

# P-721 PIFOC® Piezo Flexure Objective Scanner

## Fast Nanopositioner and Scanner for Microscope Objectives



P-721.CLQ piezo objective nan positioning system with P-721.12Q QuickLock option and objective (adapter and objective not included)

- Scans and Positions Objectives with Sub-nm Resolution
- Travel Ranges to 140 µm, Millisecond Settling Time
- Significantly Faster Response and Higher Lifetime than Motorized Z-Stages
- Parallel Precision Flexure Guiding for Better Focus Stability
- Choice of Position Sensors: Capacitive Direct Metrology (Higher Performance) or Strain Gauge (Lower Cost)
- Compatible with Metamorph™ Imaging Software
- Outstanding Lifetime Due to PICMA® Piezo Actuators
- QuickLock Adapter for Easy Attachment
- Clear Aperture up to 29 mm Ø

P-721 PIFOCs® are high-speed, piezo-driven microscope objective nanofocusing/scanning

### Application Examples

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

devices, providing a positioning and scanning range of 100 µm with sub-nanometer resolution and very high motion of linearity up to 0.03%. For applications, such as the two-photon spectroscopy which requires a particularly high resolution, there are versions which allow a free aperture of up to 29 mm in diameter.

PIFOCs® are also available with up to 460 µm travel (P-725 p. 2-28), and for exceptional dynamic and step performance (models P-726 p. 2-32 and P-725.SDD p. 2-30).

### Superior Accuracy With Direct-Metrology Capacitive Sensors

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

models. 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, strain gauge sensor (SGS) models are available. The sensors are connected in a bridge configuration to eliminate thermal drift, and assure optimal position stability in the nanometer range.

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, a vision system or photodiode PSD (position sensitive detector). These models retain the inherent piezo advantages such as high resolution and speed.

### Ordering Information

#### P-721.CDO

Fast PIFOC® Piezo Nanofocusing Z-Drive, 100 µm, Direct Metrology, Capacitive Sensor, Sub-D Connector, for Quick Lock Thread Adapters

#### P-721.CLO

Fast PIFOC® Piezo Nanofocusing Z-Drive, 100 µm, Direct Metrology, Capacitive Sensor, LEMO Connector, for Quick Lock Thread Adapters

#### P-721.SL2

Fast PIFOC® Piezo Nanofocusing Z-Drive, 100 µm, SGS-Sensor, LEMO Connector, for Quick Lock Thread Adapters

#### P-721.0LQ

Fast PIFOC® Piezo Nanofocusing Z-Drive, 100 µm, No Sensor, LEMO Connector, for Quick Lock Thread Adapters

#### P-721.CDA

Fast PIFOC® Piezo Nanofocusing Z-Drive, 100 µm, Direct Metrology, Capacitive Sensor, Sub-D Connectors, for Large Aperture QuickLock Thread Adapters

#### P-721.SDA

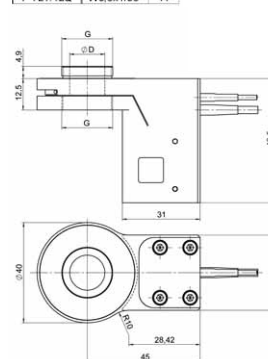
Fast PIFOC® Piezo Nanofocusing Z-Drive, 100 µm, SGS Sensor, Sub-D Connectors, for Large Aperture QuickLock Thread Adapters

### Accessories

QuickLock Thread Adapter, Large Aperture QuickLock Thread Adapter s. fig.; Extension Tubes for Objectives s. www.pi.ws

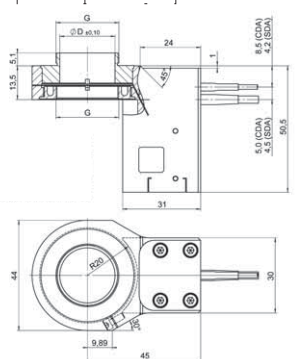
#### QuickLock Adapter

|           | G          | D  |
|-----------|------------|----|
| P-721.02Q | M26x0.75   | 21 |
| P-721.03Q | M27x0.75   | 21 |
| P-721.04Q | M28x0.75   | 21 |
| P-721.05Q | M32x0.75   | 21 |
| P-721.06Q | M26x1/36"  | 21 |
| P-721.08Q | M19x0.75   | 14 |
| P-721.11Q | M25x0.75   | 21 |
| P-721.12Q | W0.8x1/36" | 14 |



P-721.xxQ, .SL2 dimensions in mm (adapter to be ordered separately)

|           | G         | D  |
|-----------|-----------|----|
| P-721.02A | M26x0.75  | 23 |
| P-721.03A | M27x0.75  | 24 |
| P-721.04A | M28x0.75  | 25 |
| P-721.05A | M32x0.75  | 29 |
| P-721.08A | M26x1/36" | 23 |
| P-721.11A | M25x0.75  | 22 |



P-721.CDA, .SDA, dimensions in mm (adapter to be ordered separately)

### 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.

### Choice of Controllers

A large choice of analog and digital piezo controllers as OEM, bench-top and 19-inch-rack-mount versions is available.

