

Miniature Precision Translation Stages

Controlling Motion with Servo Motors, Piezo Motors, Stepper Motors



M-122 Precision Micro-Translation Stage

Fast & Compact with Direct Position Measurement



The M-122.2DD miniature translation stage features an optical linear encoder with 0.1 μm position resolution and a highly efficient ballscrew

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

The M-122 palm-top-sized translation stage combines small dimensions, high speeds and very high accuracy at a competitive price. It features a space-saving, folded drive train with the servo motor and drive screw side-by-side. Equipped with a non-contacting optical linear encoder and a preloaded, precision-ground, ball screw, these stages can provide much higher accuracy and better repeatability than conventional stepper motor stages or rotary encoder-equipped servo motor stages.

Low Friction, High Speed, Maintenance-Free

Due to its low-friction, the backlash-free ball screw yields significantly higher mechanical

efficiency than leadscrews, and allows maintenance-free, high duty-cycle operation at high velocities up to 20 mm/sec.

XY and XYZ Combinations

M-122 stages can be combined to very compact XY and XYZ systems. The M-122.AP1 mounting bracket is available to mount the Z-axis.

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

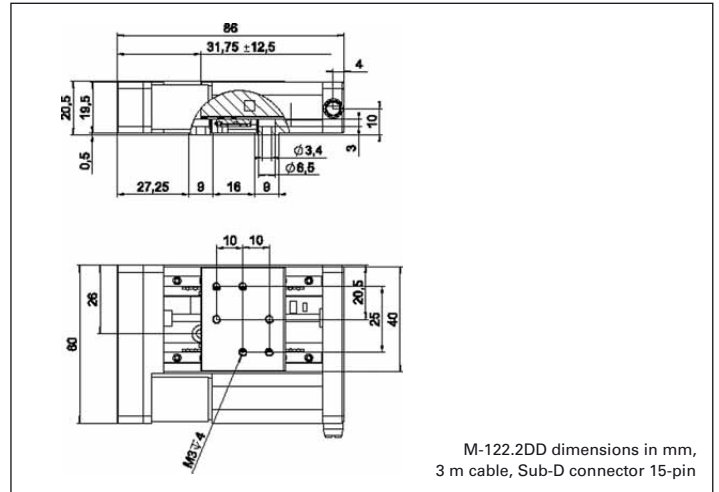
The combination of these positioners with the networkable, single-channel C-863 Mercury™ servo motor controller (s. p. 4-114) offers high performance for a very competitive price in both single- and multi-axis configurations. For multi-axis applications, the C-843 PC plug-in controller board with on-board servo amplifiers (s. p. 4-120) is another cost-effective alternative.

Ordering Information

M-122.2DD
High-Precision Translation Stage,
25 mm, Direct-Drive DC Motor,
Ballscrew

Accessories

M-122.AP1
Angle bracket for vertical
mounting of M-122 stages
Ask about custom designs



Technical Data

Model	M-122.2DD
Active axes	X
Motion and positioning	
Travel range	25 mm
Integrated sensor	Linear encoder
Sensor resolution	0.1 μm
Design resolution	0.1 μm
Min. incremental motion	0.2 μm
Backlash	0.2 μm
Unidirectional repeatability	0.15 μm
Pitch	$\pm 150 \mu\text{rad}$
Yaw	$\pm 150 \mu\text{rad}$
Max. velocity	20 mm/s
Origin repeatability	1 μm
Mechanical properties	
Drive screw	Recirculating ballscrew
Thread pitch	0.5 mm
Stiffness in motion direction	0.25 N/ μm
Max. load	50 N
Max. push/pull force	20 N
Max. lateral force	25 N
Drive properties	
Motor type	DC motor
Operating voltage	0 to $\pm 12 \text{ V}$
Electrical power	2.25 W
Limit and reference switches	Hall-effect
Miscellaneous	
Operating temperature range	-20 to +65
Material	Aluminum, steel
Dimensions	86 x 60 x 20.5 mm
Mass	0.22 kg
Recommended controller/driver	C-863 (single-axis) C-843 PCI board (up to 4 axes)

Application Examples

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

M-110 · M-111 · M-112 Compact Micro-Translation Stage

Choice of Drives & Travel Ranges, XY(Z) Combinations Possible



M-110 stage and XYZ combination

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

M-110, M-111 and M-112 are ultra-high resolution motorized translation stages providing linear motion of 5 to 25 mm in an extremely compact package. They feature a precision lead-screw with sub-micron resolution

and precision linear ball bearings guaranteeing $<0.5 \mu\text{m}$ straightness of travel.

Compact Dimensions, High Performance

To meet industrial demands, the M-11x.2 linear translation stages are equipped with a recirculating ball screw for precise motion with reduced friction. This allows 24/7 duty cycles. M-110, M-111 and M-112 can be combined to XY and XYZ systems for multiaxis alignment applications.

Stepper and Servo Motors

A miniature DC or stepper motor actuates motion via a backlash-compensated screw /

Ordering Information

Translation stage

- 0 Travel Range 5 mm
 - 1 Travel Range 15 mm
 - 2 Travel Range 25 mm
- M-11
- 1 Leadscrew
 - 2 Ball screw

- DG DC Motor Gearhead
- 2S Stepper Motor with Gearhead

Ask about custom designs!



F-130 fiber alignment system consisting of an M-110 XYZ positioning system and a P-611 XYZ Piezo-Nano Positioning system. This combination can be operated by the C-880 controller or NI controllers (request our technote!)

nut system and gearhead. Both drive options provide a cost-effective solution for industrial and OEM environments. To meet the most critical positioning demands, the DC motor is equipped with a high resolution encoder featuring resolution down to $0.007 \mu\text{m}$ per count.

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-116.DG micro rotary stage M-110

All stages 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 stage and controller (DC-motors only).

Low Cost of Ownership

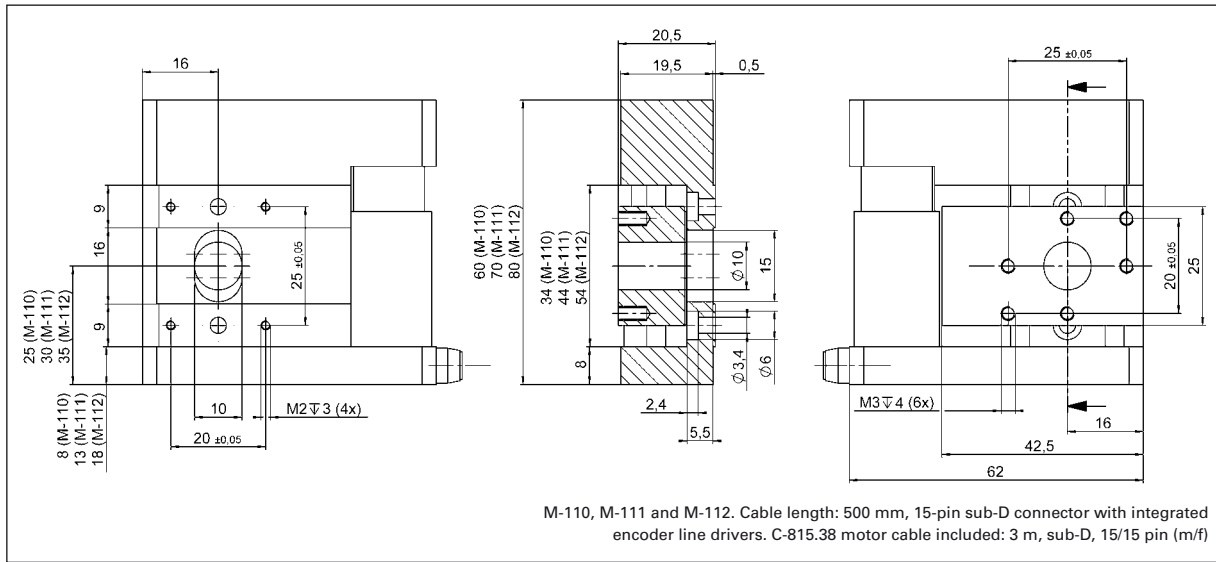
The combination of these positioners with the networkable, single-channel C-863 Mercury™ (DC-Motor, see p. 4-114) or C-663 Mercury™ Step (see p. 4-112) controller offers high performance for a very competitive price in both single- and multi-axis configurations. For 3 or 4 axes, the C-843 PC plug-in board for DC motors (see p. 4-120) can also be recommended.



XY θ_z micropositioning combination consisting of (from top to bottom) M-116 micro rotary stage and two M-111 translation stages (M-110.01 adapter for mounting the M-111 on a honeycomb breadboard)

Application Examples

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



Technical Data

Model	M-110.1DG / M-111.1DG / M-112.1DG	M-110.12S / M-111.12S / M-112.12S	M-110.2DG / M-111.2DG / M-112.2DG	M-110.22S / M-111.22S / M-112.22S	Units
Motion and positioning					
Travel range	5 / 15 / 25	5 / 15 / 25	5 / 15 / 25	5 / 15 / 25	mm
Integrated sensor	Rotary encoder	–	Rotary encoder	–	
Sensor resolution	2048		2048		Cts./rev.
Design resolution	0.0069	0.038*	0.0086	0.046*	µm
Min. incremental motion	0.05	0.05	0.2	0.2	µm
Backlash	2	2	4	4	µm
Unidirectional repeatability	0.1	0.1	0.5	0.5	µm
Pitch / Yaw	±50 / ±150 / ±150	±50 / ±150 / ±150	±50 / ±150 / ±150	±50 / ±150 / ±150	µrad
Max. velocity	1 / 1.5 / 1.5	1 / 1 / 1	1.5 / 2 / 2	1 / 1 / 1	mm/s
Mechanical properties					
Drive screw	Leadscrew	Leadscrew	Recirculating ballscrew	Recirculating ballscrew	
Thread pitch	0.4	0.4	0.5	0.5	mm
Gear ratio	28.44444:1	28.44444:1	28.44444:1	28.44444:1	
Motor resolution*	–	384*	–	384*	
Max. load	30 / 30 / 20	30 / 30 / 20	30 / 30 / 20	30 / 30 / 20	N
Max. push / pull force	10	10	10	10	N
Max. holding force	10	10	10	10	N
Max. lateral force	15 / 10 / 10	15 / 10 / 10	15 / 10 / 10	15 / 10 / 10	N
Drive properties					
Motor type	DC-motor, gearhead	2-phase stepper motor	DC-motor, gearhead	2-phase stepper motor	
Operating voltage	0 to ±12	24	0 to ±12	24	V
Electrical power	0.52 / 1.75 / 1.75	1.5	0.52 / 1.75 / 1.75	1.5	W
Current consumption	160 / 320 / 320**		160 / 320 / 320**		mA
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 (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	
Mass	0.3 / 0.4 / 0.5	0.3 / 0.4 / 0.5	0.3 / 0.4 / 0.5	0.3 / 0.4 / 0.5	kg
Recommended controller/driver	C-863 single-axis C-843 PCI board, for up to 4 axes	C-863 single-axis	C-863 single-axis C-843 PCI board, for up to 4 axes	C-863 single-axis	

*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

**thermally limited

M-126 High-Resolution Translation Stage

Compact Linear Stage with Crossed Roller Bearings



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

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

M-126 micropositioning systems are compact, high-precision translation stages with preloaded leadscrew and ballscrew drives for excellent resolution and repeatability. All models are equipped with precision crossed roller bearings providing straightness of travel of better than 2 μm .

Five motorized versions are available: M-126.CG1 utilizes a compact closed-loop DC motor with shaft-mounted high-resolution position encoder and a precision gearhead providing 0.1 μm minimum incremental motion, M-126.DG1 is equipped with a larger motor than M-126.CG1 and provides higher velocity. The M-126.2S1 stepper motor version has a 2-phase stepper motor that provides a minimum incremental motion of 0.1 μm (controller depending).

Higher Speed with ActiveDrive™ and Ballscrews

The top-of-the-line M-126.PD2 is equipped with a low friction ballscrew and provides ve-

locities to 50 mm/sec. Model M-126.PD1 features a leadscrew and is recommended for lower speeds to 15 mm/sec and/or duty cycle applications. Both versions boast the high-performance ActiveDrive™. PI's ActiveDrive™ design, 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**

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.

XY and XYZ Combinations

All stages can be cross-stacked and combined with the M-125.90 Z-axis mounting bracket to provide multi-axis motion.

Notes

For adapters, bracket, etc. see p. 4-90 *ff.*



M-126.M0 translation stage, manual version

Ordering Information

M-126.CG1
Translation Stage, 25 mm, Compact DC Motor Gearhead

M-126.DG1
Translation Stage, 25 mm, DC Motor Gearhead

M-126.PD1
Translation Stage, 25 mm, ActiveDrive™ DC Motor (includes 24 V power supply)

M-126.PD2
Translation Stage, 20 mm, ActiveDrive™ DC Motor, Ballscrew (includes 24 V power supply)

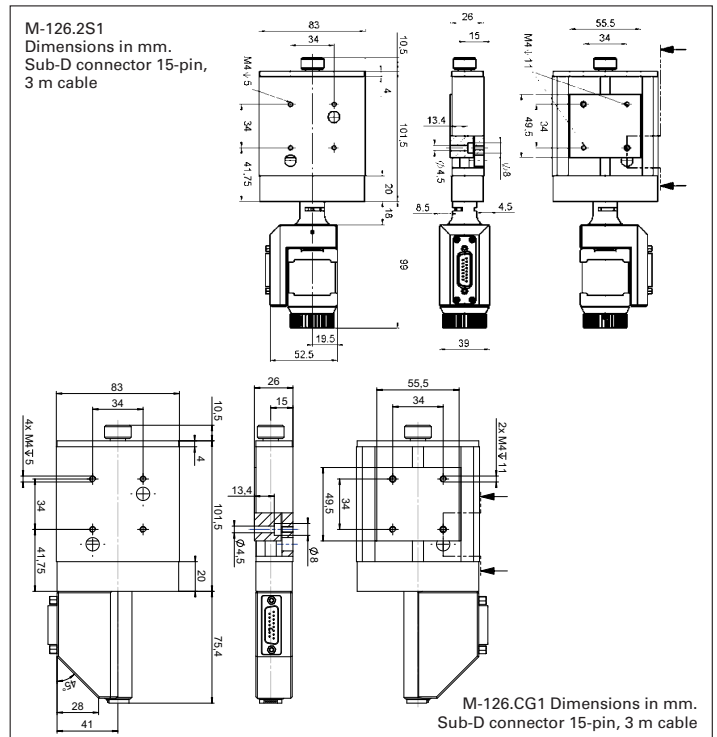
M-126.2S1
Translation Stage, 25 mm, 2-Phase Stepper Motor

M-126.M0
Translation Stage, 25 mm, Manual Drive, Leadscrew

M-125.90
Z-axis Mounting Bracket for Vertical Mount of M-126 Stages

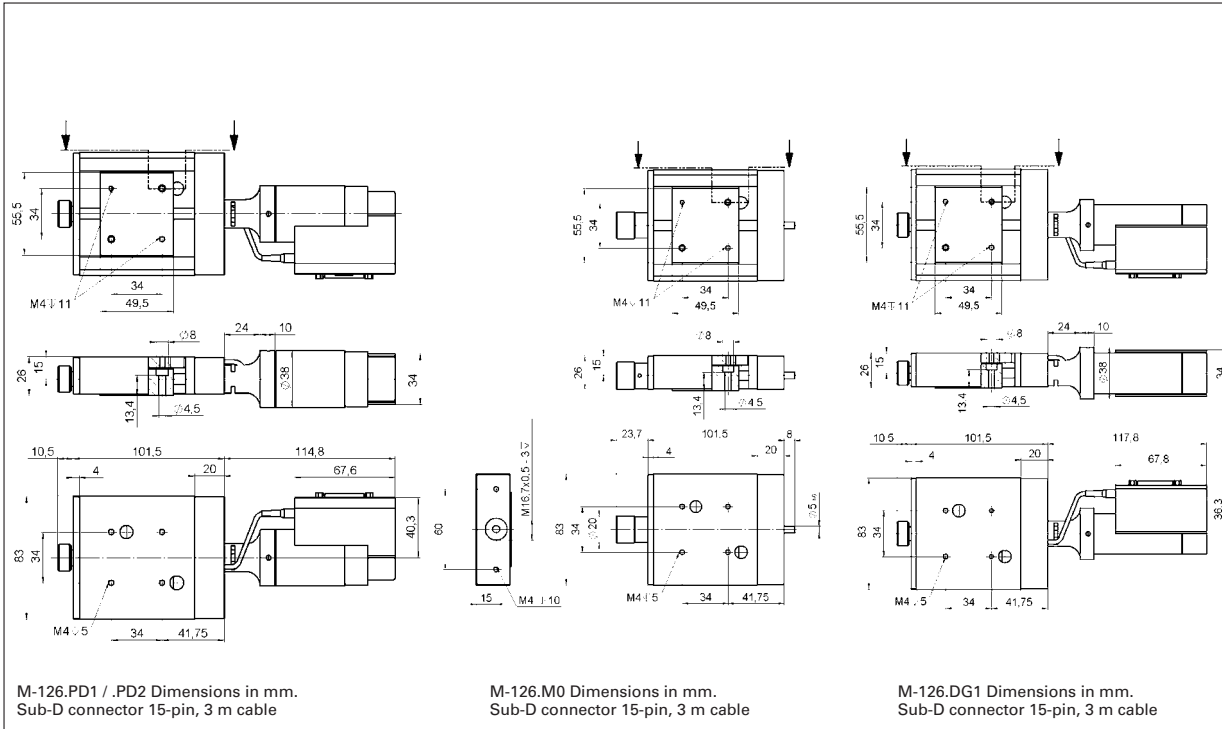
M-126.80
Adapter Plate for Honeycomb Tables

Ask about custom designs!





