

MULTILAYER PIEZO ACTUATORS

Piezo Direct's multilayer piezo actuators are constructed with up to hundreds of inner electrodes and thin ceramic layers, co-fired to form a monolithic ceramic with maximum height of a single device up to 36mm. The maximum height of these devices can be up to 100mm. Multilayer Piezo Actuators feature a longitudinal deformation when a voltage is applied. In most cases displacement can reach up to 0.15% of the total product length within a millisecond, while exerting a high force.

Multilayer piezo actuators are often used as linear electromechanical drivers or motors. They act mainly like an expanding element generating a compressive force. The complete motion cycle is nearly proportional to a voltage signal input from DC, up to high frequencies.



PIEZO ACTUATORS APPLICATIONS

Nano-positioning

Precise machining

Piezo positioning stage
Microscope and Imaging
3D Printer
Linear motors
Pumps, Valve drive



OClics

Fiber position
Add/Drop multiplexer
OClics switch
AdaClive oClics
Tunable lasers



Medical & life science

Micro-pumps

Piezo valve for drug dispenser

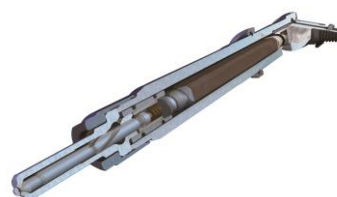


Aerospace & Automobile

Thrusters

Active trailing edge

Fuel injector for common rail system



Piezoelectric injection valve

Non-contact dispense

IC dispense

LED dispense

Camera module dispense



Part numbering

Example **PD J 150 0505 40 1**

Series No.

Nominal displacement in μm

Cross sectional dimensions in mm

Example: 0505=5mm*5mm

Driving voltage

Example: 150=150V

Shape code

Example: J= Rectangular

Y= Round

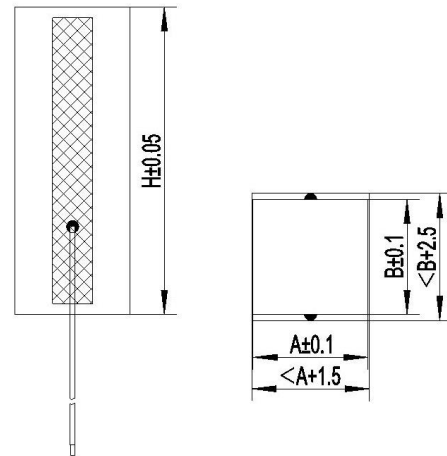
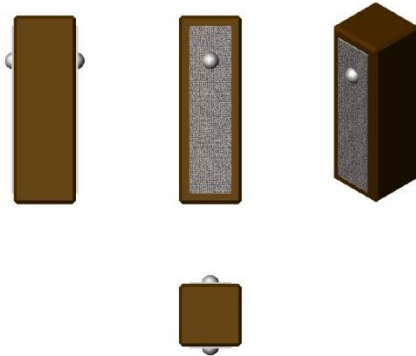
H= Ring

G= Tubular

T= Special-shaped

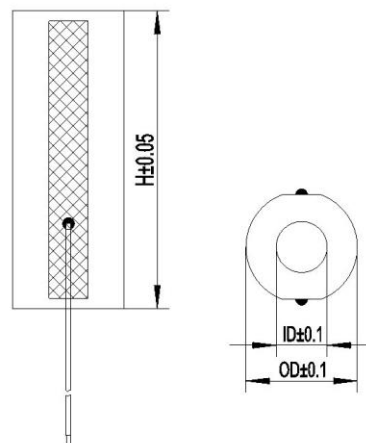
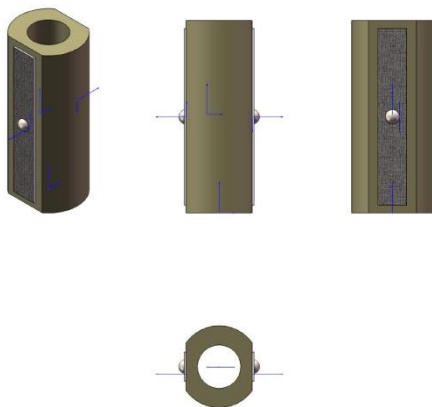
Product Code

MULTILAYER PIEZO RECTANGULAR ACTUATORS



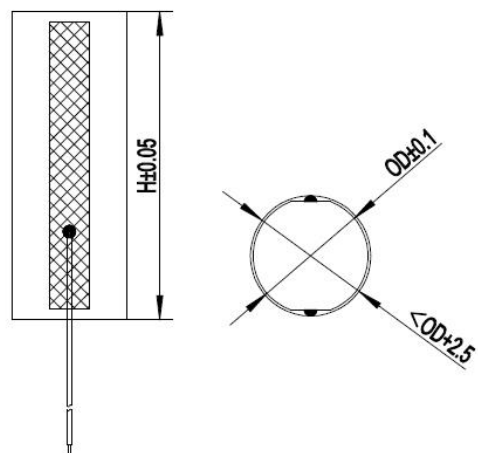
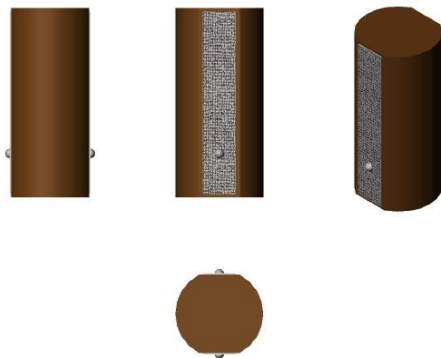
*Red wire (+),black wire (-)

