

Piezo Z-Nanofocus Systems

Imaging, Microscopy, Surface Analysis

FAST



PRECISE



INDIVIDUAL



Click on the Images to Jump to Datasheet

PIFOC[®] Objective Scanners / Fast Focus Systems



P-725 Piezo Scanners provide travel ranges to 460 μm , fast response and very high resolution to (sub-nanometer)



P-721.CLO Piezo objective scanner for travel up to 140 μm and sub-nanometer precision



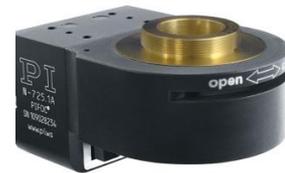
P-725.CDD provides higher stiffness and even faster response than the P-721



P-726 High-dynamics PIFOC[®] objective scanner for heavy, high NA microscope objectives, 100 μm travel range capacitive feedback.



Compact Custom Nosepiece Scanner provides nanometer precision for multiple objectives



N-725 PIFOC[®] features a PiezoWalk[®] linear motor for up to 1 mm travel and very fast response. Extreme position stability.

PIFOC® Long Range Objective Scanning System

1000 µm Travel, with PiezoWalk® Drive, Controller & Software



The microscopy package: Objective nanofocusing system with 1 mm travel range and adapters for M25 threads. The controller comes with an extensive software package e. g. for automation and also supports manual control via joystick

- **High Force and Long Travel Range: 10 N / 1 mm**
- **Dynamic Fine Positioning, Typical Step and Settle: 20 ms**
- **Drive Resolution < 1 nm, Linear Encoder Resolution 20 nm**
- **Self Locking at Rest, no Heat Generation, No Servojitter**
- **Compact Design: Ø 48 mm, 40.5 mm Height**
- **Frictionless, High-Precision Flexure Guiding System for Better Focus Stability**
- **Complete System with Controller**
- **Non-Volatile Macro Storage for Stand-Alone Functionality with Autostart Macro**
- **I/O for Automation, Joystick for Manual Operation**

The NEXACT® objective scanner provides significantly more travel range than other piezo-driven objective positioners due to its unique PiezoWalk® linear motor drive. This drive combines high stiffness, quick step-and-settle, large travel ranges and extreme position stability.

Application Examples

- Two-photon microscopy
- Confocal microscopy
- 3-D Imaging
- Screening
- Autofocus systems
- Surface analysis
- Wafer inspection

The long travel range of 1 mm is the main reason why the objective scanner offers decisive advantages for applications with large optical penetration depth such as two-photon microscopy. The focusing plane can be selected as desired over the total working range of the objective without any changes to the mechanical system. In conjunction with a step-and-settle time of less than 20 ms this increases the through-put and allows rapid Z-stack acquisition.

Simple Installation with Quick-Lock Thread Options

The PIFOC® is mounted between the turret and the objective with the QuickLock thread adapter. After threading the

adapter into the turret, the QuickLock is affixed in the desired position. Because the PIFOC® body need not to be rotated, cable wind-up is not an issue.

Controller for Manual Control and Automated Scans

The system comes with a proprietary closed-loop controller for NEXACT® piezomotor linear drives. A joystick can be connected as a manual control. Its non-volatile memory supports macro programming, e.g. to speed up automation tasks. A user-programmable „Auto-start“ macro allows for stand-alone-functionality without the need for external communication. The system includes an extensive software package to facilitate integration into com-

Ordering Information

ND72Z9LAQ

PIFOC® Piezo Nanofocusing Z-Drive with NEXACT® Linear Motor, 1 mm, Linear Encoder, 20 nm Resolution, M25 QuickLock Thread Adapters, Including Controller

Accessories:

P-721.91Q

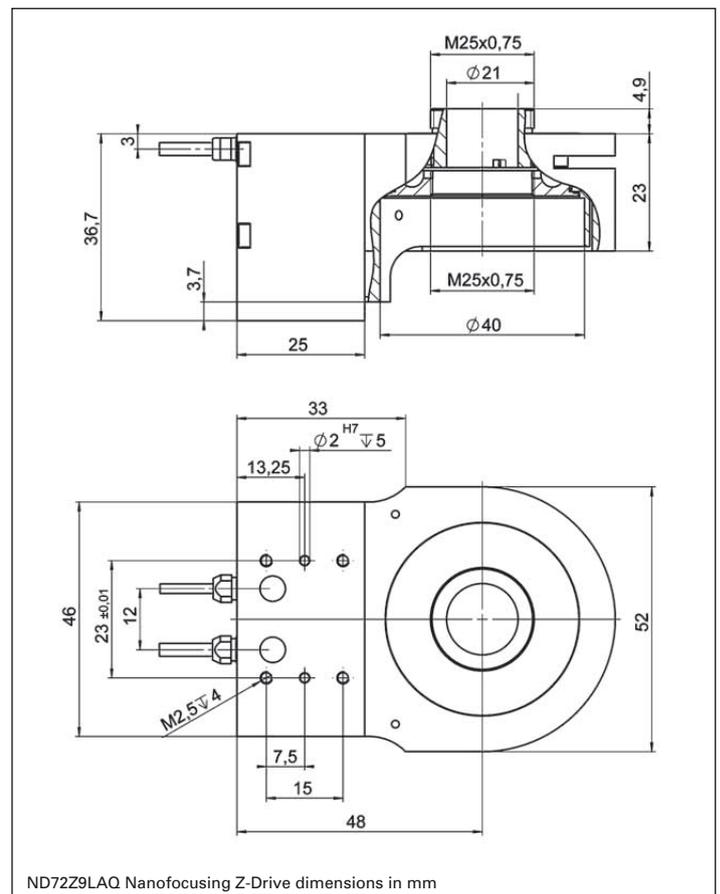
Extens. Tube, 12.5 mm, Thread M25 x 0.75

C-819.20

2-Axis Analog Joystick

plex imaging applications and also allows manual control via a joystick.