M-126.2S1 translation stage with 2-phase stepper motor (pen for size comparison)


Technical Data

Model	M-126.M0	M-126.CG1	M-126.DG1	M-126.PD1	M-126.PD2	M-126.2S1	Units
Active Axes	X	X	X	X	X	X	
Motion and positioning							
Travel range	25	25	25	25	20	25	mm
Integrated sensor	-	Rotary encoder	Rotary encoder	Rotary encoder	Rotary encoder	-	
Sensor resolution	-	2048	2000	4000	4000	-	Cts./rev
Design resolution	-	0.0035	0.0085	0.125	0.25	0.08**	µm
Min. incremental motion	1	0.1	0.1	0.25	0.5	0.1**	µm
Unidirectional repeatability	-	0.2	0.1	0.1	0.3	0.1**	µm
Bidirectional repeatability	-	2	1	1	1	1**	µm
Accuracy	-	2.5	2.5	2.5	2.5	2.5	µm
Pitch / Yaw	±50	±50	±50	±50	±50	±50	µrad
Straightness / Flatness	2	2	2	2	2	2	µm
Max. velocity	-	0.7	1.5	15*	50	6**	mm/s
Origin repeatability	-	1	1	1	1	1	µm
Mechanical properties							
Drive Screw	Leadscrew	Leadscrew	Leadscrew	Leadscrew	Recirculating ballscrew	Leadscrew	
Thread pitch	0.5	0.5	0.5	0.5	1	0.5	mm
Gear ratio	-	69.12:1	(28/12) ^{±0.1} ~ 29.6:1	-	-	-	
Motor resolution	-	-	-	-	-	6400**	steps/rev.
Max. load	200	200	200	200	200	200	N
Max. push / pull force	50 / 50	40 / 40	50 / 50	50 / 50	40 / 40	50 / 50	N
Max. lateral force	100	100	100	100	100	100	N
Drive properties							
Motor type	-	DC Motor, gearhead	DC Motor, gearhead	ActiveDrive™ DC Motor	ActiveDrive™ DC Motor	2-phase stepper motor	
Operating voltage	-	0 to ±12	0 to ±12	24 (PWM)	24 (PWM)	24	V
Electrical power	-	2	3	30	30		W
Limit and reference switches	-	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	Aluminum, steel	Aluminum, steel	Aluminum, steel	Aluminum, steel	Aluminum, steel	Aluminum, steel	
Mass	0.6	0.8	0.9	0.9	0.9	1	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-863 single-axis C-843 PCI board, for up to 4 axes	C-863 single-axis (p. 4-114) C-843 PCI board (p. 4-120), for up to 4 axes	C-863 single-axis (p. 4-112)	

*Max. recommended velocity

**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

High-Resolution Translation Stage

NANOMETER STEP SIZES



N-664

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

Reference-class translation stage with linear motor

Piezo motor-based direct drive

NEXACT® piezo stepping motor with subnanometer resolution. High load capacity and precision due to crossed roller bearings. Reference switch. Low operating voltage. Self-locking at rest, no heat generation

Direct measuring principle

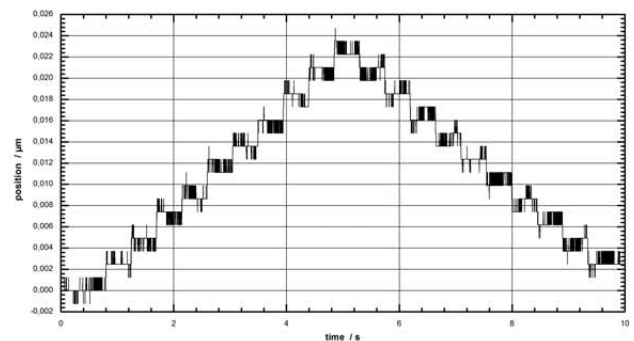
High-precision linear encoder PIONE with subnanometer resolution

Application fields

Research and industry. Option: vacuum version

Related Products

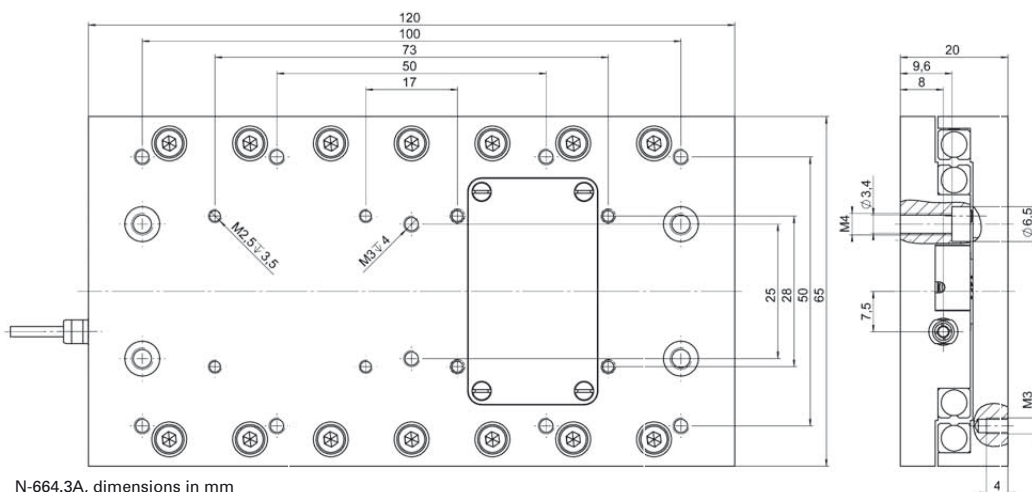
- M-511.HD Nano-Precision Heavy-Duty Stage
- N-661 Miniature Linear Stage with NEXACT® Drive



2 nm steps of a N-664.3A with an E-861 Controller

	N-664.3A	Units	Tolerance
Active axes	X		
Motion and positioning			
Travel range	30	mm	
Min. incremental motion	2	nm	
Integrated sensor	PIOne linear nanometrology encoder		
Open-loop resolution	0.03	nm	typ.
Closed-loop resolution	0.5*	nm	
Max. step frequency, open-loop	0.8	kHz	max.
Max. velocity	10*	mm/s	max.
Linearity	< 0.002% (0,5 μm) along the entire travel range; 0.03% (5 nm) along 20 μm		
Bidirectional repeatability	< 10	nm	
Pitch	40	μrad	typ.
Yaw	40	μrad	typ.
Mechanical properties			
Stiffness in motion direction	2.5	N/μm	±20%
Max. load	20	N	
Max. push / pull force (active)	10	N	max.
Max. holding force (passive)	15	N	min.
Lateral force	50	N	max.
Drive properties			
Drive type	NEXACT® linear drive		
Operating voltage	-10 to +45	V	
Miscellaneous			
Operating temperature range	0 to 50	°C	
Material	Aluminum, nickel-plated		
Mass	530	g	±5%
Cable length	1.5	m	±10 mm
Connector	HD sub-D connector, 15-pin (motor) Sub-D 15 (f) 15-pin (sensor)		
Recommended controller	E-861 controller for NEXACT® linear drives and positioners		

* With E-861. Depending on drive electronics



N-664.3A, dimensions in mm

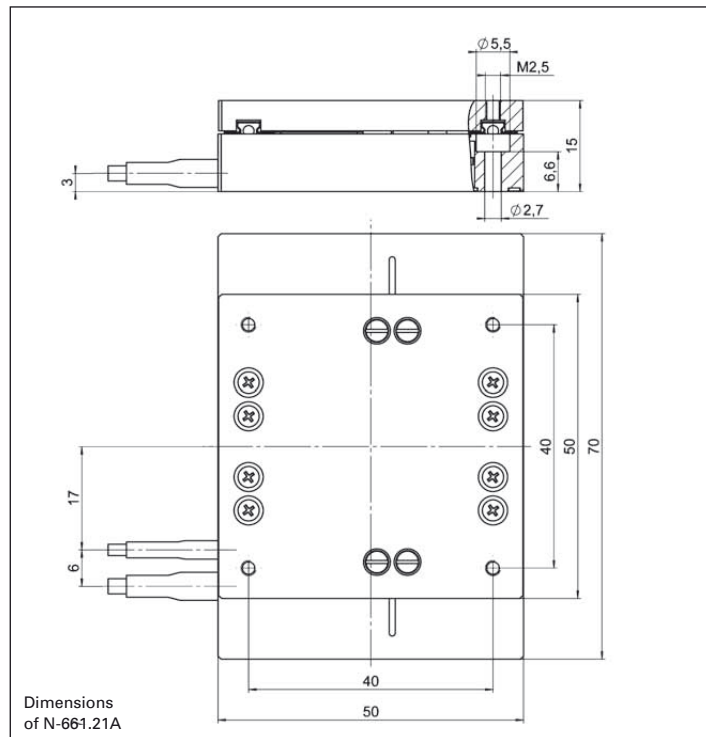
N-661 Miniature Linear Slide with NEXACT® Drive

PiezoWalk® Drive Provides Nanometer Precision, Smooth Motion and Rapid Response



The N-661 miniature linear stage integrates a PiezoWalk® NEXACT® linear motor combined with a high-resolution linear encoder. It provides 20 mm travel and resolution down to the nanometer range.

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



The compact N-661 nanopositioning stage is based on the NEXACT® PiezoWalk® drive. This dual-mode, high-performance piezo stepping linear motor can provide sub-nanometer resolution and high force, along with very rapid response. When run in its analog mode, fast oscillations with amplitudes up to 7 microns and resolutions down to 30 pm can be achieved. This mode is of great value in high-throughput applications as well as in dynamic laser tuning, cell penetration applications, or even for active vibration damping. The stage is equipped with a precision guiding system and an optical linear encoder to enable highly repeatable positioning.

Ordering Information

N-661.21A
Miniature NEXACT® Translation Stage, 20 mm, Linear Encoder, 20 nm Resolution

Ask about custom designs

Application Examples

- Life science
- Photonics
- Laser tuning
- Motion in strong magnetic fields

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

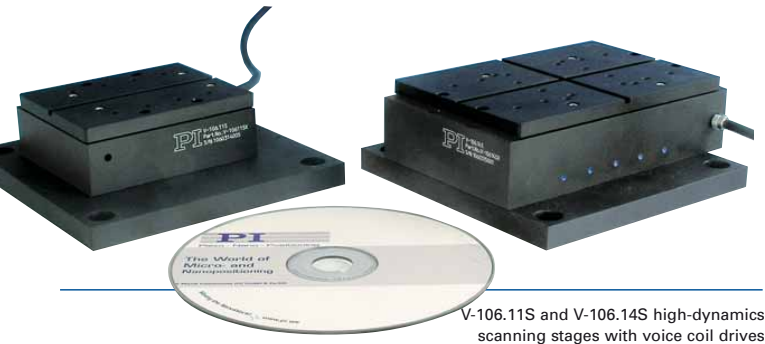
Technical Data

Model	N-661.21A
Active axes	X
Motion and positioning	
Travel range	20 mm
Step size in stepping mode (open-loop)	To 5 µm
Integrated sensor	Linear encoder
Sensor resolution	20 nm *
Travel range in analog mode	7 µm
Open-loop resolution	0.03 nm
Closed-loop resolution	20 nm*
Bidirectional repeatability	200 nm
Pitch	500 µrad
Yaw	150 µrad
Max. Step frequency (open-loop)	0.8 kHz
Max. velocity	10 mm/s*
Mechanical properties	
Stiffness in motion direction	2.4 N/µm
Max. load capacity	20 N
Max. push / pull force (active)	10 N
Max. holding force (passive)	15 N
Lateral Force	20 N
Drive properties	
Drive type	NEXACT® linear drive
Operating Voltage	-10 V to +45 V
Miscellaneous	
Operating temperature range	0 to 50 °C
Material	Aluminum
Mass	150 g
Cable length	1.5 m
Connector	15-pin sub-HDD connector, one channel
Recommended controller/driver	E-861.1A1 Controller for NEXACT® (see p. 1-20)

*With E-861. Depending on drive electronics.

V-106 QuickScan™ High-Dynamics Scanner

Voice-Coil Drive with Direct Position Measurement



V-106.11S and V-106.14S high-dynamics scanning stages with voice coil drives

- **Fast Scanning and Positioning**
- **Travel Ranges of 20 mm and 6 mm**
- **Linear Encoder Provides 0.1 μm Resolution, 0.2 μm Repeatability**
- **Scanning Frequency to Tens of Hz**
- **Velocity up to 270 mm/s**
- **PCI-Card Controller with On-Board Amplifiers Available**

QuickScan™ micropositioning stages of the V-106 series were designed for high-dynamics precision scanning and positioning applications, like those in biotechnology and fiber optics. They are based on zero-friction voice coil drives (linear motors), which, combined with high-precision linear encoders, offer a position resolution of 0.1 μm and minimal step size of 0.2 μm.

V-106 micropositioning stages achieve significantly higher dynamics than leadscrew-based units. The specially design-

ed voice coil drive system makes possible scanning frequencies of some tens of hertz. With an applied load of 90 grams, the scan frequency of the V-106.11S is still 20 Hz over a travel range of 1 mm. The excellent dynamic characteristics are advantageous not only for scanning applications: positioning tasks see them as short settling times like 75 ms for 5 mm with a 90 gram load.