MULTILAYER PIEZO RING ACTUATORS



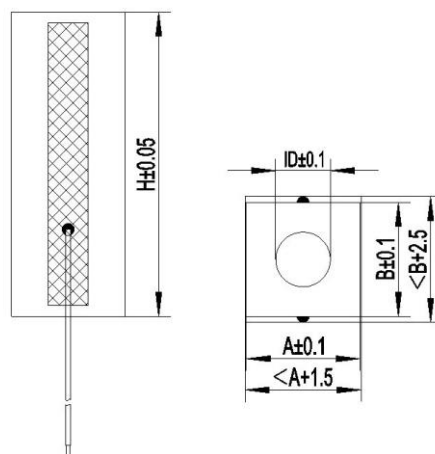
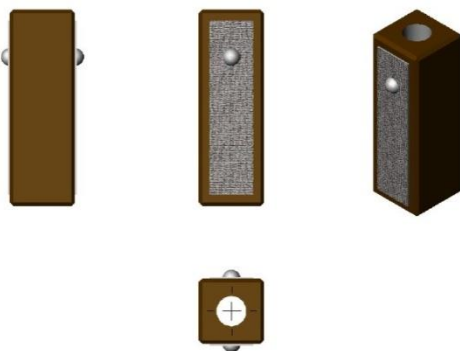
*Red wire (+),black wire (-)

MULTILAYER PIEZO ROUND ACTUATORS



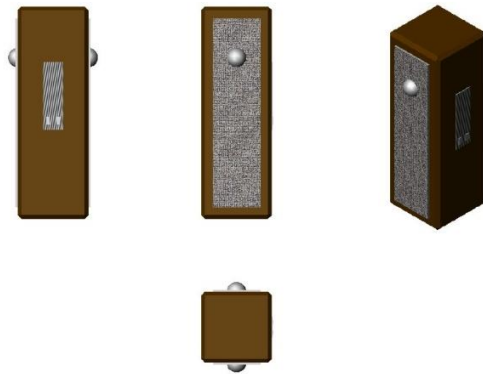
*Red wire (+), black wire (-).

MULTILAYER PIEZO SPECIAL-SHAPED ACTUATORS



*Red wire (+), black wire (-)

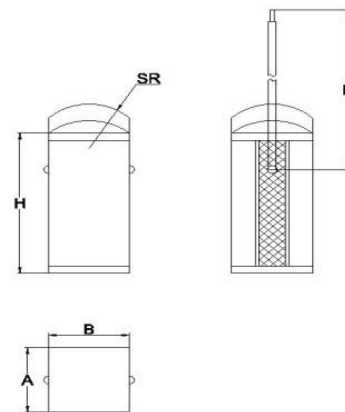
CUSTOM DESIGNS



Strain gage glued type



Tips mounted type



SPECIFICATION – for Rectangular Actuators
PDJ150 Series for Rectangular Actuators – Max. driving voltage=150VDC

Model	Dimensions A×B×H [mm]	Nominal Displacement [μm@150V] ±10%	Blocking Force [N@150V]	Stiffness [N/μm]	Capacitance [μF@1v,1kHz] ±20%	Resonant Frequency [kHz] ±20%
PDJ1500303041	3×3×5	4	330	80	0.14	300
PDJ1500303051	3×3×6	5	330	66	0.18	250
PDJ1500302091	3×2×9	9	250	28	0.25	165
PDJ1500303101	3×3×10	10	330	33	0.30	150
PDJ1500302181	3×2×18	18	250	14	0.6	83
PDJ1500303181	3×3×18	18	330	18	0.5	83
PDJ1500505051	5×5×6	5	900	180	0.44	250
PDJ1500505101	5×5×10	10	900	90	0.8	150
PDJ1500505201	5×5×18	20	900	45	1.5	83
PDJ1500505202	5×5×20	22	900	41	1.8	74
PDJ1500505301	5×5×28	30	900	30	2.4	53
PDJ1500505401	5×5×36	40	900	28	3	42
PDJ1500505402	5×5×34	40	900	28	2.9	44
PDJ1500505403	5×5×40	44	900	20	3.6	37
PDJ1500505601	5×5×54	60	900	15	4.5	28
PDJ1500707101	7×7×10	10	1800	180	1.6	150
PDJ1500707201	7×7×18	20	1800	90	3	83
PDJ1500707301	7×7×28	30	1800	60	4.7	53
PDJ1500707361	7×7×30	36	1800	50	5	50
PDJ1500707362	7×7×30	36	1800	50	5	50
PDJ1500707381	7×7×32	38	1800	47	5.3	47
PDJ1500707401	7×7×36	40	1800	45	6.1	42
PDJ1500707501	7×7×42	50	1800	36	6.9	36
PDJ1501010101	10×10×10	10	3600	360	3.2	150
PDJ1501010201	10×10×18	20	3600	180	6.0	83
PDJ1501010301	10×10×28	30	3600	120	9.2	53
PDJ1501010401	10×10×36	40	3600	90	12	42
PDJ1501010501	10×10×46	50	3600	72	15.2	33
PDJ1501010601	10×10×54	60	3600	66	18	28
PDJ1501414101	14×14×10	10	7200	720	6.2	150
PDJ1501414201	14×14×20	20	7200	360	13.1	75
PDJ1501414301	14×14×30	30	7200	240	19.3	50
PDJ1501414401	14×14×40	40	7200	180	26.2	37