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



Easy System Set-up, Comprehensive Software Package

All parameters can be set and checked via software. For system setup and configuration the versatile PIMikroMove user-interface software is included. Interfacing to custom software is facilitated with LabView drivers and DLLs.

Scanners for Higher Resolution and Larger Loads

PI offers a range of related PIFOC® objective scanners with different specifications. The P-725 models e.g. (s.p. 2-28) offer resolutions of less than one nanometer. For larger loads

and dynamic scanning applications the models P-726 (s.p. 2-32) and P-725.DD (s.p. 2-30) are also available with travel ranges of up to 100 µm.

NEXACT® PiezoWalk® Technology

See page 1-12 for further information.

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

Technical Data

Model	ND72Z9LAQ
	Long-travel objective scanning system, incl. controller
Active axes	Z
Motion and positioning	
Travel range	1 mm
Integrated sensor	Linear encoder
Sensor resolution	20 nm
Linearity, closed-loop	0.1 %
Bidirectional repeatability	50 nm
Runout (X, Y) typ.	15 µrad / 100 µm
Step and settle (200 nm) typ.	20 ms
Max. velocity	10 mm/s
Mechanical properties	
Stiffness in motion direction	0.5 N/µm
Max. push / pull force (active)	10 N
Drive resolution	< 1 nm
Drive properties	
Drive type	NEXACT® linear drive
Controllers	
Communication interfaces	USB 1.0, RS-232 (9-pin (m) sub-D)
I/O ports	4 analog/digital in, 4 digital out (TTL)
User software	PIMikroMove®, PI Terminal
Software drivers	GCS-DLL, LabVIEW Driver
Supported functionality	Digital setting of the control parameters on-the-fly; start-up macro; data recorder for recording parameters such as motor input voltage, velocity, position or position error; internal safety circuit: watchdog timer
Miscellaneous	
Operating temperature range	0 to 50 °C
Material Scanner	Aluminum
Weight	440 g (scanner), 1.1 kg (controller)
Cable length to controller	1.5 m
Dimensions controller	206 x 130 x 66 mm (including mounting rails)

Fast Piezo Focus Systems: 100 μm - 400 μm PIFOC[®]

Affordable High Performance: With Digital Controller & Software



Several PIFOC[®] piezo objective scanners (fast focus mechanisms) with QuickLock thread adapter and digital controller (objective not included)

- Complete System with Controller: Fast Digital Controller, Software-Configurable Servo Parameters
- Travel Ranges to 400 μm
- Scans and Positions Objectives with Sub-nm Resolution
- Frictionless, High-Precision Flexure Guiding System for Better Focus Stability
- Choice of SGS Sensor (Lower Cost) and Capacitive Feedback with Direct Metrology for highest Stability and Linearity
- Clear Aperture up to 29 mm \varnothing , QuickLock Adapter for Easy Attachment
- Interfaces: USB, RS-232 and analog
- Comprehensive Software Package, Compatible with MetaMorph Imaging Software

The PIFOC[®] piezo objective scanner systems include a high precision piezo mechanism and a custom-tuned compact digital controller. This combination provides higher performance at reduced costs. The integrated, frictionless and stiff piezo flex-

ure drive ensures high stiffness and fast settling times, as well as an exceptional guiding accuracy and response. The settling time of less than 10 ms increases the throughput and allows rapid Z-stack acquisition.

level resolution can be used which are applied to appropriate places on the drive train and thus measure the displacement of the moving part of the stage. The linearity is improved considerably with the digital controller provided.

Simple Installation with QuickLock Thread Options

The PIFOC[®] is mounted between the turret and the objective with the QuickLock thread adapter. After threading the adapter into the turret, the QuickLock is affixed in the desired position. Because the PIFOC[®] body need not to be rotated, cable wind-up is not an issue. For applications which require a particularly large optical aperture a version with a 29 mm diameter threaded inserts is available.

Digital Controller for Automated Scans

Included in the delivery is a digital controller which opens up the possibilities of digital control for piezo-driven nanopositioning systems for the same price as analog controllers. The advantage: higher linearity, simple operation and access to advanced features.

Ordering Information

PD72Z1CAA
Fast PIFOC[®] Piezo Nanofocusing Z-Drive, 100 μm , Capacitive Sensor, M32 Large Aperture QuickLock Thread Adapters, Digital Controller with USB, RS-232

PD72Z1CAQ
Fast PIFOC[®] Piezo Nanofocusing Z-Drive, 100 μm , Capacitive Sensor, M25 QuickLock Thread Adapters, Digital Controller with USB, RS-232

PD72Z1SAA
Fast PIFOC[®] Piezo Nanofocusing Z-Drive, 100 μm , SGS Sensor, M32 Large Aperture QuickLock Thread Adapters, Digital Controller with USB, RS-232

PD72Z1SAQ
Fast PIFOC[®] Piezo Nanofocusing Z-Drive, 100 μm , SGS Sensor, M25 QuickLock Thread Adapters, Digital Controller with USB, RS-232

PD72Z2CAA
Fast PIFOC[®] Piezo Nanofocusing Z-Drive, 250 μm , Capacitive Sensor, M32 Large Aperture QuickLock Thread Adapters, Digital Controller with USB, RS-232

PD72Z2CAQ
Fast PIFOC[®] Piezo Nanofocusing Z-Drive, 250 μm , Capacitive Sensor, M25 QuickLock Thread Adapters, Digital Controller with USB, RS-232

