

# P-725 PIFOC® Long-Travel Objective Scanner

## High-Precision Positioner / Scanner for Microscope Objectives



P-725.2CL with QuickLock option  
P-721.12Q for W0.8 x 1/36" threads  
and objective (QuickLock adapter  
and objective not included)

- Travel Ranges to 460  $\mu\text{m}$
- Significantly Faster Response and Higher Lifetime than Motorized Z-Stages
- Scans and Positions Objectives with Sub-nm Resolution
- Direct Metrology with Capacitive Sensors for Highest Linearity
- Parallel Precision Flexure Guiding for Better Focus Stability
- Compatible with Metamorph™ Imaging Software
- Outstanding Lifetime Due to PICMA® Piezo Actuators
- QuickLock Adapter for Easy Attachment

P-725 PIFOC® nanofocus systems are long-travel, high-speed, piezo-driven microscope objective nanofocusing/scanning devices. Despite the increased travel ranges (up to 460  $\mu\text{m}$ ), they are 20% shorter than P-721 units (p. 2-25) while providing sub-nanometer resolution. The innovative, frictionless, flexure guiding system provides enhanced precision for superior focus stability with fast response for rapid settling and scanning.

### Application Examples

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

### Fastest Step-and-Settle: 25 Milliseconds for 250 Microns

The P-725.2CL can perform a 250  $\mu\text{m}$  step to 1% accuracy in only 25 ms (E-665.CR controller, no load) and in 50 ms with a load of 150 g.

### Superior Accuracy With Direct-Metrology Capacitive Sensors

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

Open-loop models are available for applications where fast

response and very high resolution are essential. Here, specifying or reporting absolute position values is either not required or is handled by external sensors, such as interferometers, vision system or photodiode PSD (position sensitive detector). These models retain the inherent piezo advantages as high resolution and speed.

### 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 Quick Lock 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-725.1CD**  
PIFOC® Piezo Nanofocusing  
Z-Drive for Long Scanning Ranges,  
100  $\mu\text{m}$ , Capacitive Sensors, Sub-D  
Connector, for Quick Lock Thread  
Adapters

**P-725.1CL\***  
PIFOC® Piezo Nanofocusing  
Z-Drive for Long Scanning Ranges,  
100  $\mu\text{m}$ , Capacitive Sensors, LEMO  
Connector, for Quick Lock Thread  
Adapters

**P-725.2CD**  
PIFOC® Piezo Nanofocusing  
Z-Drive for Long Scanning Ranges,  
250  $\mu\text{m}$ , Capacitive Sensors, Sub-D  
Connector, for Quick Lock Thread  
Adapters

**P-725.2CL\***  
PIFOC® Piezo Nanofocusing  
Z-Drive for Long Scanning Ranges,  
250  $\mu\text{m}$ , Capacitive Sensors, LEMO  
Connector, for Quick Lock Thread  
Adapters

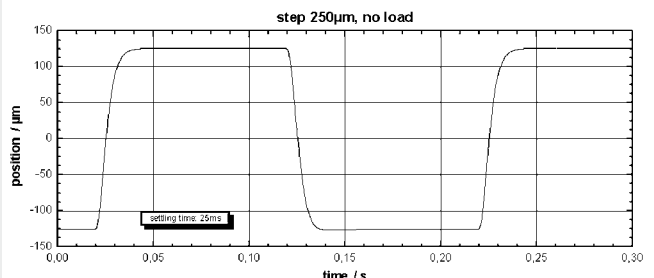
**P-725.4CD**  
PIFOC® Piezo Nanofocusing  
Z-Drive for Long Scanning Ranges,  
400  $\mu\text{m}$ , Capacitive Sensors, Sub-D  
Connector, for Quick Lock Thread  
Adapters

**P-725.4CL\***  
PIFOC® Piezo Nanofocusing  
Z-Drive for Long Scanning Ranges,  
400  $\mu\text{m}$ , Capacitive Sensors, LEMO  
Connector, for Quick Lock Thread  
Adapters

