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Ordering Information

P-722.00
PIFOC® Objective Positioner & Scanner, 200 µm, Thread W0.8 × 1/36"

P-722.07
PIFOC Objective Positioner & Scanner, 200 µm, Specify Thread (P-722.01 - .08)

P-722.10
PIFOC® Objective Positioner & Scanner, 200 µm, LVDT, W0.8 × 1/36"

P-722.17
PIFOC® Objective Positioner & Scanner, 200 µm, LVDT, Specify Thread (P-722.01 - .08)

P-723.00
PIFOC® Objective Positioner & Scanner, 350 µm, Thread W0.8 × 1/36"

P-723.07
PIFOC® Objective Positioner & Scanner, 350 µm, Specify Thread (P-722.01 - .08)

P-723.10
PIFOC® Objective Positioner & Scanner, 350 µm, LVDT, W0.8 × 1/36"

P-723.17
PIFOC® Objective Positioner & Scanner, 350 µm, LVDT, Specify Thread (P-722.01 - .08)

Custom Designs for Volume Buyers

Optional Threads for P-722.07/17 & P-723.07/17:

P-722.01
Thread M25 × 0.75 for P-722.07/17, P-723.07/17

P-722.02
Thread M26 × 0.75 for P-722.07/17, P-723.07/17

P-722.03
Thread M27 × 0.75 for P-722.07/17, P-723.07/17

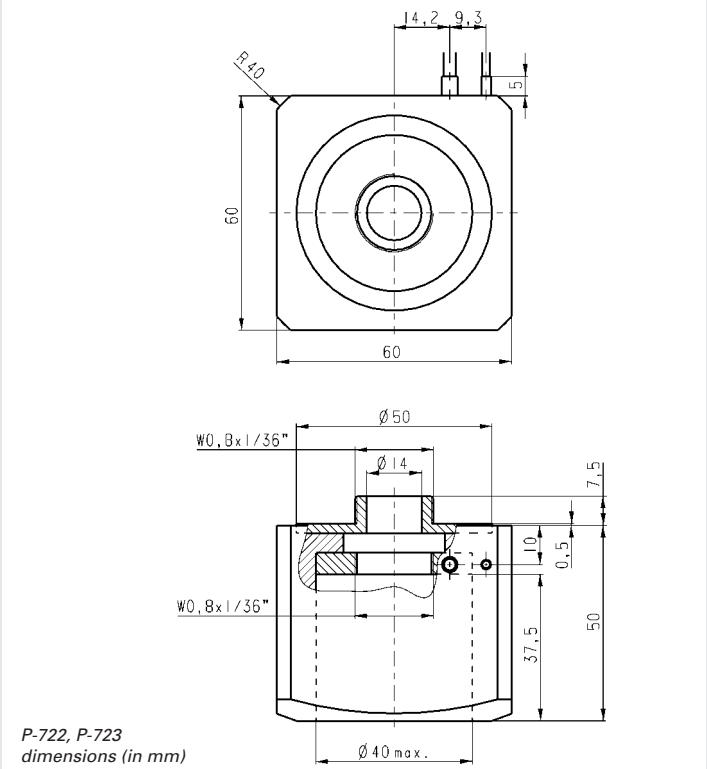
P-722.04
Thread M28 × 0.75 for P-722.07/17, P-723.07/17

P-722.05
Thread M32 × 0.75 for P-722.07/17, P-723.07/17

P-722.06
Thread M26 × 1/36" for P-722.07/17, P-723.07/17

P-722.08
Thread M19 × 0.75 for P-722.07/17, P-723.07/17

Objective Extension Tubes:
see P-720/P-721 Ordering Information (page 2-10)



P-722, P-723 dimensions (in mm)