PD72Z4CAA
Fast PIFOC[®] Piezo Nanofocusing Z-Drive, 400 μm , Capacitive Sensor, M32 Large Aperture QuickLock Thread Adapters, Digital Controller with USB, RS-232

PD72Z4CAQ
Fast PIFOC[®] Piezo Nanofocusing Z-Drive, 400 μm , Capacitive Sensor, M25 QuickLock Thread Adapters, Digital Controller with USB, RS-232

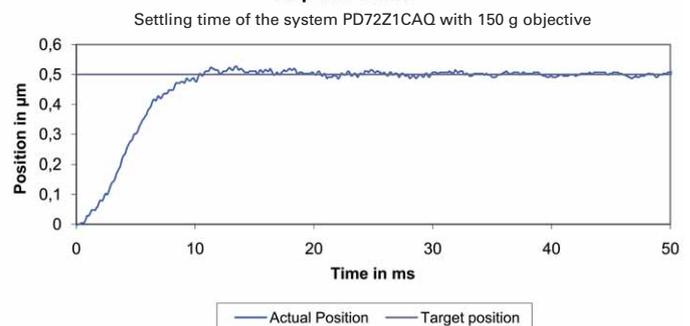
Application Examples

- Microscopy
- Confocal microscopy
- 3D Imaging
- Screening
- Autofocus systems
- Surface analysis
- Wafer inspection

Position Measurement with Highly Accurate Capacitive Sensors or Lower-Priced Strain Gauge Sensors

Capacitive sensors measure the position directly and without contact, they offer therefore a position resolution of far below one nanometer and excellent values in linearity. As an alternative, compact and lower-priced strain gauge sensors (SGS) with nanometer-

Step and Settle



Information on Laser Autofocus System: [Click Here](#)

Flexibility: Software Configurable Servo Parameters

All servo controllers require tuning and adjustment of servo parameters for optimum performance (e.g. as a result of changes to the load or the motion profile). With a digital controller, all adjustments are carried out by simple software commands and the resulting motion or transient characteristics can be viewed, analyzed and further optimized immedi-

ately with the provided software. It is also possible to switch between previously found sets of parameters when the controller is in operation. Since jumpers and potentiometers no longer have to be set manually, system integration becomes much more straightforward.

System setup with the included user-interface software is fast and easy, interfacing to the customers' software is facilitated with the included LabVIEW drivers and DLLs.

