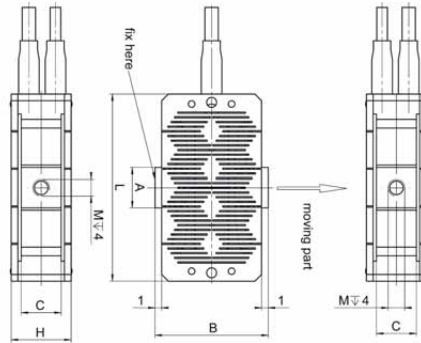


# P-602 High Stiffness Flexure Actuators, to 1000 $\mu\text{m}$ Integrated Guiding System, High Force and Large Travel Ranges



P-602 linear actuator family featuring travel ranges of 100, 500, and 1000  $\mu\text{m}$  (from left to right)



	L	B	H
P-602.1xx	28	17	9
P-602.3xx	46	19	9
P-602.5xx	85	26	9
P-602.8xx	126	34	14
P-602.1x8	28	22	14
P-602.3x8	46	24	14
P-602.5x8	85	31	14

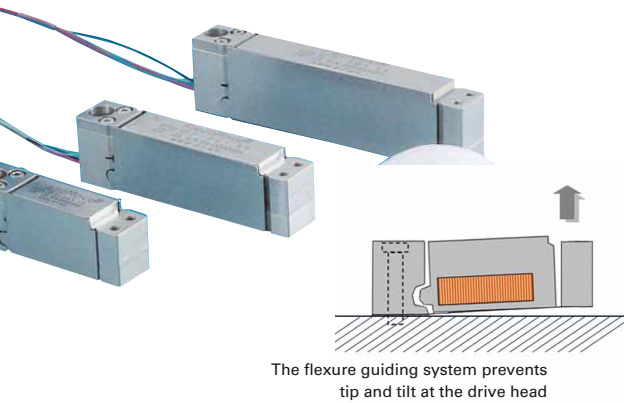
	M	A	C
P-602.1xx	M2,5	6	6
P-602.3xx	M2,5	6	6
P-602.5xx	M2,5	6	6
P-602.8xx	M4	10	11
P-602.1x8	M2,5	6	11
P-602.3x8	M2,5	6	11
P-602.5x8	M2,5	6	11

- Frictionless Flexure Guiding System for Straight Motion
- Integrated Motion Amplifier for Travel Ranges to 1 mm
- High Dynamics and Stiffness, Forces to 400 N, Backlash-Free Construction
- Outstanding Lifetime Due to PICMA® Piezo Actuators
- Available with Integrated Position Sensor
- Custom Designs with Larger Travel or Faster Response and Non-Magnetic Versions Feasible

Model	P-602.100 P-602.1S0 P-602.1SL	P-602.300 P-602.3S0 P-602.3SL	P-602.500 P-602.5S0 P-602.5SL	P-602.108 P-602.1S8 P-602.1L8	P-602.308 P-602.3S8 P-602.3L8	P-602.508 P-602.5S8 P-602.5L8	P-602.800 P-602.8S0 P-602.8SL	Units	Tolerance
Active axes	X	X	X	X	X	X	X		
<b>Motion and positioning</b>									
Integrated sensor	- / SGS / SGS	- / SGS / SGS	- / SGS / SGS	- / SGS / SGS	- / SGS / SGS	- / SGS / SGS	- / SGS / SGS		
Open-loop travel, -20 to +120 V	120	300	600	100	300	500	1000	$\mu\text{m}$	min. (+20%/-0)
Closed-loop travel	- / 100 / 100	- / 300 / 300	- / 500 / 500	- / 100 / 100	- / 300 / 300	- / 500 / 500	- / 1000 / 1000	$\mu\text{m}$	
Open-loop resolution	0.2	0.3	0.4	0.2	0.3	0.4	0.5	nm	typ.
Closed-loop resolution	- / 2 / 2	- / 3 / 3	- / 3 / 3	- / 2 / 2	- / 3 / 3	- / 3 / 3	- / 7 / 7	nm	typ.
Linearity, closed-loop	- / 0.5 / 0.5	- / 0.5 / 0.5	- / 0.5 / 0.5	- / 0.5 / 0.5	- / 0.5 / 0.5	- / 0.5 / 0.5	- / 1.5 / 1.5	%	typ.
Repeatability	- / 10 / 10	- / 20 / 20	- / 35 / 35	- / 10 / 10	- / 20 / 20	- / 35 / 35	- / 60 / 60	nm	typ.
<b>Mechanical properties</b>									
Stiffness in motion direction	0.8	0.35	0.3	2.3	0.75	0.65	0.4	N/ $\mu\text{m}$	$\pm 20\%$
Unloaded resonant frequency	1000	450	230	1000	450	230	150	Hz	$\pm 20\%$
Blocking force	80	105	150	230	225	325	400	N	max.
<b>Drive properties</b>									
Ceramic type	PICMA® P-885	PICMA® P-885	PICMA® P-885	PICMA® P-888	PICMA® P-888	PICMA® P-888	PICMA® P-888		
Electrical Capacitance	1.5	3.1	6.2	6	13	26	39	$\mu\text{F}$	$\pm 20\%$
Dynamic operating current coefficient	1.9	1.3	1.6	7.5	5	6	4	$\mu\text{A}/(\text{Hz}\cdot\mu\text{m})$	$\pm 20\%$
<b>Miscellaneous</b>									
Operating temperature range	-20 to 80	-20 to 80	-20 to 80	-20 to 80	-20 to 80	-20 to 80	-20 to 80	$^{\circ}\text{C}$	
Material	Stainless steel	Stainless steel	Stainless steel	Stainless steel	Stainless steel	Stainless steel	Stainless steel		