SPECIFICATION – for Rectangular Actuators
PDJ200 series for Rectangular Actuators – Max. driving voltage=200VDC

Model	Dimensions A×B×H [mm]	Nominal Displacement [μm@200V] ±10%	Blocking Force [N@200V]	Stiffness [N/μm]	Capacitance [μF@1v,1kHz] ±20%	Resonant Frequency [kHz] ±20%
PDJ2000303051	3×3×6	5	330	66	0.15	250
PDJ2000303101	3×3×10	10	330	33	0.27	150
PDJ2000505051	5×5×6	5	900	180	0.2	250
PDJ2000505101	5×5×10	10	900	90	0.52	150
PDJ2000505121	5×5×12	12	900	75	0.43	125
PDJ2000505201	5×5×18	20	900	45	0.67	83
PDJ2000505301	5×5×28	30	900	30	1.1	53
PD2000505302	5×5×30	30	900	30	1.1	50
PDJ2000505401	5×5×36	40	900	23	1.34	42
PDJ2000505402	5×5×35	40	900	23	1.34	43
PDJ2000707101	7×7×10	10	1800	180	0.69	150
PDJ2000707201	7×7×18	20	1800	90	1.3	83
PDJ2000707301	7×7×28	30	1800	60	2	53
PDJ2000707381	7×7×32	38	1800	47	2.4	47
PDJ2000707401	7×7×36	40	1800	45	2.6	42
PDJ2000707501	7×7×42	50	1800	36	3.1	36
PDJ2001010101	10×10×10	10	3600	360	1.5	150
PDJ2001010201	10×10×18	20	3600	180	2.7	83
PDJ2001010301	10×10×28	30	3600	120	4.3	53
PDJ2001010401	10×10×36	40	3600	90	5.5	42
PDJ2001414101	14×14×10	10	7200	720	2.8	150
PDJ2001414201	14×14×20	20	7200	360	5.8	75
PDJ2001414301	14×14×30	30	7200	240	8.6	50
PDJ2001414401	14×14×40	40	7200	180	12	37

SPECIFICATION – for Ring Actuators

PDH150 series for Ring Actuators – Max. driving voltage=150VDC

Model	Dimensions OD/ID/H [mm]	Nominal Displacement [μm@150V] ±10%	Blocking Force [N@150V]	Stiffness [N/μm]	Capacitance [μF@1v,1kHz] ±20%	Resonant Frequency [kHz] ±20%
PDH1500525051	Φ5/Φ2.5/6	5	600	120	0.3	250
PDH1500525101	Φ5/Φ2.5/10	10	700	70	0.5	150
PDH1500525201	Φ5/Φ2.5/18	20	700	35	1	83
PDH1500845101	Φ8/Φ4.5/10	10	1300	130	0.8	150
PDH1500845201	Φ8/Φ4.5/18	20	1300	65	1.5	83
PDH1501006101	Φ9.5/Φ5.5/10	10	1500	150	1.2	150
PDH1501005101	Φ10/Φ5.5/10	10	1500	150	1.2	150
PDH1501205201	Φ12/Φ5/20	20	3400	170	6.0	75
PDH1501206101	Φ12/Φ6/10	10	3000	220	2.4	150
PDH1501206161	Φ12/Φ6/16	18	3000	122	4	94
PDH1501206201	Φ12/Φ6/20	22	3000	100	5	75
PDH1501304201	Φ13/Φ4/20	22	3600	163	7.2	75
PDH1502015051	Φ20/Φ15/6	5	4000	800	1.4	250
PDH1502619201	Φ26/Φ19/18	20	7200	360	14	83

PDH200 series for Ring Actuators – Max. driving voltage=200VDC

Model	Dimensions OD/ID/H [mm]	Nominal Displacement [μm@200V] ±10%	Blocking Force [N@200V]	Stiffness [N/μm]	Capacitance [μF@1v,1kHz] ±20%	Resonant Frequency [kHz] ±20%
PDH2001304201	Φ13/Φ4/20	20	3600	180	4.6	74
PDH2002015051	Φ20/Φ15/6	5	4000	800	1.3	250
PDH2002619201	Φ26/Φ19/18	20	7200	360	7.7	80
PDH2001304401	Φ13/Φ4/40	40	3600	90	9.2	37
PDH2002619351	Φ26/Φ19/35	35	7200	205	15.3	43

High pressure series for Ring Actuators – Max. driving voltage=1000VDC

Model	Dimensions OD/ID/H [mm]	Nominal Displacement [μm] ±10%	Blocking Force [N]	Stiffness [N/μm]	Capacitance [μF@1v,1kHz] ±20%	Resonant Frequency [kHz] ±20%
PDH2501203201	Φ12/Φ3/20	20@250V	3500@250V	175	4.6	75
PDH2502515301	Φ25/Φ15/30	30@250V	9000@250V	300	13.5	50
PDH10002515301	Φ25/Φ15/30	30@1000V	8600@1000V	280	3	50