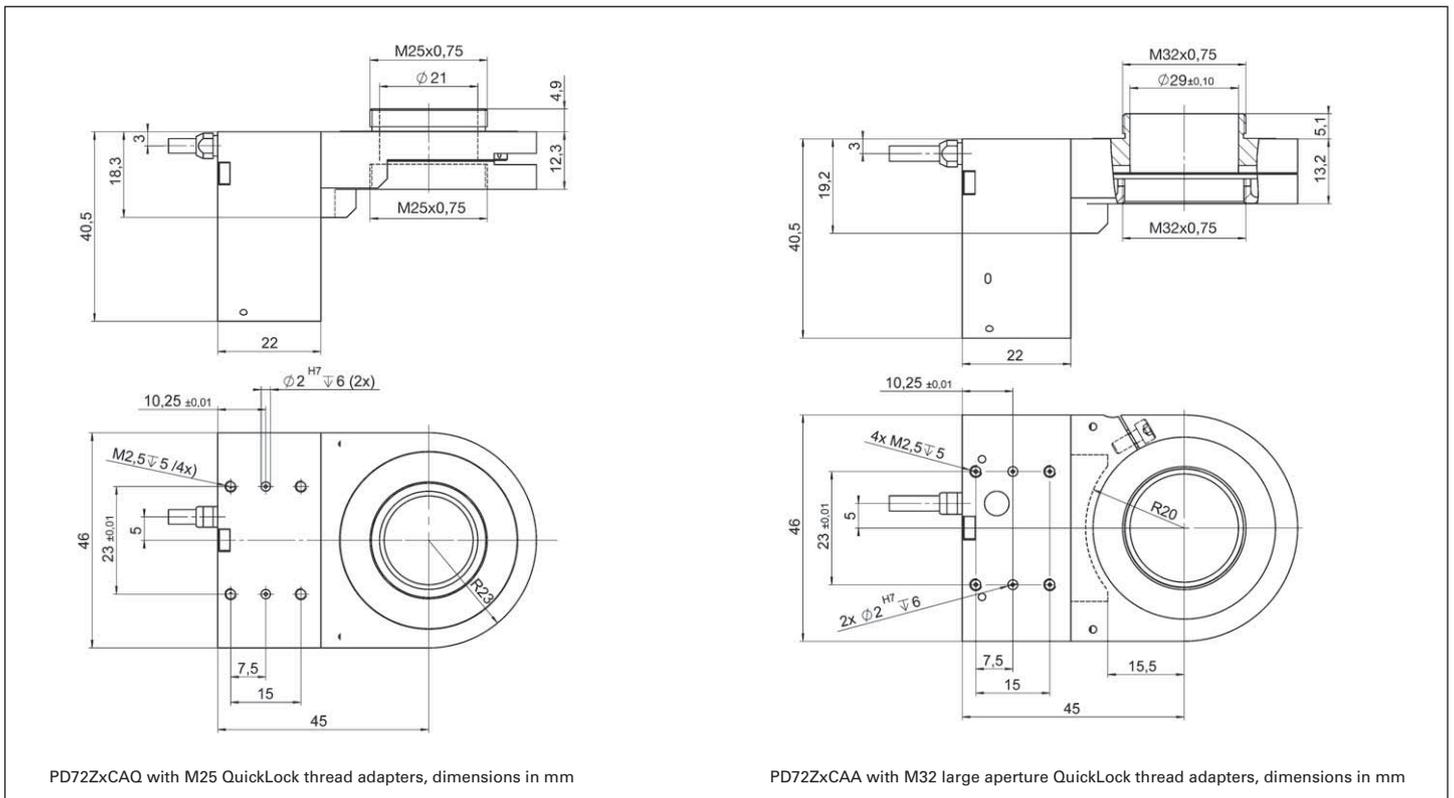
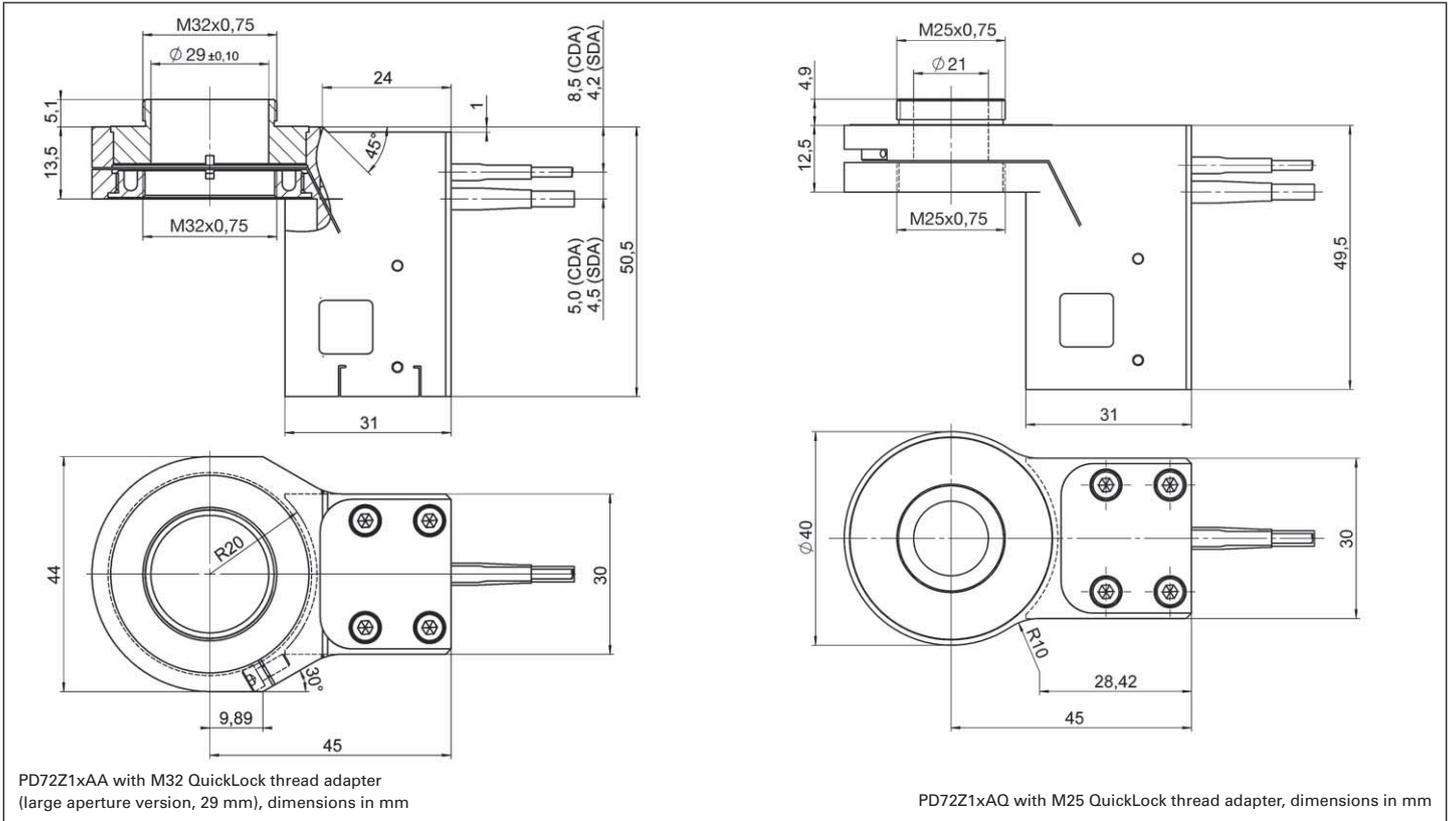
Drivers for MetaMorph and μ Manager are available.

Technical Data

Model	PD72Z1SAA PD72Z1SAQ	PD72Z1CAA PD72Z1CAQ	Units	Tolerance
Active axes	Z	Z		
Motion and positioning				
Integrated sensor	SGS	Capacitive		
Closed-loop travel	100	100	μ m	
Closed-loop resolution	5	1	nm	typ.
Closed-loop linearity	0.2	0.06	%	typ.
Repeatability	\pm 10	\pm 5	nm	typ.
Runout θ X, θ Y	13	13	μ rad	typ.
CrossTalk in X, Y	100	100	nm	typ.
Settling time (0.5 μ m step with 5 % accuracy, 150 g)	10	10	ms	typ.
Mechanical properties				
Stiffness in motion direction	0.3	0.3	N/ μ m	\pm 20%
Unloaded resonant frequency	580	580	Hz	\pm 20%
Resonant frequency @ 120 g	235	235	Hz	\pm 20%
Resonant frequency @ 200 g	180	180	Hz	\pm 20%
Push/pull force capacity in motion direction	100 / 20	100 / 20	N	Max.
Drive properties				
Ceramic type	PICMA® P-885	PICMA® P-885		
Controller				
Function	Digital controller for single-axis piezo nanopositioning systems			
Processor	DSP 32-bit floating point, 150 MHz			
Communication interfaces	USB, RS-232			
Linearization	5th order polynomials			
Amplifier power	10 W (<5 ms); 5 W (>5 ms)			
I/O Connector	HD-Sub-D 26-pin, 1 Analog input 0 to 10 V, 1 Sensor monitor 0 to 10 V, 1 digital input (LVTTTL, programmable), 5 digital outputs (LVTTTL, 3 predefined, 2 programmable)			
User software	PIMikroMove, NanoCapture			
Software drivers	LabVIEW drivers, DLLs			
Supported functionality	Digital setting of the control parameters, wave generator, data recorder, auto zero, trigger I/O; compatible to MetaMorph, μ Manager			
Display	Status LED, overflow LED			
Miscellaneous				
Operating temperature range	10 to 50	10 to 50	$^{\circ}$ C	
Material scanner	Aluminum	Aluminum		
Weight	0.22 (scanner), 0.5 (controller)	0.24 (scanner), 0.5 (controller)	kg	\pm 5%
Cable length to controller	1	1	m	
Dimensions controller	160 x 96 x 33	160 x 96 x 33	mm	

