P-840 · P-841 Preloaded Piezo Actuators

Optional with Integrated Position Sensor

P-840, P-841 piezo translators (DIP switch for size comparison)

Ordering Information

Preloaded Piezo Actuator, 1000/50 N

P-84 □ . □ □ (V)

- **0** No Sensor
- **1** SGS Sensor

- **1** 15 µm Travel Range
- **2** 30 µm Travel Range
- **3** 45 µm Travel Range
- **4** 60 µm Travel Range
- **6** 90 µm Travel Range

- **0** without Ball Tip
- **B** with Ball Tip

V: Vacuum Compatible to 10^{-6} hPa

- **Outstanding Lifetime Due to PICMA® Piezo Ceramic Stacks**
- **Travel Range to 90 µm**
- **Compact Case**
- **Pushing Forces to 1000 N**
- **Pulling Forces to 50 N**
- **Sub-Millisecond Response, Sub-Nanometer Resolution**
- **Versions: with Ball Tip, Vacuum Versions**

The P-840 and P-841 series translators are high-resolution linear actuators for static and dynamic applications. They provide sub-millisecond response and sub-nanometer resolution.

Application Examples

- Static and dynamic Precision positioning
- Disc-drive-testing
- Adaptronics
- Smart structures
- Active vibration control
- Switches
- Laser tuning
- Patch-Clamp
- Nanotechnology

Design

These translators are equipped with highly reliable multilayer piezo ceramic stacks protected by a non-magnetic stainless steel case with internal spring preload. The preload makes them ideal for dynamic applications and for tensile loads as well.

Ceramic Insulated Piezo Actuators Provide Long Lifetime

The highest possible reliability is assured by employing the award-winning PICMA® multilayer piezo actuators. PICMA® actuators are the only actuators on the market with a ceramic-only insulation, which makes them resistant to ambient humidity and leakage-current failures. They are thus far superior to conventional actuators in reliability and lifetime.

Optimum UHV Compatibility – Minimum Outgassing

The lack of polymer insulation and the high Curie temperature make for optimal ultra-high-vacuum compatibility (no outgassing / high bakeout temperatures, up to 150 °C).

Mounting

Mounting is at the foot, with push/pull forces of less than 5 N, the actuator can be held by clamping the case. The versions with ball tip decouple torque and off-center forces from the piezoceramic.
To provide magnetic coupling, the P-176.20 magnetic adapter can be screwed into the top piece (only for versions without ball tip).

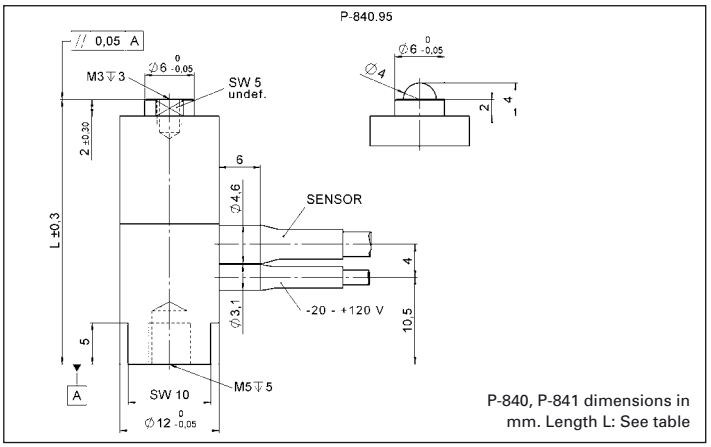
Read details in Mounting and Handling Guidelines (p. 1-67).

