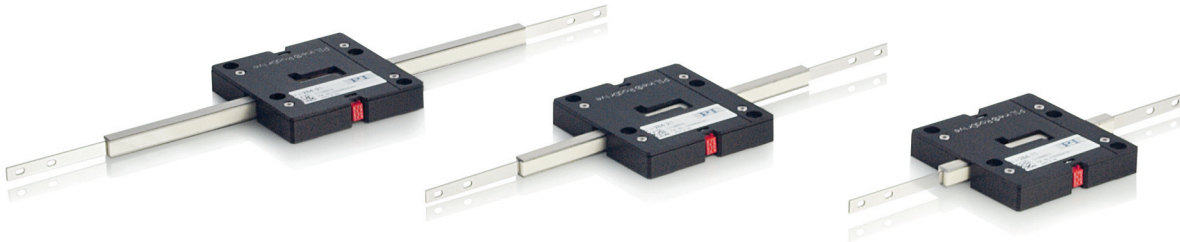


Application Examples

- Automation
- Handling
- Micromanipulation
- Metrology

RodDrive Piezomotor Direct Drive

LOW PROFILE, HIGH SPEED, EASY INTEGRATION



PILine RodDrive with variable travel ranges

U-264

- 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

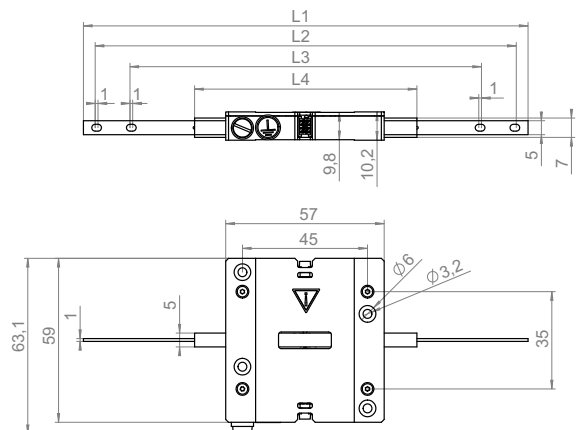
For integration into guided systems

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

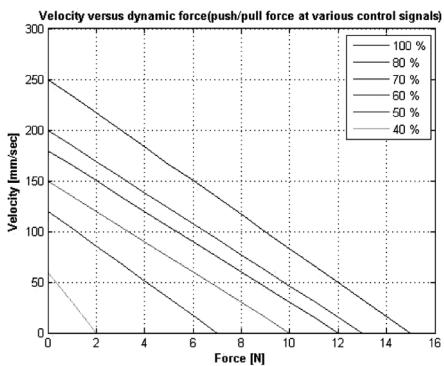
Related Products

- M-272 Linear Drive for Automation
- N-310 NEXACT OEM Miniature Linear Motor / Actuator
- C-872 Driver for PILine® Ultrasonic Piezomotors

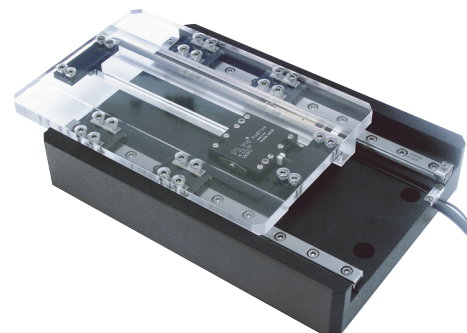
	U-264.10/20/30	U-264.11/21/31	Units	Tolerance
Motion and positioning				
Travel range	50 / 100 / 150	50 / 100 / 150	mm	
Open-loop step size	0.1*	2*	μm	typ.
Open-loop velocity	250	200	mm/sec	max.
Mechanical properties				
Stiffness when powered down	1.5	1.5	N/μm	±10 %
Holding force when powered down	8	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

N-381 NEXACT® Linear Actuator, Manipulator, Piezo Stepper

High-Resolution PiezoWalk® Linear Actuator with Optional Position Sensor

N-381 piezo stepper linear actuator for sample positioning and manipulation provides long travel, high speed and very high resolution; shown with E-861 NEXACT® Controller



- **Travel Range 30 mm**
- **Zero-Wear Piezo Stepping Drive, Ideal for Micro- and Nano-Manipulation**
- **Integrated Linear Encoder Option for Highest Accuracy with 20 nm Resolution**
- **Very High Acceleration, e.g. for Cell Penetration**
- **Two Operating Modes: Continuous Stepping Mode and Continuously Variable, High-Dynamics Analog Mode for 30 µm Resolution****
- **Up to 10 N Force Generation**
- **Self Locking at Rest, no Heat Generation**
- **Smooth Motion, no Closed-Loop Jitter**
- **Vacuum-Compatible and Non-Magnetic Versions**

The compact N-381 linear actuators are ideal drives and micro manipulators e.g. for biotechnology and nanotechnology applications. Rapid accelerations, velocities of 10 mm/s

and forces up to 10 N enable high-dynamics and throughput for automation tasks. The PiezoWalk® drive principle allows long travel ranges and fast oscillations of 7 µm amplitude with frequencies up to several 100 Hz. This “analog mode” can be used to provide rapid acceleration, e.g. in cell penetration applications, or smooth motion for dynamic laser tuning or even for active damping of oscillations. Two models are available: The N-381.3A model is equipped with a high-resolution position sensor, allowing sub-micrometer repeatability in closed-loop operation. The N-381.30 open-loop version is intended for high precision applications where the absolute position is

not important or is controlled by an external loop (video, laser, quadcell, etc.).

Piezo Stepping Drive — the Multi-Functional Piezo Linear Motor

A great advantage characteristic of the NEXACT® piezo stepping drive is its dual-mode operating principle combining the best features of other piezo motor designs, such as high resolution, high force and high speed into one compact unit. At the target position the drive requires no current and generates no heat while providing long-term, nanometer stability. This autolocking feature also completely eliminates servo-jitter as it occurs with other

Ordering Information

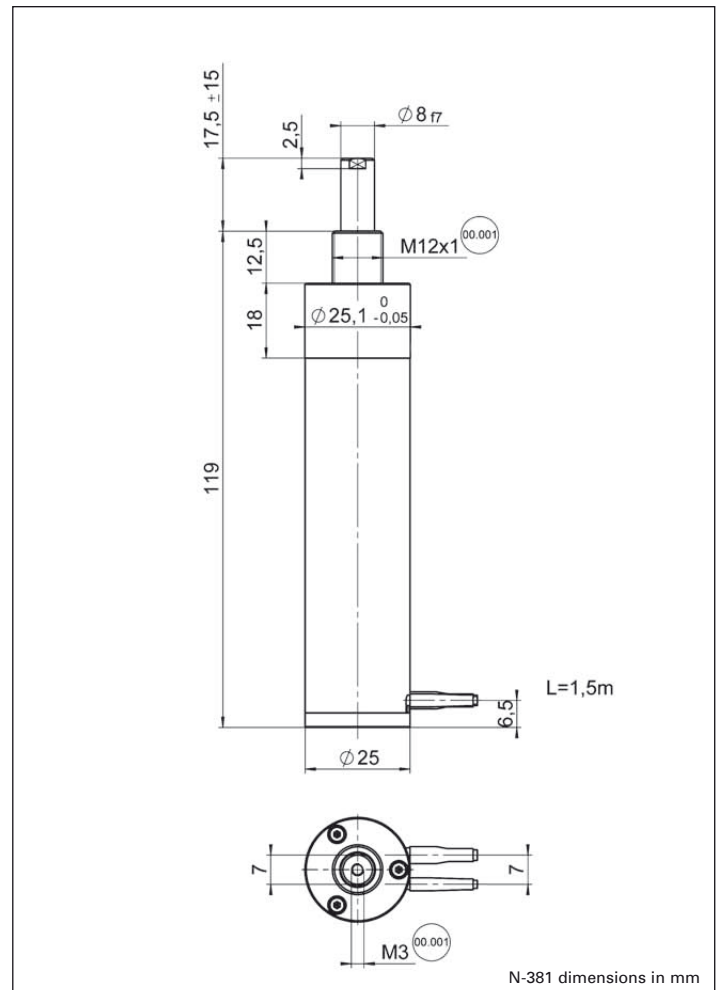
N-381.3A
NEXACTUATOR® Linear Actuator, 30 mm, 20 nm Encoder Resolution

N-381.30
NEXACTUATOR® Linear Actuator, 30 mm, Open-Loop

Available on request

Ask about custom designs!

closed-loop motors. Since motion is not based on dynamic friction as with piezo inertial drives (stick-slip-motors) but solely caused by the nanometer precise motion of clamped piezo actuators, there is no wear to limit the lifetime. When operated in closed-loop, excellent velocity control is achieved.



Application Examples

- Drive unit for scanning stage
- Cell manipulation, biohandling
- Micromanipulation
- Life science
- Photonics
- Laser tuning
- Motion in strong magnetic fields

Working Principle for Application Flexibility

NEXACT® PiezoWalk® technology overcomes the limitations of conventional nanopositioning drives and combines virtually unlimited travel ranges with high stiffness in a very small package. Furthermore, NEXACT® actuators provide piezo-class resolution (far below one nanometer) and millisecond responsiveness. The special drive design reduces the operating voltage to 45 V and below.

