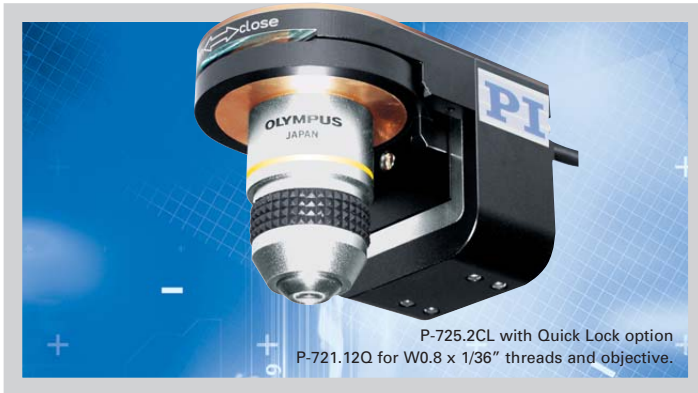


P-725

PIFOC® Long-Range, High-Speed Nanofocusing Z-Drives with Direct Metrology

>> Click <http://www.pi.ws/fwd/Piezo-Stage> for the Latest Specs on these Products



P-725.2CL with Quick Lock option
P-721.12Q for W0.8 x 1/36" threads and objective.

- Scans and Positions Objectives with Sub-nm Resolution
- High Linearity and Stability with Direct-Measuring Capacitive Sensors
- Travel to 460 μm, Fast Response & Settling Time
- Frictionless Precision Flexure Guiding System
- Enhanced Guiding Precision for Better Focus Stability
- Ask about DIC Prism Holder Option
- Controller Compatible with Metamorph™ Imaging Software
- Quick Lock Adapter for Easy Attachment

P-725 PIFOCs® are long-travel, high-speed, piezo-driven microscope objective nanofocusing/scanning devices.

Despite the increased travel ranges (up to 460 μm), they are 20% shorter than P-721 units (see page 2-20), while providing sub-nanometer resolution. Equipped with ultra-precise, direct-measuring capacitive sensors, these devices are ideal for tasks such as surface metrology or deconvolution microscopy (Z-stack acquisition). The newly designed, frictionless, flexure guiding system provides enhanced precision

for superior focus stability with fast response for rapid settling and scanning.

P-725 PIFOCs® are mounted between the turret and the objective, extending the optical path by only 12.5 mm (infinitely corrected microscope required; extension tubes are available to adjust path lengths of other objectives on the turret). Custom designs for positioning the complete turret are available on request.

Superior Accuracy Through Direct-Motion Metrology with Capacitive Sensors

P-725s are equipped with absolute-measuring, direct-metrology capacitive sensors. These sensors make possible motion linearity to 0.03% with effective resolution in the sub-nanometer range. They boast high bandwidth and exhibit no periodic errors.

Unlike conventional sensors, capacitive sensors measure the actual distance between the fixed frame and the mov-

ing part of the stage. They detect errors contributed by all components in the drive train—from the actuator through the flexures to the platform. This results in higher motion linearity, long-term stability, phase fidelity, and—because external disturbances are seen by the sensor immediately—a stiffer, faster-responding servo-loop. See p. 2-4 *ff.* and p. 5-2 *ff.* for more information.

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

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

Controllers

A variety of analog and digital controllers is available to drive these units. The P-725.xCD models can be operated with the E-665 servo-controller through an analog or digital interface (see page 6-30). The E-750 high-speed digital NanoAutomation® controller can also be used (see page 6-12).

Working Principle / Reliability

PIFOCs® are equipped with the award winning PICMA® piezo drives, integrated into a sophisticated flexure guiding system. The wire-EDM-cut flexures are FEA modeled for zero stiction, zero friction and exceptional guiding precision. The ceramic-encapsulated

Ordering Information

P-725.1CL*

PIFOC® Objective Positioner & Scanner, 100 μm, Capacitive Sensor, LEMO Connectors, for Quick Lock Thread Adapters

P-725.1CD

PIFOC® Objective Positioner & Scanner, 100 μm, Capacitive Sensor, Sub-D Connector, for Quick Lock Thread Adapters

P-725.2CL*

PIFOC® Objective Positioner & Scanner, 250 μm, Capacitive Sensor, LEMO Connectors, for Quick Lock Thread Adapters

P-725.2CD

PIFOC® Objective Positioner & Scanner, 250 μm, Capacitive Sensor, Sub-D Connector, for Quick Lock Thread Adapters

P-725.4CL*

PIFOC® Objective Positioner & Scanner, 400 μm, Capacitive Sensor, LEMO Connectors, for Quick Lock Thread Adapters

P-725.4CD

PIFOC® Objective Positioner & Scanner, 400 μm, Capacitive Sensor, Sub-D Connector, for Quick Lock Thread Adapters

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

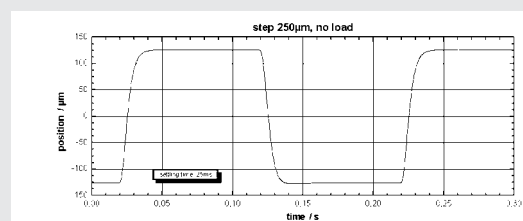
Accessories

Quick Lock adapters and objective distance tubes see p. 2-21

Ask about custom designs!