Technical Data

Models	P-722.00	P-722.10	P-723.00	P-723.10	Units	Notes see p. 2-44
Max. objective diameter	39	39	39	39	mm	
Open-loop travel @ 0 to 100 V	200	200	350	350	µm ±20%	A2
Closed-loop travel ≥	-	200	-	350	µm	A5
Integrated feedback sensor	-	LVDT	-	LVDT		B
Closed-loop / open-loop ** resolution≤	- / 2	10 / 2	- / 3	10 / 3	nm	C1
Closed-loop linearity (typ.)	-	0.1	-	0.1	%	
Full-range repeatability (typ.)		±40		±60	nm	C3
Stiffness	0.38	0.38	0.32	0.32	N/µm ±20%	D1
Push/pull force capacity (in operating direction)	20 / 20	20 / 20	20 / 20	20 / 20	N	D3
Tilt (θ_x, θ_y) (typ.)	15	15	25	25	µrad	E1
Electrical capacitance	7.8	7.8	11.1	11.1	µF ±20%	F1
* Dynamic operating current coefficient (DOCC)	4.8	4.8	3.9	3.9	µA/(Hz × µm)	F2
Unloaded resonant frequency	300	300	150	150	Hz ±20%	G2
Resonant frequency @ 150 g load	180	180	100	100	Hz ±20%	G3
Operating temperature range	- 20 to 80	- 20 to 80	- 20 to 80	- 20 to 80	°C	H2
Voltage connection	VL	VL	VL	VL		J1
Sensor connection	-	L	-	L		J2
Weight (with cables)	400	410	410	420	g ±5%	
Body material	Al	Al	Al	Al		L
Recommended driver/controller (codes explained p. 6-46)	G, C, (A)	H, E	G, C, (A)	H, E		

** Dynamic Operating Current Coefficient in µA per hertz and µm.*
Example: Sinusoidal scan of 30 µm at 10 Hz requires approximately 1.4 mA drive current (P-722).

*** Resolution of PZT NanoPositioners is not limited by friction or stiction. Noise equivalent motion with E-503 amplifier.*

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P-725

PIFOC® Long Range Microscope Objective Positioners & Scanners with Capacitive Sensors

P-725.2CL with QuickLock 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 500 µm**
- **Most-Compact Unit with Direct Metrology**
- **Enhanced Guiding Precision for Better Focus Stability**
- **Fast Response & Settling Time**
- **Compatible with Metamorph™ Imaging Software**
- **QuickLock Adapter for Easy Attachment**

P-725s are long-range-travel additions to our PIFOC® family of microscope objective nanofocussing devices. Despite the increased travel ranges (up to 500 µm) the units are 20 % shorter than the P-721 series (page 2-10), while providing sub-nanometer resolution. The long travel range is achieved with a newly designed, friction-free and extremely stiff flexure system which also offers high guiding accuracy and rapid settling.

P-725 PIFOCs® are screwed between the turret and the objective, extending the optical path by only 12.5 mm (infinity-corrected microscope required; extension tubes are available to adjust path lengths of other objectives on the turret).

Superior Accuracy Through Direct-Motion-Metrology Capacitive Feedback Sensors

P-725s are equipped with direct-measuring capacitve position sensors. Unlike conventional indirect systems, they measure the position rather than strain in the actuator / guiding system. Capacitive sensors are absolute-measuring devices and show none of the periodic errors found in incremental linear encoders. This permits motion linearity of better than 0.03% and resolution in the sub-nanometer range. This technique, combined with the inherent precision of the non-contact, two-plate capacitive sensor and the temperature-compensated design, results in higher linearity scans, and provides superior responsiveness, resolution, repeatability and stability at the nanometer level.

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 50 ms with a load of 150 g.

A variety of analog and digital controllers (OEM, bench-top and rackmount) are available to drive the units. The P-725.xCD model can be operated with the new E-665 servo-controller through an analog or RS-232 interface or the E-750 high-speed digital NanoAutomation® controller (see page 6-12). This controller also features a number of options such as high-throughput PIO (parallel I/O) or fiber link interfacing and InputShaping® signal processing for even faster settling.