### Technical Data

| Model  | P-721.CLO   | P-721.CDQ<br>P-721.CDA   | P-721.SL2<br>P-721.SDA  | P-721.0LQ                        | Units      | Tolerance       |
|--|---|--|---|----------------------------------|------------|-----------------|
| Active axes                                  | Z   | Z  | Z   | Z                                |            |                 |
| <b>Motion and positioning</b>                |   |  |   |                                  |            |                 |
| Integrated sensor                            | Capacitive  | Capacitive   | SGS   | –                                |            |                 |
| Open-loop travel, -20 to +120 V              | 140   | 140  | 140   | 140                              | µm         | min. (+20%/-0%) |
| Closed-loop travel                           | 100   | 100  | 100   | –                                | µm         | calibrated      |
| Open-loop resolution                         | 0.5   | 0.5  | 0.5   | 0.5                              | nm         | typ.            |
| Closed-loop resolution                       | 0.7   | 0.7  | 5   | –                                | nm         | typ.            |
| Linearity, closed-loop                       | 0.03  | 0.03   | 0.2   | –                                | %          | typ.            |
| Repeatability                                | ±5  | ±5   | ±10   | –                                | nm         | typ.            |
| Runout $\theta_X$ , $\theta_Y$               | 13  | 13   | 13  | 13                               | µrad       | typ.            |
| Crosstalk X, Y                               | 100   | 100  | 100   | 100                              | nm         | typ.            |
| <b>Mechanical properties</b>                 |   |  |   |                                  |            |                 |
| Stiffness in motion direction                | 0.3   | 0.3  | 0.3   | 0.3                              | N/µm       | ±20 %           |
| Unloaded resonant frequency                  | 580   | 580  | 580   | 550                              | Hz         | ±20 %           |
| Resonant frequency @ 120 g                   | 235   | 235  | 235   | 235                              | Hz         | ±20 %           |
| Resonant frequency @ 200 g                   | 180   | 180  | 180   | 180                              | Hz         | ±20 %           |
| Push/pull force capacity in motion direction | 100 / 20  | 100 / 20   | 100 / 20  | 100 / 20                         | N          | Max.            |
| <b>Drive properties</b>                      |   |  |   |                                  |            |                 |
| Ceramic type                                 | PICMA® P-885  | PICMA® P-885   | PICMA® P-885  | PICMA® P-885                     |            |                 |
| Electrical capacitance                       | 3.1   | 3.1  | 3.1   | 3.1                              | µF         | ±20 %           |
| Dynamic operating current coefficient        | 3.9   | 3.9  | 3.9   | 3.9                              | µA/(Hz·µm) | ±20 %           |
| <b>Miscellaneous</b>                         |   |  |   |                                  |            |                 |
| Operating temperature range                  | -20 to 80   | -20 to 80  | -20 to 80   | -20 to 80                        | °C         |                 |
| Material                                     | Aluminum  | Aluminum   | Aluminum  | Aluminum                         |            |                 |
| Mass   | 0.24  | 0.24   | 0.22  | 0.22                             | kg         | ±5 %            |
| Max. objective diameter                      | 39  | 39   | 39  | 39                               | mm         |                 |
| Cable length                                 | 1   | 1  | 1   | 1                                | m          | ±10 mm          |
| Sensor / voltage connection                  | LEMO  | Sub-D Special  | LEMO/Sub-D Special  | LEMO (no sensor)                 |            |                 |
| Recommended controller / amplifier           | E-610 servo controller/amplifier (p. 2-110), modular piezo controller system E-500 (p. 2-142) with amplifier module E-505 (high performance) (p. 2-147) and E-509 servo controller (p. 2-152) | E-625 servo controller, bench top (p. 2-114), E-665 powerful servo controller, bench-top (p. 2-116), Single-channel digital controller: E-753 (bench-top) (p. 2-108) E-709 single-channel digital controller | SL2 version: E-610 servo controller/amplifier, E-625 servo controller, bench-top, E-665 powerful servo controller, bench-top SDA version: E-709 single-channel digital controller | E-610 servo controller/amplifier |            |                 |

Resolution of PI Piezo Nanopositioners is not limited by friction or stiction. Value given is noise equivalent motion with E-503 amplifier (p. 2-144)

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

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