# P-601 PiezoMove™ Flexure-Actuator

## Flexure-Guided OEM Piezo Actuator with Long Stroke to 400 µm



- Flexure Guidance for Frictionless, Ultra-Straight Motion
- Travel Ranges to 400 µm
- Resolution to 0.2 nm
- High Dynamics and Stiffness
- Custom Designs with Longer Travel or Faster Response and Non-Magnetic Versions Feasible
- Outstanding Lifetime Due to PICMA® Piezo Actuators
- Choice of Closed-Loop and Open-Loop Models
- Ideal OEM Actuator for Precision Motion Control in Optics, Medical, Biotech and Microfluidics Applications

The flexure-guided, lever-amplified PiezoMove™ P-601 actuators provide large vertical travel ranges up to 400 µm, fast response and high positioning accuracy in a very small package. With settling times of only a few milliseconds and a resolution in the sub-nanometer range they are well suited for both static and dynamic applications.

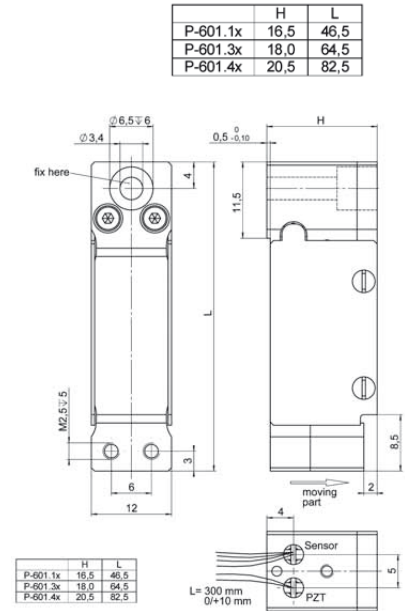
P-601 PiezoMove™ lever-amplified actuators cover the range between direct-driven pre-loaded piezo translators, such as the P-840 series (see p. 1-74) and single-axis nanopositioning stages, like the P-611 series (see p. 2-20). Compared to direct-driven piezo translators, lever-amplified actuators offer larger travel ranges and much higher lateral stiffness and guiding precision. Compared to single-axis nanopositioning stages, they offer significantly smaller sizes.

### OEM Actuator with Integrated Guidance

With their highly precise, frictionless flexure guidance, a very high stiffness and excellent straightness of motion are achieved. Together with their small dimensions and the cost-effective design, the P-601 lever amplified actuators are especially suited for OEM applications. Versions with strain-gauge sensors (SGS) are equipped with a full bridge circuit that is insensitive to thermal drift. Versions without sensors are also available for open-loop applications such as in high-speed switches and pumps. In addition to the standard steel models, special invar and non-magnetic versions are available on request.

### Ceramic Insulated Piezo Actuators Provide Long Lifetime

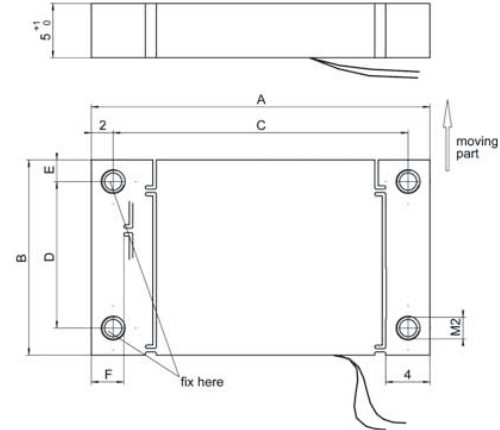
Highest possible reliability is assured by the use of award-winning PICMA® multilayer piezo actuators.