Direct Drive and Direct Metrology—Precise Motion

The design of the V-106 is based on three key precision components:

- A frictionless voice-coil (linear motor) drive
- A non-contacting direct-motion metrology linear encoder for sub-micron repeatability
- Precision cross-roller bearings for ultra-straight and smooth motion

Unlike leadscrew-driven translation stages, the voice-coil lin-

ear-motor in the V-106 is frictionless, quiet and not subject to wear and tear. In addition, it provides higher dynamics, speed, acceleration and responsiveness (step-and-settle)—ideal features for high-throughput applications. The embedded drive also reduces the length considerably compared to conventional motor/screw-driven stages.

For highly repeatable motion, a non-contacting optical linear encoder with 0.1 μm resolution is mounted inside the stage and feeds position information back to the motion controller.

The integrated, non-contact reference switch increases versatility in automation applications.

Versatile PCI Board Controller

V-106 voice coil stages can be controlled by the C-843 digital controller in PCI plug-in-board format. C-843 controllers are equipped with on-board linear servo-amplifiers for precise control of up to four axes. This lowers system costs and simplifies setup by eliminating additional external amplifiers and cables.

Ordering Information

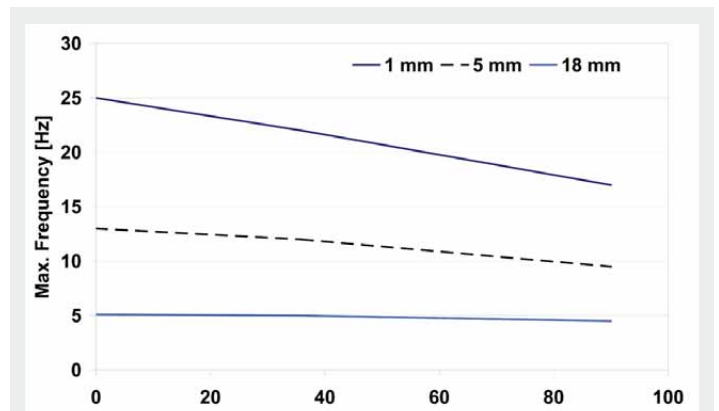
V-106.11S
QuickScan Voice Coil Scanning Stage, 6 mm

V-106.14S
QuickScan Voice Coil Scanning Stage, 20 mm

Frictionless Voice Coil Linear Drives

High-accuracy voice coil linear drives work on the same principle as electromagnetic loudspeakers. However, for precision positioning applications, they must provide much higher forces and high stability to hold a position without jitter. They must also be designed for closed-loop operation to allow for precise positioning.

These zero-friction magnetic linear drives, characterized by their excellent dynamics, are ideally suited for scanning applications requiring travel ranges in the millimeter to centimeter range. PI offers voice coil drives in V-106 standard systems; custom systems are available on request.



V-106.14S maximum scanning frequency for different loads and scan amplitudes for example 18 mm scans with up to 90 g load at >4 Hz frequency are feasible. The velocity is up to 270 mm/s

High-Speed Piezo Linear Motor-Driven Stages

M-661 / M-662 PLine® Open-Loop Translation Stages with Piezo Linear Motors



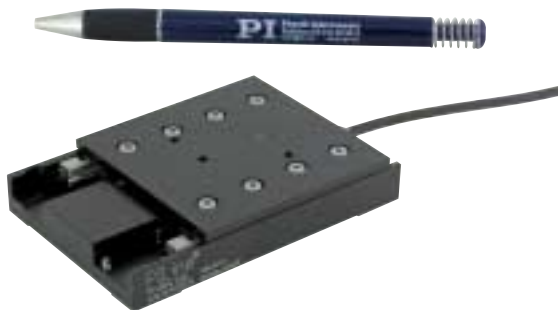
PLine® M-662 (left side) and M-661 stages are the smallest piezo-motor-driven translation stages available on the market that achieve speeds of up to 500 mm/s.

- Smallest Translation Stages with Linear Piezomotor Drive
- Travel Ranges to 20 mm
- Max. Velocity 500 mm/s
- Acceleration 10 g
- Incremental Motion to 50 nm
- XY Combinations Possible

Model	Travel Range	Drive Type / Pushing Force	Unidir. Repeatability	Maximum Velocity	Dimensions
M-661.370	18 mm	PLine® P-661, 2 N	-	500 mm/s	30 x 23 x 10 mm
M-662.470	20 mm	PLine® P-661, 2 N	-	500 mm/s	28 x 28x 8 mm

M-664

Ultra-Low-Profile PLine® Linear Stage with Linear Encoder



The M-664 linear translation stage with a profile height of only 15 mm

- Travel Range 25 mm
- Low Profile 15 mm
- Max. Velocity 400 mm/s
- Up to 6 N Pushing Force
- Direct Metrology Linear Encoder, 0,1 µm Resolution
- High Guiding Accuracy from Crossed Roller Bearings
- XY Combinations Possible

Model	Travel Range	Drive Unidir	Repeatability	Maximum Velocity	Dimensions
M-664.164	25 mm	PLine® P-664, 6 N	0.3 µm	400 mm/s	90 x 60 x 15 mm

M-674K High-Precision Z Actuator for Bio-Automation

Ceramic PLine® Motor and Linear Encoder for High Speed & Precision

Equipped with two ultrasonic piezo-motors, the slim M-674KCPP offers up to 7 N push and pull force. The 9 mm width is matched to standard multiwell plate sizes, ideally suited to automation tasks in biotechnology



- High Speed to 100 mm/sec
- High Push/Pull Force to 7 N
- Extremely Slim Design, Matched with Standard Multiwell Plates
- Stackable
- Integrated Linear Encoder for Highest Accuracy
- Self Locking at Rest
- Non-Magnetic and Vacuum-Compatible Working Principle

Model	Travel	Push/pull force	Velocity	Resolution	Dimensions
M-674KCPP Compact PLine® Positioner	50 mm	7 N	100 mm/s	0.1 µm	120 x 40 x 9 mm

M-664K Vertical Drive for Bio-Automation

High-Speed, Compact, Cost-Effective, Stackable PLine® Actuator

Stack of 8 M-664KCEP linear actuators, shown with well plate. The integrated ceramic piezomotor provides high speeds to 100 mm/sec. The low-profile design with only 9 mm width allows stacking for multi-channel dispensing in bio-automation tasks



- High Speed to 100 mm/sec
- Slim Design, Matched with Standard Multiwell Plates
- Travel range 50 mm
- Cost-Effective Design
- Stackable
- Non-Magnetic and Vacuum-Compatible Working Principle
- Self Locking at Rest

Model	Travel	Push/pull force	Max. closed-loop velocity	Resolution	Dimensions
M-664KCEP Compact PLine® Positioner	50 mm	5 N	100 mm/s	0.5 µm	120 x 40 x 9 mm

M-682K Non-Magnetic Translation Stage

Low-Profile, High-Speed with Piezo Ceramic Motor



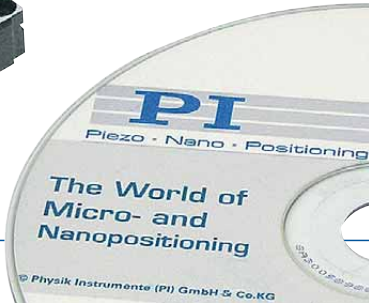
Custom non-magnetic M-682KNMS linear stage with integrated RodDrive linear motor

- Integrated Non-Magnetic PLine® RodDrive
- Travel Range 50 mm
- Integrated Linear Encoders with 0.1 µm Resolution
- Up to 6 N Force Generation
- Closed-Loop Velocity up to 100 mm/s
- Low Profile, Small Footprint

Model	Travel	Load capacity	Max. push/pull force	Dimensions
M-682KNMS PLine® Positioner	50 mm	50 N	6 N	110 x 110 x 20 mm

U-164 PLine® Piezo Linear Drive

Fast, Compact OEM Ultrasonic Linear Motor



OEM ultrasonic piezo linear motor
U-164.01

- Patented Principle Features with High Forces in Small Space
- Easy Mounting
- Max. Velocity 500 mm/s
- Acceleration up to 5 g
- Min. Incremental Motion to 0,05 µm
- Self Locking, Push-/Pull Forces to 4 N
- No Electro-Magnetic Fields
- 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® piezo motors have a new, patented, ultrasonic drive

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.

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

The PLine® motors 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 inside a 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. 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

U-164.01
PLine® Piezo Linear Motor, 4 N

Accessories:

P-664.B01
Friction Bar for PLine® Miniature Linear Piezomotor, 15 mm

P-664.B02
Friction Bar for PLine® Miniature Linear Piezomotor, 25 mm

P-664.B05
Friction Bar for PLine® Miniature Linear Piezomotor, 55 mm

C-184.164
Analog OEM Driver Board for PLine® Motors

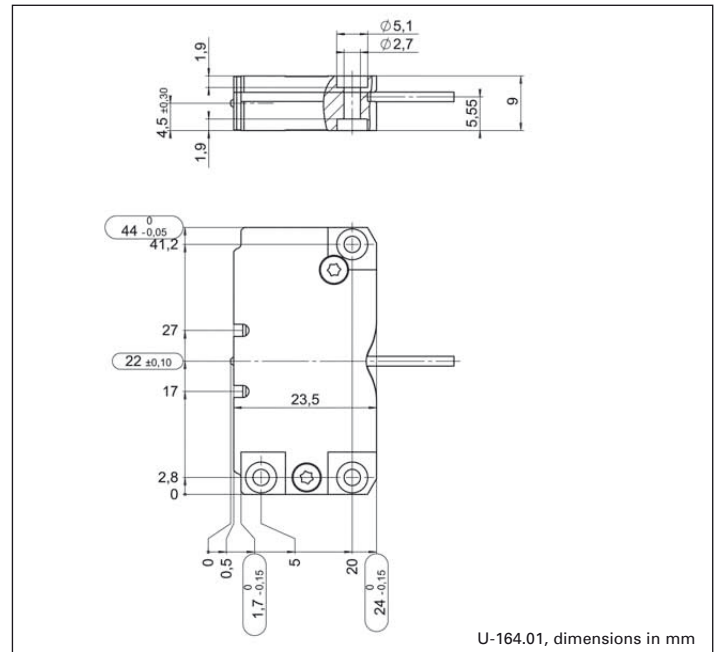
C-185.164
Analog Stand-Alone Drive Electronics with Power Supply for PLine® Motors

Controllers for closed-loop operation are available as C-867 (see p. 4-116).

Ask about custom designs!

Patent Information

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



U-164.01, dimensions in mm

Application Examples

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

Technical Data (preliminary)

Model	U-164.01	Unit	Tolerance
Motion and positioning			
Displacement	unlimited*	mm	
Minimum incremental motion, open-loop	0.05**	μm	typ.
Max. velocity	500	mm/s	
Mechanical properties			
Stiffness when powered down	3	N/μm	±10 %
Holding force when powered down	3	N	Max.
Push / pull force	4	N	Max.
Preload on friction bar	18	N	±10 %
Drive properties			
Resonant frequency	155	kHz	typ.
Motor voltage	60 (RMS)	V	
Operating voltage driver electronics	12	V	
Max. el. power consumption driver	10	W	
Miscellaneous			
Operating temperature range	-20 to +50	°C	
Body material	Al (black anodized)		
Mass	0.02	kg	±5 %
Cable length	1.0	m	±10 mm
Connector	Open leads		
Recommended controller/driver	C-184.164 OEM board C-185.164 in box		

*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 specifications it is important to follow the mounting guidelines of the OEM-motors.

M-663 PLine® Linear Motor Stage

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



PILine® M-663 micropositioning stages, standard & vacuum version w/ C-867 controller/driver in the background

- **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 PLine® Micropositioning Systems

The ultrasonic piezoceramic drives used in PLine® 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 PLine® 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 PLine® Systems with P-661 Motors

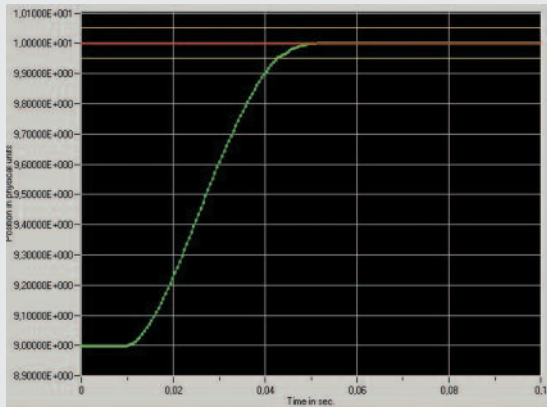
Driver for use with separate controller:

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

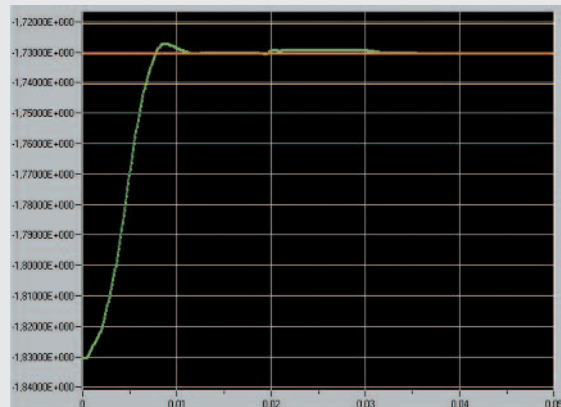
optimum performance the driver must be tuned together with the mechanics and should be ordered at the same time as the motor/stage.

Note

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



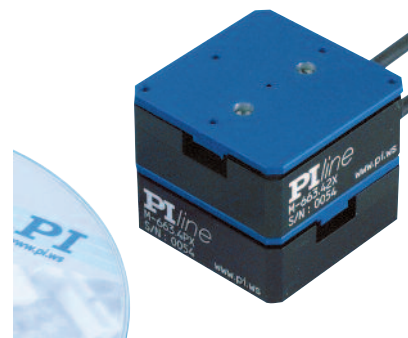
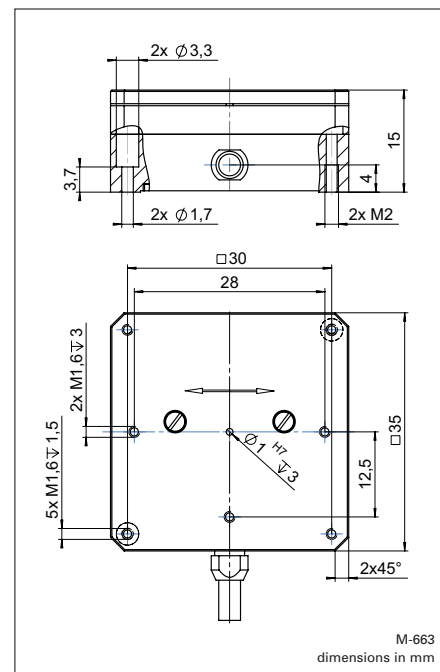
A 1 mm step performed by an M-663 stage with 300 g load controlled by a C-867 controller/driver reaches the end position in less than 40 ms



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	0.1	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	$^{\circ}\text{C}$	
Material	Al (black anodized)		
Dimensions	35 x 35 x 15	mm	
Mass	40	g	$\pm 5\%$
Cable length	1.5	m	$\pm 10\text{ mm}$
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-683 PLine® Precision Micro Translation Stage

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



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

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

- Self Locking at Rest

M-683 precision micropositioning stages make use of PLine® ultrasonic piezo linear motors enabling a compact design and low profile. An integrated linear encoder enables closed-loop control with 0.1 µm resolution. The M-683 translation stages use paired crossed-roller bearings mount-

ed on ground-aluminum profiles for better guiding accuracy. Integrated U-164 PLine® linear motors provide push forces to 6 N and a maximum velocity of up to 350 mm/s. The stages can be arranged to form compact XY systems. If an additional Z-axis is required, the M-110 micro-stage series (see page 4-22) is recommended due to its higher holding force. The M-683 design is scalable and can be extended to provide longer travel ranges to 300 mm. Vacuum-compatible versions are also available on request.