In operation, piezoceramic bending elements act on the runner, which is connected to the moving part of the application. The length of the runner determines the travel range

and can be chosen as required. To move the runner over longer distances the stepping mode is used, whereas for distances smaller than one step, the analog mode enables high-dynamics positioning with resolutions far below one nanometer.

Controllers and Drivers Optimized for the Application

NEXACT® actuators require special drive electronics to control the complex stepping sequences. The E-861 (see p. 1-20) includes a complete NEXACT® servo-controller with low-noise drivers and a powerful DSP. It also comes with ample software for easy integration and highly effective computer control. For applications which do not require the highest reso-

lution, the E-862 (see p. 3-10) lower-priced drive electronics, can be ordered.

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

German Patent No. P4408618.0

Technical Data (Preliminary)

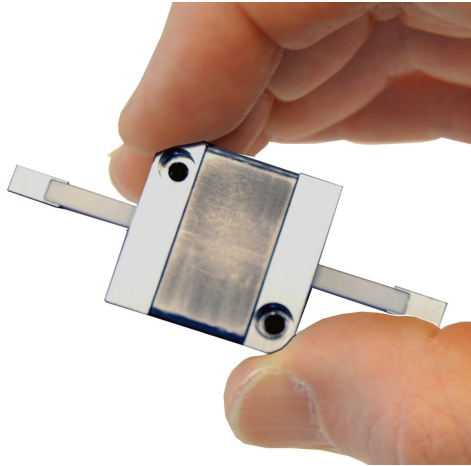
Model	N-381.30	N-381.3A
Active axes	X	X
Motion and positioning		
Travel range	30 mm	30 mm
Step size (in step mode)	0.1 to 15 µm	–
Integrated sensor	–	Incremental linear encoder
Sensor resolution	–	20 nm*
Travel range in analog mode	7 µm	7 µm
Open-loop resolution	0.03 nm**	0.03 nm**
Closed-loop resolution	–	20 nm*
Step frequency	0 to 800 Hz	–
Max. velocity	10 mm/s*	10 mm/s*
Mechanical properties		
Stiffness in motion direction	2.4 N/µm	2.4 N/µm
Max. push / pull force (active)	10 N	10 N
Max. holding force (passive)	15 N	15 N
Lateral force	10 N	10 N
Drive properties		
Drive type	NEXACT® linear drive	NEXACT® linear drive
Operating voltage	-10 V to +45 V	-10 V to +45 V
Miscellaneous		
Operating temperature range	0 to 50 °C	0 to 50 °C
Material	Stainless steel / CFRP	Stainless steel / CFRP
Mass	250 g	255 g
Cable length	1.5 m	1.5 m
Connector	15-pin HD-Sub-D connector, one channel	15-pin HD-Sub-D connector, one channel
Recommended controller/driver	E-860 series (see p. 1-20)	E-861.1A1 (see p. 1-20)

*With E-861. Depending on drive electronics.

**Depending on the drive electronics. 1 nm with E-861.

N-310 NEXACT® OEM Miniature Linear Motor/Actuator

Compact, High-Speed PiezoWalk® Drive



N-310 Actuator with E-861 Servo-Controller (integrated drive electronics)

- 10 to 125 mm Standard Travel Range, Flexible Choice of the Runner Length
- Compact and Cost-Effective Design
- 0.03 nm Resolution**
- To 10 N Push/Pull Force
- Low Operating Voltage
- Self Locking at Rest, No Heat Generation, Nanometer Stability
- Non-Magnetic and Vacuum-Compatible Working Principle

N-310 NEXACT® PiezoWalk® linear drives feature travel ranges of up to 125 mm and push/pull force capacities to 10 N in a compact package of only 25 x 25 x 12 mm. With their high resolution, NEXACT® drives, are ideal for high-precision positioning over long travel ranges. The N-310 can be operated in open-loop and closed-loop mode (with the addition of an external

position sensor). A variety of NEXACT® controllers facilitates the integration into micro- or nanopositioning applications.

Working Principle for Application Flexibility

NEXACT® PiezoWalk® technology overcomes the limitations of conventional nanopositioning drives and combines virtually unlimited travel ranges with high stiffness in a very small package. Furthermore, NEXACT® actuators provide piezo-class resolution (far below one nanometer) and millisecond responsiveness. The special drive design reduces the operating voltage to 45 V and below.

In operation, piezoceramic bending elements act on the runner, which is connected to the moving part of the application. The length of the runner determines the travel range.

Force capacity, resolution and velocity are determined by the piezo geometry and drive electronics and are scalable. To move the runner over longer distances the stepping mode is used, whereas for distances smaller than one step, the linear (analog) mode enables high-dynamics positioning with resolutions far below one nanometer.

Wear- and Maintenance-Free

In contrast to ordinary DC or stepper motor drives, the PiezoWalk® drives effect linear motion directly, without the need to transform rotation with mechanical elements such as gears, leadscrews and nuts. Therefore, mechanical limitations such as backlash and wear are eliminated and the drive is maintenance-free.

Self-Locking PiezoWalk® Piezo Stepping Drive

NEXLINE® and NEXACT® exhibit high stiffness and are self-locking even when powered down due to the clamping action of the piezo actuators in the mechanics. This entails nanometer position stability at rest, with no heat generation or servo-dither.

Controller and Drive Electronics Optimized for the Application

NEXACT® actuators require special drive electronics to control the complex stepping sequences. The E-860 series NEXACT® controllers are available in different open-and closed-loop versions. For example, the E-861 includes a complete NEXACT® servo-controller with low-noise, 24-bit drivers and a powerful DSP. It also comes with ample software for easy integration and highly effective computer control. For applications which do

Ordering Information

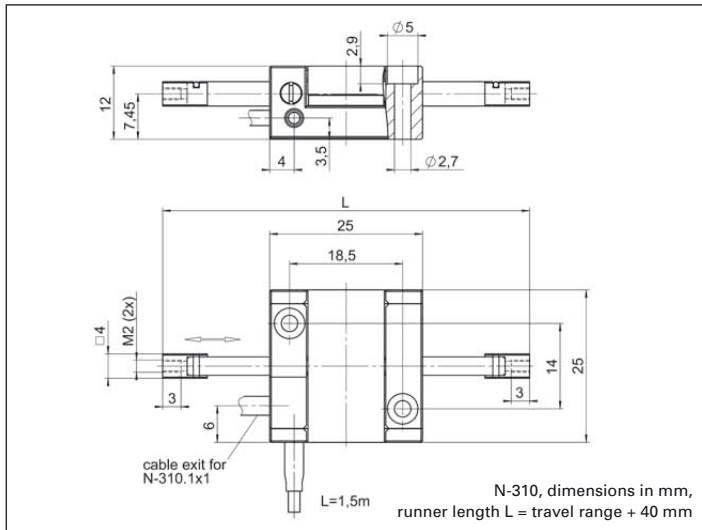
- N-310.10**
NEXACT® OEM Linear Drive, 10 mm, 10 N
 - N-310.101**
NEXACT® OEM Linear Drive, 10 mm, 10 N, Shifted Cable Exit
 - N-310.11**
NEXACT® PiezoWalk® OEM Linear Drive, 20 mm, 10 N
 - N-310.111**
NEXACT® PiezoWalk® OEM Linear Drive, 20 mm, 10 N, Shifted Cable Exit
 - N-310.12**
NEXACT® OEM Linear Drive, 30 mm, 10 N
 - N-310.121**
NEXACT® OEM Linear Drive, 30 mm, 10 N, Shifted Cable Exit
 - N-310.13**
NEXACT® OEM Linear Drive, 50 mm, 10 N
 - N-310.131**
NEXACT® OEM Linear Drive, 50 mm, 10 N, Shifted Cable Exit
 - N-310.14**
NEXACT® OEM Linear Drive, 75 mm, 10 N
 - N-310.141**
NEXACT® OEM Linear Drive, 75 mm, 10 N, Shifted Cable Exit
 - N-310.15**
NEXACT® OEM Linear Drive, 100 mm, 10 N
 - N-310.151**
NEXACT® OEM Linear Drive, 100 mm, 10 N, Shifted Cable Exit
 - N-310.16**
NEXACT® OEM Linear Drive, 125 mm, 10 N
 - N-310.161**
NEXACT® OEM Linear Drive, 125 mm, 10 N, Shifted Cable Exit
- Ask about custom designs!**

not require the highest resolution, the E-862 lower-priced drive electronics can be ordered.

The products described in this document are in part protected by the following patents: German Patent No. P4408618.0

Application Examples

- Semiconductor technology
- Wafer inspection
- Nano lithography
- Surface Measurement Technique
- Profilometry
- Microscopy
- Motion in strong magnetic fields



Translation stage with N-310 NEXACT® drive. The positioner offers 20 mm travel range with an encoder resolution of 25 nm

Technical Data

Model	N-310	Tolerance
Active axes	X	
Motion and positioning		
Travel range	N-310.10: 10 mm N-310.11: 20 mm N-310.12: 30 mm N-310.13: 50 mm N-310.14: 75 mm N-310.15: 100 mm N-310.16: 125 mm	
Step size (in step mode)	5 nm to 5 μ m	
Travel range in analog operation	7 μ m	max.
Open-loop resolution	0.03 nm**	typ.
Step frequency	1.5 kHz*	max.
Max. speed	10 mm/s*	max.
Mechanical properties		
Push/Pull force (active)	10 N	max.
Drive properties		
Drive type	NEXACT® linear drive	
Operating voltage	-10 V to +45 V	
Miscellaneous		
Operating temperature range	0 to 50 °C	
Body material	Stainless steel, non-magnetic	
Mass	50 g (20 mm travel range)	\pm 5%
Cable length	1.5 m	\pm 10 mm
Connector	HD Sub-D connector 15 pin, single channel	
Recommended controller/driver	E-862, E-861 (see p. 1-20)	

*Depending on the control electronics.