Technical Data

Model	PD72Z2CAA PD72Z2CAQ	PD72Z4CAA PD72Z4CAQ	Units	Tolerance
Active axes	Z	Z		
Motion and positioning				
Integrated sensor	Capacitive	Capacitive		
Closed-loop travel	250	400	μm	
Closed-loop resolution	1.5	2.5	nm	typ.
Linearity, closed-loop	0.06	0.06	%	typ.
Repeatability	±5	±5	nm	typ.
Runout θX	6	10	μrad	typ.
Runout θY	45	45	μrad	typ.
Crosstalk in X	20	60	nm	typ.
Crosstalk in Y	40	60	nm	typ.
Settling time	15	20	ms	typ.
(0.5 μm step to 5 % accuracy, 150 g)				
Mechanical properties				
Stiffness in motion direction	0.17	0.12	N/μm	±20%
Unloaded resonant frequency	330	230	Hz	±20%
Resonant frequency @ 150 g	140	120	Hz	±20%
Push/pull force capacity in motion direction	100 / 20	100 / 20	N	Max.
Drive properties				
Ceramic type	PICMA® P-885	PICMA® P-885		
Controller				
	Digital controller for single-axis piezo nanopositioning systems			
Processor	DSP 32-bit floating point, 150 MHz			
Communication interfaces	USB, RS-232			
Linearization	5th order polynomials			
Amplifier power	10 W (<5 ms); 5 W (>5 ms)			
I/O Connector	HD-Sub-D 26-pin, 1 Analog input 0 to 10 V, 1 Sensor monitor 0 to 10 V, 1 digital input (LVTTTL, programmable), 5 digital outputs (LVTTTL, 3 predefined, 2 programmable)			
User software	PIMikroMove, NanoCapture			
Software drivers	LabVIEW drivers, DLLs			
Supported functionality	Digital setting of the control parameters, wave generator, data recorder, auto zero, trigger I/O; Compatible to MetaMorph, μManager			
Display	Status LED, overflow LED			
Miscellaneous				
Operating temperature range	10 to 50 °C			
Material scanner	Aluminum			
Weight	0.23 kg (scanner), 0.5 kg (controller)			±5%
Cable length to controller	1.5 m			
Dimensions controller	160 x 96 x 33 mm			



P-726 PIFOC® High-Load Objective Scanner

High-Dynamic Piezo Z Scanner for Heavy Objectives



High-dynamics P-726 PIFOC® for large microscope objectives over 60 mm in length

- High-Dynamics Positioning and Scanning for Large Objectives
- 1120 Hz Resonant Frequency, 560 Hz with 210 g Load
- Typical Settling Time about 6 ms
- Travel Range 100 µm
- Direct-Metrology Capacitive Sensors for Best Linearity, Stability and Control Dynamics
- Resolution to 0.3 nm
- Frictionless, High-Precision Flexure Guiding System for Better Focus Stability

The P-726 PIFOC® Nanofocusing system was developed to achieve the fastest possible stepping time with the heavy, high-numerical-aperture objectives used in many of today's high-resolution microscopy applications. Its extremely stiff design offers excellent settling time and scanning frequency values even when objectives of several hundred grams are moved. High stiffness is

achieved with the rotationally symmetric arrangement of multiple piezo drives and the optimized design of the flexure and lever elements, which assure the excellent guiding accuracy and dynamics.

Furthermore, like other members of the PIFOC® family, the P-726 is equipped with direct metrology capacitive position sensors that allow resolutions far below one nanometer.

Direct Metrology with Capacitive Sensors for Highest Stability and Accuracy

PI's proprietary capacitive position sensors measure the actual motion of the moving part relative to the stationary base (direct metrology). Errors in the drive train, actuator, lever arm or in guiding system do not influence the measurements. The result is exceptional

motion linearity, higher long-term stability and a stiffer, more-responsive servo loop, because external influences are immediately recognized by the sensor. Due to this sensor principle, the P-726 features a resolution of under 0.4 nm in closed-loop and a linearity of 0.02 %.

Simple Installation with QuickLock Thread Options

The PIFOC® is mounted between the turret and the objective with the QuickLock thread adapter. After threading the adapter into the turret, the QuickLock is affixed in the desired position. Because the PIFOC® body need not to be rotated, cable wind-up is not an issue.