Limit and Reference Switches

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

Advantages of PLine® Micro Positioning Systems

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

- 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
- No Lubricants
- Non-Magnetic and Vacuum Compatible Operating Principle

Optimized Controller and Drive Electronics

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

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

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

Ordering Information

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

Accessories:

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

the mechanics and should be ordered at the same time as the motor/stage.

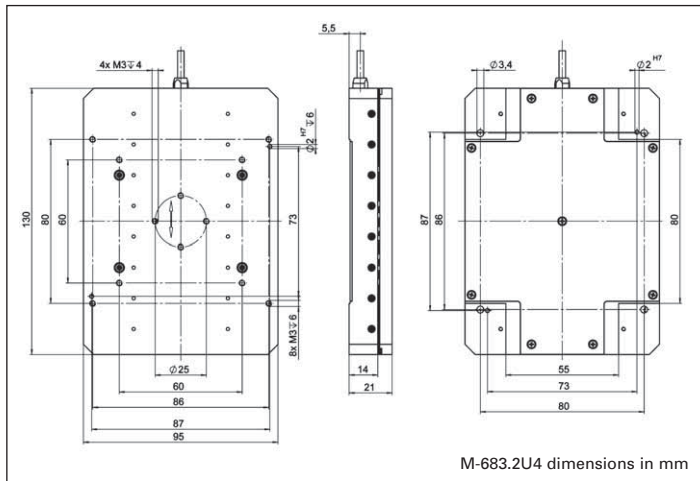
Patent Protection

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

US Pat. No. 6,765,335
German Patent No. 10154526

Application Examples

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



Technical Data

Model	M-683.2U4	Tolerance
Active axes	X	
Motion and positioning		
Travel range	50 mm	
Integrated sensor	Linear encoder	
Sensor resolution	0.1 μm	
Min. incremental motion	0.3 μm	typ.
Bidirectional repeatability	$\pm 1 \mu\text{m}$	typ.
Unidirectional repeatability	0.2 μm	typ.
Pitch	$\pm 150 \mu\text{rad}$	typ.
Yaw	$\pm 50 \mu\text{rad}$	typ.
Max. velocity	350 mm/s	
Reference switch repeatability	1 μm	typ.
Mechanical properties		
Max. load capacity	50 N	
Max. push / pull force	6 N	
Max. holding force	6 N	
Drive properties		
Motor type	2 x U-164 PLine® ultrasonic piezo drive	
Operating Voltage	60 V _{rms} *	
Electrical power	15 W**	nominal
Power consumption	1.5 A**	
Reference Switch	optical	
Limit Switches	Hall-effect	
Miscellaneous		
Operating temperature range	0 to +50 °C	
Material	Al (black anodized)	
Dimensions	130 x 95 x 21 mm	
Mass	0.65 kg	$\pm 5 \%$
Cable length	1.5 m	$\pm 10 \text{ mm}$
Connector	MDR, 14-pin	
Recommended controller / driver	C-867.160 single-axis controller / driver C-185.D64 drive electronics	

*Power to the motor is supplied by the drive electronics, which runs on 12 V DC, or by the controller (24 V).

**For drive electronics

M-686 PLine® XY Piezo Linear-Motor Stage

Fast, Low Profile and Large Aperture with Direct Position Measurement



The M-686.D64 open-frame stage with closed-loop piezo motors provides 25 x 25 mm travel range

- **Integrated Closed-Loop Piezomotor Drives Provide High Speed to 100 mm/s**
- **Travel Ranges 25 x 25 mm**
- **Integrated Linear Encoders with 0.1 µm Resolution**
- **Compact Design:**
32 mm Profile Height, 170 x 170 mm Footprint
- **Clear Aperture 78 x 78 mm, 66 x 66 mm in Extreme Position**
- **Self-Locking at Rest**
- **Compatible with PI Piezo Nanopositioning / Scanning Stages**

M-686 open-frame piezomotor stages are mainly designed for automated positioning applications in microscopy. The optimized form factor with a low profile height of only 32 mm and the standardized mounting pattern allows the combination with many PI standard nanopositioning systems.

Application Examples

- Biotechnology
- Microscopy
- Scanning microscopy
- Confocal microscopy
- Semiconductor testing
- Handling

Space Saving Piezomotors

Compared to conventional motorized translation stages, the M-686 provides a lower profile and smaller footprint. The compact PLine® piezoelectric linear motors and high-resolution linear encoders make both, the lead screw duct and the flanged, bulky stepper motor employed in traditional stages obsolete. In addition, the piezomotors are self-locking at rest and hold the stage in a stable position without heating up.

Compatibility to PI Nanopositioning and Scanning Stages

A number of standard PI piezo flexure stages (150 x 150 mm footprint) can be mounted directly on the M-686 open-

frame stage. Depending on the application, these highly specialized, ultra-precise nanopositioning systems are available as fast XY scanners (for fluorescence microscopy), as vertical Z positioners (3D imaging), or with up to 6 degrees of freedom.

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.

Advantages of PLine® Micropositioning Systems

The ultrasonic piezoceramic drives used in PLine® 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

Ordering Information

M-686.D64
XY Open-Frame Stage with Closed-Loop PLine® Piezomotor Drives, 25 x 25 mm, 7 N, 0.1 µm Linear Encoder

Ask about custom designs!

Notes

Nanopositioning stages that fit directly on the M-686:

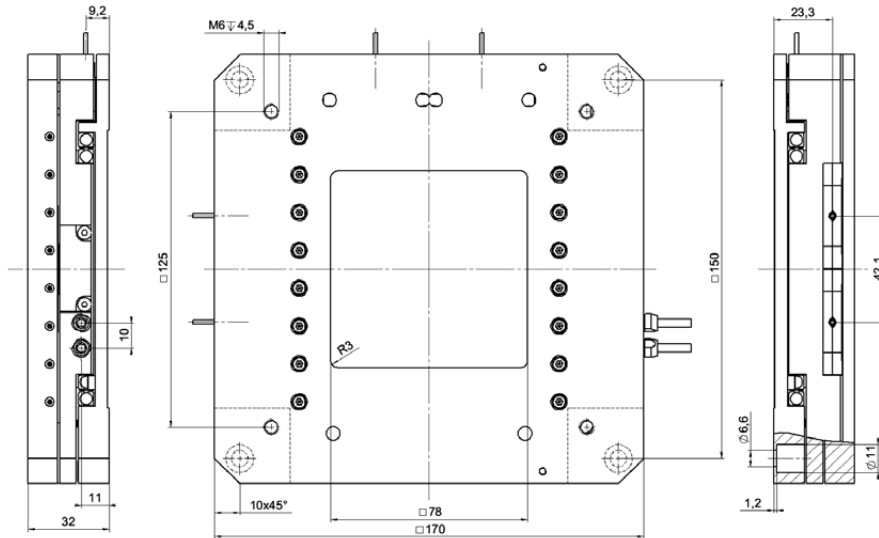
P-561 to P-563
PIMars™ XYZ Nanopositioning systems with up to 300 µm travel

P-541.2 to P-542.2
Low-profile microscopy XY scanners

P-541.Z
Low-profile Z/tip/tilt piezo nanopositioning stages for microscopy

Customized M-686 stage with a bigger footprint, to sink the piezo Z scanner. The system height together with the P-541 piezo scanner is reduced to only 33 mm





M-686.D64, dimensions in mm. The minimum aperture is 66 x 66 mm with both axes at the maximum position

Technical Data

Model	M-686.D64
Active axes	XY
Motion and positioning	
Travel range	25 x 25 mm
Integrated sensor	Linear encoder
Sensor resolution	0.1 μm
Design resolution	0.1 μm
Min. incremental motion	0.3 μm
Bidirectional repeatability	0.3 μm
Pitch / yaw	$\pm 50 \mu\text{rad}$
Max. velocity	100 mm/s
Mechanical properties	
Load Capacity*	50 N
Max. push/pull force	7 N
Max. lateral force	4 N
Drive properties	
Motor type	2 x PLine® P-664 per axis
Operating voltage	190 V (Peak-Peak)** 67 V (RMS)**
Electrical power	10 W / axis***
Miscellaneous	
Operating temperature range	-20 to +50 °C
Material	Aluminium (black anodized)
Mass	1.2 kg
Cable length	1.5 m
Connector	2 x MDR connector, 14-pin
Recommended controller/driver	2 x C-867.D64 single-axis controller / driver 2 x C-185.D64 single-axis drive electronics for external servo-controllers (p. 4-116, p. 1-36)

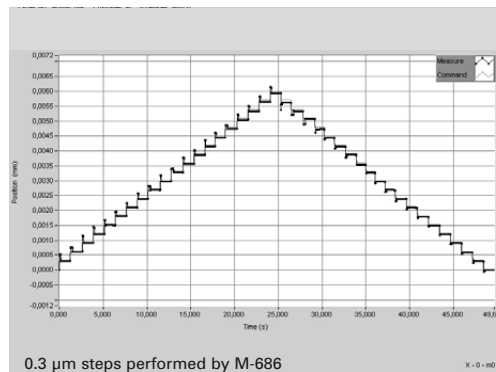
*10 N for max. velocity

**The operating voltage or the piezomotor is supplied by the drive electronics which requires 12 VDC

***For drive electronics



M-686 open-frame stage with P-541.2DD piezo scanner on top, providing a resolution of 0.1 nm and a scanning range of 30 x 30 μm . The system height of the combination with the P-541 XY (or Z) piezo scanner is only 48 mm



M-674 PLine® RodDrive Piezo Linear Drive

Integrated Fast Ultrasonic Piezo Drives



The M-674 PLine® RodDrive, shown with C-184 OEM and C-185 bench-top driver electronics, provides 7 N pushing force and travel ranges of 50, 100 and 150 mm



■ Drive-Component for Integration into Micropositioning Systems

- Travel Ranges to 150 mm
- Push/Pull Forces to 7 N
- Min. Incremental Motion to 0.05 µm
- Velocity to 450 mm/s
- Self-Locking at Rest

M-674 PLine® RodDrives represent a level of integration between PLine® OEM piezo linear motors such as P-664 (see p. 1-28) and guided micropositioning systems such as the M-682 (see p. 4-32) series stages.

RodDrives may replace classical drive elements like rotary motor/leadscrew assemblies, or magnetic linear drives integrated into a micropositioner.

Application Examples

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

They consist of a rod which is preloaded by 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.

Advantages of PLine® Micropositioning Systems

The ultrasonic piezoceramic drives used in PLine® 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

Working Principle

RodDrives employ a patented ultrasonic drive developed by PI. The highly compact, integrated P-664 piezomotors can provide velocities of 450 mm/s, together with high resolution and holding force. The maximum travel is determined by the length of the rod and is basically unlimited. Customized adaptations in terms of operating and holding force are feasible by varying type and number of motors used. Because the integrated ceramic motors are preloaded against the rod, RodDrives resist motion with an intrinsic holding force when at rest. The result is very high position stability without the heat dissipation common with conventional linear motors. Furthermore, there are no gears, leadscrews or other mechanical components to contribute play or backlash.

Variety of Drivers / Controllers

PLine® piezomotors require a drive electronics for exciting the ultrasonic oscillations. The drive electronics is available as OEM board, stand-alone device or integrated inside a closed-loop motion controller and therefore not included in the delivery.

Ordering Information

M-674.164
PLine® RodDrive, 50 mm, 7 N

M-674.264
PLine® RodDrive, 100 mm, 7 N

M-674.364
PLine® RodDrive, 150 mm, 7 N

Accessories:

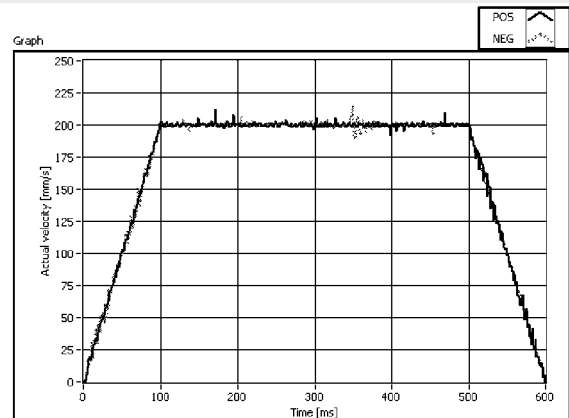
C-184.D64
Analog OEM Driver Board for PLine® RodDrive M-674

C-185.164
Analog Stand-Alone Drive Electronics with Power Supply for PLine® P-664 Motors

C-867.D64
Piezomotor Controller with Drive Electronics, 1 Channel, for PLine® Systems with M-674 RodDrive

Closed-Loop Operation: Optimized for High Velocity and Rapid Step/Settling

Together with a position sensor, RodDrives can be operated in closed-loop with the C-867.D64 (see p. 4-116) piezo motor controller. This specialized servo-controller also integrates the motor drive electronics and enables highly constant speeds up to 350 mm/s with very short settling times (tens of milliseconds). RodDrives can also be operated with conventional servo-controllers. In this case, the C-185 (see p. 1-36)



Constancy of closed-loop velocity at 200 mm/s of an integrated M-674 RodDrive

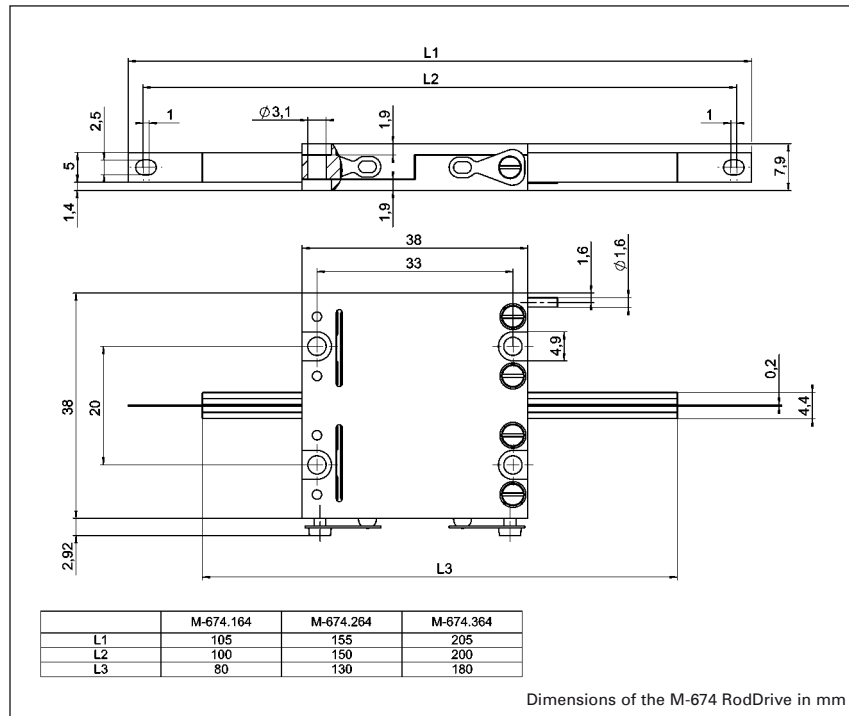
(to be ordered separately) external drive electronics is required which accepts a ± 10 V analog signal from the controller.