	P-601.1S P-601.1SL	P-601.4S P-601.4SL	Units
Active axes	Z	Z	s
<b>Motion and positioning</b>			
Integrated sensor	SGS	SGS	
Open-loop travel, -20 to +120 V	100	400	µm
Closed-loop travel	100	400	µm
Open-loop resolution	0.2	0.4	nm
Closed-loop resolution	2	12	nm
Linearity, closed-loop	0.1	0.3	%
Repeatability	8	30	nm
Runout $\theta_x, \theta_y$	20 / 10	20 / 10	µrad
<b>Mechanical properties</b>			
Stiffness in motion direction	0.8	0.28	N/µm
Unloaded resonant frequency	750	350	Hz
Resonant frequency @ 30 g	620	290	Hz
Push/pull force capacity in motion direction	30/10	15/10	N
Lateral force	30	30	N
<b>Drive properties</b>			
Ceramic type	PICMA® P-885	PICMA® P-885	
Electrical capacitance	1.5	4.6	µF
<b>Miscellaneous</b>			
Operating temperature range	-20 to 80	-20 to 80	°C
Material	Stainless steel	Stainless steel	
Mass without cables	0.05	0.11	kg
Cable length	S-version: 0.3 SL-version: 1.5	S-version: 0.3 SL-version: 1.5	m
Sensor / voltage connection	S-version: open leads SL-version: LEMO	S-version: open leads SL-version: LEMO	

# P-603 PiezoMove Linear Flexure Actuator

## Low-cost and with Large Travel Ranges



	A	B	C	D	E	F
P-603.1xx	31	18	27	13,5	2	3
P-603.3xx	51	20	47	13,5	3,25	3,5
P-603.5xx	60	20	56	16	2	3

P-603 linear actuators with 500 and 100  $\mu\text{m}$  travel range (from left to right). CD for size comparison

- Frictionless, High-Precision Flexure Guiding System
- Travel Ranges to 500  $\mu\text{m}$
- Cost-Effective Design
- Outstanding Lifetime Due to PICMA® Piezo Actuators
- Available with Integrated Position Sensor
- Ideal OEM Actuators for Precision Motion Control in Optics, Medical, Biotech and Microfluidics Applications
- Custom Designs with Larger Travel or Faster Response and Non-Magnetic Versions Feasible

P-603 PiezoMove flexure-guided piezo actuators integrate a frictionless high-efficiency motion amplifier to combine large travel ranges up to 500  $\mu\text{m}$  with high stiffness and very fast response. The flexure guides reduce tip at the drive head to a minimum saving the cost for additional guiding systems when integrating these actuators in micro-dispensing devices, pumps or servo valves. The overall precision of 10s of nanometers also makes these devices ideal for nanomanipulation applications.

### Options and Custom Versions

For OEM applications, PiezoMove actuators can be modified in various ways to suit the customer's requirements. The stiffness and force generation can be influenced via the lever design and the dimensions of the piezo ceramics used in the actuator.

### Technical Data (preliminary)

Model	P-603.1S0 P-603.1SL	P-603.3S0 P-603.3SL	P-603.5S0 P-603.5SL	P-603.x00 open-loop versions	Units
Active axes	X	X	X	X	
<b>Motion and positioning</b>					
Integrated sensor	SGS	SGS	SGS	–	
Open-loop travel, -20 to +120 V	100	300	550	as P-603.xS0	$\mu\text{m}$
Closed-loop travel	100	300	500	–	$\mu\text{m}$
Open-loop resolution	0.2	0.3	0.4	as P-603.xS0	nm
Closed-loop resolution	2	4	7.5	–	nm
Linearity, closed-loop	0.3	0.3	0.3	–	%
Repeatability	8	10	30	–	nm
<b>Mechanical properties</b>					
Stiffness in motion direction	0.25	0.14	0.06	as P-603.xS0	N/ $\mu\text{m}$
Unloaded resonant frequency	900	450	300	as P-603.xS0	Hz
Blocking force	20	35	25	as P-603.xS0	N
<b>Drive properties</b>					
Ceramic type	PICMA® P-885	PICMA® P-885	PICMA® P-885	PICMA® P-885	
Electrical Capacitance	1.5	3.1	3.7	as P-603.xS0	$\mu\text{F}$
Dynamic operating current coefficient	1.9	1.3	1.6	as P-603.xS0	$\mu\text{A}/(\text{Hz}\cdot\mu\text{m})$
<b>Miscellaneous</b>					
Operating temperature range	-20 to 80	-20 to 80	-20 to 80	-20 to 80	$^{\circ}\text{C}$
Material	Stainless steel	Stainless steel	Stainless steel	Stainless steel	
Dimensions	31x18x5	50x20x5	51x20x5	as P-603.xS0	mm
Mass	0.02 / 0.031	0.032 / 0.043	0.038 / 0.049	as P-603.xS0	kg
Cable length	0.5	0.5	0.5	0.5	m
Sensor / voltage connection	S-version: open leads SL-version: LEMO connector (SGS Sensor)	S-version: open leads SL-version: LEMO connector (SGS Sensor)	S-version: open leads SL-version: LEMO connector (SGS Sensor)	Open leads	