**Depending on the drive electronics. 1 nm with E-861.

Low Cost Micropositioning Actuator Series

High-Load, Compact and Highly Cost-Efficient, with Limit Switches



M-228 and M-229 series linear actuators are driven by powerful direct-drive stepper motors, or are equipped with more compact, gearhead stepper motors:
M-229.26S, M-228.11S, M-229.25S, M-228.10S (from left)

- **Highly Cost-Efficient, Compact Design**
- **10 and 25 mm Travel Range**
- **High Load Capacity to 80 N**
- **Gearhead Version: 46 nm Resolution (with C-663 Controller)**
- **Direct Drive: Max. Velocity 5 mm/s**
- **Non-Rotating Tip**
- **Non-Contact Limit and Reference Switches**

M-228 and M-229 series linear actuators provide a travel range of 10, resp. 25 mm, and are equipped with high-resolution stepper motors. The stepper mikes can push or pull loads up to 80 N, and provide speeds up to 5 mm/s. Models featuring gearhead/stepper motor combinations offer the same stroke in a more compact package.

Cost-Effective Design, Valuable Features

The cost-effective design offers many useful features such as a non-rotating tip, limit and reference switches and a mechanical position display.

A spherical tip and a 3 m extension cable are included in the delivery. The more compact gearhead versions include an additional flat tip.

Non-Rotating Tip

Compared to conventional rotating-tip micrometer drives, the non-rotating tip design offers several advantages:

- Elimination of torque-induced positioning errors
- Elimination of sinusoidal motion errors
- Elimination of wear at the contact point

- Elimination of tip-angle-dependent wobble

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.

Low Cost of Ownership

The combination of these actuators with the networkable C-663 Mercury Step controller (s. p. 4-112) offers high performance for a very competitive price in both single and multi-axis configurations.

Ordering Information

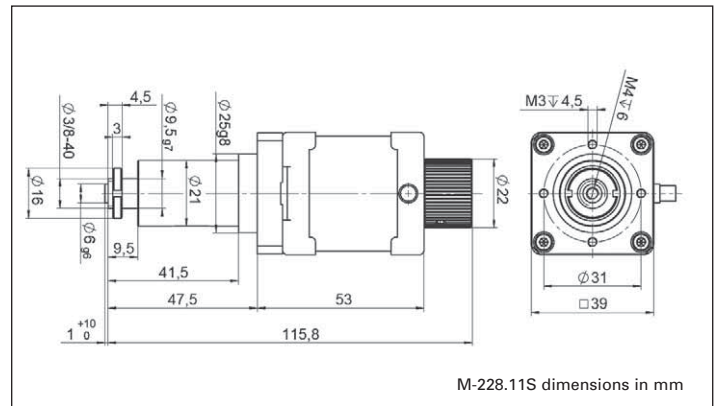
M-228.10S
Stepper-Mike Linear Actuator, 10 mm, Stepper Motor, Gearhead, Limit Switches

M-228.11S
Stepper-Mike Linear Actuator, 10 mm, Stepper Motor, Direct Drive, Limit Switches

M-229.25S
Stepper-Mike Linear Actuator, 25 mm, Stepper Motor, Gearhead, Limit Switches

M-229.26S
Stepper-Mike Linear Actuator, 25 mm, Stepper Motor, Direct Drive, Limit Switches

Ask about custom designs!



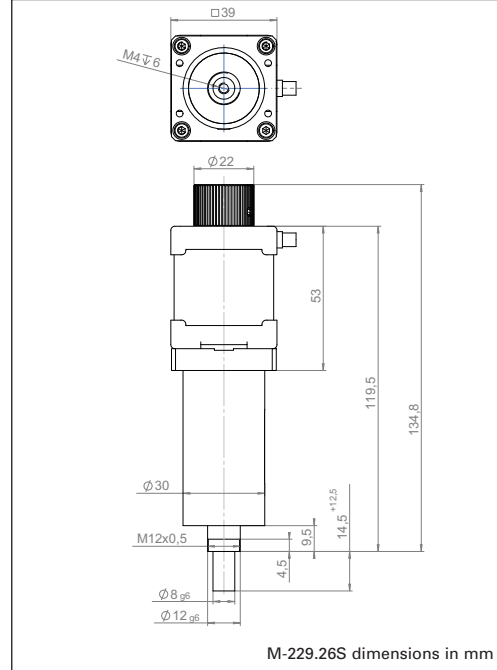
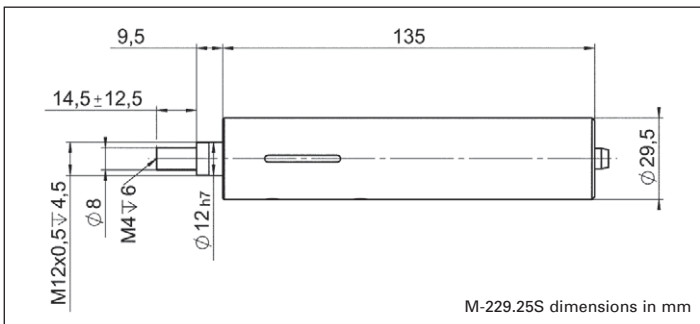
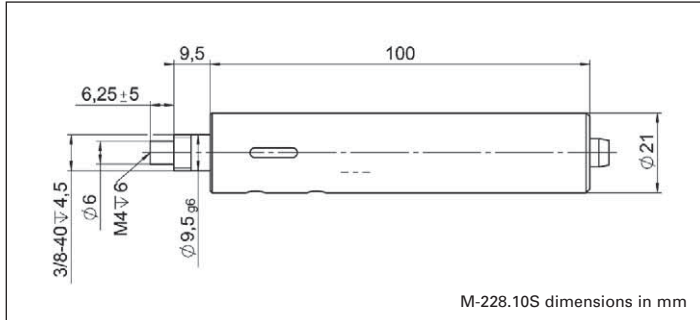
M-228.11S dimensions in mm



M-229 high-load stepper mike with gearhead, C-663 Mercury stepper motor controller (rear)

Application Examples

- Quality assurance testing
- Testing equipment
- Alignment of secondary mirrors
- Automation
- Metrology
- Precision machining



Technical Data

Model	M-228.10S	M-228.11S	M-229.25S	M-229.26S	Units
Active axes	X	X	X	X	
Motion and positioning					
Displacement	10	10	25	25	mm
Design resolution*	0.046	0.078	0.046	0.078	μm
Min. incremental motion*	1	1	1	1	μm
Backlash**	5	10	10	10	μm
Unidirectional repeatability	±2	±2	±2	±2	μm
Max. velocity*	1.5	5	1.5	5	mm / s
Reference switch repeatability	1	1	1	1	μm
Mechanical properties					
Drive screw	Leadscrew	Leadscrew	Leadscrew	Leadscrew	
Thread pitch	0.5	0.5	0.5	0.5	mm / rev.
Gear ratio	28.44444:1	–	28.44444:1	–	
Motor resolution*	384	6400	384	6400	steps / rev.
Max. push/pull force	20	50	50	80	N
Drive properties					
Motor type	2-phase stepper motor	2-phase stepper motor	2-phase stepper motor	2-phase stepper motor	
Operating voltage	24***	24*	24**	24*	V
Reference and limit 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-(anodized), steel, brass	Al-(anodized), steel, brass	Al-(anodized), steel, brass	Al-(anodized), steel, brass	
Mass	0.23	0.36	0.4	0.61	kg
Cable length	0.5	0.6	0.5	0.6	m
Connector	15-pin sub-D connector	15-pin sub-D connector	15-pin sub-D connector	15-pin sub-D connector	
Recommended controller	C-663 single-axis	C-663 single-axis	C-663 single-axis	C-663 single-axis	

Please avoid lateral forces at the tip.

* with C-663 stepper motor controller
 ** with preload
 *** max. 0.25 A / phase; 24 full steps / rev.
 † max. 0.85 A / phase; 400 full steps / rev.
 †† max. 1 A / phase; 24 full steps / rev.

M-230 High Precision Micropositioning Actuator

Non-Rotating Tip, Limit Switches, Stroke to 25 mm



M-230.10, M-230.25, high-resolution DC-Mike actuators, 10 and 25 mm travel range

- Travel Range 10 & 25 mm
- Min. Incremental Motion to 0,05 µm
- Non-Rotating Tip
- Max. Velocity 1.5 mm/s
- Closed-Loop DC Motors and Stepper Motors
- Non-Contact Limit and Reference Switches
- Front Mount or Clamp Mount
- MTBF>20.000 h

M-230 are ultra-high-resolution linear actuators providing linear motion up to 25 mm with sub-micron resolution in a compact package. They consist of a micrometer with non-rotating tip driven by a 2-phase stepper motor or a closed-loop DC motor / gearhead combination with motor-shaft-mounted, high-resolution encoder.