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



The M-674 integrated into a Micropositioning Stage



Technical Data

Model	M-674.164	M-674.264	M-674.364	Units	Tolerance
Motion and positioning					
Travel range	50	100	150	mm	x
Minimum incremental motion, open-loop	0.05*	0.05*	0.05*	μm	typ.
Max. velocity	450	450	450	mm/s	
Max. acceleration	10	10	10	m/s^2	
Mechanical properties					
Stiffness when powered down	5**	5**	5**	$\text{N}/\mu\text{m}$	$\pm 10\%$
Holding force when powered down	7	7	7	N	max.
Push / pull force	7	7	7	N	max.
Drive properties					
Resonant frequency	155	155	155	kHz, typ.	
Integrated piezo motor	2 x PILine® P-664 (Dual Motor)	2 x PILine® P-664 (Dual Motor)	2 x PILine® P-664 (Dual Motor)		
Motor voltage range	190 (peak-peak)*** 67 (RMS)***	190 (peak-peak)*** 67 (RMS)***	190 (peak-peak)*** 67 (RMS)***	V	
Operating voltage drive electronics	12	12	12	V	
Max. elec. power consumption drive electronics	15	15	15	W	
Miscellaneous					
Operating temperature range	-20 to +50	-20 to +50	-20 to +50	$^{\circ}\text{C}$	
Body material	PEEK-PTFE	PEEK-PTFE	PEEK-PTFE		
Mass	0.1	0.12	0.14	kg	$\pm 5\%$
Cable length	1.5	1.5	1.5	m	± 10 mm
Connector	LEMO connector	LEMO connector	LEMO connector	LEMO connector	
Recommended controller/driver	C-184.D64 OEM drive electronics board C-185.D64 driver ****C-867.D64 Controller for closed-loop operation	C-184.D64 OEM drive electronics board C-185.D64 driver ****C-867.D64 Controller for closed-loop operation	C-184.D64 OEM drive electronics board C-185.D64 driver ****C-867.D64 Controller for closed-loop operation		

*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-drives.

**Stiffness at 25 $^{\circ}\text{C}$.

***The operating voltage is supplied by the drive electronics.

****MDR 14-connector for closed-loop systems separate required

P-629.2 PIHera® X/XY/XYZ Piezo Flexure Stage Family

High-Precision Nanopositioner Family—Compact and Long Travel Ranges



PIHera® XY nanopositioning systems provide travel ranges from 50 x 50 µm to 1800 x 1800 µm

- Travel Ranges 50 to 1800 µm
- High-Precision, Cost-Efficient
- Resolution to 0.1 nm
- Frictionless, High-Precision Flexure Guiding System
- 0,02 % Positioning Accuracy
- Outstanding Lifetime Due to PICMA® Piezo Actuators
- X-, XY-, Z- and XYZ-Versions
- Vacuum-Compatible Versions Available

Two-axis (XY) PIHera® systems are piezo-nanopositioning stages featuring travel ranges from 50 to 1800 µm. Despite the increased travel ranges, the units are extremely compact and provide rapid response and high guiding precision. This, and the long travel range is achieved with a friction-free and extremely stiff flexure system sub-nanometer resolution. The PI-

Hera® piezo nanopositioning series also includes Z and X stages (see p. 2-22 and p. 2-40).

Nanometer Precision in Milliseconds

One of the advantages of PIHera® stages over motor-driven positioning stages is the rapid response to input changes and the fast and precise settling behavior. The P-622.1CD, for example, can settle to an accuracy of 10 nm in only 30 msec (other PI stages provide even faster response)!

Superior Accuracy With Direct-Metrology Capacitive Sensors

A choice of tasks such as optical path adjustment in interferometry, sample positioning in microscopy, precision align-

ment or optical tracking require the relatively long scanning ranges and nanometer precision offered by PIHera® nanopositioning stages. PI's proprietary capacitive sensors measure position directly and without physical contact. They are free of friction and hysteresis, a fact which, in combination with the positioning resolution of well under 1 nm, makes it possible to achieve very high levels of linearity. A further advantage of direct metrology with capacitive sensors is the high phase fidelity and the high bandwidth of up to 10 kHz.

Designed for Precision

High stiffness is achieved with the FEA-optimized design of the frictionless flexure elements, which assure excellent guiding accuracy and dynamics. A straightness and flatness in the nanometer range is achieved.

Ordering Information

P-620.2CD* / P-620.2CL*
PIHera® Precision XY Nanopositioning System, 50 x 50 µm, Direct Metrology, Capacitive Sensors

P-621.2CD* / P-621.2CL*
PIHera® Precision XY Nanopositioning System, 100 x 100 µm, Direct Metrology, Capacitive Sensors

P-622.2CD* / P-622.2CL*
PIHera® Precision XY Nanopositioning System, 250 x 250 µm, Direct Metrology, Capacitive Sensors

P-625.2CD* / P-625.2CL*
PIHera® Precision XY Nanopositioning System, 500 x 500 µm, Direct Metrology, Capacitive Sensors

P-628.2CD* / P-628.2CL*
PIHera® Precision XY Nanopositioning System, 800 x 800 µm, Direct Metrology, Capacitive Sensors

P-629.2CD* / P-629.2CL*
PIHera® Precision XY Nanopositioning System, 1500 x 1500 µm, Direct Metrology, Capacitive Sensors

*.2CD with Sub-D Connector
*.2CL with LEMO Connector

Open-loop versions are available as P-62x.20L.
Vacuum versions to 10⁻³ hPa are available as P-62x.2UD.

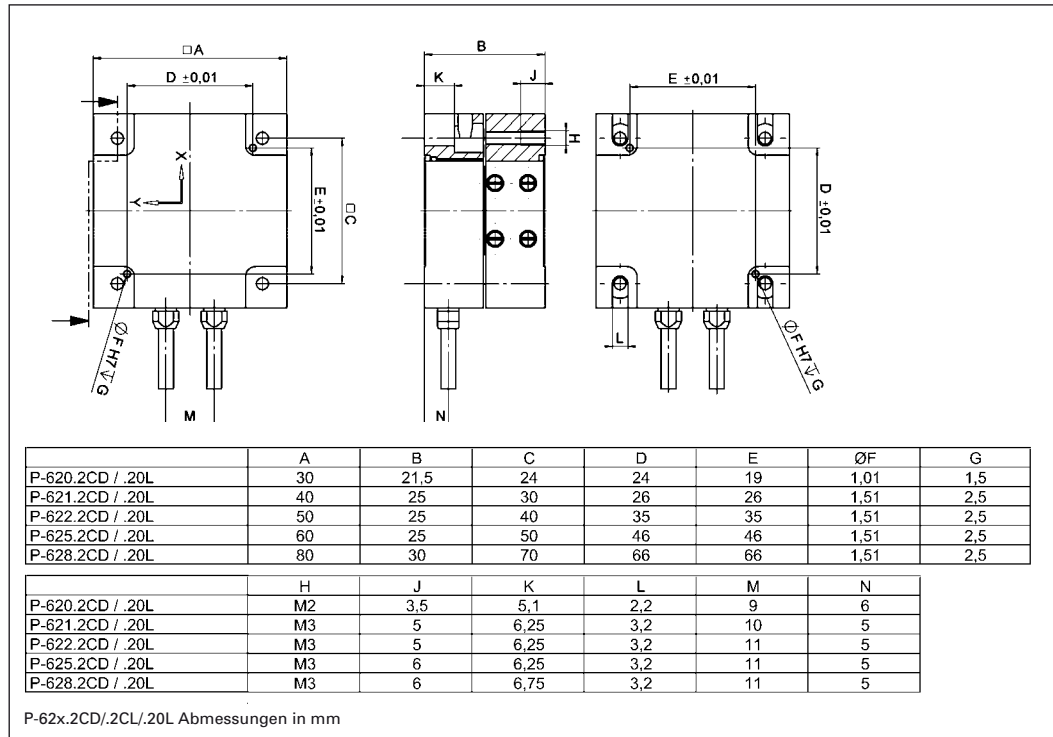
Application Examples

- Interferometry
- Microscopy
- Nanopositioning
- Biotechnology
- Quality assurance testing
- Semiconductor technology



XYZ Combination

For Controllers, X & Z Versions and other Piezo Flexure Nanopositioning Stages Request the Main PI Catalog or Download from <http://www.pi.ws/catalog>



Technical Data

Model	P-620.2CD/ P-620.2CL	P-621.2CD/ P-621.2CL	P-622.2CD/ P-622.2CL	P-625.2CD/ P-625.2CL	P-628.2CD/ P-628.2CL	P-629.2CD P-629.2CL	P-62x.20L open-loop versions	Units	Tolerance	
Active axes	X, Y	X, Y	X, Y	X, Y	X, Y	X, Y	X, Y			
Motion and positioning										
Integrated sensor	Capacitive	Capacitive	Capacitive	Capacitive	Capacitive	Capacitive	–			
Open-loop travel X, Y, -20 to +120 V	60	120	300	600	950	1800	as P-62x.2CD	µm	min. (+20%/-0%)	
Closed-loop travel	50	100	250	500	800	1500	–	µm		
Open-loop resolution	0.1	0.2	0.4	0.5	0.5	2	as P-62x.2CD	nm	typ.	
Closed-loop resolution	0.2	0.4	0.7	1.4	3.5	3.5	–	nm	typ.	
Linearity	0.02	0.02	0.02	0.03	0.03	0.03	–	%	typ.	
Repeatability	±2	±2	±2	±5	±10	±14	as P-62x.2CD	nm	typ.	
Pitch / yaw	±3	±3	±3	±3	±20	±30	as P-62x.2CD	µrad	typ.	
Mechanical properties										
Stiffness	0.22	0.25	0.2	0.1	0.05	0.1	as P-62x.2CD	N/µm	±20%	
Unloaded resonant frequency in X,	575	420	225	135	75	60	as P-62x.2CD	Hz	±20%	
Unloaded resonant frequency in Y	800	535	300	195	105	100	as P-62x.2CD	Hz	±20%	
Resonant frequency in X @ 50 g	270	285	180	120	60	55	as P-62x.2CD	Hz	±20%	
Resonant frequency in Y @ 50 g	395	365	215	150	85	85	as P-62x.2CD	Hz	±20%	
Resonant frequency in X @ 100 g	285	220	160	105	55	50	as P-62x.2CD	Hz	±20%	
Resonant frequency in Y @ 100 g	300	285	175	125	75	80	as P-62x.2CD	Hz	±20%	
Push/pull force capacity in motion direction	10 / 5	10 / 8	10 / 8	10 / 8	10 / 8	10 / 8	as P-62x.2CD	N	Max.	
Load capacity	10	10	10	10	10	10	as P-62x.2CD	N	Max.	
Lateral Force	10	10	10	10	10	10	as P-62x.2CD	N	Max.	
Drive properties										
Ceramic type	PICMA® P-883	PICMA® P-885	PICMA® P-885	PICMA® P-885	PICMA® P-887	PICMA® P-888	as P-62x.2CD			
Electrical Capacitance	0.35	1.5	3.1	6.2	19	52	as P-62x.2CD	µF	±20%	
Dynamic operating current coefficient	0.9	1.9	1.9	1.6	3	4.3	as P-62x.2CD	µA/(Hz·µm)	±20%	
Miscellaneous										
Operating temperature range	-20 to 80	-20 to 80	-20 to 80	-20 to 80	-20 to 80	-20 to 80	-20 to 150	°C		
Material	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum			
Mass	0.195	0.295	0.348	0.43	0.7	1.37	as P-62x.2CD	kg	±5%	
Cable length	1.5	1.5	1.5	1.5	1.5	1.5	1.5	m	±10 mm	
Sensor / voltage connection	CD version: 2x Sub-D special CL version: LEMO	CD version: 2x Sub-D special CL version: LEMO	CD version: 2x Sub-D special CL version: LEMO	CD version: 2x Sub-D special CL version: LEMO	CD version: 2x Sub-D special CL version: LEMO	CD version: 2x Sub-D special CL version: LEMO	CD version: 2x Sub-D special CL version: LEMO	2x LEMO (no sensor)		

Lower axis: X; upper axis: Y.

Resolution of PI Piezo Nanopositioners is not limited by friction or stiction. The value given is noise equivalent motion with E-710 controller (p. 2-128)

Recommended controller

CD version: E-610 servo controller / amplifier (p. 2-110), E-625 servo controller, bench-top (p. 2-114), E-665 powerful servo controller, bench-top (p. 2-116)

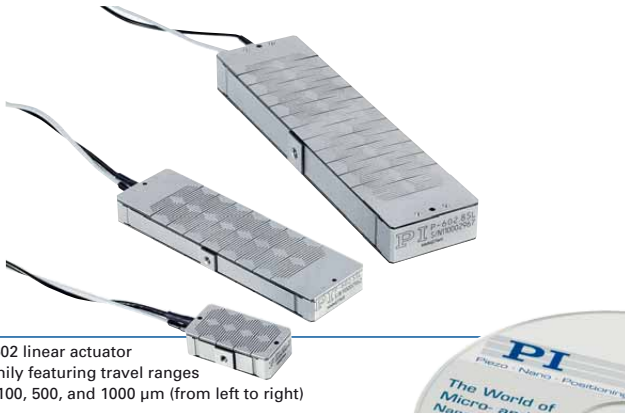
Multi-channel digital controllers: E-710 bench-top (p. 2-128), E-712 modular (p. 2-140), E-725 high-power (p. 2-126), E-761 PCI board (p. 2-140)

CL version: E-500 modular piezo controller system (p. 2-142) with E-505 amplifier module (1 per axis, high power) (p. 2-147) and E-509 controller (p. 2-152)

Open-loop versions: E-500 modular piezo controller system (p. 2-142) with E-505 amplifier module (1 per axis, high power) (p. 2-147)

P-602 PiezoMove Flexure Actuator with High Stiffness

Integrated Guiding System, High Force and Large Travel Ranges



P-602 linear actuator family featuring travel ranges of 100, 500, and 1000 µm (from left to right)

- Frictionless Flexure Guiding System for Straight Motion
- Integrated Motion Amplifier for Travel Ranges to 1 mm
- High Dynamics and Stiffness, Forces to 400 N, Backlash-Free Construction
- Outstanding Lifetime Due to PICMA® Piezo Actuators
- Available with Integrated Position Sensor
- Custom Designs with Larger Travel or Faster Response and Non-Magnetic Versions Feasible
- Ideal for OEM-Applications in Adaptronics, Biotechnology or Microfluidics

P-602 PiezoMove flexure-guided piezo actuators integrate a frictionless high-efficiency motion amplifier to combine large travel ranges up to 1 millimeter

Application Examples

- Nanopositioning
- Adaptronics
- Active vibration control
- Nano-imprinting
- Active Tool control
- Laser technology
- Semiconductor technology
- Active and adaptive optics

with high stiffness and very fast response. They do not contain any components that require maintenance or are subject to wear or tear. The flexure guides eliminate tip motion permitting only for a very slight tilt at the drive head. This design feature saves the cost for additional guiding systems when integrating these actuators in applications for the active control of tools, vibrations or deformations for accuracies down to a few 10s of nanometers.