SPECIFICATION – for Round Actuators

PDY150 series for Round Actuators – Max. driving voltage=200VDC

Model	Dimensions OD/H [mm]	Nominal Displacement [μm] ±10%	Blocking Force [N]	Stiffness [N/μm]	Capacitance [μF@1v,1kHz] ±20%	Resonant Frequency [kHz] ±20%
PDY15014241	Φ14.2/24	24@150V	7500@150V	312	16	62
PDY15014481	Φ14.2/48	48@150V	7500@150V	156	30	31
PDY15014201	Φ14.7/20	20@150V	7500@150V	375	13	75
PDY15014401	Φ14.7/40	40@150V	7500@150V	188	27	38
PDY20014051	Φ14.2/6	5@200V	7500@200V	1500	1.4	250

SPECIFICATION – for Special-shaped Actuators

PDT150 series for Special-shaped Actuators – Max. driving voltage=150VDC

Model	Dimensions OD/ID/H [mm]	Nominal Displacement [μm@150V] ±10%	Blocking Force [N@150V]	Stiffness [N/μm]	Capacitance [μF@1v,1kHz] ±20%	Resonant Frequency [kHz] ±20%
PDT150080804161	7.5×7.5/Φ3.5/16	16	1600	100	1.6	94

Remarks:

- 1 Measuring voltage range: 0 to150V and/or 0 to 200V and/or 0 to 1000V
- 2 Recommended preload for dynamic operation: 15MPa
- 3 Maximum preload for constant force: 20MPa.
- 4 Operating voltage: -20 to 150V DC and/or -20 to 200V DC
- 5 Operating temperature range: -20 to120°
- 6 Wire lead, the red is for electrode (+), and the black is for electrode (-)

***Customization available on request.**

***All specifications are subject to changes, please check with Piezo Direct before ordering.**

Testing method (Fig. 1)

- 1 The actuator must be placed vertically on a table and the table must be keCI level before testing. The test contactor must be set vertically on the table and keCI kept in contact with the center of top of the actuator during testing.
- 2 Only DC voltage should be applied.
- 3 The red lead wire is the positive (+) and the black lead wire is the negative (-)

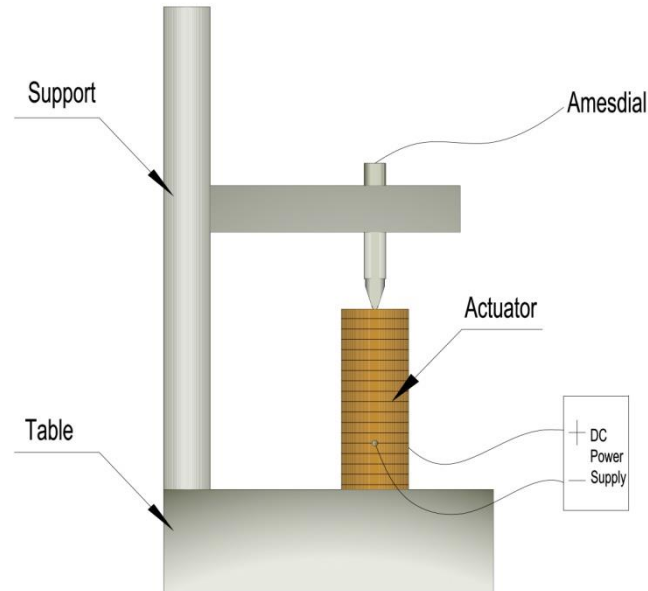
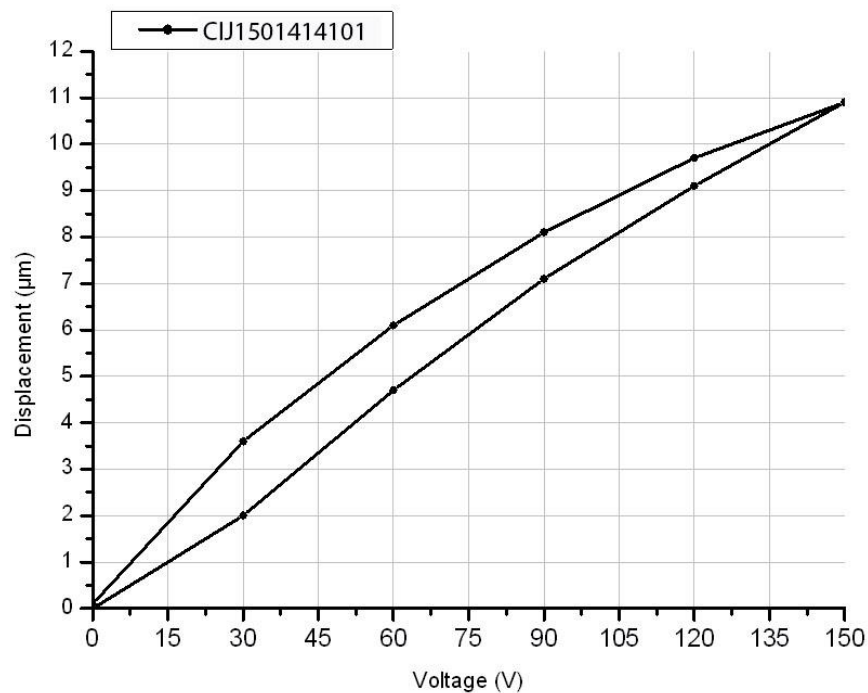