PICMA® drives are more robust than conventional piezo actuators, featuring superior lifetime and performance in both dynamic and static applications.

Because guidance, actuators and sensors are all frictionless and maintenance-free, these



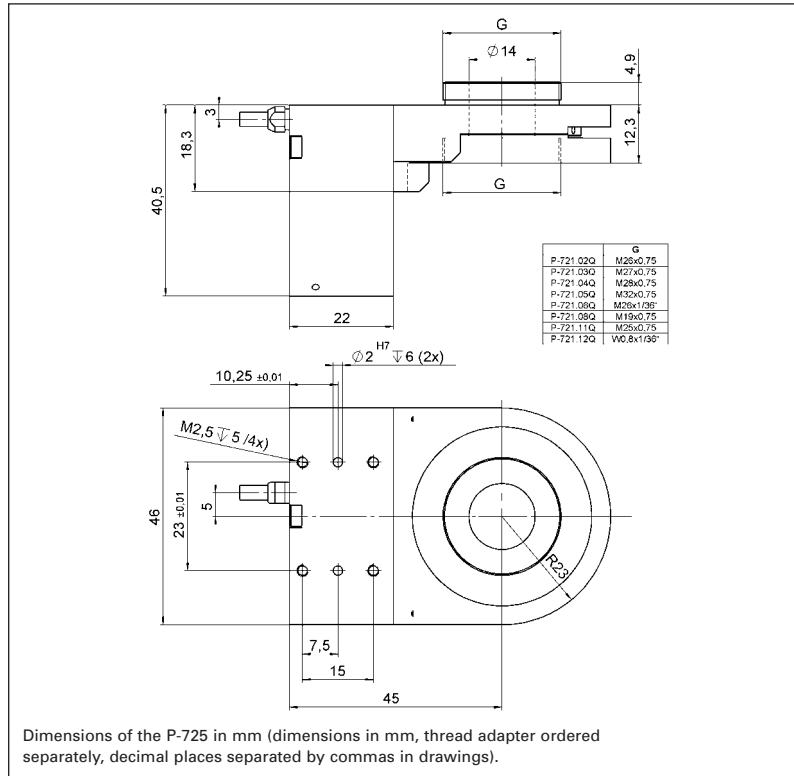
25 ms for a 250 μm step top dynamic performance of the P-725.2CL

nanopositioning systems achieve outstanding levels of reliability.

Notes

For low-profile, large aperture Z stages, see the P-541.ZSL on p. 2-48 and the P-541.ZCD on p. 2-50.

See the "Selection Guide" on p. 2-14 ff. for comparison with other nanopositioning systems.



Technical Data

Models	P-725.1CL, P-725.1CD	P-725.2CL, P-725.2CD	P-725.4CL, P-725.4CD	Units	Notes see p. 2-84
Max. objective diameter	39	39	39	mm	
Min. open-loop travel @ -20 to 120 V	150	330	460	$\mu\text{m} \pm 20\%$	A2
Closed-loop travel	100	250	400	μm	A5
Integrated feedback sensor	Capacitive	Capacitive	Capacitive		B
* Closed-loop resolution	0.65	0.75	1.25	nm	C1
Closed-loop linearity (typ.)	0.03	0.03	0.03	%	
Full-range repeatability (typ.)	± 2	± 3	± 5	nm	C3
Stiffness	0.25	0.2	0.15	$\text{N}/\mu\text{m} \pm 20\%$	D1
Push/pull force capacity (in operating direction)	100 / 20	100 / 20	100 / 20	N	D3
Tilt (θ_x) (typ.)	1	6	18	μrad	E1
Tilt (θ_y) (typ.)	20	45	25	μrad	E1
Lateral runout (Y) (typ.)	40	40	40	nm	E2
Electrical capacitance	4.2	6.0	6.0	$\mu\text{F} \pm 20\%$	F1
** Dynamic operating current coefficient (DOCC)	4.0	2.5	1.9	$\mu\text{A}/(\text{Hz} \times \mu\text{m})$	F2
Unloaded resonant frequency	530	330	200	$\text{Hz} \pm 20\%$	G2
Resonant frequency @ 120 g load	205	180	115	$\text{Hz} \pm 20\%$	G3
Resonant frequency @ 200 g load	160	140		$\text{Hz} \pm 20\%$	G3
Operating temperature range	-20 to 80	-20 to 80	-20 to 80	$^{\circ}\text{C}$	H2
Voltage connection	VL ***	VL ***	VL ***		J1
Sensor connection	2 x C ***	2 x C ***	2 x C ***		J2
Weight (with cables)	215 (230)	230 (245)	230 (245)	$\text{g} \pm 5\%$	
Body material	Al	Al	Al		L
Recommended driver/controller (codes explained p. 2-17)	H, M, F	H, M, F	H, M, F		

* For calibration information see p. 2-8.
Resolution of PI piezo nanopositioners is not limited by friction or stiction. The value given is noise equivalent motion with E-503 amplifier.

** Dynamic Operating Current Coefficient in μA per Hz and μm . Example (P-725.2C): Sinusoidal scan of $30 \mu\text{m}$ at 10 Hz requires approximately 0.75 mA drive current.

*** P-725.xCD with Sub-D connector for voltage and sensor.