Options and Custom Versions

For OEM applications, PiezoMove actuators can be modified in various ways to suit the customer's requirements. The

Ordering Information

PiezoMove® OEM Linear Actuator with High Stiffness

- 1 Travel Range 100 µm
- 3 Travel Range 300 µm
- 5 Travel Range 500 µm
- 8 Travel Range 1000 µm

- P-602.
- 00 Open-loop
 - S0 SGS Sensor
 - SL SGS Sensor, LEMO Connector

PiezoMove® OEM Linear Actuators with High Force

- 1 Travel Range 100 µm
- 3 Travel Range 300 µm
- 5 Travel Range 500 µm

- P-602.
- 08 Open-loop
 - S8 SGS Sensor
 - L8 SGS Sensor, LEMO Connector

Ask about custom designs!

stiffness and force generation can be influenced via the lever design and the dimensions of the piezo ceramics used in the actuator. If only a small force and low guiding accuracy are required, large strokes of several 100 µm and high frequencies can be achieved with small actuators, e.g. for micropump drives. For high-accuracy applications, an integrated position feedback sensor is available. The actuators were designed to allow for considerable cost savings in large production runs.

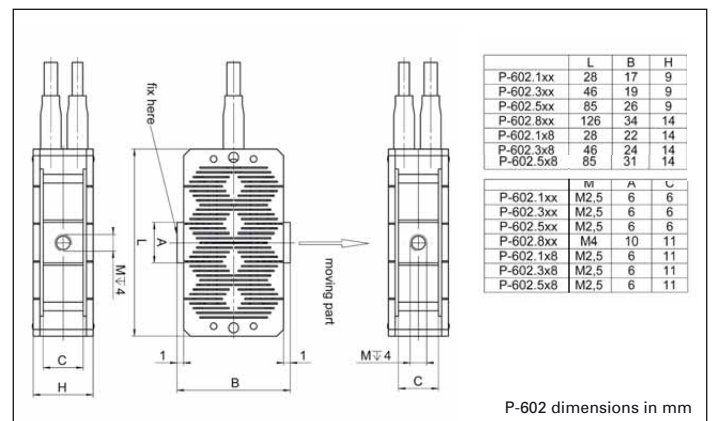
OEM Control Electronics

PI also supplies a variety of controllers to match the actuators. These range from simple amplifier modules (see p. 2-164) and analog closed-loop OEM controllers (see p. 2-110)

to high-performance digital controllers (see p. 2-100ff). The great choice of actuators and controllers allows customers to select the optimum combination of performance and cost for their application.

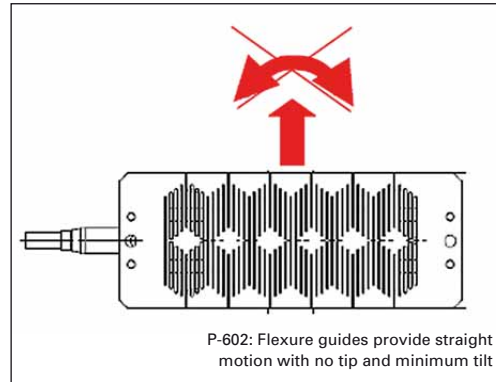
Ceramic-Insulated Piezo Actuators Provide Superior Lifetime

The highest possible reliability is assured by employing the award-winning PICMA® multi-layer piezo actuators. PICMA® actuators are the only actuators on the market with a ceramic-only insulation which makes them resistant to ambient humidity and leakage-current failures. They are thus far superior to conventional actuators in reliability and lifetime.





PI offers a large variety of standard and custom lever-amplified piezo actuators for almost any application



Technical Data (preliminary)

Model	P-602.100 P-602.1S0 P-602.1SL	P-602.300 P-602.3S0 P-602.3SL	P-602.500 P-602.5S0 P-602.5SL	P-602.108 P-602.1S8 P-602.1L8	P-602.308 P-602.3S8 P-602.3L8	P-602.508 P-602.5S8 P-602.5L8	P-602.800 P-602.8S0 P-602.8SL	Units	Tolerance
Active axes	X	X	X	X	X	X	X		
Motion and positioning									
Integrated sensor	- / SGS / SGS	- / SGS / SGS	- / SGS / SGS	- / SGS / SGS	- / SGS / SGS	- / SGS / SGS	- / SGS / SGS		
Open-loop travel, -20 to +120 V	120	300	600	100	300	500	1000	μm	min. (+20%/-0)
Closed-loop travel	- / 100 / 100	- / 300 / 300	- / 500 / 500	- / 100 / 100	- / 300 / 300	- / 500 / 500	- / 1000 / 1000	μm	
Open-loop resolution	0.2	0.3	0.4	0.2	0.3	0.4	0.5	nm	typ.
Closed-loop resolution	- / 2 / 2	- / 3 / 3	- / 3 / 3	- / 2 / 2	- / 3 / 3	- / 3 / 3	- / 7 / 7	nm	typ.
Linearity, closed-loop	- / 0.5 / 0.5	- / 0.5 / 0.5	- / 0.5 / 0.5	- / 0.5 / 0.5	- / 0.5 / 0.5	- / 0.5 / 0.5	- / 1.5 / 1.5	%	typ.
Repeatability	- / 10 / 10	- / 20 / 20	- / 35 / 35	- / 10 / 10	- / 20 / 20	- / 35 / 35	- / 60 / 60	nm	typ.
Mechanical properties									
Stiffness in motion direction	0.8	0.35	0.3	2.3	0.75	0.65	0.4	N/μm	± 20%
Unloaded resonant frequency	1000	450	230	1000	450	230	150	Hz	± 20%
Blocking force	80	105	150	230	225	325	400	N	max.
Drive properties									
Ceramic type	PICMA® P-885	PICMA® P-885	PICMA® P-885	PICMA® P-888	PICMA® P-888	PICMA® P-888	PICMA® P-888		
Electrical Capacitance	1.5	3.1	6.2	6	13	26	39	μF	± 20%
Dynamic operating current coefficient	1.9	1.3	1.6	7.5	5	6	4	μA/(Hz•μm)	± 20%
Miscellaneous									
Operating temperature range	-20 to 80	-20 to 80	-20 to 80	-20 to 80	-20 to 80	-20 to 80	-20 to 80	°C	
Material	Stainless steel	Stainless steel	Stainless steel	Stainless steel	Stainless steel	Stainless steel	Stainless steel		
kg	28 x 17 x 9	46 x 19 x 9	85 x 26 x 9	28 x 22 x 14	46 x 24 x 14	85 x 31 x 14	126 x 34 x 14	mm	
Mass	0.022	0.04	0.105	0.05	0.088	0.215	0.355	kg	± 5%
Cable length	0.5 / 0.5 / 2	0.5 / 0.5 / 2	0.5 / 0.5 / 2	0.5 / 0.5 / 2	0.5 / 0.5 / 2	0.5 / 0.5 / 2	0.5 / 0.5 / 2	m	± 10 mm
Sensor / voltage connection	0- and S-version: open leads SL-version: LEMO connector	0- and S-version: open leads SL-version: LEMO connector	0- and S-version: open leads SL-version: LEMO connector	0- and S-version: open leads L-version: LEMO connector	0- and S-version: open leads L-version: LEMO connector	0- and S-version: open leads L-version: LEMO connector	0- and S-version: open leads SL-version: LEMO connector		

Recommended controller / amplifier

E-610 controller / amplifier see p. 2-110, E-625 bench-top controller see p. 2-114

N-310 NEXACT® OEM Miniature Linear Motor/Actuator

Compact, High-Speed PiezoWalk® Drive



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

- 20 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 Head Dissipation, Nanometer Stability
- Non-Magnetic and Vacuum-Compatible Working Principle

N-310 NEXACT® PiezoWalk® linear drives feature travel ranges of 20 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.

Application Examples

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

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.

Advantages of PiezoWalk® Piezo Stepping Drives

NEXLINE® and NEXACT® drives offer several advantages over traditional drive technologies:

- Resolution in the picometer range
- Compact dimensions
- High drive forces from ten newtons (NEXACT®) up to several hundred newtons (NEXLINE®)
- High-dynamics performance with sub-microsecond response

- Self-locking when powered down; no holding current
- Zero backlash, no wear or maintenance, no mechanical components like gears or leadscrews.
- Non-Magnetic and Vacuum Compatible Operating Principle

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

Ordering Information

N-310.11
NEXACT® OEM linear drive, 20 mm, 10 N

N-310.111
NEXACT® OEM linear drive, 20 mm, 10 N, Shifted Cable Exit

Ask about custom designs

limitations such as backlash and wear are eliminated and the drive is maintenance-free.

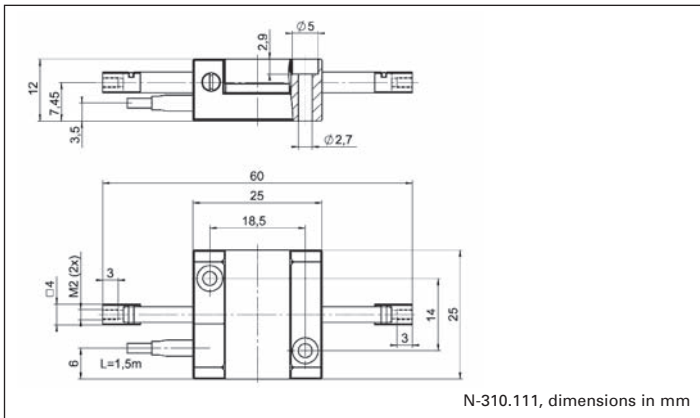
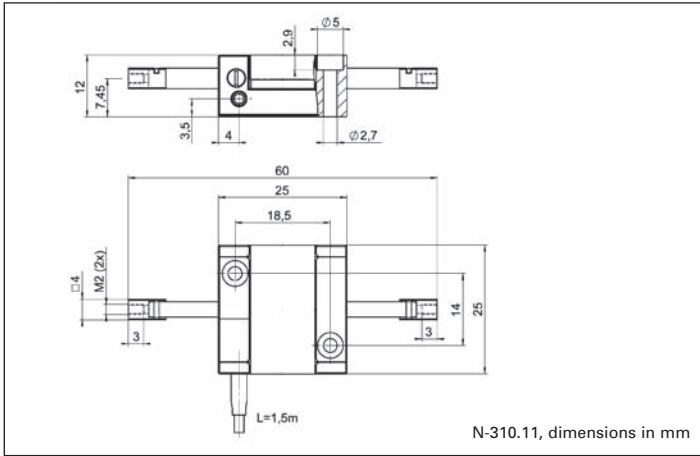
Self-Locking PiezoWalk® Piezo Stepping Drive

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 dissipation 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 not require the highest resolution lower-priced drive electronics, ranging all the way to OEM boards, can be ordered.

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



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-310.11, N-310.111	Tolerance
Active axes	X	
Motion and positioning		
Travel range	20 mm	
Step size (in step mode)	5 nm to 5 µm	
Travel range in analog operation	7 µm	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	±5 %
Cable length	1.5 m	±10 mm
Connector	HD Sub-D connector 15 pin, single channel	
Recommended controller/driver	E-860-series (see p. 1-20)	

*Depending on the control electronics.

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

E-861 PiezoWalk® NEXACT® Controller/Driver

Networkable Controller for NEXACT® Linear Drives and Positioners



PiezoWalk® System: E-861.1A1 NEXACT® Controller

Ordering Information

E-861.1A1
NEXACT® Controller, 1 Channel,
Linear Encoder

Easy System Setup, Comprehensive Software

All parameters can be set and checked by software. System setup and configuration is done with the included PIMikroMove™ user-interface software. Interfacing to custom software is facilitated with included LabV iew drivers and DLLs. With the PI General Command Set (GCS), system programming is the same with all PI controllers, so controlling a system with a variety of different controllers is possible without difficulty.

- For NEXACT® Drives and Positioning Systems
- Complete System with Controller, Integrated Power Amplifiers and Software
- Open-Loop Operation, or Closed-Loop with Linear Encoder
- High Performance at Low Cost
- Daisy-Chain Networking for Multi-Axis Operation
- Non-Volatile Macro Storage for Stand-Alone Functionality with Autostart Macro
- I/O for Automation, Joystick for Manual Operation
- Parameter Changes On-the-Fly

The new, compact E-861 controller is designed to operate NEXACT® linear drives and closed-loop positioning systems using them, simply and precisely. In perfect harmony with the mechanics, the E-861 supports both motion modes of the PiezoWalk® stepping drive: for longer moves, the stepping mode, and for moves shorter than typically 7 µm, the analog mode, which provides high-dynamics positioning with resolutions of less than 1 nm. The NEXACT® drive design minimizes piezo operating voltages to 45 V and below.

Flexible Automation

E-861 controllers offer a number of features to support automation and handling. For example, macros can be stored in non-volatile memory.

A programmable autostart macro allows stand-alone operation without external communication. Upon power up, the macro with its internal command sequence is executed automatically.

For easy synchronization of motion with internal or external trigger signals, four input and four output lines are provided.

Multi-Axis Operation

Up to 16 E-861 controllers can be networked and controlled over a single PC interface.

Such daisy chain networks are flexible, can be extended at any time and are compatible with other PI controllers (e.g. DC servo-motor and stepper motor controllers).

Technical Data

Model	E-861.1A1
Function	Controller for NEXACT® drives / systems
Drive type	N-310.01 NEXACT® linear drive
Channels	1
Motion and control	
Servo characteristics	P-I-D servo control, parameter change on-the-fly
Trajectory profile modes	Trapezoidal
Encoder input	Analog encoder input sine-cosine, interpolation circuit preset for differential transmission, 2 V _{pp} amplitude and 2.27 V offset of the encoder signal
Stall detection	Servo off, triggered by programmable position error
Input limit switch	2 x TTL (pull-up/pull-down, programmable)
Input reference switch	1 x TTL
Electrical properties	
Output power	max. 40 W
Output voltage	-10 to +45 V
Current consumption	max. 2 A
Interfaces and operation	
Communication interfaces	USB 1.0, RS-232 (9-pin (m) D-Sub)
Motor connector	D-Sub 15-pin (f) High Density
Sensor connector	D-Sub 15-pin (m) High Density
Controller network	Up to 16 units on single interface
I/O ports	4 analog/digital in, 4 digital out (TTL)
Command set	PI General Command Set (GCS)
User software	PIMikroMove™, PI Terminal
Software drivers	GCS-DLL, LabVIEW drivers
Supported functionality	Start-up macro; data recorder for categories like current position or velocity; internal safety circuitry: watchdog timer
Manual control (optional)	Joystick, Y-cable for 2D motion, pushbutton box
Miscellaneous	
Operating voltage	24 V included: external power supply, 24 V, 2.5 A
Operating temperature range	0 to +50 °C
Mass	1.1 kg
Dimensions	206 x 130 x 66 mm (with mounting rails)

C-867 Controller for PLine® Piezo Linear Drives Servo-Controller with Integrated Driver for High-Speed Ultrasonic Piezo Motors



C-867 piezomotor controller together with an extremely low-profile M-692 positioner with integrated piezoceramic PLine® linear drive

- **Optimized for PLine® Ultrasonic Piezo Linear Motors**
- **High-Bandwidth Encoder Inputs Allow High Speed and Resolution**
- **PID Servo-Control with Dynamic Parameter Switching**
- **Integrated Piezo Motor Power Driver**
- **USB, RS-232 and Analog Interfaces (e. g. for Joystick)**
- **4 + 4 Programmable TTL-I/Os for Flexible Automation**
- **Data Recorder**
- **Daisy-Chain Networking for up to 16 Axes**
- **Powerful Macro Programming Language, e. g. for Stand-Alone Operation**
- **Extensive Software Support, LabVIEW, DLL ...**

The C-867 controller is especially designed for closed-loop positioning systems equipped with PLine® piezo linear motor drives. A compact case contains both drive electronics for the piezo ceramic motors and components for controlling and communication.