Fig. 1: Installation and Application Method

Testing Curve (Fig. 2~ Fig. 7)

Fig. 2: Displacement VS Voltage Diagram (quasi-static)



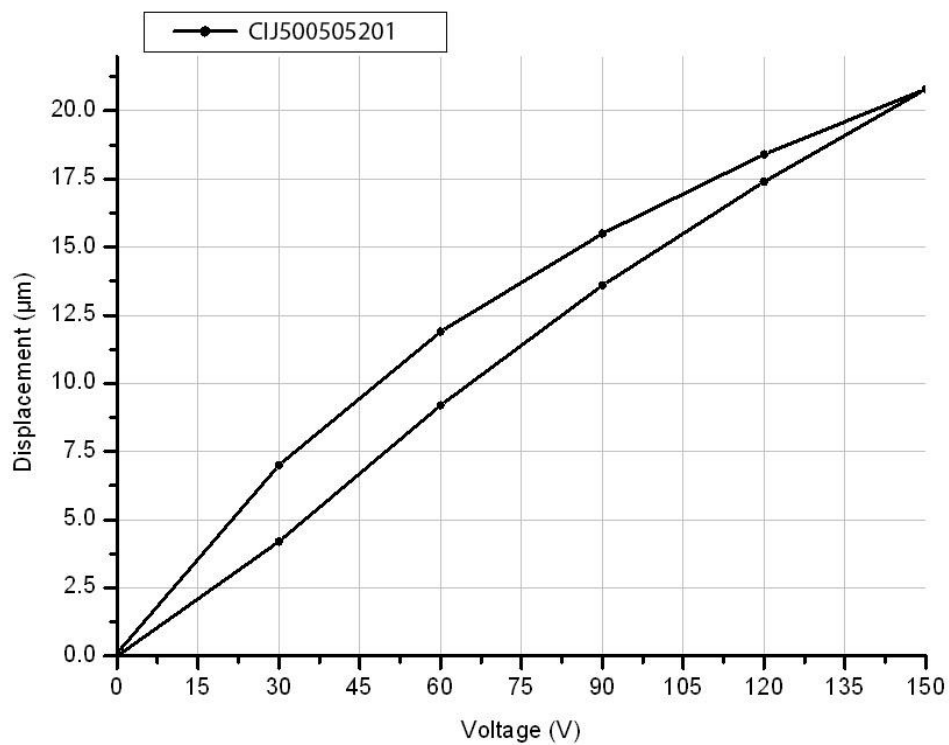


Fig. 3: Displacement VS Voltage Diagram (quasi-static)

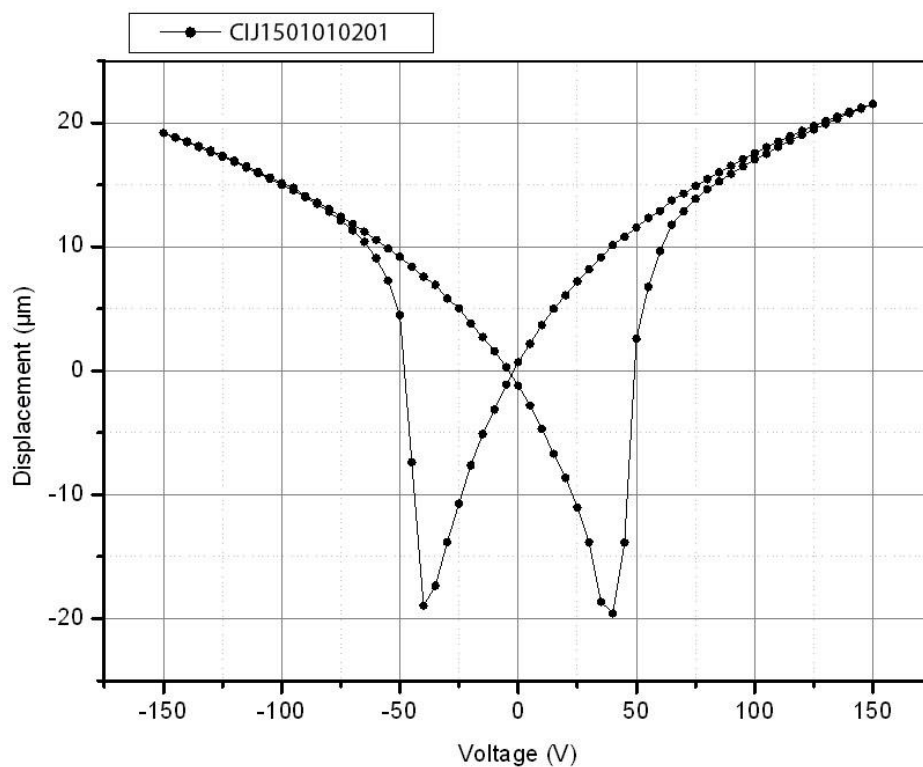


Fig. 4: Displacement VS Voltage diagram (dynamic)

