

P-620.1 – P-628.1

PIHera® Miniature Long-Range Piezo Nanopositioning Stages with Direct Metrology

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P-622.1CD, P-621.1CD, P-620.1CD and P-625.1CD PIHera® piezo nanotranslation stages, from left to right (credit card for size comparison).

- Travel to 950 μm
- Compact Design
- Resolution <1 nm
- Frictionless Precision Flexure Guiding System
- PICMA® High-Performance Piezo Drives
- Direct Metrology with Capacitive Sensors for Highest Precision
- Up to 0.02% Position Accuracy
- X, XY, Z, XYZ Versions
- Vacuum-Compatible Versions

P-620.1CD – P-628.1CD PIHera® systems are piezo-nanopositioning stages featuring travel ranges from 60 to 950 μm . Despite the increased travel ranges, the units are extremely compact and provide sub-nanometer resolution. The long travel range is achieved with a newly designed, friction-free and extremely stiff flexure system, which also offers rapid response and excellent guiding accuracy (typically less than 5

μrad pitch/yaw over the full travel range).

Superior Accuracy Through Direct-Motion Metrology with Capacitive Sensors

The capacitive-sensor-equipped versions provide motion linearity to 0.02% with effective resolution in the sub-nanometer range. PI capacitive sensors are absolute-measuring, direct-metrology devices that boast very high bandwidth and exhibit no periodic errors.

Unlike conventional sensors, capacitive sensors measure the actual distance between the fixed frame and the moving 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.

Nanometer Precision in Milliseconds

One of the advantages of PIHera® stages over motor-driven positioning stages is the rapid response to input changes and fast and precise settling behavior. The P-622.1CD, for example, can settle to an accuracy of 10 nm in only 30 msec (other PI stages provide even faster response)! Furthermore our new digital control electronics with DDL (Dynamic Digital Linearization) can be used to increase linearity and effective bandwidth in scanning applications by up to 1000-fold (see p. 6-16).

Working Principle / Reliability

PIHera® stages are equipped with the award winning PICMA® piezo drives, integrated into a sophisticated flexure guiding system. The flexures are FEA-modeled for zero-friction and exceptional guiding precision. The ceramic-encap-

Ordering Information

P-620.1CD * / P-620.1CL *
PIHera® Nanopositioning System, 50 μm , Capacitive Sensors.

P-620.10L
PIHera® Nanopositioning System, 60 μm , Open-Loop, LEMO Conn.

P-621.1CD * / P-621.1CL *
PIHera® Nanopositioning System, 100 μm , Capacitive Sensors.

P-621.10L
PIHera® Nanopositioning System, 120 μm , Open-Loop, LEMO Conn.

P-622.1CD * / P-622.1CL *
PIHera® Nanopositioning System, 250 μm , Capacitive Sensors

P-622.10L
PIHera® Nanopositioning System, 300 μm , Open-Loop, LEMO Conn.

P-625.1CD * / P-625.1CL *
PIHera® Nanopositioning System, 500 μm , Capacitive Sensors

P-625.10L
PIHera® Nanopositioning System, 600 μm , Open-Loop, LEMO Conn.

P-628.1CD * / P-628.1CL
PIHera® Nanopositioning System, 800 μm , Capacitive Sensors

P-628.10L
PIHera® Nanopositioning System, 950 μm , Open-Loop, LEMO Conn.

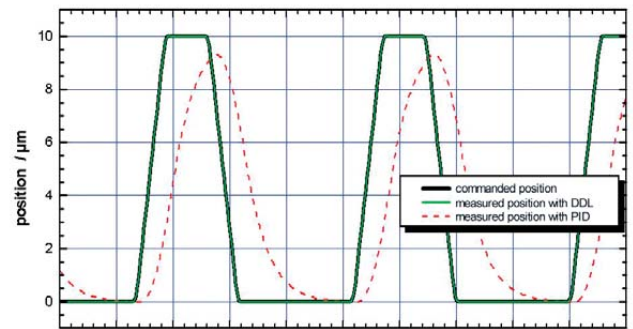
* .1CD with Sub-D Connector
* .1CL with LEMO Connectors

Vacuum versions to 10^{-9} hPa are available as part numbers P-62x.1UD

Custom sizes & specifications available!