\*Also available w/o sensor (open-loop): P-725.10L, P-725.20L and P-725.40L

### Accessories

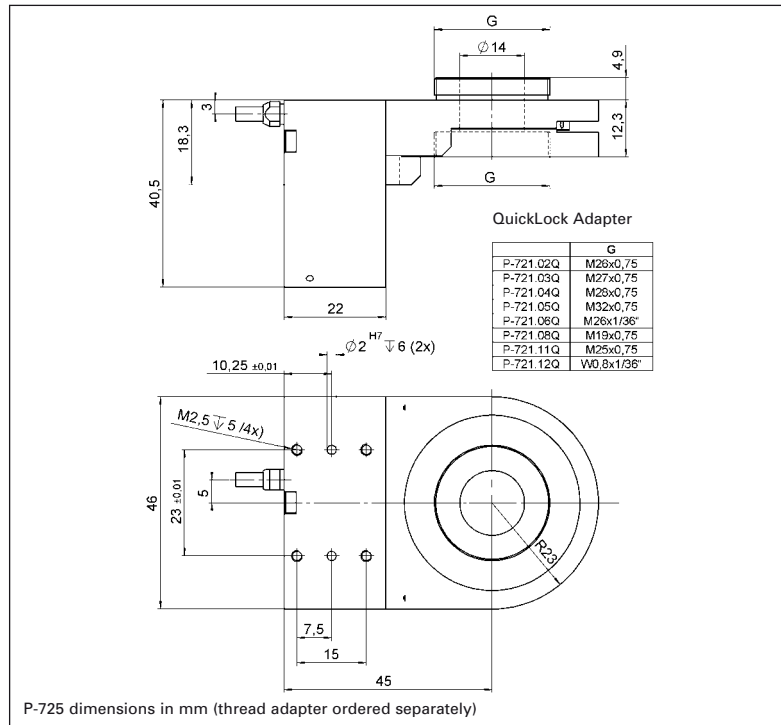
QuickLock thread adapters and extension tubes for objectives (see p. 2-26)



Top dynamic performance of the P-725.2CL PIFOC®: only 25 ms for a 250  $\mu\text{m}$  step

## Specimen Stages & Faster Scanners

For the highest dynamics, the P-726 (see p. 2-32) and P-725.DD (see p. 2-30) models are also available. Alternatively, the sample can be moved into focus: The P-737 piezo Z specimen stage features a large aperture for a variety of sample holders.



## Linear Actuators & Motors

### Nanopositioning / Piezoelectrics

#### Piezo Flexure Stages / High-Speed Scanning Systems

Linear

Vertical & Tip/Tilt

2- and 3-Axis

6-Axis

Fast Steering Mirrors / Active Optics

Piezo Drivers / Servo Controllers

Single-Channel

Multi-Channel

Modular

Accessories

Piezoelectrics in Positioning

## Nanometrology

## Micropositioning

## Index

## Technical Data

Model	P-725.1CL, P-725.1CD	P-725.2CL, P-725.2CD	P-725.4CL, P-725.4CD	Units	Tolerance
Active axes	Z	Z	Z		
<b>Motion and positioning</b>					
Integrated sensor	Capacitive	Capacitive	Capacitive		
Open-loop travel, -20 to +120 V	150	330	460	μm	min. (+20%/0%)
Closed-loop travel	100	250	400	μm	calibrated
Open-loop resolution	0.3	0.4	0.5	nm	typ.
Closed-loop resolution	0.65	0.75	1.25	nm	typ.
Linearity, closed-loop	0.03	0.03	0.03	%	typ.
Repeatability	±5	±5	±5	nm	typ.
Runout $\Theta_x$	1	6	10	μrad	typ.
Runout $\Theta_y$	20	45	45	μrad	typ.
Crosstalk in X	20	20	60	nm	typ.
Crosstalk in Y	20	40	60	nm	typ.
<b>Mechanical properties</b>					
Stiffness in motion direction	0.23	0.17	0.12	N/μm	±20 %
Unloaded resonant frequency	470	330	230	Hz	±20 %
Resonant frequency @ 150 g	185	140	120	Hz	±20 %
Push/pull force capacity in motion direction	100 / 20	100 / 20	100 / 20	N	Max.
<b>Drive properties</b>					
Ceramic type	PICMA® P-885	PICMA® P-885	PICMA® P-885		
Electrical capacitance	4.2	6.2	6.2	μF	±20 %
Dynamic operating current coefficient	5.2	3.1	1.9	μA/(Hz • μm)	±20 %
<b>Miscellaneous</b>					
Operating temperature range	-20 to 80	-20 to 80	-20 to 80	°C	
Material	Aluminum	Aluminum	Aluminum		
Max. objective diameter	39	39	39	mm	
Mass	0.215	0.23	0.23	kg	±5 %
Sensor / voltage connection	CL-version: LEMO CD-version: Sub-D special	CL-version: LEMO CD-version: Sub-D special	CL-version: LEMO CD-version: Sub-D special		

Recommended controller / amplifier  
 "CL"-versions:  
 E-610 servo controller / amplifier (p. 2-110); E-500 modular piezo controller system (p. 2-142) with E-505 high-performance amplifier module (p. 2-147) and E-509 controller (p. 2-152)  
 "CD"-versions:  
 E-621 controller module (p. 2-160), E-625 servo controller, bench-top (p. 2-114), E-665 display servo controller, with digital interface, bench-top (p. 2-116)  
 Single-channel digital controller: E-753 (bench-top) (p. 2-108)