Ceramic Insulated Piezo Actuators Provide Long Lifetime

Highest possible reliability is assured by the use of award-winning PICMA® multilayer piezo actuators. PICMA® actuators are the only actuators on the market with ceramic-only

Ordering Information

P-726.1CD
High-Dynamics PIFOC® Piezo Nanofocusing Z-Drive, 100 µm, Capacitive Sensor

QuickLock Thread Adapter as Accessories:

P-726.04
P-726 PIFOC® Thread Adapter M28 x 0.75

P-726.05
P-726 PIFOC® Thread Adapter M32 x 0.75

P-726.06
P-726 PIFOC® Thread Adapter M26 x 1/36"

P-726.11
P-726 PIFOC® Thread Adapter M25 x 0.75

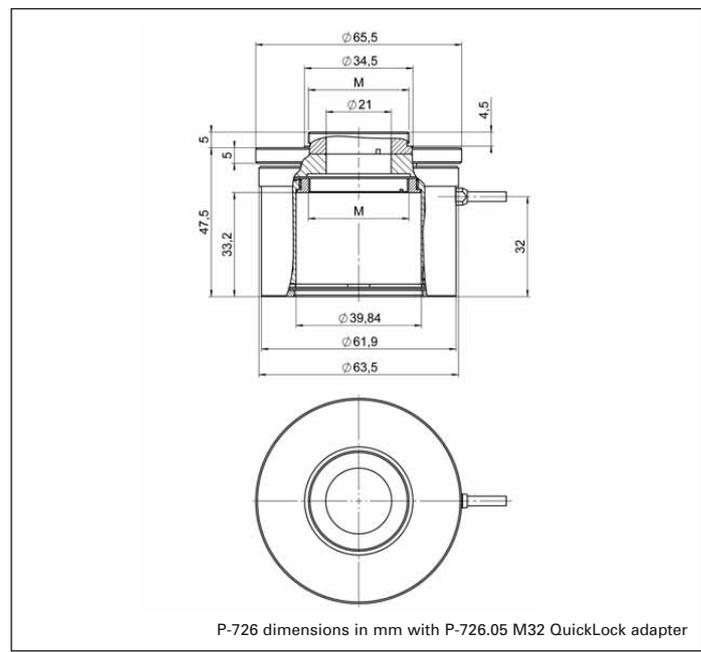
P-726.12
P-726 PIFOC® Thread Adapter W0.8 x 1/36"

Ask about custom designs!

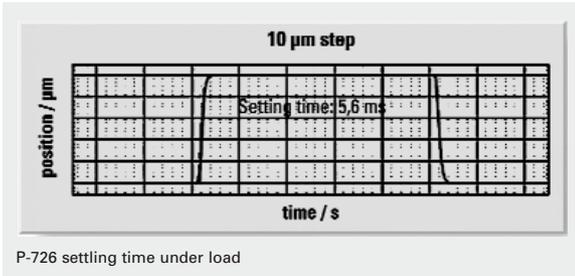
insulation, which makes them resistant to ambient humidity and leakage-current failures. They are thus far superior to conventional actuators in reliability and lifetime.

Application Examples

- 3-D Imaging
- Screening
- Autofocus systems
- Microscopy
- Confocal microscopy
- Surface analysis
- Wafer inspection



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Technical Data

	P-726.1CD	Tolerance
Active axes	Z	
Motion and positioning		
Integrated sensor	Capacitive, direct metrology	
Closed-loop travel	100 μm	calibrated
Closed-loop resolution	0.4 nm	typ.
Open-loop resolution	0.3 nm	typ.
Linearity, closed-loop	0.02 %	typ.
Repeatability	± 3 nm	typ.
Runout Θ_x, Θ_y	± 5 μrad	typ.
Crosstalk X, Y	50 nm	typ.
Mechanical properties		
Stiffness in motion direction	3.4 N/ μm	± 20 %
Unloaded resonant frequency	1120 Hz	± 20 %
Resonant frequency under load	560 Hz @ 210 g	± 20 %
Resonant frequency under load	480 Hz @ 310 g	± 20 %
Push/pull force capacity in motion direction	100 / 50 N	Max.
Drive properties		
Piezo ceramic type	PICMA® P-885	
Electrical capacitance	6 μF	± 20 %
Dynamic operating current coefficient	7.5 $\mu\text{A}/(\text{Hz} \cdot \mu\text{m})$	± 20 %
Miscellaneous		
Operating temperature range	-20 to 80 °C	
Material	Aluminum, steel	
Dimensions	Diameter: 65 mm, Height: 50.7 mm	
Max. objective diameter	M32	
Mass	575 g	± 5 %
Cable length	1.5 m	± 10 mm
Sensor / voltage connection	Sub-D Special	
Recommended controller / amplifier	Single-channel digital controller: E-753 (bench-top) (p. 2-108) E-625 bench-top controller (p. 2-114), E-665 high-power bench-top controller (p. 2-116) E-500 modular piezo controller system (p. 2-142) with E-505 high-power amplifier module (p. 2-147) and E-509 servo-controller (p. 2-152)	
System properties		
System configuration	E-500 modular piezo controller system with E-505 high-power amplifier module and E-509 servo-controller 310 g load (objective mass)	
Closed-loop amplifier bandwidth, small signal, 10 μm	130 Hz	
Closed-loop amplifier bandwidth, large signal	70 Hz	

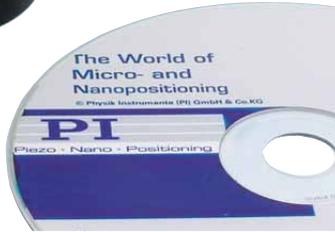


P-725.xDD PIFOC® High-Dynamics Piezo Scanner

Nanopositioning and Scanning System for Microscope Objectives



P-725.CDD direct-drive version for high-dynamics focusing



- **Fastest Settling Time under 5 ms with Microscope Objective**
- **18 µm Travel Range**
- **Scans and Positions Objectives with Sub-nm Resolution**
- **Parallel Flexure Guiding for Minimized Objective Offset**
- **Choice of Position Sensors: Capacitive Direct Metrology (Higher Performance) or Strain Gauges (Lower Cost)**
- **Compatible with Metamorph™ Imaging Software**
- **Outstanding Lifetime Due to PICMA® Piezo Actuators**
- **QuickLock Adapter for Easy Attachment**

Direct Drive for Ultra-Fast Scanning and Positioning

The P-725.xDD objective positioners were designed for extremely fast motion over relatively short travel ranges up to 18 µm. Their ultra-stiff direct piezo drive (1.2 kHz resonant frequency) enables the highest scanning rates and response

Application Examples

- 3D-Imaging
- Screening
- Interferometry
- Metrology
- Disc-drive-testing
- Autofocus systems
- Confocal microscopy
- Biotechnology
- Semiconductor testing

times of only 5 msec – essential for time-critical tasks.