Increased Lifetime with New Piezoceramic

The P-725 PIFOC® units are driven with PI Ceramic's PICMA high-performance, multilayer piezo ceramic actuators. These newly designed and highly optimized drives are more robust than conventional piezo actuators, and feature superior lifetime in dynamic and static applications. Because guidance and sensors are all frictionless and maintenance-free, PIFOC® systems achieve exceptional levels of reliability.

Working Principle

PIFOC® positioners are equipped with high-performance piezoelectric drives integrated in a sophisticated flexure guiding system. The force exerted by the piezo drive pushes a flexure parallelogram via an integrated motion amplifier. The wire-EDM-cut flexures are FEA modeled for zero stiction/friction, high resolution and exceptional guiding precision. An integrated, direct-measuring, non-contact, two-plate capacitive position sen-

Ordering Information

P-725.1CL
PIFOC® Objective Positioner & Scanner, 100 µm, Capacitive Sensor, LEMO Connectors, for QuickLock Thread Adapters

P-725.1CD
PIFOC® Objective Positioner & Scanner, 100 µm, Capacitive Sensor, Sub-D connector, for QuickLock Thread Adapters

P-725.2CL
PIFOC® Objective Positioner & Scanner, 250 µm, Capacitive Sensor, LEMO Connectors, for QuickLock Thread Adapters

P-725.2CD
PIFOC® Objective Positioner & Scanner, 250 µm, Capacitive Sensor, Sub-D connector, for QuickLock Thread Adapters

P-725.4CL (Preliminary Data)
PIFOC® Objective Positioner & Scanner, 400 µm, Capacitive Sensor, LEMO Connectors, for QuickLock Thread Adapters

P-725.4CD (Preliminary Data)
PIFOC® Objective Positioner & Scanner, 400 µm, Capacitive Sensor, Sub-D connector, for QuickLock Thread Adapters

Custom Designs for Volume Buyers

Application Examples

- **Scanning interferometry**
- **Surface structure analysis**
- **Disk drive testing**
- **Autofocus systems**
- **Confocal microscopy**
- **Biotechnology**
- **Semiconductor test equipment**

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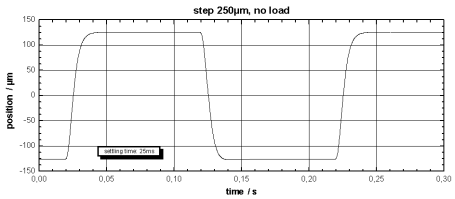
sor provides the highest possible resolution, linearity and stability in closed-loop operation.

QuickLock

The new QuickLock thread adapter options allow

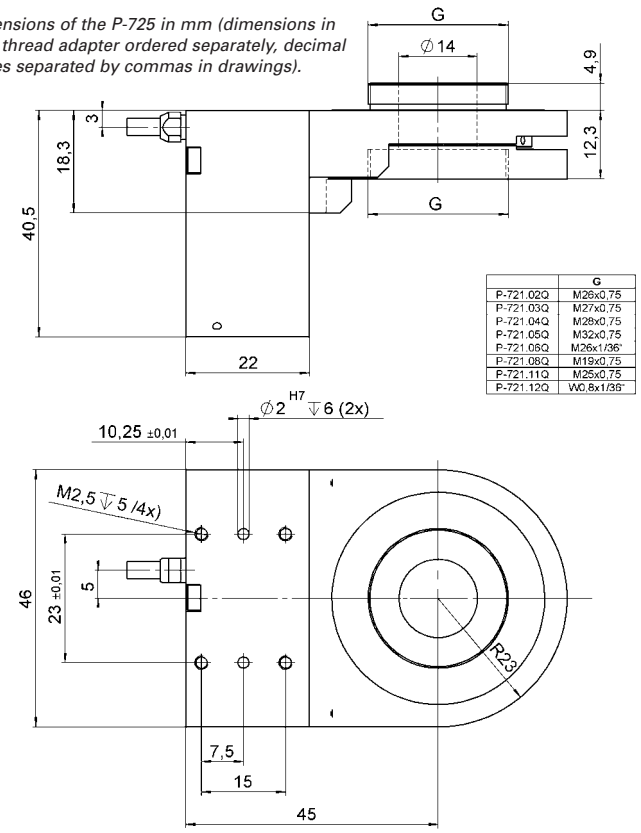
- Easy attachment of the PIFOC® to the microscope.
- Flexible use of different thread adapter options with one PIFOC® nanofocussing device.