High Accuracy in Closed-Loop Operation

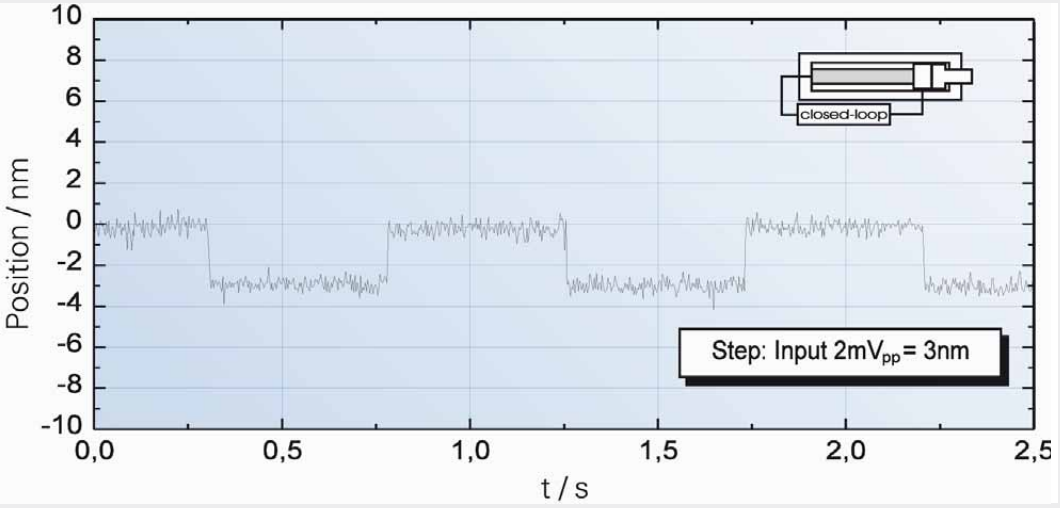
The standard model P-840 is designed for open-loop positioning. Version P-841 with integrated high-resolution strain gauge position sensors provides high precision for closed-loop operation (further details see p. 2-199).

Piezo Drivers, Controllers & Amplifiers

High-resolution amplifiers and servo-control electronics, both digital and analog, are described in the "Piezo Drivers / Servo Controllers" (see p. 2-99) section.



P-840, P-841 dimensions in mm. Length L: See table



Response of a P-841.10 to a 3 nm peak-to-peak square wave control input signal, measured with servo-control bandwidth set to 240 Hz and 2 msec setting time.

Linear Actuators & Motors
PiezoWalk® Motors / Actuators
PILine® Ultrasonic Motors
DC-Servo & Stepper Actuators
Piezo Actuators & Components
Guided / Preloaded Actuators
Unpackaged Stack Actuators
Patches / Benders / Tubes / Shear..
Nanopositioning / Piezoelectrics
Nanometrology
Micropositioning
Index

Technical Data

Model	P-841.1 P-840.1	P-841.2 P-840.2	P-841.3 P-840.3	P-841.4 P-840.4	P-841.6 P-840.6	Units
Open-loop travel @ 0 to 100 V	15	30	45	60	90	µm ±20%
Closed-loop travel	15 / –	30 / –	45 / –	60 / –	90 / –	µm
Integrated feedback sensor*	SGS / –	SGS / –	SGS / –	SGS / –	SGS / –	
Closed-loop / open-loop resolution**	0.3 / 0.15	0.6 / 0.3	0.9 / 0.45	1.2 / 0.6	1.8 / 0.9	nm
Static large-signal stiffness***	57	27	19	15	10	N/µm ±20%
Pushing forces to 1000 N	1000	1000	1000	1000	1000	N
Pulling forces to 50 N	50	50	50	50	50	N
Max. torque limit (on tip)	0.35	0.35	0.35	0.35	0.35	Nm
Electrical capacitance	1.5	3.0	4.5	6.0	9.0	µF ±20%
Dynamic operating current coefficient (DOCC)	12.5	12.5	12.5	12.5	12.5	µA / (Hz • µm)
Unloaded resonant frequency fo	18	14	10	8.5	6	kHz ±20%
Operating temperature	-20 to +80	-20 to +80	-20 to +80	-20 to +80	-20 to +80	°C
Mass without cables	20	28	46	54	62	g ±5%
Material: case, end pieces	N-S	N-S	N-S	N-S	N-S	
Length L	32	50	68	86	122	mm ±0.3

*Closed-loop models can attain linearity up to 0.15% and are shipped with performance reports.
**Resolution of piezo actuators is not limited by stiction or friction. Value given is noise equivalent motion with E-503 amplifier. (p. 2-146)
***Dynamic small-signal stiffness is ~ 30% higher.
Voltage connection: LEMO FFA.00.250. Coaxial cable, RG 178, 1 m.
Sensor connector: LEMO FFA.0S.304. Coaxial cable, 1 m.
Recommended amplifiers / controllers
Single-channel: E-610 servo-controller / amplifier (p. 2-110), E-625 servo-controller, bench-top (p. 2-114), E-621 controller module (p. 2-160)
Modular piezo controller system E-500 (p. 2-142) with amplifier module E-505 (high-power) (p. 2-147) and E-509 controller (p. 2-152) (optional)
Multi-channel: modular piezo controller system E-500 (p. 2-142) with amplifier module E-503 (three channels) (p. 2-146) or E-505 (1 per axis, high-power) (p. 2-147) and E-509 controller (p. 2-152) (optional)