Application Examples

- **Biotechnology**
- **Microscopy**
- **Fiber positioning**
- **Automation**
- **Photonics / integrated optics**
- **Quality assurance testing**
- **Testing equipment**

The controller can be operated from a host PC either via a USB port or an RS-232 interface. Alternatively, a stand-alone operation is possible. Here, stored macro commands can be executed, or manual control by joystick or pushbutton box is possible.

Two models are available: C-867.160 is used to operate single-axis positioning systems, the two-channel C-867.260 is used with XY scanning stages.

Highly Specialized PID Servo-Controller

The C-867 is based on a highly specialized DSP (Digital Signal Processor) that handles the PID servo-control algorithm as well as other system functions.

Because of the motion properties typical for ultrasonic piezomotors, the controller has a number of advanced features, including dynamic control parameter adaption. By automatically switching between gainsets for dynamic and static operation an optimized settling behavior within a couple of 10 milliseconds is achieved. The broadband encoder input (50 MHz) allows high resolution encoders to be used with the outstandingly high accelerations and velocities that PLine® drives deliver.

Highest Stability by Frequency Control

The integrated piezomotor drive electronics support all PLine® ultrasonic piezomotors used for the M-66x to M-69x positioning stage series.

Drift in the mechanical frequency of the motor caused by temperature or load changes is automatically compensated by a frequency-control loop which adjusts the operating frequency of the driving voltage. This leads to the highest stability in pushing force, velocity and closed-loop control.

Software / Programming

In addition to the user software for setup, system optimization and operation, comprehensive LabVIEW and DLL libraries are provided.

The PIMikroMove™ user software provides the PITuningTool for optimizing system performance. Graphic displays show the system's behaviour and facilitate parameter setting.

Advantages of PLine® Micropositioning Systems

Positioning systems equipped with ceramic ultrasonic drives of the PLine® series provide

Ordering Information

C-867.160
Piezomotor Controller with Drive Electronics, Networkable, for PLine® Systems

C-867.260
Piezomotor Controller with Drive Electronics, 2 Channels, for PLine® Systems

Accessories:
C-819.20
Analog Joystick for 2 axes

C-819.20Y
Y-Cable for Connecting 2 Controllers to C-819.20

C-170.PB
Pushbutton Box, 4 Buttons and 4 LEDs

Ask about custom designs!

several advantages over positioners that apply classic drive technology:

- **Smaller dimensions**
- **Higher holding force when powered down; no holding current**
- **Increased acceleration of up to 5 g**
- **Increased velocity of up to 500 mm/s or 720°/s**
- **No leadscrews, gears or other mechanical components, no wear or maintenance**
- **No lubricants**
- **Non-magnetic and vacuum-compatible operating principle**



The two-channel C-867.260 controller operates XY scanning stages, here:
a customized M-686 stage for microscopy

Technical Data

Model	C-867.160	C-867.260
Function	Controller and drive electronics for PLine® piezomotors / systems	
Drive type	PLine® motors, single and dual drives with P-661, P-664, U-161 or U-164	
Channels	1	2
Motion and control		
Servo characteristics	Programmable PID V-ff filter, parameter changes on the fly	
Trajectory profile modes	Trapezoidal	
Encoder input	A/B differential signals, 50 x 10 ⁶ impulses/s	
Stall detection	Servo off, triggered by programmable position error	
Limit switch	2 x TTL per channel (programmable)	
Reference switch	1 x TTL per channel (active high / low, programmable)	
Electrical properties		
Max. output power / channel	15 W	
Max. output voltage / channel	200 V _{pp}	
Interfaces and operation		
Communication interfaces	USB, RS-232	
Motor connector	MDR14	2 x MDR14
Controller network	Up to 16 units on single interface	
I/O ports	4 analog/digital in, 4 digital out (Mini-DIN, 9-pin) digital: TTL analog: 0 to 5 V	
Command set	PI General Command Set (GCS)	
User software	PIMikroMove	
Software drivers	GCS-DLL, LabVIEW drivers	
Supported functionality	Start-up macro; macro; data recorder for recording parameters as motor input voltage, velocity, position or position error	
Manual control	Pushbutton box, joystick, Y-cable for control of 2 axes with joystick	Pushbutton box, joystick
Miscellaneous		
Operating voltage	24 VDC from external power supply (included)	
Current consumption	300 mA + motor current (2 A max.)	600 mA + motor current (4 A max.)
Operating temperature range	+5 °C to +40 °C	
Mass	1.0 kg	2.4 kg
Dimensions	206 x 130 x 66 mm (including mounting rails)	320 x 150 x 80.5 mm (including mounting rails)

C-184 · C-185 PLine® Drive Electronics

OEM Boards and Stand-Alone Units for Ultrasonic Piezomotors



C-185.D64 single-channel bench-top driver electronics with PLine® M-674 RodDrive featuring travel ranges up to 150 mm and 7 N drive force at 450 mm/s

- For PLine® Ultrasonic OEM Motors and Positioners
- Accepts Analog Drive Signal from Standard Controller
- Available as Cost-Effective OEM board and Plug-and-Play Desktop Unit

sitioners 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

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

Ordering Information

- 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
- C-184.164**
Analog OEM Driver Board for PLine® P-664 Motors
- C-185.164**
Analog Stand-Alone Drive Electronics with Power Supply for PLine® P-664 Motors
- C-184.D64**
Analog OEM Driver Board for PLine® RodDrive M-674
- C-185.D64**
Analog Stand-Alone Drive Electronics with Power Supply for PLine® RodDrive M-674

The C-184 OEM-board and the C-185 stand-alone unit are single-channel drive electronics for PLine® ultrasonic piezomotors and PLine® stages. Piezo-motor drive electronics convert analog input signals into the high-frequency drive signals necessary to excite the required oscillations in the piezomotor stator which cause the motion. Both the C-184 and C-185 are available in three versions, for use with different motors and translation stages.

OEM and Integrated Electronics

The philosophy behind the design of PLine® ultrasonic drives dictates that they be easily adaptable to customer requirements. This includes making the drive electronics both independent of control signal type and available either as an OEM board or as a stand-alone unit in its own case.

While the OEM boards are the most economic solution for large quantities, the stand-alone units make it possible to plug a system with PLine® stages together and put it into operation quickly and easily, for example for system evaluation purposes.

Analog Control

Both drivers control the motor speed based on an analog signal from 0 to 10 V. With an external position sensor and a servo controller, it is possible to set up a very fast, closed-loop system.

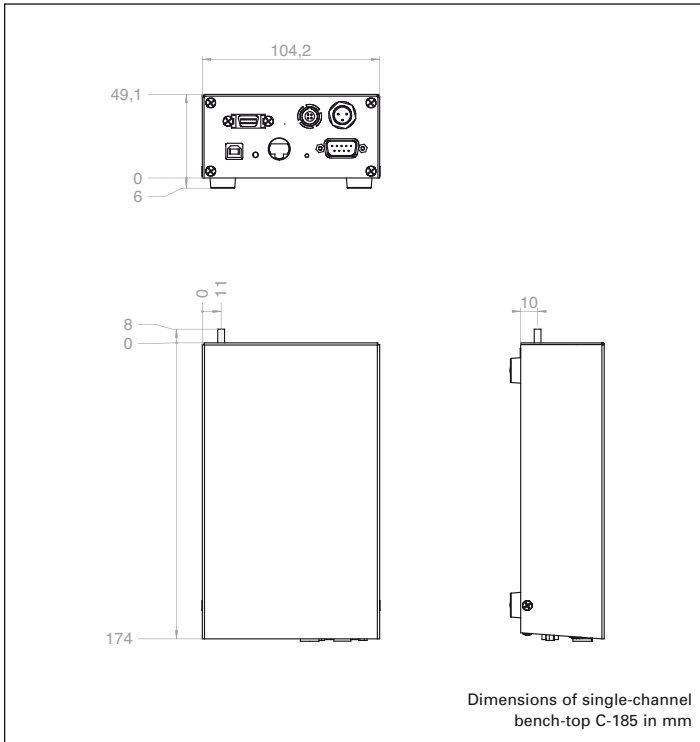
For optimum closed-loop system performance, the C-867 (see p. 4-116) piezo servo-controller is recommended.

Advantages of PLine® Micropositioning Systems

The ultrasonic piezoceramic drives used in PLine® micropo-



C-184.164 OEM driver board with PLine® P-664 OEM motor



Technical Data

Model	C-184	C-185
Function	Analog drive electronics (OEM board) for PLine® C-184.161: P-661 Motors & Positioners C-184.164: P-664 Motors & Positioners C-184.D64: M-674 RodDrive	Analog single-channel driver box for PLine® C-185.161: P-661 Motors & Positioners C-185.164: P-664 Motors & Positioners C-185.D64: M-674 RodDrive
Channels	1	1
Electrical properties		
Control in	Differential, -10 V up to +10 V, polarity controls direction	Differential, -10 V up to +10 V, polarity controls direction
Operating voltage	12 V, ±10 %	12 VDC external power supply (included)
Output power / channel	Model dependent: C-184.161: 5 W C-184.164: 10 W C-184.D64: 15 W	Model dependent: C-185.161: 5 W C-185.164: 10 W C-185.D64: 15 W
Output voltage / channel	Model dependent: C-184.161: 120 V _{PP} / 42 V _{RMS} , 210 kHz C-184.164: 168 V _{PP} / 60 V _{RMS} , 155 kHz C-184.D64: 190 V _{PP} / 67 V _{RMS} , 155 kHz	Model dependent: C-185.161: 120 V _{PP} / 42 V _{RMS} , 210 kHz C-185.164: 168 V _{PP} / 60 V _{RMS} , 155 kHz C-185.D64: 190 V _{PP} / 67 V _{RMS} , 155 kHz
Interfaces and operation		
Motor connector	Solder pads	LEMO connector or MDR connector, 14-pin
I/O ports	Solder pads	Sub-D connector, 15-pin
Miscellaneous		
Operating temperature range	+5 to +40 °C	+5 to +40 °C
Mass	C-184.161, C-184.164: 15 g C-184.D64: 24 g	690 g
Dimensions	65 x 38 mm	174 x 104 x 49 mm (without ground connection, pads and fitting panel) 182 x 104 x 49 mm (with ground connection)

C-663 Mercury™ Step Controller 1-Axis Networkable Stepper-Motor Controller



C-663 Mercury™ Step stepper motor controller for cost-sensitive micropositioning tasks

- High Performance at Low Cost
- Stand-Alone Functionality
- Network Capability for Multi-Axis Applications
- Compatible and Networkable with C-863 Mercury™ DC-Motor Controllers
- Joystick Port for Manual Control
- Non-Volatile Macro Memory
- Parameters Changeable On-the-Fly

The Mercury™ Step stepper motor controller is the perfect solution for cost-effective and flexible motion control applications where a precision positioner is to be controlled by a PC or PLC (programmable

logic controller). The C-663 supplements the successful C-863 Mercury™ servo motor controller.

Microstepping of 1/16 full step (up to 6400 steps/rev. with PI

stepper motors) provides for ultra-smooth, high-resolution motion.

Multi-Axis Control, Combination of DC & Stepper Motors

The networking feature allows the user to start out with one Mercury™ controller and add more units later for multi-axis setups.

The Mercury™ Step stepper motor controller shares its programming language with the well-established Mercury™ DC-motor controller. Up to 16 Mercury™ controllers (DC and stepper) can be daisy chained and operated from one computer.

Flexible Automation

The C-663 offers a number of features to achieve automation and handling tasks in a very cost-effective way. Programming is facilitated by the high-level mnemonic command language with macro and compound-command functionality. Macros can be stored in the non-volatile memory for later recall.

For easy synchronization of motion with internal or external trigger signals four input and four output lines are provided. A joystick can also be connected for manual control.

Stand-alone capability is provided by a user-programmable autostart macro to run automation tasks at power up (no runtime computer communication required!).

User-Friendly: Comprehensive Software Package and Two Interface Options

Easy data interchange with laptop or PC is possible via the USB interface. To facilitate industrial applications, an RS-232 interface is also standard.

The included software supports networking of multiple controller devices. LabVIEW™ drivers and Windows DLLs allow for easy programming and integration into your system. Mercury™ Step controllers can also be operated using the PI General Command Set (GCS) via a DLL. PI-GCS allows networking of different PI-con-

Ordering Information

C-663.10
Mercury™ Step Stepper Motor Controller with Wide-Range Power Supply, 24 V

C-819.20
2-Axis Analog Joystick for Mercury™ Controller

C-819.20Y
Y-Cable for Connecting 2 Controllers to C-819.20

C-170.IO
I/O cable, 2 m, open end

C-170.PB
Push Button Box, 4 Buttons and 4 LEDs

trollers such as piezo drivers and multi-axis servo controllers with minimal programming effort.

Contents of Delivery

Each Mercury™ Step comes with a wide-range power supply, RS-232 communications cables, a USB cable and a comprehensive software package.

Application Examples

- Flexible automation
- Handling
- Quality control
- Testing equipment
- Photonics applications
- Fiber positioning



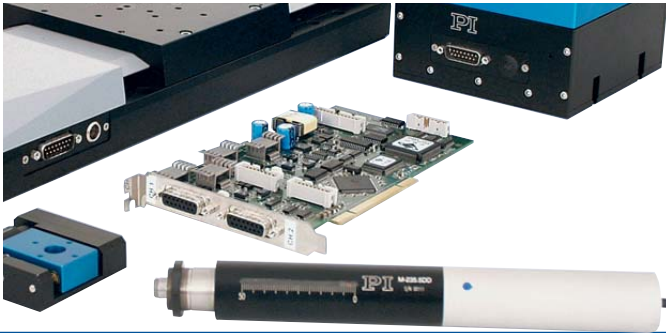
Mercury™ Step controller with M-403.62S precision translation stage

Technical Data

Model	C-663.10
Function	Stepper motor controller, stand-alone capability
Drive type	2-phase stepper motor
Channels	1
Motion and control	
Trajectory profile modes	Trapezoidal, point-to-point
Microstep resolution	1/16 full step
Limit switches	2 x TTL, programmable
Reference switches	1 x TTL, programmable
Motor brake	1 x TTL, programmable
Electrical properties	
Operating voltage	15 to 30 V
Current limitation per motor phase	1000 mA
Interface and operation	
Interface/Communication	USB, RS-232 (bus architecture)
Motor connector	Sub-D 15 (f)
Controller network	Up to 16 units* on single interface
I/O ports	4 analog/digital in, 4 digital out
Command set	Mercury™ native command set, GCS
User software	MMCRun, PIMikroMove®
Software drivers	GCS (PI General Command Set)-DLL, LabVIEW drivers, native Mercury™ DLL
Supported functionality	Start-up macro
Manual control	Joystick, Y-cable for 2D motion, pushbutton box
Miscellaneous	
Operating temperature range	0 to 50 °C
Mass	0.3 kg
Dimensions	130 x 76 x 40 mm ³

*16 with USB; 6 with RS-232 (depending on RS-232 output driver of PC)

C-843 DC-Servo-Motor Controller Servo Motion Controller/Driver PCI Board for 2 or 4 Axes



C-843.41 DC-motor controller board with M-110.DG linear stage, M-235.5DG heavy duty linear actuator, M-511.DD direct drive translation stage and M-501.1DG vertical stage. No external amplifier is required to drive any of these or other PI stages. Small motors are driven through the C-843's onboard linear amplifiers, direct-drive PI stages (e.g. M-511.DD) employ ActiveDrive™ controlled off the C-843's PWM outputs.