Superior Accuracy With Direct-Metrology Capacitive Sensors

Capacitive position feedback is used in the top-of-the-line model. 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.

Alternatively compact, more cost-efficient strain gauge sensors (SGS) featuring nanometer resolution are implemented. Absolute-measuring SGS-sen-

sors are applied to appropriate places on the drive train and thus measure the displacement of the moving part of the stage relative to the base.

Simple Installation with QuickLock Thread Options

The PIFOC® is mounted between the turret and the objective with the QuickLock thread adapter. After threading the adapter into the turret, the QuickLock is affixed in the desired position. Because the PIFOC® body need not to be rotated, cable wind-up is not an issue.

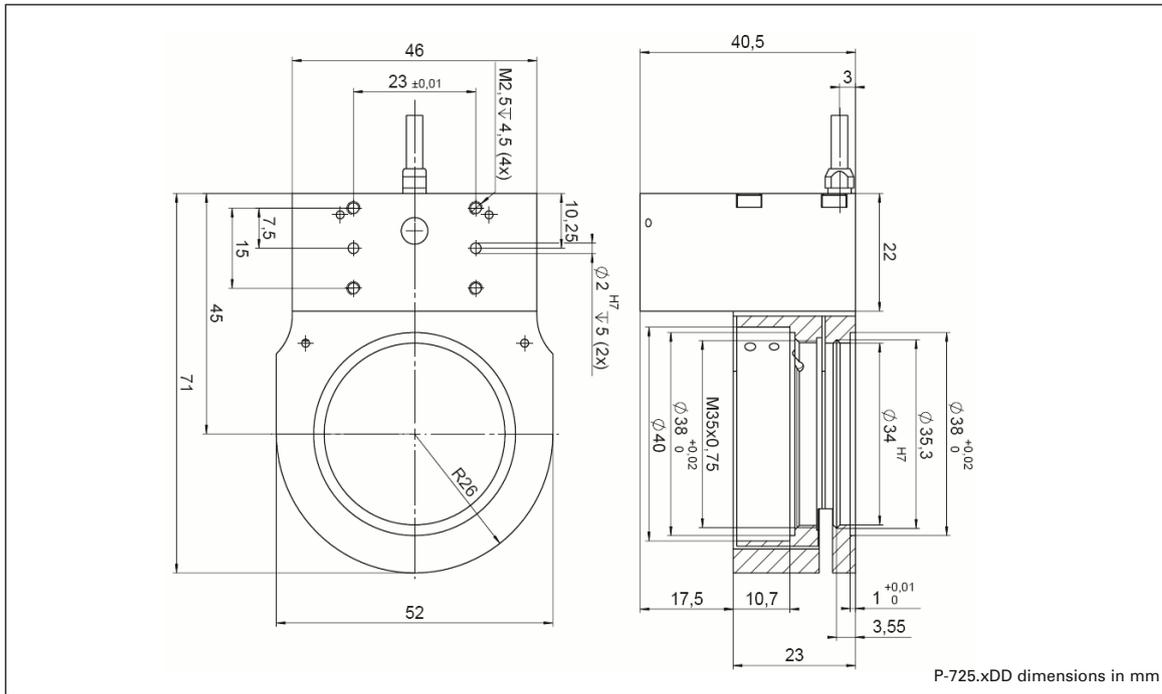
High Reliability and Long Lifetime

The compact PIFOC® systems are equipped with preloaded PICMA® high-performance piezo actuators which are integrated into a sophisticated, FEA-modeled, flexure guiding system. The PICMA® actuators feature cofired ceramic encapsulation and thus offer better performance and reliability than conventional piezo actuators. Actuators, guidance and sensors are maintenance-free and not subject to wear, and thus offer an extraordinary reliability.

Ordering Information

- P-725.CDD**
Fast PIFOC® Piezo Nanofocusing Z-Drive, 18 µm, Capacitive Sensor, Sub-D Connector, for QuickLock Thread Adapters
- P-725.SDD**
Fast PIFOC® Piezo Nanofocusing Z-Drive, 18 µm, SGS-Sensor, LEMO Connector, for QuickLock Thread Adapters
- Accessories**
QuickLock Thread Adapters
- P-721.11Q**
QuickLock Thread Adapter M25 x 0.75
- P-721.12Q**
QuickLock Thread Adapter W0.8 x 1/36"
- P-721.02Q**
QuickLock Thread Adapter M26 x 0.75
- P-721.03Q**
QuickLock Thread Adapter M27 x 0.75
- P-721.04Q**
QuickLock Thread Adapter M28 x 0.75
- P-721.05Q**
QuickLock Thread Adapter M32 x 0.75
- P-721.06Q**
QuickLock Thread Adapter M26 x 1/36 "
- P-721.08Q**
QuickLock Thread Adapter M19 x 0.75
- Extension Tubes for Objectives**
- P-721.90Q**
Extension Tube, 12.5 mm, Thread W0.8 x 1/36"
- P-721.91Q**
Extens. Tube, 12.5 mm, Thread M25 x 0.75
- P-721.92Q**
Extension Tube, 12.5 mm, Thread M26 x 0.75
- P-721.93Q**
Extension Tube, 12.5 mm, Thread M27 x 0.75
- P-721.94Q**
Extension Tube, 12.5 mm, Thread M28 x 0.75
- P-721.95Q**
Extension Tube, 12.5 mm, Thread M32 x 0.75
- P-721.96Q**
Extension Tube, 12.5 mm, Thread M26 x 1/36"
- P-721.98Q**
Extension Tube, 12.5 mm, Thread M19 x 0.75
- Ask about custom designs!**