Non-Rotating Tip

Compared to conventional rotating-tip micrometer drives, the non-rotating-tip design offers several advantages:

- Elimination of torque-induced positioning errors
- Elimination of sinusoidal motion errors
- Elimination of wear at the contact point
- Elimination of tip-angle-dependent wobble

High Accuracy & Long Life

M-230 actuators provide a cost-effective solution for heavier-duty industrial and OEM environments. They feature extremely low-stiction, low-friction construction, allowing for minimum incremental motion as low as 50 nanometers.

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 au-

tomation applications with high precision.

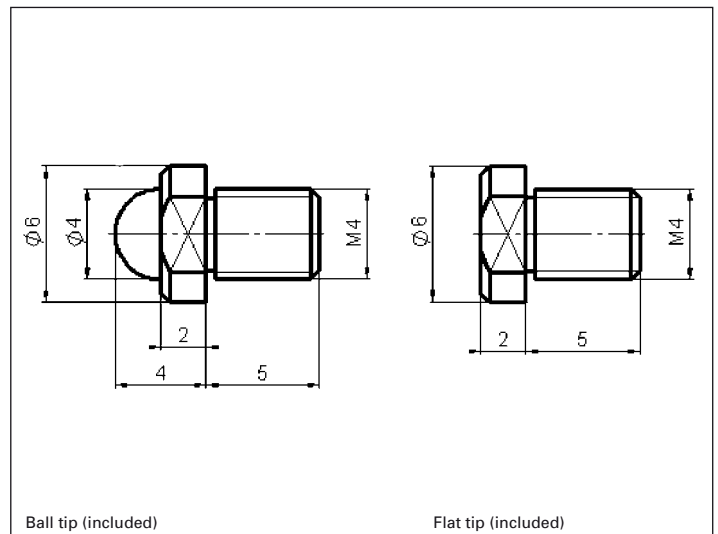
Integrated Line Drivers

All actuators include an integral 0.5 m cable with 15-pin sub-D connector and come with a 3 m extension cable. On the DC servo versions, the connector features integrated line drivers for cable lengths up to 10 meters between actuator and controller.

High-Load Versions

For higher loads and travel ranges refer to the M-235 (see p. 1-50) and M-238 (see p. 1-52).

A screw-in ball tip and a flat tip are included.



Ball tip (included)

Flat tip (included)

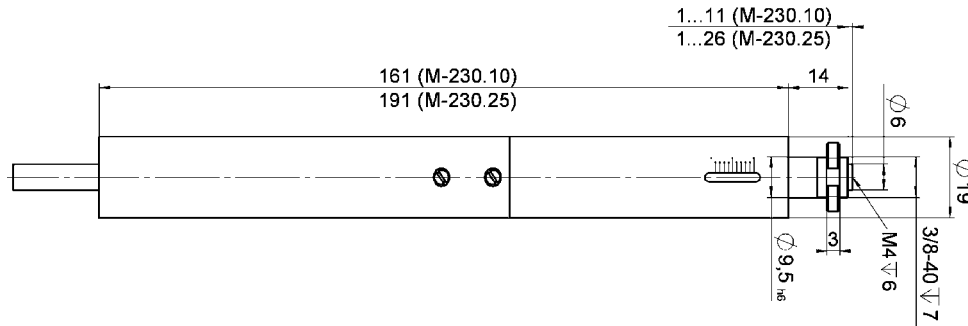
Ordering Information

M-230.10
High-Resolution DC-Mike Linear Actuator, 10 mm, Limit Switches

M-230.10S
High-Resolution Stepper-Mike Linear Actuator, 10 mm, Limit Switches

M-230.25
High-Resolution DC-Mike Linear Actuator, 25 mm, Limit Switches

M-230.25S
High-Resolution Stepper-Mike Linear Actuator, 25 mm, Limit Switches



M-230. Cable length: 500 mm, 15-pin sub-D connector with integrated line drivers (DC motor models). Dimensions in mm

Technical Data

Model	M-230.10	M-230.25	M-230.10S	M-230.25S	Units
Active axes	X	X	X	X	
Motion and positioning					
Travel range	10	25	10	25	mm
Integrated sensor	Rotary encoder	Rotary encoder			
Sensor resolution	2,048	2,048			Cts./rev.
Design resolution	0.0046	0.0046	0.037	0.037	μm
Min. incremental motion	0.05	0.05	0.05	0.05	μm
Backlash	2	2	2	2	μm
Unidirectional repeatability	0.1	0.1	0.1	0.1	μm
Max. velocity	0.8	0.8	1.5	1.5	mm/s
Reference switch repeatability	1	1	1	1	μm
Mechanical properties					
Spindle	Leadscrew	Leadscrew	Leadscrew	Leadscrew	
Spindle pitch	0.4	0.4	0.4	0.4	mm
Gear ratio	42.92063:1	42.92063:1	28.44444:1	28.44444:1	
Motor resolution**			384**	384**	steps/rev.
Max. push/pull force	70	70	45*	45*	N
Max. lateral force	30	20	30	20	N
Drive properties					
Motor type	DC-motor, gearhead	DC-motor, gearhead	2-phase stepper motor**	2-phase stepper motor**	
Operating voltage	0 to ±12	0 to ±12	24	24	V
Electrical power	2	2			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 (anodized), steel	Al (anodized), steel	Al (anodized), steel	Al (anodized), steel	
Mass	0.3	0.35	0.3	0.35	kg
Cable length	0.5	0.5	0.5	0.5	m
Connector	15-pin sub-D connector	15-pin sub-D connector	15-pin sub-D connector	15-pin sub-D connector	
Recommended controller/driver	C-863 single-axis C-843 PCI board, for up to 4 axes	C-863 single-axis (p. 4-114) C-843 PCI board, for up to 4 axes (p. 4-120)	C-663 single-axis	C-663 single-axis (p. 4-112)	

*at velocities of up to 1 mm/s

**2-phase stepper motor, 24 V chopper voltage, max. 0.25 A/phase, 24 full steps/rev., motor resolution with C-663 stepper motor controller

M-231 DC-Mike High Precision Micropositioning Actuator

With Limit Switches, Suitable for Fiber Alignment



M-231.17 high-resolution DC-Mike actuator, 17 mm travel range

Ordering Information

M-231.17
High-Resolution DC-Mike Linear Actuator, 17 mm, Limit Switches

- Travel Range 17 mm
- Min. Incremental Motion to 0.1 μm
- Max. Velocity 2.5 mm/s
- Closed-Loop DC-Motors
- Non-Contact Limit and Reference Switches
- Fits M-105 Fiber Aligners
- MTBF >5.000 h

The M-231 is an ultra-high-resolution linear actuator providing linear motion up to 17 mm with sub-micron resolution in a compact package. It consists of a leadscrew which is driven by a closed-loop DC-motor/gearhead combination with motor-shaft-mounted, high-resolution encoder (2048 counts/rev.).

Upgrade for Manual Aligners

The M-231 was especially designed to fit existing manual translation stages (e.g. M-105, see p. 4-50 ff) as a direct replacement for a manual micrometer.

Limit and Reference Switches

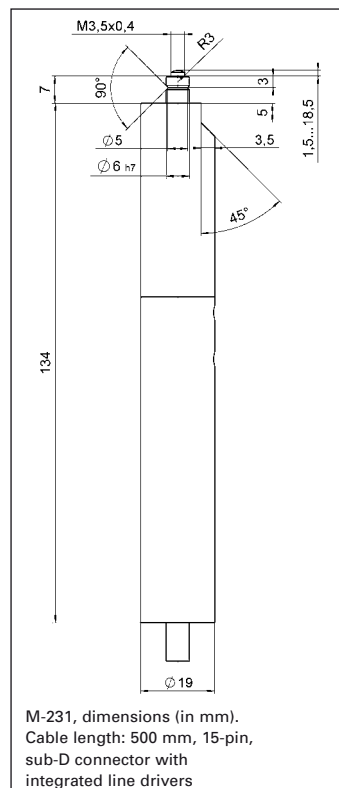
For the protection of your equipment, non-contact Hall-effect limit and reference switches are installed. The reference switch supports advanced automation applications with high precision.

Application Examples

- Fiber positioning
- Metrology
- Photonics packaging
- Quality assurance testing
- Testing equipment

Integrated Line Drivers

All actuators include an integral 0.5 m cable with 15-pin sub-D connector and come with a 3 m extension cable. On the DC servo versions, the connector features integrated line drivers for cable lengths up to 10 meters between actuator and controller.



For higher loads and travel ranges, refer to the M-230 (see p. 1-46), M-235 (see p. 1-50) and M-238 (see p. 1-52).