P-842 – P-845 Preloaded Piezo Actuators

For High Loads and Force Generation, Optional with Integrated Position Sensors

P-844 piezo actuators
(battery for size comparison)

- **Outstanding Lifetime Due to PICMA® Piezo Ceramic Stacks**
- **Travel Range to 90 µm**
- **Pushing Forces to 3000 N**
- **Pulling Forces to 700 N**
- **Sub-Millisecond Response, Sub-Nanometer Resolution**
- **Vacuum Version, Optional Water-Resistant Case**

The P-842 / P-843 and P-844 / P-845 series piezo translators are high-resolution linear actuators for static and dynamic applications. They provide sub-millisecond response and sub-nanometer resolution.

Design

These translators are equipped with PICMA® multilayer piezo ceramic stacks protected by a non-magnetic stainless steel case with internal spring preload. The preload makes them ideal for dynamic applications (such as precision machining, active damping etc.) and for tensile loads as well.

High Accuracy in Closed-Loop Operation

P-842 and P-844 are designed for open-loop positioning or use with external feedback. Versions P-843 and P-845 are equipped with integrated high-resolution SGS-position sensors for high precision in closed-loop operation (for further notes see the nanopositioning tutorial, see p. 2-199).

Ceramic Insulated Piezo Actuators Provide Long Lifetime

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

Application Examples

- Static and dynamic precision positioning
- Disc-drive-testing
- Optics
- Metrology / interferometry
- Smart structures / adaptronics
- Precision mechanics / machining
- Active vibration control
- Switches
- Laser tuning

Technical Data and Product Order Numbers

Model	Open-loop travel for 0 to 100 V [µm] ±20 %	Closed-loop travel [µm]*	Integrated feedback sensor**	Closed-loop / Open-loop resolution [nm]***	Static large-signal stiffness [N/µm] ±20 %	Push/pull force capacity [N]	Electrical capacitance [µF] ±20 %
P-842.10 (V)	15	–	–	- / 0.15	57	800 / 300	1.5
P-842.20 (V)	30	–	–	- / 0.3	27	800 / 300	3.0
P-842.30 (V)	45	–	–	- / 0.45	19	800 / 300	4.5
P-842.40 (V)	60	–	–	- / 0.6	15	800 / 300	6.0
P-842.60 (V)	90	–	–	- / 0.9	10	800 / 300	9.0
P-843.10 (V)	15	15	SGS	0.3 / 0.15	57	800 / 300	1.5
P-843.20 (V)	30	30	SGS	0.6 / 0.3	27	800 / 300	3.0
P-843.30 (V)	45	45	SGS	0.9 / 0.45	19	800 / 300	4.5
P-843.40 (V)	60	60	SGS	1.2 / 0.6	15	800 / 300	6.0
P-843.60 (V)	90	90	SGS	1.8 / 0.9	10	800 / 300	9.0
P-844.10 (V)	15	–	–	- / 0.15	225	3000 / 700	6.0
P-844.20 (V)	30	–	–	- / 0.3	107	3000 / 700	12.0
P-844.30 (V)	45	–	–	- / 0.45	75	3000 / 700	18.0
P-844.40 (V)	60	–	–	- / 0.6	57	3000 / 700	24.0
P-844.60 (V)	90	–	–	- / 0.9	38	3000 / 700	36.0
P-845.10 (V)	15	15	SGS	0.3 / 0.15	225	3000 / 700	6.0
P-845.20 (V)	30	30	SGS	0.6 / 0.3	107	3000 / 700	12.0
P-845.30 (V)	45	45	SGS	0.9 / 0.45	75	3000 / 700	18.0
P-845.40 (V)	60	60	SGS	1.2 / 0.6	57	3000 / 700	24.0
P-845.60 (V)	90	90	SGS	1.8 / 0.9	38	3000 / 700	36.0

tors are the only actuators on the market with ceramic-only insulation, which makes them resistant to ambient humidity and leakage-current failures. They are thus far superior to conventional actuators in reliability and lifetime.