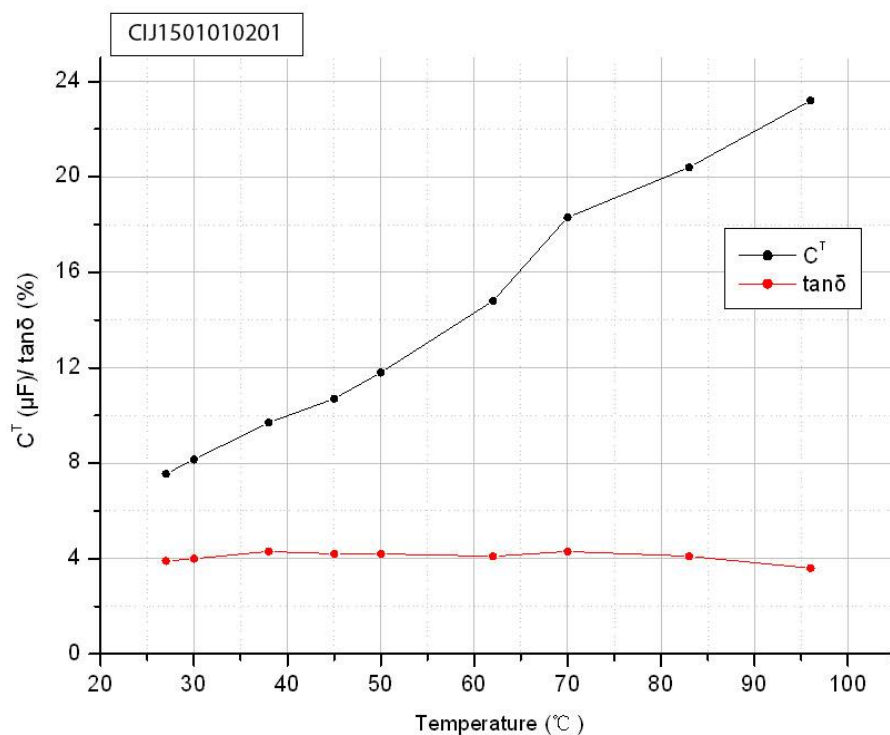


Fig. 5: Capacitance VS temperature diagram (quasi-static)

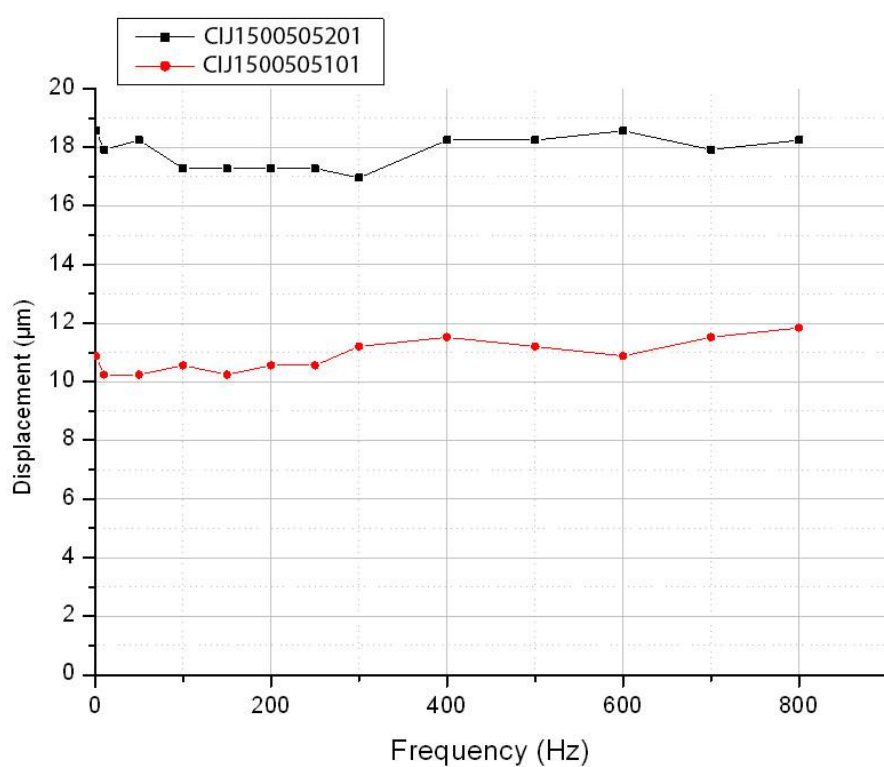


Fig. 6: Displacement VS Frequency diagram (quasi-static)