M-231 mounted on M-105 XYZ positioning systems

Technical Data

Model	M-231.17	Units
Active axes	X	
Motion and positioning		
Travel range	17	mm
Integrated sensor	Rotary encoder	
Sensor resolution	2,048	Cts./rev.
Design resolution	0.007	μm
Min. incremental motion	0.1	μm
Backlash	2	μm
Unidirectional repeatability	0.2	μm
Max. velocity	1.5	mm/s
Reference switch repeatability	1	μm
Mechanical properties		
Spindle	Leadscrew	
Spindle pitch	0.4	mm
Gear ratio	28.44444:1	
Max. push/pull force	40	N
Drive properties		
Motor type	DC-motor, gearhead	
Operating voltage	0 to ± 12	V
Electrical power	2	W
Limit and reference switches	Hall-effect	
Miscellaneous		
Operating temperature range	-20 to +65	$^{\circ}\text{C}$
Material	Al (anodized), steel	
Mass	0.17	kg
Recommended controller/driver	C-863 single-axis (p. 4-114) C-843 PCI board, for up to 4 axes (p. 4-120)	

M-232 Compact High Precision Micropositioning Actuator

Compact Package, Suitable for Fiber Alignment



M-232.17 high-resolution DC-Mike actuator mounted on M-105 translation stage

- Travel Range 17 mm
- Min. Incremental Motion to 0,1 µm
- Max. Velocity 2,5 mm/s
- Closed-Loop DC-Motors
- Non-Contact Limit and Reference Switches
- Fits M-105 Fiber Aligners
- MTBF >5.000 h

The M-232 is an ultra-high-resolution linear actuator providing linear motion up to 17 mm with sub-micron resolution in a compact package. It features a space-saving design with a leadscrew side-by-side to a closed-loop DC-motor/gearhead combination and a high-resolution encoder (2048 counts/rev.). They feature a low-stiction, low-friction construction allowing for minimum incremental motion of 100 nanometers at speeds of up to 2.5 mm/sec.

Upgrade for Manual Aligners

The M-232 was especially designed to fit existing manual translation stages (e.g. M-105 see p. 4-50 ff) as a direct replacement for a manual micrometer.

Application Examples

- Fiber positioning
- Metrology
- Photonics packaging
- Quality assurance testing
- Testing equipment

Limit and Reference Switches

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

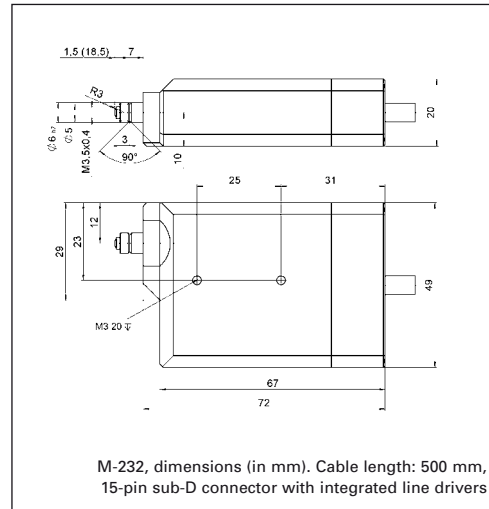
Integrated Line Drivers

All actuators include an integral 0.5 m cable with 15-pin sub-D connector and come with a 3 m extension cable. On the DC servo versions, the connector features integrated line drivers for cable lengths up to 10 meters between actuator and controller.

For higher loads and travel ranges, refer to the M-230 (see p. 1-46), M-235 (see p. 1-50) and M-238 (see p. 1-52).

Ordering Information

M-232.17
Compact High-Resolution DC-Mike Linear Actuator, 17 mm, Limit Switches



Technical Data

Model	M-232.17	Units
Active axes	X	
Motion and positioning		
Travel range	17	mm
Integrated sensor	Rotary encoder	
Sensor resolution	2,048	Cts./rev.
Design resolution	0.007	µm
Min. incremental motion	0.1	µm
Backlash	2	µm
Unidirectional repeatability	0.2	µm
Max. velocity	1.5	mm/s
Reference switch repeatability	1	µm
Mechanical properties		
Spindle	Leadscrew	
Spindle pitch	0.4	mm
Gear ratio	28.44444:1	
Max. push/pull force	40	N
Drive properties		
Motor type	DC-motor, gearhead	
Operating voltage	0 to ±12	V
Electrical power	2	W
Limit and reference switches	Hall-effect	
Miscellaneous		
Operating temperature range	-20 to +65	°C
Material	Al (anodized), steel	
Mass	0.17	kg
Recommended controller/driver	C-863 single-axis (p. 4-114) C-843 PCI board, for up to 4 axes (p. 4-112)	

M-235 High Force Precision Micropositioning Actuator

High-Dynamics, Stroke to 50 mm, Forces to 120 N



M-235.2DG (top) and M-235.5DG (bottom) high-resolution DC-Mike, ballscrew

- Travel Range 20 & 50 mm
- Min. Incremental Motion to 0.1 μm
- High-Speed Direct Drive Option
- Push/Pull Load 120 N
- Lateral Force 100 N
- Recirculating Ballscrew Drives Provide High Speeds & Long Lifetimes
- Closed-Loop DC Motors and Stepper Motors
- Non-Contact Limit and Reference Switches
- MTBF >20.000 h
- Vacuum-Compatible Versions Available to 10^{-6} hPa

The M-235 is an ultra-high-resolution linear actuator providing linear motion of up to 50 mm with sub-micron resolution in a compact package. It consists of a preloaded ultra-low-friction, heavy-duty ballscrew which is driven by a 2-phase stepper motor or a closed-loop DC motor with motor-shaft-mounted, high-resolution encoder (2048 counts/rev.).

Three Different Drives

The M-235 is available with three different motor drives:

Application Examples

- Fiber positioning
- Automation
- Metrology
- Photonics packaging
- Quality assurance testing
- Testing equipment

The M-235.5DD version is equipped with a direct drive motor for high-speed positioning applications. The DC-motor models provide a minimum incremental motion of 100 nm only and are equipped with high-resolution rotary encoders for position control. The M-235.x2S versions have a high-power, low-vibration 2-phase stepper motor.

Non-Rotating Tip

Compared to conventional rotating-tip micrometer drives, the non-rotating-tip design offers several advantages:

- Elimination of torque-induced positioning errors
- Elimination of sinusoidal motion errors
- Elimination of wear at the contact point
- Elimination of tip-angle-dependent wobble

Ballscrews for High Speed and Long Lifetime

The recirculating ballscrew is maintenance-free and pre-loaded to eliminate mechanical play. Its significantly reduced friction, compared to conventional lead screws, allows for higher velocity, lower power consumption and longer service life. Thus, a bidirectional repeatability of 1 μm is made 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 switch supports advanced automation applications with high precision.

Integrated Line Drivers

All actuators include an integral 0.5 m cable with 15-pin sub-D connector and come with a 3 m extension cable. On the DC servo versions, the connector features integrated line drivers for cable lengths up to 10 meters between actuator and controller (DC-motors only).

A screw-in ball tip and a flat tip are included.