Optimum UHV Compatibility - Minimum Outgassing

The lack of polymer insulation and the high Curie temperature make for optimal ultra-high-vacuum compatibility (no outgassing / high bakeout temperatures, up to 150 °C).

Mounting

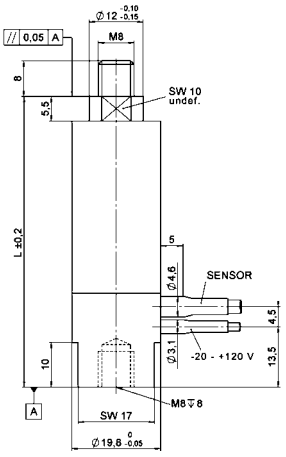
Mounting is at the foot, with push/pull forces of less than 100 N, the actuator can be held by clamping the case. Read details in Mounting and Handling Guidelines (p. 1-67).

Accessories

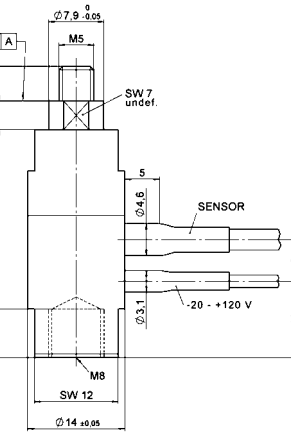
The flexible tips P-176.50 / P-176.60 can be applied for protection of the ceramics from shearing forces (only for versions without ball tip).
P-176.50
Flexible tip for P-842 / P-843 (see p. 1-103 *ff*)
P-176.60
Flexible tip for P-844 / P-845 (see p. 1-103 *ff*)
For extensions, adapter cables and connectors, see "Accessories" in the Piezo Actuators & Components section (p. 2-168 *ff*).

Piezo Drivers, Controllers & Amplifiers

High-resolution amplifiers and servo-control electronics, both digital and analog, are described in the "Piezo Drivers / Servo Controllers" section.



P-844, P-845 dimensions in mm. Length L: see table. Max. torque at top piece: 1 Nm



P-842, P-843 dimensions in mm. Length L: see table. Max. torque at top piece: 0.35 Nm

Dynamic operating current coefficient [µA / (Hz • µm)]	Resonant frequency (unloaded) [kHz] ±20 %	Mass without cable [g] ±5 %	Length L [mm]
12.5	18	31	37
12.5	14	42	55
12.5	10	53	73
12.5	8.5	64	91
12.5	6	86	127
12.5	18	31	37
12.5	14	42	55
12.5	10	53	73
12.5	8.5	64	91
12.5	6	86	127
50	16	84	47
50	12	108	65
50	9	132	83
500	7.5	156	0101
50	5.5	204	137
50	16	84	47
50	12	108	65
50	9	132	83
50	7.5	156	101
50	5.5	204	137

Voltage Connection:
LEMO FFA.00.250. Coaxial Cable, RG 178, 1 m.

Sensor Connector:
LEMO FFA.0S.304. Coaxial Cable, 1 m.

Temperature range: -40 to 80 °C; Case / end pieces: non-magnetic steel.

*Closed-loop models can attain linearity up to 0.15 % and are shipped with performance reports.
**Resolution of piezo actuators is not limited by stiction or friction. Noise equivalent motion with E-503 amplifier (see p. 2-146).
***Dynamic small-signal stiffness is ~ 30 % higher.
Recommended amplifiers / controllers
Single-channel: E-610 servo-controller / amplifier (p. 2-110), E-625 servo-controller, bench-top(p. 2-114), E-621 controller module (p. 2-160)
Single channel: modular piezo controller system E-500 (p. 2-142) with amplifier module E-505 (high-power) (p. 2-147) and E-509 controller (p. 2-152) (optional)
Multi-channel: modular piezo controller system E-500 (p. 2-142) with amplifier module E-503 (three channels) (p. 2-146) or E-505 (1 per axis, high-power, see p. 2-147) and E-509 controller (p. 2-152) (optional)