Recommended controller / amplifier  
E-610 controller / amplifier see p. 2-110, E-625 bench-top controller see p. 2-114

## Program Overview

- Piezo Ceramic Actuators & Motors
- Piezo Nanopositioning Systems and Scanners
- Active Optics / Tip-Tilt Platforms
- Capacitive Nanometrology Sensors
- Piezo Electronics: Amplifiers and Controllers
- Hexapod 6-Axis Positioners / Robots
- Micropositioning Stages & Actuators
- Photonics Alignment Systems, Solutions for Telecommunications
- Motor Controllers
- Ultrasonic Linear Motors

## Request or download the complete PI Nanopositioning & Piezo Actuator Catalog



### USA (East) & CANADA

**PI (Physik Instrumente) L.P.**  
 16 Albert St.  
 Auburn, MA 01501  
 Tel: +1 (508) 832 3456  
 Fax: +1 (508) 832 0506  
 info@pi-usa.us  
 www.pi-usa.us

### USA (West) & MEXICO

**PI (Physik Instrumente) L.P.**  
 5420 Trabuco Rd., Suite 100  
 Irvine, CA 92620  
 Tel: +1 (949) 679 9191  
 Fax: +1 (949) 679 9292  
 info@pi-usa.us  
 www.pi-usa.us

### JAPAN

**PI Japan Co., Ltd.**  
 Akebono-cho 2-38-5  
 Tachikawa-shi  
 J-Tokyo 190  
 Tel: +81 (42) 526 7300  
 Fax: +81 (42) 526 7301  
 info@pi-japan.jp  
 www.pi-japan.jp

**PI Japan Co., Ltd.**  
 Hanahara Dai-ni Building, #703  
 4-11-27 Nishinakajima,  
 Yodogawa-ku, Osaka-shi  
 J-Osaka 532  
 Tel: +81 (6) 6304 5605  
 Fax: +81 (6) 6304 5606  
 info@pi-japan.jp  
 www.pi-japan.jp

### CHINA

**Physik Instrumente (PI Shanghai) Co., Ltd.**  
 Building No. 7-301  
 Longdong Avenue 3000  
 201203 Shanghai, China  
 Tel: +86 (21) 687 900 08  
 Fax: +86 (21) 687 900 98  
 info@pi-china.cn  
 www.pi-china.cn

### UK & IRELAND

**PI (Physik Instrumente) Ltd.**  
 Trent House  
 University Way,  
 Cranfield Technology Park,  
 Cranfield,  
 Bedford MK43 0AN  
 Tel: +44 (1234) 756 360  
 Fax: +44 (1234) 756 369  
 uk@pi.ws  
 www.physikinstrumente.co.uk

### FRANCE

**PI France S.A.S**  
 244 bis, avenue Max Dormoy  
 92120 Montrouge  
 Tel: +33 (1) 55 22 60 00  
 Fax: +33 (1) 41 48 56 62  
 info.france@pi.ws  
 www.pi-france.fr

### ITALY

**Physik Instrumente (PI) S.r.l.**  
 Via G. Marconi, 28  
 I-20091 Bresso (MI)  
 Tel: +39 (02) 665 011 01  
 Fax: +39 (02) 873 859 16  
 info@pionline.it  
 www.pionline.it

### GERMANY

**Physik Instrumente (PI) GmbH & Co. KG**  
 Auf der Römerstr. 1  
 D-76228 Karlsruhe/Palmbach  
 Tel: +49 (721) 4846-0  
 Fax: +49 (721) 4846-100  
 info@pi.ws · www.pi.ws