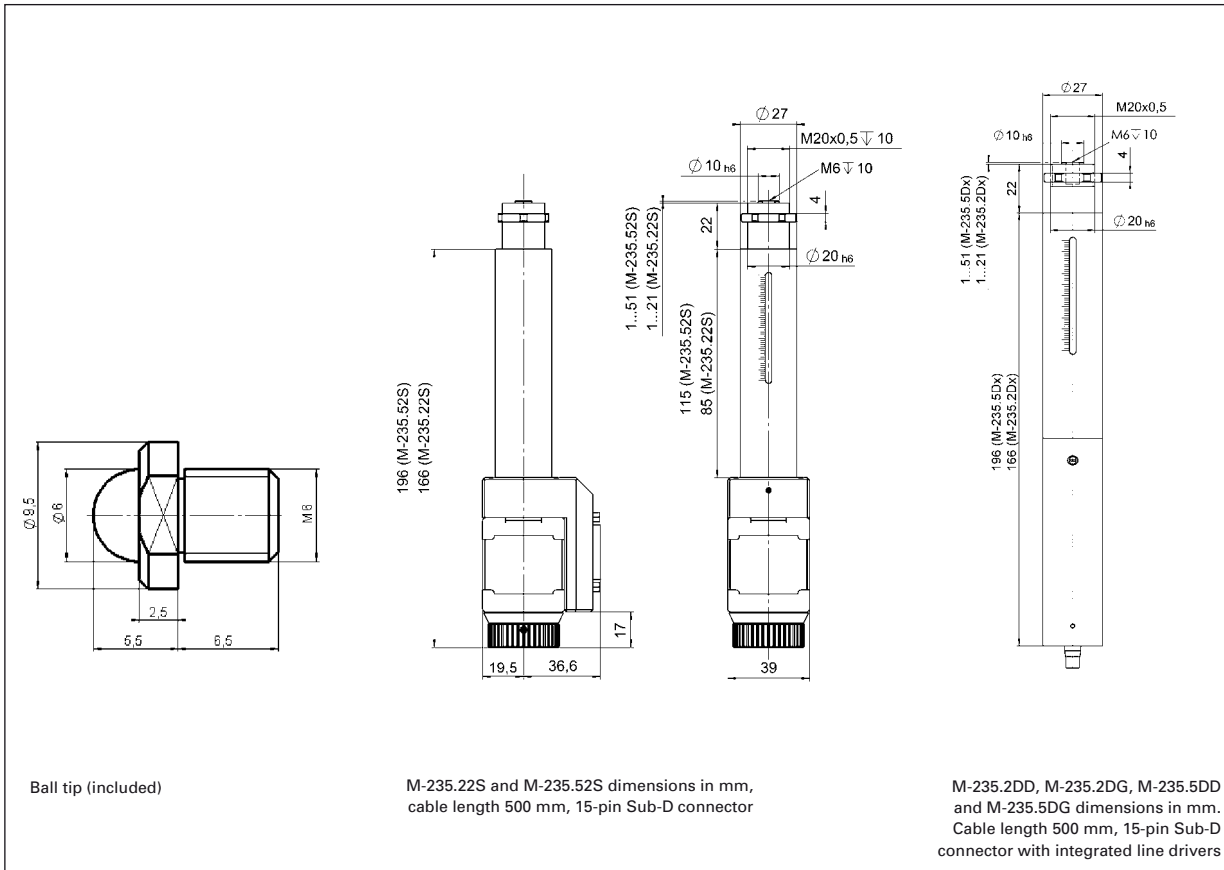
Ordering Information

- M-235.2DD**
High-Power Linear Actuator, 20 mm, Ballscrew, Direct-Drive DC Motor
- M-235.2VD**
Vacuum Version of M-235.2DD
- M-235.2DG**
High-Power Linear Actuator, 20 mm, Ballscrew, DC Motor Gearhead
- M-235.2VG**
Vacuum Version of M-235.2DG
- M-235.22S**
High-Power Linear Actuator, 20 mm, Ballscrew, Stepper Motor
- M-235.5DD**
High-Power Linear Actuator, 50 mm, Ballscrew, Direct-Drive DC Motor
- M-235.5VD**
Vacuum Version of M-235.5DD
- M-235.5DG**
High-Power Linear Actuator, 50 mm, Ballscrew, DC Motor Gearhead
- M-235.5VG**
Vacuum Version of M-235.5DG
- M-235.52S**
High-Power Linear Actuator, 50 mm, Ballscrew, Stepper Motor

Ask about custom designs!



M-235.22S high-resolution Stepper-Mike, 20 mm travel range, ballscrew



Technical Data

Model	M-235.2DG	M-235.2DD	M-235.22S	M-235.5DG	M-235.5DD	M-235.52S	Units
Active axes	X	X	X	X	X	X	
Motion and positioning							
Travel range	20	20	20	50	50	50	mm
Integrated sensor	Rotary encoder	Rotary encoder		Rotary encoder	Rotary encoder		
Sensor resolution	2.048	2.048		2.048	2.048		Cts./rev.
Design resolution	0.016	0.5	0.156	0.016	0.5	0.156	μm
Min. incremental motion	0.1	0.5	0.1	0.1	0.5	0.1	μm
Unidirectional repeatability	0.1	0.5	0.2	0.1	0.5	0.2	μm
Bidirectional repeatability	1	1	1	1	1	1	μm
Max. velocity	2.6	>30	20	2.6	>30	20	mm/s
Mechanical properties							
Gear ratio	29.6:1			29.6:1			
Motor resolution*			6,400*			6,400*	steps/rev.
Max. push/pull force	120	50	100**	120	50	100**	N
Max. lateral force	100	100	100	100	100	100	N
Drive properties							
Motor type	DC-motor, gearhead	DC-motor	2-phase stepper motor*	DC-motor, gearhead	DC-motor	2-phase stepper motor*	
Operating voltage	0 to ±12	0 to ±12	24	0 to ±12	0 to ±12	24	V
Electrical power	4	17	4.75	4	17	4.75	W
Limit and reference switches	Hall-effect	Hall-effect	Hall-effect	Hall-effect	Hall-effect	Hall-effect	
Miscellaneous							
Operating temperature range	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	°C
Material	Al (anodized), steel	Al (anodized), steel	Al (anodized), steel	Al (anodized), steel	Al (anodized), steel	Al (anodized), steel	
Mass	0.55	0.5	0.65	0.7	0.65	0.8	kg
Recommended controller/driver	C-863 single-axis C-843 PCI board, for up to 4 axes	C-863 single-axis C-843 PCI board, for up to 4 axes	C-663 single-axis	C-863 single-axis C-843 PCI board, for up to 4 axes	C-863 single-axis (p. 4-114) C-843 PCI board, for 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

**at up to 10 mm/sec

Data for vacuum versions may differ.

M-238 High-Load, High-Resolution Micropositioning Actuator

Forces to 400 N, Optional Direct Position Measurement



M-238.5PL Heavy-Duty Mike actuator (with CD for size comparison)

- High Load Capacity to 400 N
- Travel Range 50 mm
- Resolution to 0.1 μm
- Max. Velocity 30 mm/s
- Preloaded Frictionless Ball Screw
- Optional 0.1 μm Direct-Metrology Linear Encoder for Exceptional Precision
- MTBF >20,000 h
- Vacuum-Compatible Versions Available for 10^{-6} hPa

The M-238 is a high-load, high-precision actuator providing linear motion up to 50 mm, a load capacity to 400 N and high velocity to 30 mm/s. It consists of a low-friction, heavy-duty ballscrew, driven by a closed-loop, ActiveDrive™ DC-Motor with gearbox. The M-238 is therefore well suited for high duty-cycle operation in industrial environments. An optional linear encoder provides exceptional accuracy and repeatability.

Direct Metrology Linear Encoder to Compensate Mechanical Play

The M-238.5PL model is equipped with a non-contact, optical, linear encoder (direct metrology) with an output resolution of 0.1 μm . Because the encoder measures the actual position of the non-rotating actuator tip, drive-train errors like backlash and elastic deformations are eliminated. A lower-cost version with a rotary encoder is available as model number M-238.5PG.

ActiveDrive™ DC-Motor

DC motor drives offer several advantages, such as high dynamics, high torque at low rotational speed, low heat and low vibration.

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

Non-Rotating Tip

Compared to conventional rotating-tip micrometer drives, the non-rotating-tip design offers several advantages:

- Elimination of torque-induced positioning errors
- Elimination of sinusoidal motion errors
- Elimination of wear at the contact point
- Elimination of tip-angle dependent wobble

The lateral guiding of the tip withstands lateral forces of up to 100 N.

Ordering Information

M-238.5PG
Heavy-Duty DC-Mike Actuator, 400 N, 50 mm, ActiveDrive™

M-238.5PL*
Heavy-Duty DC-Mike Actuator, 400 N, 50 mm, ActiveDrive™, Direct-Metrology Encoder

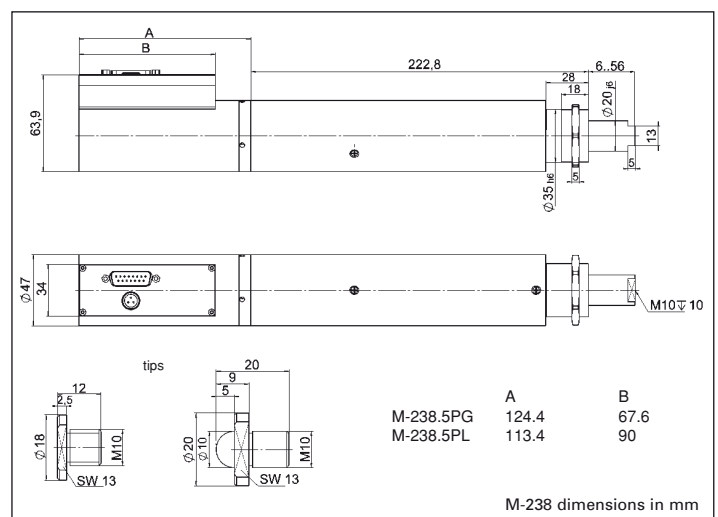
*Ask for availability in your region

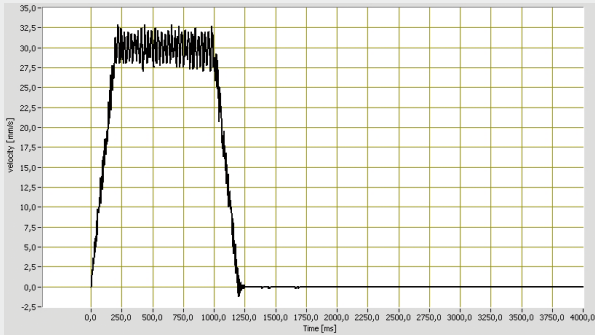
Ballscrews for High Speed, Precision and Lifetime

The precision-ground ballscrew is maintenance-free and preloaded to eliminate mechanical play. Its significantly reduced friction, compared to conventional leadscrews, allows for higher velocity, lower power consumption and longer lifetime.

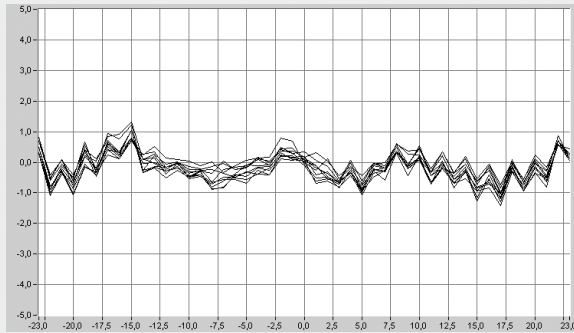
Limit and Reference Switches

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.

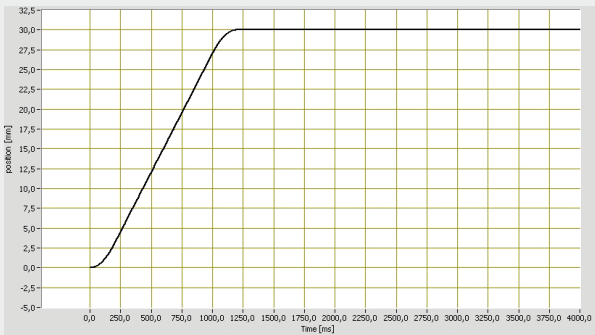




M-238.5PL velocity at 30 mm/s is highly constant.