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Technical Data

Model	P-725.CDD	P-725.SDD	Units	Tolerance
Active axes	Z	Z		
Motion and positioning				
Integrated sensor	Capacitive	SGS		
Open-loop travel, -20 to +120 V	18	18	µm	min. (+20%/-0%)
Closed-loop travel	18	18	µm	calibrated
Open-loop resolution	0.2	0.2	nm	typ.
Closed-loop resolution	0.2	0.2	nm	typ.
Linearity, closed-loop	0.04*	0.5	%	typ.
Repeatability	±1.5	±5	nm	typ.
Runout θ_x, θ_y	2	2	µrad	typ.
Crosstalk in X, Y	150	150	nm	typ.
Mechanical properties				
Stiffness in motion direction	1.5	1.5	N/µm	±20%
Unloaded resonant frequency	1180	1180	Hz	±20%
Resonant frequency @ 200 g	450	450	Hz	±20%
Push/pull force capacity in motion direction	100 / 20	100 / 20	N	Max.
Drive properties				
Ceramic type	PICMA® P-887	PICMA® P-887		
Electrical capacitance	3.1	3.1	µF	±20%
Dynamic operating current coefficient	19.4	19.4	µA/(Hz • µm)	±20%
Miscellaneous				
Operating temperature range	-20 to 80	-20 to 80	°C	
Material	Aluminum	Aluminum		
Mass	0.21	0.2	kg	±5%
Cable length	1.5	1.5	m	±10 mm
Sensor / voltage connection	Sub-D Special	LEMO		

Recommended controller

E-610 servo controller / amplifier (p. 2-110), E-625 servo controller, bench-top (p. 2-114), E-665 high-power servo controller, bench-top (p. 2-116)

Single-channel digital controller: E-753 (bench-top) (p. 2-108)

* With E-753 digital controller. Non-linearity of direct drive stages measured with analog controllers is up to 0.1% typ.

P-720 PIFOC® Piezo Nanofocusing Systems

Compact High-Dynamics Scanner for Small Objectives



The P-720 objective nanofocusing / scanning drive (objective not included) was designed for small objectives. Similar PIFOC® systems are available for large objectives and with position sensors

- Travel Range 100 μm
- Rapid Response & Settling Behavior
- Scans and Positions Objectives with Sub-nm Resolution
- Frictionless, High-Precision Flexure Guiding System
- Outstanding Lifetime Due to PICMA® Piezo Actuators

Model	Max. objective diameter	Travel	Open-loop resolution	Stiffness	Push/pull force capacity	Rotation around θ_x, θ_y
P-720.00	25 mm	100 μm	0.5 nm	0.2 N/ μm	100 / 20 N	13 μrad

P-721K PIFOC® Nosepiece Nanopositioner

Compact Design, Sub-Nanometer Resolution



P-721KTPZ Compact Nosepiece Nanopositioner

- Positioning and Scanning of Microscope Turrets
- Direct-Metrology Capacitive Sensors for Highest Linearity, Stability and Control Dynamics
- Frictionless, High-Precision Flexure Guiding System for Better Focus Stability
- Outstanding Lifetime Due to PICMA® Piezo Actuators

Model	Travel	Closed-loop/open-loop resolution	Resonant frequency (fully loaded)	Dimensions (W x L x H)
P-721KTPZ Turret-PIFOC®	80 μm	10 / 0.5 nm	215 Hz	44.5 x 42 x 53 mm

P-721K Power-PIFOC® Nosepiece Nanopositioner

For High-Resolution Microscopy. High-Load Capacity, Capacitive Feedback



The P-721KTPZ high-load PIFOC® allows precision positioning of a complete microscope turret

- Scans and Positions Objectives with Sub-nm Resolution
- Travel Ranges to 150 μm , Millisecond Settling Time
- Parallel Flexure Guiding for Minimized Objective Offset
- Direct Metrology with Capacitive Sensors for Highest Linearity
- Outstanding Lifetime Due to PICMA® Piezo Actuators

Model	Load capacity	Closed-loop travel	Resonant frequency	Mass
P-721KTPZ	20 N	to 150 μm	410 Hz (no load)	1.5 kg

P-915K Low-Profile Piezo Objective Scanner

For High Scanning Frequencies



- Very Low Profile of 15 mm
- Travel Range 75 μm
- Clear Aperture for Objectives with W0.8 x 1/36" Thread
- Frictionless, High-Precision Flexure Guiding System for Better Focus Stability and Minimized Runout
- Very Low Profile
- Outstanding Lifetime Due to PICMA[®] Piezo Actuators

The P-915KLPZ objective scanner allows high scanning frequencies

Model	Active axes	Travel range	Resonant frequency @ 150 g	Dimensions
P-915KLPZ Objective Scanner	Z	75 μm	200 Hz	60 x 60 x 15 mm

Program Overview

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- Active Optics / Tip-Tilt Platforms
- Capacitive Nanometrology Sensors
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Request or download the complete PI Nanopositioning & Piezo Actuator Catalog



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