After the thread adapter is screwed into the microscope, the PIFOC® is attached to the adapter with the QuickLock system in the desired position. Mounting does not require rotation of the PIFOC® unit, so there are no cable twisting issues. Be sure to order the required thread adapters separately: the basic P-725 PIFOC® units do not include any QuickLock thread adapters.



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

Dimensions of the P-725 in mm (dimensions in mm, thread adapter ordered separately, decimal places separated by commas in drawings).



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

Technical Data

Models	P-725.1CL, P-725.1CD	P-725.2CL, P-725.2CD	P-725.4CL, P-725.4CD Preliminary Data	Units	Notes see page 2-44
Max. objective diameter	39	39	39	mm	
Min. Open-loop travel @ -20 to 120 V	150	330	500	µm ±20%	A2
Closed-loop travel	100	250	400	µm	A5
Integrated feedback sensor	Capacitive	Capacitive	Capacitive		B
Closed-loop ** resolution	0.65	0.75		nm	C1
Closed-loop linearity (typ.)	0.03	0.03		%	
Full-range repeatability (typ.)	±5	±5		nm	C3
Stiffness	0.25	0.2		N/µm ±20%	D1
Push/pull force capacity (in operating direction)	100 / 20	100 / 20		N	D3
Tilt (θ_x) (typ.)	1	6		µrad	E1
Tilt (θ_y) (typ.)	20	45		µrad	E1
Lateral runout (Y) (typ.)	40	40		nm	E2
Electrical capacitance	4.2	6.0		µF ±20%	F1
* Dynamic operating current coefficient (DOCC)	4.0	2.5		µA/(Hz × µm)	F2
Unloaded resonant frequency	530	330		Hz ±20%	G2
Resonant frequency @ 120 g load	205	180		Hz ±20%	G3
Resonant frequency @ 200 g load	160	140		Hz ±20%	G3
Operating temperature range	- 20 to 80	-20 to 80		°C	H2
Voltage connection	P-725.xCL: VL; P-725.xCD: D				J1
Sensor connection	P-725.xCL: 2 × C; P-725.xCD: D				J2
Weight (with cables)	215 (230)	230 (245)			g ±5%
Body material	Al	Al	Al		L
Recommended driver/controller (codes explained p. 6-46)	H, M, F	H, M, F	H, M, F		

** Dynamic Operating Current Coefficient in µA per hertz and µm.*
Example: Sinusoidal scan of 30 µm at 10 Hz requires approximately 1.4 mA drive current.

*** Resolution of PZT NanoPositioners is not limited by friction or stiction. Noise equivalent motion with E-503 amplifier.*

Notes

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

Objective Extension Tubes

P-721.90Q
Objective extension tube, 12.5 mm, thread W0.8 x 1/36"

P-721.91Q
Objective extension tube, 12.5 mm, thread M25 x 0.75

P-721.92Q
Objective extension tube, 12.5 mm, thread M26 x 0.75

P-721.93Q
Objective extension tube, 12.5 mm, thread M27 x 0.75

P-721.94Q
Objective extension tube, 12.5 mm, thread M28 x 0.75

P-721.95Q
Objective extension tube, 12.5 mm, thread M32 x 0.75

P-721.96Q
Objective extension tube, 12.5 mm, thread M26 x 1/36"

P-721.98Q
Objective extension tube, 12.5 mm, thread M19 x 0.75

P-721.12Q QuickLock thread adapter, exploded view with microscope objective and PIFOC®. Mounting tools are included.