Application Examples

- (Dynamic) interferometry
- Microscopy
- Nanopositioning
- Biotechnology
- Quality assurance
- Semiconductor technology



Rapid scanning motion of a P-621.1CD (commanded rise time 5 ms) with the E-710 controller and DDL option. Digital Dynamic Linearization virtually eliminates the tracking error (<20 nm) during the scan. The improvement over a classical PID controller is up to 3 orders of magnitude, and grows with the scanning frequency.

sulated. 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 nanopositioning systems achieve outstanding levels of reliability.

Single & Multi-Axis Versions

See page 2-42 and page 2-54 for Z and XY versions. XZ and XYZ combinations can be assembled without adapters.

Notes

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

	A	B	C	D	E	F	G	H	J	K	∅L	M	N	P	Q	R	S	∅T	∅U
P-620.1CD / 10L	30	12	24	15	12	15	18	19	24	15	1.01	1.5	M2	4	4.5	6	2	4.4	2.2
P-621.1CD / 10L	40	15	30	20	14	18	24	26	26	20	1.51	2.5	M2.5	5	5	5	3	5	3.2
P-622.1CD / 10L	50	15	40	24	20	25	30	35	35	24	1.51	2.5	M2.5	5	5.5	5	3	6	3.2
P-625.1CD / 10L	60	15	50	40	27	32	44.5	46	46	40	1.51	2.5	M2.5	5	5.5	5	3	6	3.2
P-628.1CD / 10L	80	17	70	58	41	45	63	66	66	58	1.51	2.5	M2.5	5	5.5	5	3	6	3.2

Dimensions of the P-62x.1CD/.1CL/.10L in mm, decimal places separated by commas.

Piezo Actuators

Nanopositioning & Scanning Systems

Active Optics / Steering Mirrors

Tutorial: Piezo-electrics in Positioning

Capacitive Position Sensors

Piezo Drivers & Nanopositioning Controllers

Hexapods / Micropositioning

Photonics Alignment Solutions

Motion Controllers

Ceramic Linear Motors & Stages

Index

Technical Data

Models	P-620.1CD/ P-620.1CL	P-621.1CD/ P-621.1CL	P-622.1CD/ P-622.1CL	P-625.1CD/ P-625.1CL	P-628.1CD/ P-628.1CL	P-62x.10L	Units	Notes see p. 2-84
Active axes	X	X	X	X	X	X		
Open-loop travel -20 to 120 V	60	120	300	600	950	see P-62x.1CD	µm	A2
Closed-loop travel	50	100	250	500	800	-	µm	A5
Integrated feedback sensor	capacitive	capacitive	capacitive	capacitive	capacitive	-		B
* Closed-loop / open-loop resolution	0.2 / 0.1	0.4 / 0.2	0.7 / 0.4	1.4 / 0.5	1.8 / 0.5	- / see P-62x.1CD	nm	C1
Closed-loop linearity (typ.)	0.02	0.02	0.02	0.03	0.03	-	%	
Stiffness	0.42	0.35	0.15	0.10	-	see P-62x.1CD	N/µm	D1
Push / pull force capacity (in X)	10/5	10/8	10/8	10/8	10/8	see P-62x.1CD	N	D3
Max. Load	10	10	10	10	10	see P-62x.1CD	N	D4
Lateral force limit	10	10	10	10	10	see P-62x.1CD	N	D5
Tilt (θ _y , θ _z) (typ.)	3	3	3	6	6	see P-62x.1CD	µrad	E1
Electrical capacitance	0.75	1.5	3.0	6.0	18.6	see P-62x.1CD	µF ±20%	F1
Dynamic operating current coefficient (DOCC)	1.9	1.9	1.5	1.5	-	see P-62x.1CD	µA/(Hz x µm)	F2
Unloaded resonant frequency	1240	800	400	215	125	see P-62x.1CD	Hz ±20%	G2
Resonant frequency @ 20 g load	550	520	340	180	115	see P-62x.1CD	Hz ±20%	G3
Resonant frequency @ 120 g load	260	240	185	110	90	see P-62x.1CD	Hz ±20%	G3
Operating temperature range	-40 - 120	-40 - 120	-40 - 120	-40 - 120	-40 - 120	-40 - 150	°C	H2
Voltage Connection	D **	D **	D **	D **	D **	VL		J1
Sensor Connection	D **	D **	D **	D **	D **	-		J2
Weight (with cables)	108	158	195	238	375		g ±5%	
Body material	Al	Al	Al	Al	Al	Al		L
Recommended amplifier/controller (codes explained p. 2-17)	F, M, L, H	F, M, L, H	F, M, L, H	F, M, L, H	F, M, L, HF	C, G		

* 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-710 controller
 ** Version .1CL with Lemo connectors.