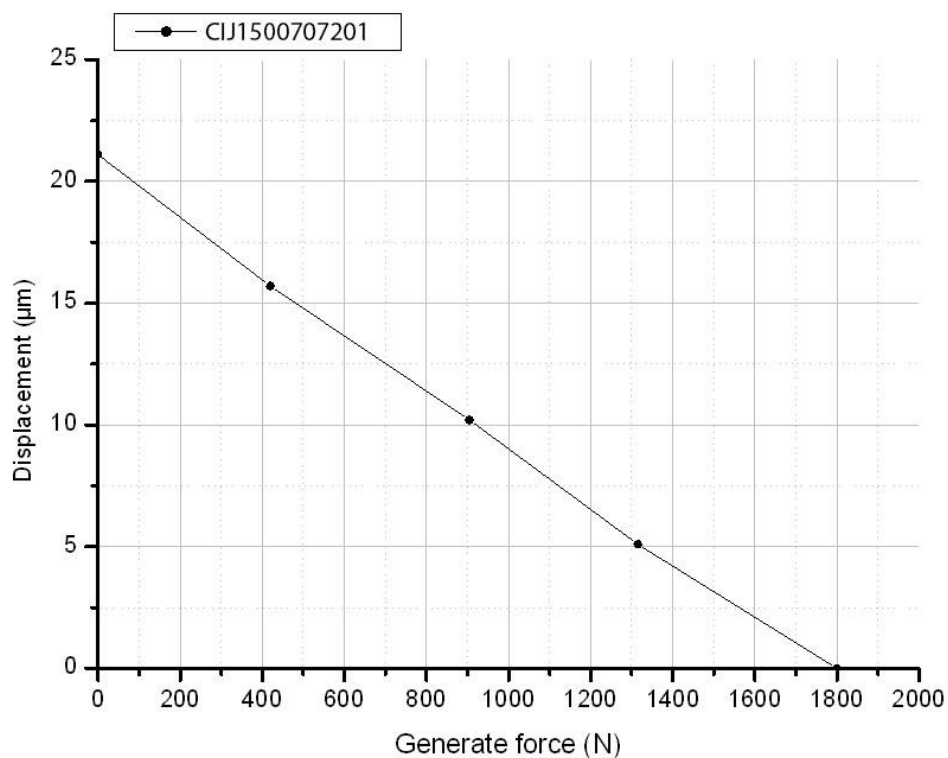


Fig. 7: Displacement VS Blocking force diagram (dynamic)

Mount and connect

1. The actuator should be connected in-line with the element, and be driven by rigid connection.
2. No load is prohibited. Please apply 20Mpa preload if response time is below 100μs. Please refer to the tables below for details.

Preload force for Rectangle Actuators

Length [mm]	Width [mm]	Normal Pressure [MPa]	Max. Pressure [MPa]	Proposal preload force [N]	Max. preload force [N]
3	3	15	20	135	180
5	5	15	20	375	500
7	7	15	20	735	980
10	10	15	20	1500	2000
14	14	15	20	2940	3920

Preload force for Ring Actuators

Length [mm]	Width [mm]	Normal Pressure [MPa]	Max. Pressure [MPa]	Proposal preload force [N]	Max. preload force [N]
5	2.5	15	20	220	300
8	4.5	15	20	510	690
10	5.5	15	20	820	1100
12	5	15	20	1400	1870
12	6	15	20	1400	1870
10	5.5	15	20	700	940

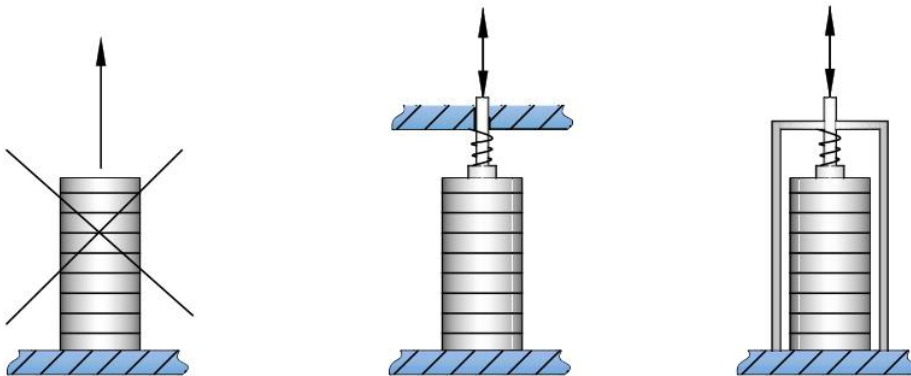
20	15	15	20	2060	2750
13	4	15	20	1800	2400
26	19	15	20	3700	4950
12	3	15	20	1590	2120
25	15	15	20	4710	6280

Outer diameter [mm]	Normal Pressure [MPa]	Max. Pressure [MPa]	Proposal preload [N]	Max. preload [N]
14.2	15	20	2400	3200
14.7	15	20	2500	3400

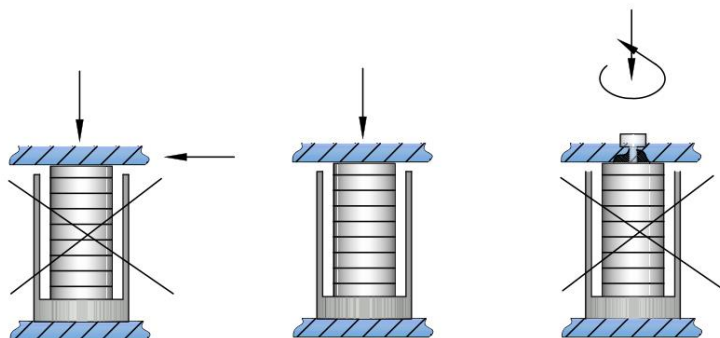
Preload force for Special-shaped Actuators