- **Two and Four Axis Version**
- **Very Cost-Effective: Servo Amplifiers On-Board**
- **Additional PWM Outputs for High-Power Motors**
- **Trapezoidal Curve, S-Curve and Velocity Profile**
- **32 kSamples RAM for High-Speed Buffer Operations**
- **16 I/O Lines for Flexible Automation**
- **Fast PCI Communication, 120 µs for Position Read**
- **Motor-Brake Control Output**
- **Extensive Software Support**
- **General Command Set (GCS) Compatible**

The C-843 PCI motion controller card drives up to 4 axes of micropositioning equipment. Because there is no need for external servo-amplifiers, this new card is a very cost-effective, easy-to-set-up solution.

On-Board Servo-Amplifiers

Unlike other PCI controller cards, the new C-843 comes with on-board, low-noise linear amplifiers for the small DC motors used in most compact micropositioning stages and actuators.

In addition, PWM outputs are available to drive more powerful equipment (all direct-drive

translation and rotation stages from PI feature the integrated ActiveDrive™ PWM amplifiers, and also connect to the C-843 with no external power amplifiers).

The PWM mode and linear amplifier mode can be programmed individually for each of the 4 (or 2) channels.

High-Performance PID Control

The C-843 employs a fast DSP (digital signal processor) providing high-performance PID motion control with many options for trajectory generation and filter settings for superior positioning and tra-

cking accuracy. Position, velocity, acceleration and several other motion parameters can be programmed individually for each axis on-the-fly. High-bandwidth counters (5 MHz) support differential encoder feedback (incremental rotary encoders or linear scales) for fast and accurate positioning.

I/O for Flexible Automation

In addition to 3 TTL inputs per channel for limit and reference signals, 16 more I/O lines are available for flexible automation tasks (trigger functions, etc.). The C-843 also features motor-brake output lines (e.g. for M-531.DDB stages).

High-Speed Buffering

The integrated 32 k-sample trace memory allows online buffering (read and write) at integer multiples of the servo-loop time of up to four independent system variables (positions, velocities, internal register contents, etc.) This allows the observation of the motion system and also performing customized trajectory profiles.

PI General Command Set (GCS)

The comprehensive command structure is based on the PI General Command Set (GCS). With GCS the development of custom application programs is simplified, because the commands for all supported devices are identical in syntax and function. PI controllers for nanopositioning systems, for piezomotors and servo or stepper motors can be commanded with GCS.

Software / Programming

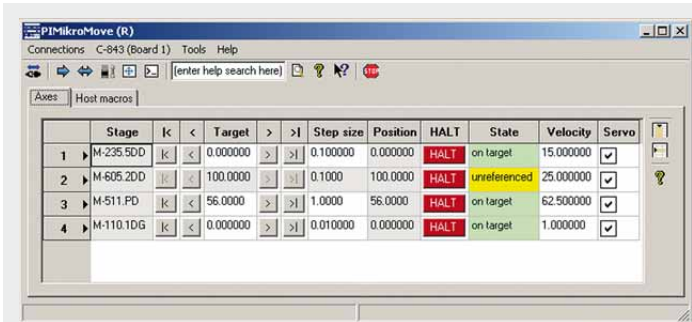
In addition to the user software for setup, system optimization and operation, comprehensive LabVIEW and DLL libraries are

Ordering Information

- C-843.21**
DC-Motor Controller PCI PC Board, 2-Axis
- C-843.41**
DC-Motor Controller PCI PC Board, 4-Axis
- C-843.JS**
Joystick and PCI Interface Board for C-843 Motor Controller

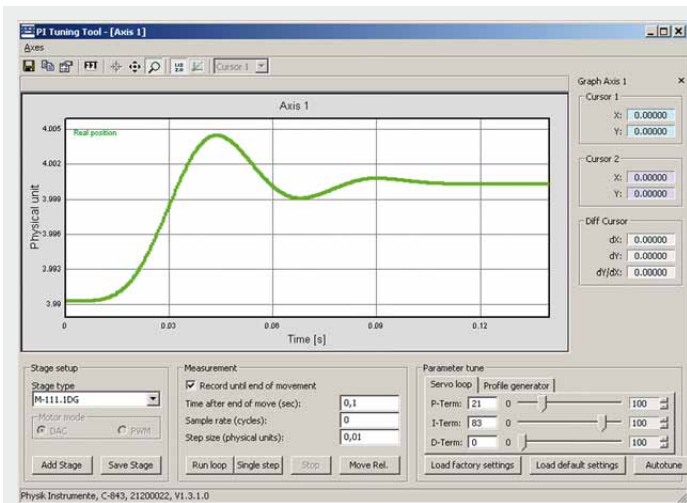
provided. The user friendly PI MikroMove™ provides a convenient interface for stage operation including tuning tool, joystick operation, terminal and macro editor.

Communications to/from the board consist of packet-based messages passed via memory access. An interrupt line is provided so that the chipset can signal the PC when special conditions arise, such as reception of an encoder index pulse. For system programmers the C-843 offers direct access to the DSP.



	Stage	k	<	Target	>	>	Step size	Position	HALT	State	Velocity	Servo
1	M-235.5DD	k	<	0.000000	>	>	0.100000	0.000000	HALT	on target	15.000000	✓
2	M-605.2DD	k	<	100.0000	>	>	0.1000	100.0000	HALT	unreferenced	25.000000	?
3	M-511.PD	k	<	56.00000	>	>	1.0000	56.00000	HALT	on target	62.500000	✓
4	M-110.1DG	k	<	0.000000	>	>	0.010000	0.000000	HALT	on target	1.000000	✓

PIMikroMove® tabular presentation of four connected axes with display of absolute and relative positioning input, current position, halt axis button, state and velocity setting.



The Tuning Tool which is integrated in PIMikroMove® demonstrates acquiring and displaying step and settle data of micropositioning systems. Controls allow adjustment of the PID parameters for best performance.

Technical Data

Model	C-843
Function	PC plug-in DC-servo-motor controller board, 32-bit plug-and-play PCI-bus interface, supported by main boards with 3.3 V and 5 V PCI bus connectors (universal card)
Axes	2 (C-843.21); 4 (C-843.41)
Servo characteristics	Programmable PID V-ff filter, parameter changes on-the-fly
Profile modes	Trapezoidal, S-curve, velocity profile
Output power / resolution	Analog 6 watts/channel (drawn directly from PC power supply), 12-bit D/A converters, PWM 10-bit, 24.5 kHz
Current limitation	500 mA per channel (short-circuit-proof)
Encoder input	AB (quadrature) differential TTL signals, 5×10^6 counts/s
Stall detection	Servo off, triggered by programmable position error
Limit switches	2 TTL / axis (active high/low, programmable)
Reference switches	1 TTL / axis (active high/low, programmable)
I/O ports	8 TTL inputs, 8 TTL outputs
Motor connectors	15-pin (f) sub-D per channel (2 on board + 2 on bracket for C-843.41)
Interface/communication	PC PCI bus
Command set	PI General Command Set (see p. A-11)

C-863 Mercury™ Servo Controller 1-Axis DC-Servo-Motor Controller with Network Feature



The C-863 Mercury™ DC servo controller features USB and RS-232 interfaces and incremental encoder signal processing at 20 MHz bandwidth

- High Performance at Low Cost
- DC Servo-Motor Controller Supplies up to 30 W
- 20 MHz Encoder Input for High Speed & Resolution
- Macro Programmable Stand-Alone Functionality
- Network Capability for Multi-Axis Applications
- Non-Volatile EEPROM for Macros and Parameters
- Digital I/O Lines (TTL)
- Motor-Brake Control
- USB and RS-232 Interface
- Optional Joystick for Manual Control
- Works with All PI Micropositioners

The latest generation Mercury™ C-863 servo motor controller is even more powerful and versatile than its predecessors. Easy data interchange with laptop or PC is possible via the USB interface. The RS-232 interface provides for easy integration in industrial applications. The compact design with its integrated amplifier makes it ideal for building high-performance,

cost-effective micropositioning systems.

Flexible Automation

The Mercury™ offers a number of features to achieve automation and handling tasks in research and industry in a very cost-effective way. Programming is facilitated by the high-level mnemonic command language with macro and compound-command functionality. Macros can be stored in the non-volatile memory for later recall.

Stand-alone capability is provided by a user-programmable autostart macro to run automation tasks at power up (no runtime computer communication required!).

For easy synchronization of motion with internal or external trigger signals four input and four output lines are provided.

Multi-Axis Control, Combination of DC & Stepper Motors

Up to 16 C-863 Mercury™ DC servo controllers and C-663 stepper motor controllers can be daisy-chained and addressed via the same interface.

The networking feature allows the user to start out with one controller and add more units later for multiaxis setups.

Easy Programming

All servo and stepper motor controllers of the Mercury™ family can be operated using the PI general command set (GCS). PI-GCS allows networking of different controller units, both for piezo-based and motorized positioning units, with minimal programming effort. In addition, the C-863 can be programmed using the native command set of previous Mercury™ controllers.

Cost-Saving Due to Integrated Amplifier and PWM Outputs

The unique Mercury™ concept combines a high-performance motion controller and an integrated power amplifier in a small package. Additional PWM control outputs allow the direct operation of any DC-motor-driven PI micro-positioning system—even high-speed stages such as the M-500 ActiveDrive™ Translation Stages—reducing costs, increasing reliability and simplifying the setup.

Contents of Delivery

Each controller is delivered with a wide-range power sup-

Ordering Information

C-863.10
Mercury™ DC-Motor Controller, 1 Channel, with Wide-Range Power Supply

C-819.20
2-Axis Analog Joystick for Mercury™ Controller

C-819.20Y
Y-Cable for Connecting 2 Controllers to C-819.20

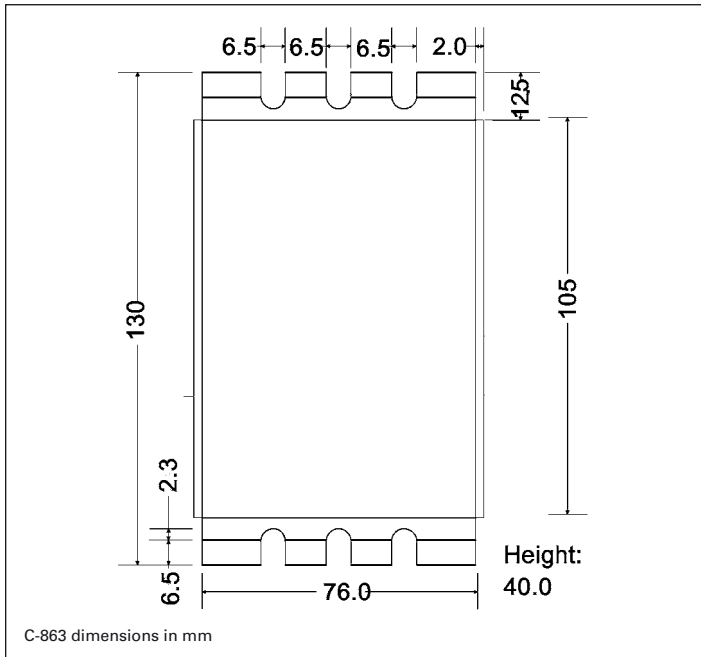
C-170.IO
I/O Cable, 2 m, Open End

C-170.PB
Push Button Box, 4 Buttons and 4 LEDs

ply, RS-232 communication cable, a daisy-chain network cable and a comprehensive software package.

Application Examples

- Fiber positioning
- Automation
- Photonics / integrated optics
- Quality assurance testing
- Testing equipment



Technical Data

Model	C-863.10
Function	DC-servo-motor controller, 1 channel
Motion and control	
Servo characteristics	P-I-D servo control, parameter change on-the-fly
Trajectory profile modes	Trapezoidal, point-to-point
Encoder input	AB (quadrature) single-ended or differential TTL signal, 20 MHz
Stall detection	Servo off, triggered by programmable position error
Input limit switch	2 x TTL (pull-up/pull-down, programmable)
Input reference switch	1 x TTL
Motor brake	1 x TTL, software controlled
Electrical properties	
Output power	max. 30 W (PWM)
Output voltage	0 to 15 V
Current	80 mA + motor current (3 A max.)
Interfaces and operation	
Communication interfaces	USB, RS-232 (9-pin [m] sub-D)
Motor connector	15-pin (f) sub-D
Controller network	Up to 16 units on single interface
I/O ports	4 analog/digital in, 4 digital out (TTL)
Command set	Mercury Command Set, GCS (via DLL)
User software	PIMikroMove®, MMCRun
Software drivers	GCS (PI General Command Set)-DLL, LabVIEW drivers, native Mercury™ DLL
Supported functionality	Start-up macro; internal safety circuitry: watchdog timer
Manual control (optional)	2-axis joystick, Y-cable for 2D motion, pushbutton box
Miscellaneous	
Operating voltage	15 to 30 V included: external power supply, 15 V / 2 A
Operating temperature range	+5 to +50 °C
Mass	0.3 kg
Dimensions	130 x 76 x 40 mm

Micropositioning, Nanopositioning, NanoAutomation®

Cutting-Edge Motion Control Solutions for Industry and Research



PI headquarters

Nanopositioning Technology - 30 Years Ahead of its Time

PI has been a world market leader in nanopositioning technology and ultra-high-precision motion-control systems for many years. The first nanopositioning systems served research centers working in interferometry and laser technology. Today, entire branches of industry – such as the semiconductor industry, biotechnology and, increasingly, the machine-tool industry – are dependent on progress in nanopositioning.

Key Technologies Under One Roof: A Plus for Our Customers

PI has a strategy of vertical integration with all key technologies developed and maintained in one company. This permits direct control over every step from conception to shipment, optimizing quality and cost. As a customer, you, too, can profit from our over 30 years experience in micro- and nanopositioning. PI can react quickly to development and production needs of OEM customers – even for highly complex custom products and assemblies.

Applications

Today PI delivers Micro- & Nanopositioning solutions for all important high-tech markets:

- Semiconductors
- Data Storage
- Photonics, Fiber Optics, Telecom
- Life Sciences
- Lasers, Optics, Microscopy
- Aerospace Engineering
- Precision Machining
- Astronomy



Request the 500 p. Hardbound PI Catalog





The new hardbound "Piezo Nano Positioning Inspirations 2009" catalog from PI is available now. The 530 page publication is the most comprehensive reference book on the fundamentals of nanopositioning, piezo systems and micropositioning technology yet. The new catalog contains 200 product families, 30% of them new, with more than 1000 drawings, graphs, images and technical diagrams.

The 530 page publication presents PI's state-of-the-art products and technologies-such as:

- Nanopositioning / Scanning Stages
- Scanning Microscopy Stages
- Steering Mirrors, Mirror Shifters
- Piezo Actuators
- Piezo Motors
- Piezo Controllers
- Motorized Stages & Actuators
- Motor Controllers
- Hexapod 6-Axis Alignment Systems

The catalog also contains a tutorial on piezo technology and application examples of nanopositioning products in the following industries:

- Biotechnology / Life Sciences
- Semiconductor Technology
- Data Storage Technology
- Nanotechnology
- Aeronautics
- Astronomy
- Adaptive Optics
- Metrology / Laser-Systems
- Precision Machining

Headquarters

GERMANY

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

PI Ceramic GmbH
 Lindenstr.
 07589 Lederhose
 Tel: +49 (36604) 882-0
 Fax: +49 (36604) 882-25
 info@piceramic.de
 www.piceramic.de

Subsidiaries

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
 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
 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.
 32 rue Delizy
 93694 Pantin Cedex
 Tel: +33 (1) 57 14 07 10
 Fax: +33 (1) 41 71 18 98
 info@pifrance.fr
 www.pifrance.fr

ITALY

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