M-238.5PL repeatability is better than 0.3 μm .



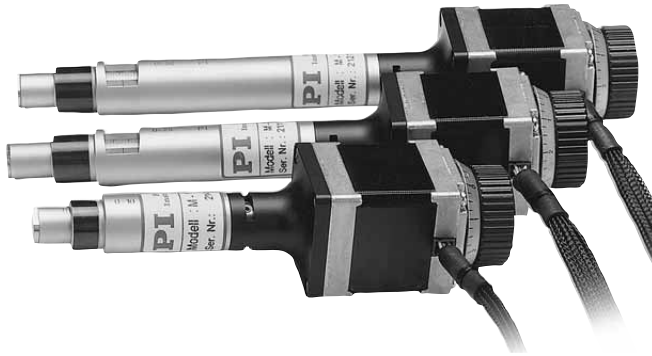
The settling time for a 30 mm step is less than 1.5 seconds.

Technical Data

Model	M-238.5PG	M-238.5PL	Units	Tolerance
Active axes	X	X		
Motion and positioning				
Travel range	50	50	mm	
Integrated sensor	Rotary encoder	Linear encoder		
Sensor resolution	4000 cts/rev.	0.1 μm		
Design resolution	0.13	0.1	μm	typ.
Min. incremental motion	0.5	0.3	μm	typ.
Backlash	3	1	μm	typ.
Unidirectional repeatability	1	0.3	μm	typ.
Max. velocity	30	30	mm/s	
Origin repeatability	1	1	μm	$\pm 20\%$
Mechanical properties				
Spindle pitch	2	2	mm/rev.	
Gear ratio	3.71:1	3.71:1		
Push/pull force	400	400	N	Max.
Lateral force	100	100	N	Max.
Drive properties				
Motor type	DC-motor, ActiveDrive™	DC-motor, ActiveDrive™		
Operating voltage	24 (PWM)	24 (PWM)	V	
Electrical power	80	80	W	nominal
Miscellaneous				
Operating temperature range	-10 to 50	-10 to 50	$^{\circ}\text{C}$	
Material	Al (anodized), steel	Al (anodized), steel		
Mass	2.4	2.4	kg	$\pm 5\%$
Cable length	3	3	m	$\pm 10\text{ mm}$
Connector	D-Sub 15 (m)	D-Sub 15 (m)		
Recommended controller/driver	C-863, C-843	C-863 (p. 4-114), C-843 (p. 4-120)		

M-168 Micropositioning Actuator w/ Stepper Motor

Non-Rotating Tip, Strokes to 50 mm



M-168 Stepper-Mikes providing 10, 25 and 50 mm travel range (from front to back)

- 10, 25 and 50 mm Travel Range
- Resolution <math><0.1 \mu\text{m}</math>
- 2-Phase Stepper Motor
- Manual Positioning Knob
- Sub-nm-Resolution with Optional PZT Actuator
- >5,000 h MTBF

M-168 are compact, high-resolution linear actuators providing linear motion up to 50 mm with sub-micron resolution. They consist of a micrometer drive with non-rotating tip driven by a 6400 microstep/rev and 2-phase stepper motor.

Non-Rotating Tip

Compared to conventional rotating-tip micrometer drives, the non-rotating-tip design offers several advantages:

- Elimination of torque-induced positioning errors
- Elimination of sinusoidal motion errors
- Elimination of wear at the contact point
- Elimination of tip-angle-dependent wobble

M-168 Stepper-Mikes feature an extremely low-stiction, low-friction construction allowing for high resolution and repeatability. A manual positioning knob provides coarse resolution of 5 μm . All models come with standard flat tips (see

p. 1-58 for spherical tips and other options).

High-Resolution Piezo Option

The optional piezo tip provides 20 μm travel with sub-nanometer resolution for dynamic scanning and tracking (see p. 1-73).

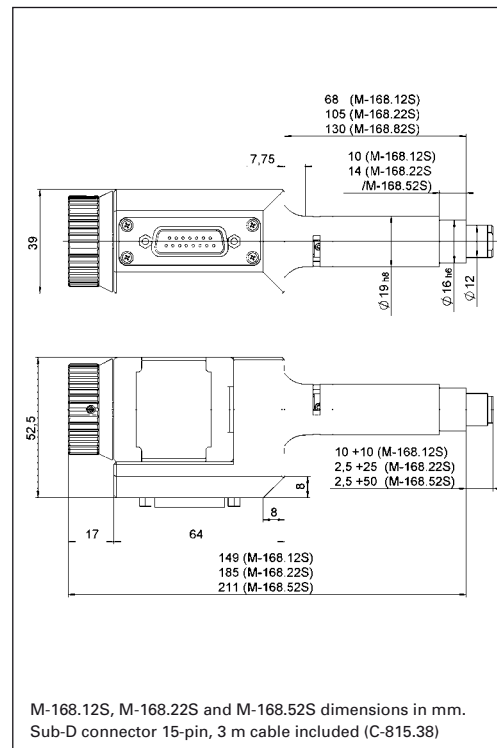
Ordering Information

M-168.12S
High-Resolution Stepper-Mike
Linear Actuator, 10 mm

M-168.22S
High-Resolution Stepper-Mike
Linear Actuator, 25 mm

M-168.52S
High-Resolution Stepper-Mike
Linear Actuator, 50 mm

Ask about custom designs!

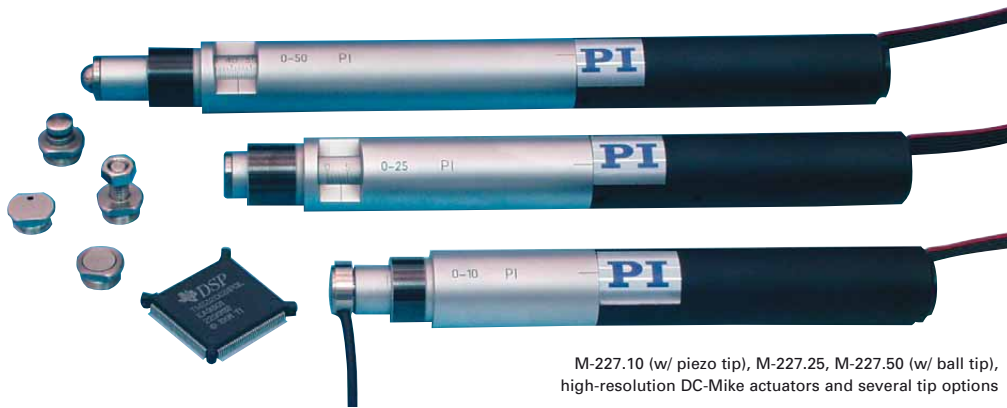


Technical Data

Model	M-168.12S	M-168.22S	M-168.52S	Unit
Travel range	10	25	50	mm
Design resolution	0.078	0.078	0.078	μm
Min. incremental motion	0.3	0.3	0.3	μm
Unidirectional repeatability	0.1	0.1	0.1	μm
Backlash	2	2	2	μm
Max. velocity	5	5	5	mm/s
Max. push/pull force	50	50	50	N
Max. lateral force	0.02	0.02	0.02	N (at tip)
Motor resolution*	6400*	6400*	6400*	steps/rev.
Drive screw pitch	0.5	0.5	0.5	mm/rev.
Weight	0.4	0.45	0.5	kg
Recommended motor controllers	C-663 single-axis	C-663 single-axis	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

M-227 High-Resolution Micropositioning Actuator w/ DC Motor Non-Rotating Tip, Long Stroke to 50 mm



M-227.10 (w/ piezo tip), M-227.25, M-227.50 (w/ ball tip), high-resolution DC-Mike actuators and several tip options

Ordering Information

- M-227.10**
High-Resolution DC-Mike Linear Actuator, 10 mm
- M-227.25**
High-Resolution DC-Mike Linear Actuator, 25 mm
- M-227.50**
High-Resolution DC-Mike Linear Actuator, 50 mm
- M-219.10**
Ball Tip
- P-855.20**
Piezo Actuator for Micrometer Drive

- Travel Ranges 10, 25 and 50 mm
- Min. Incremental Motion to 0.05 μm
- Non-Rotating Tip
- Closed-Loop DC-Motors
- Sub-nm Resolution with Optional PZT Drive
- MTBF >5,000 h

M-227 are ultra-high-resolution linear actuators providing linear motion up to 50 mm with sub-micron resolution in a compact package. They consist of a micrometer with non-rotating tip, driven by a closed-loop DC-motor/gearhead combination with motor-shaft-mounted high-resolution encoder. The combination of an extremely low stiction/friction construction and high-resolution encoder allows for a minimum incremental motion of 50 nanometers at speeds up to 1 mm/sec.

Non-Rotating Tip

Compared to conventional rotating-tip micrometer drives, the non-rotating-tip design offers several advantages:

- Elimination of torque-induced positioning errors
- Elimination of sinusoidal motion errors
- Elimination of wear at the contact point
- Elimination of tip-angle-dependent wobble

Compact, High-Precision, Cost-Effective

M-227 actuators provide a cost-effective solution for industrial and OEM environments.