Length [mm]	Width [mm]	ID [mm]	Normal Pressure [MPa]	Max. Pressure [MPa]	Proposal preload [N]	Max. preload [N]
7.5	7.5	3.5	15	20	700	940

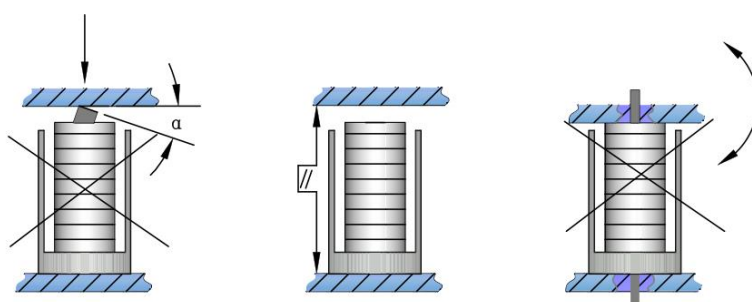
- Do not apply a voltage exceeding Max. driving voltage value to the actuator.
- The actuator should be used in a dry atmosphere below 75% RH and in a range of temperature -20~120°C. Otherwise, a drop in insulation resistance or shortened working life may occur.
- The resin-coated type of actuator is weak to a tensile force because of its structure. As a result, the direction of the generated force must be the same as the center axis of the actuator. Please see the examples shown below.



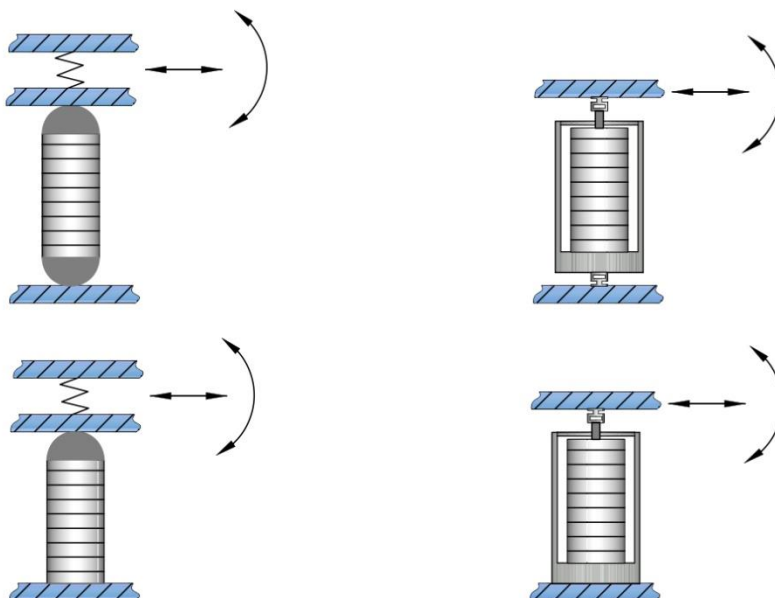
No pulling force without preload

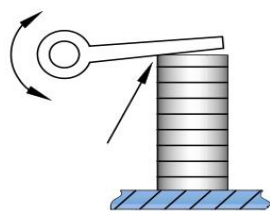


No lateral force or torque

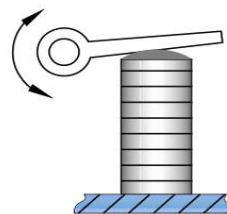


Bolting between plates is not recommended

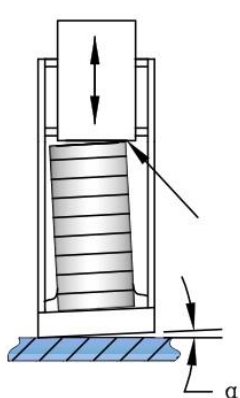




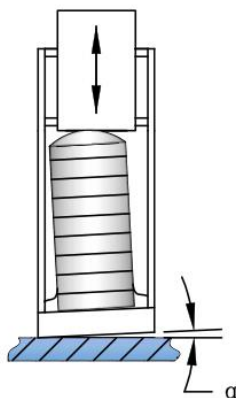
Wrong: do not squeeze edge



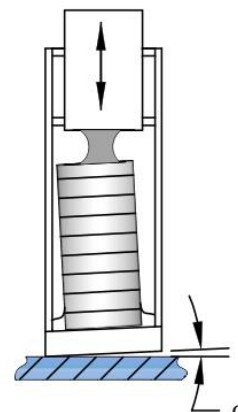
Correct



Wrong: do not squeeze edge



Correct



Correct

Material performance table

Key Technical Index	Unit	Value
Relative dielectric constant ϵ_{r3}^T	—	3500 $\pm$ 20%
Electromechanical coupling factor K_p	—	70%
Longitudinal piezoelectric strain coefficient d_{33}	10^{-12}C/N	≥ 650
Piezoelectric voltage constant g_{33}	10^{-3}Vm/N	17
Elastic flexible coefficient S_{11}^E	$10^{-12}\text{m}^2/\text{N}$	14.3
Elastic flexible coefficient S_{33}^E	$10^{-12}\text{m}^2/\text{N}$	18.5
Dielectric loss $\text{tg}\delta$	10^{-3}	≤ 1.5
Mquality factor Q_m	—	45
Curie temperature T_c	$^{\circ}\text{C}$	180
Density ρ	g/cm^3	7.9