Integrated Line Drivers

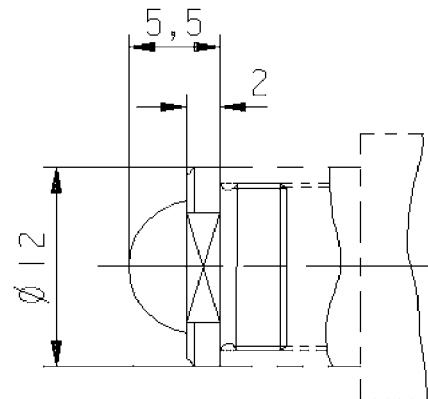
All actuators include an integral 0.5 m cable with 15-pin sub-D connector and come with a 3 m extension cable. On the DC servo versions, the connector features integrated line drivers for cable lengths up to 10 meters between actuator and controller.

High-Resolution Piezo Option

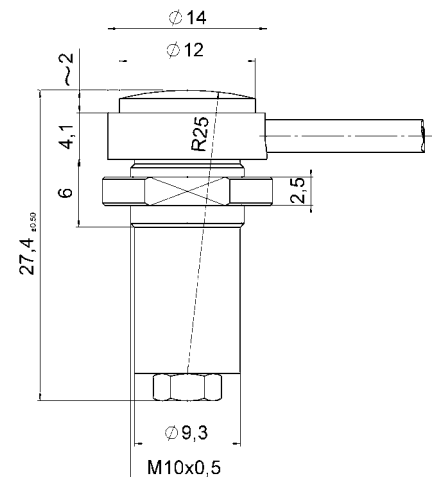
All models come with standard flat tips. A variety of other tips are also available, such as a piezoelectric tip featuring 20 μm travel with sub-nanometer resolution for dynamic scanning and tracking see p. 1-73 and 1-58.

For higher loads and integrated limit switches refer to the

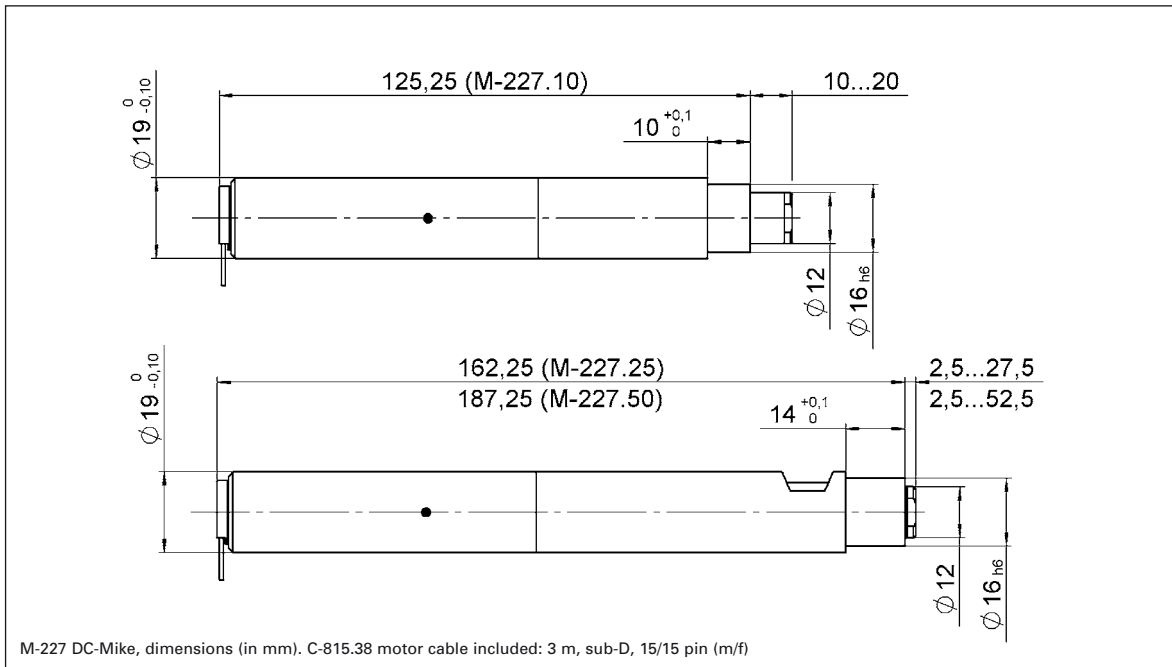
M-230 (see p. 1-46 ff), M-235 (see p. 1-50 ff) and M-238.



M-219.10 ball tip option



P-855.20 piezo tip option



Technical Data

Model	M-227.10	M-227.25	M-227.50	Units
Active axes	X	X	X	
Motion and positioning				
Travel range	10	25	50	mm
Integrated sensor	Rotary encoder	Rotary encoder	Rotary encoder	
Sensor resolution	2048	2048	2048	Cts./rev.
Design resolution	0.0035	0.0035	0.0035	µm
Min. incremental motion	0.05	0.05	0.05	µm
Backlash	2	2	2	µm
Unidirectional repeatability	0.1	0.1	0.1	µm
Max. velocity	0.75	0.75	0.75	mm/s
Mechanical properties				
Drive screw	Leadscrew	Leadscrew	Leadscrew	
Thread pitch	0.5	0.5	0.5	mm
Gear ratio	69.12:1	69.12:1	69.12:1	
Max. push/pull force	40	40	40	N
Max. lateral force	0.1	0.1	0.1	N
Drive properties				
Motor type	DC-motor, gearhead	DC-motor, gearhead	DC-motor, gearhead	
Operating voltage	0 to ±12	0 to ±12	0 to ±12	V
Electrical power	1.25	1.25	1.25	W
Miscellaneous				
Operating temperature range	-20 to +65	-20 to +65	-20 to +65	°C
Material	Al (anodized), steel	Al (anodized), steel	Al (anodized), steel	
Mass	0.16	0.22	0.26	kg
Cable length	0.1	0.1	0.1	m
Connector	15-pin sub-D connector	15-pin sub-D connector	15-pin sub-D connector	
Recommended controller/driver	C-863 single-axis C-843 PCI-board, for up to 4 axes	C-863 single-axis C-843 PCI-board, for up to 4 axes	C-863 single-axis (see p. 4-114) C-843 PCI-board, for up to 4 axes (see p. 4-120)	

*Higher forces on request

Program Overview

- Piezo Ceramic Actuators & Motors
- Piezo Nanopositioning Systems and Scanners
- Active Optics / Tip-Tilt Platforms
- Capacitive Nanometrology Sensors
- Piezo Electronics: Amplifiers and Controllers
- Hexapod 6-Axis Positioners / Robots
- Micropositioning Stages & Actuators
- Photonics Alignment Systems, Solutions for Telecommunications
- Motor Controllers
- Ultrasonic Linear Motors

Request or download the complete PI Nanopositioning & Piezo Actuator Catalog



USA (East) & CANADA

PI (Physik Instrumente) L.P.
16 Albert St.
Auburn, MA 01501
Tel: +1 (508) 832 3456
Fax: +1 (508) 832 0506
info@pi-usa.us
www.pi-usa.us

USA (West) & MEXICO

PI (Physik Instrumente) L.P.
5420 Trabuco Rd., Suite 100
Irvine, CA 92620
Tel: +1 (949) 679 9191
Fax: +1 (949) 679 9292
info@pi-usa.us
www.pi-usa.us

JAPAN

PI Japan Co., Ltd.
Akebono-cho 2-38-5
Tachikawa-shi
J-Tokyo 190
Tel: +81 (42) 526 7300
Fax: +81 (42) 526 7301
info@pi-japan.jp
www.pi-japan.jp

PI Japan Co., Ltd.
Hanahara Dai-ni Building, #703
4-11-27 Nishinakajima,
Yodogawa-ku, Osaka-shi
J-Osaka 532
Tel: +81 (6) 6304 5605
Fax: +81 (6) 6304 5606
info@pi-japan.jp
www.pi-japan.jp

CHINA

**Physik Instrumente
(PI Shanghai) Co., Ltd.**
Building No. 7-301
Longdong Avenue 3000
201203 Shanghai, China
Tel: +86 (21) 687 900 08
Fax: +86 (21) 687 900 98
info@pi-china.cn
www.pi-china.cn

UK & IRELAND

PI (Physik Instrumente) Ltd.
Trent House
University Way,
Cranfield Technology Park,
Cranfield,
Bedford MK43 0AN
Tel: +44 (1234) 756 360
Fax: +44 (1234) 756 369
uk@pi.ws
www.physikinstrumente.co.uk

FRANCE

PI France S.A.S
244 bis, avenue Max Dormoy
92120 Montrouge
Tel: +33 (1) 55 22 60 00
Fax: +33 (1) 41 48 56 62
info.france@pi.ws
www.pi-france.fr

ITALY

Physik Instrumente (PI) S.r.l.
Via G. Marconi, 28
I-20091 Bresso (MI)
Tel: +39 (02) 665 011 01
Fax: +39 (02) 873 859 16
info@pionline.it
www.pionline.it

GERMANY

**Physik Instrumente (PI)
GmbH & Co. KG**
Auf der Römerstr. 1
D-76228 Karlsruhe/Palmbach
Tel: +49 (721) 4846-0
Fax: +49 (721) 4846-100
info@pi.ws · www.pi.ws