V22 Version

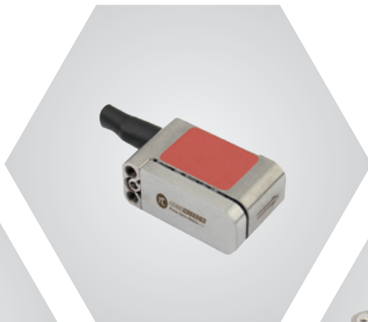
CORE MORROW
Piezo Nano Motion

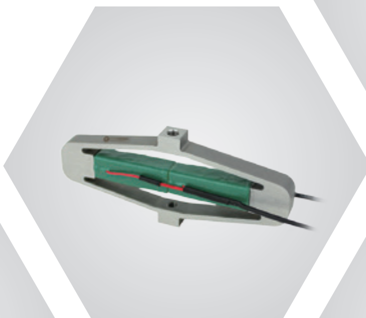
# Piezo Nano Motion

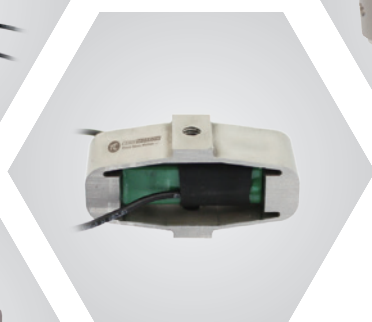
## - Amplified Piezo Actuators -

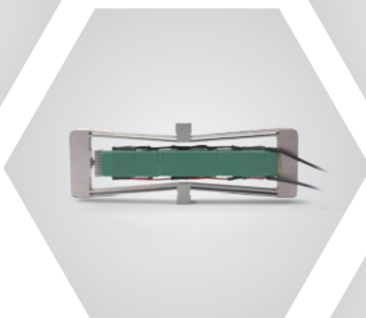
Harbin Core Tomorrow Science & Technology Co.,Ltd.

# Amplified Piezo Actuators









The amplified piezo actuators adopt amplifying mechanism design to amplify the displacement of piezo stacks and output.

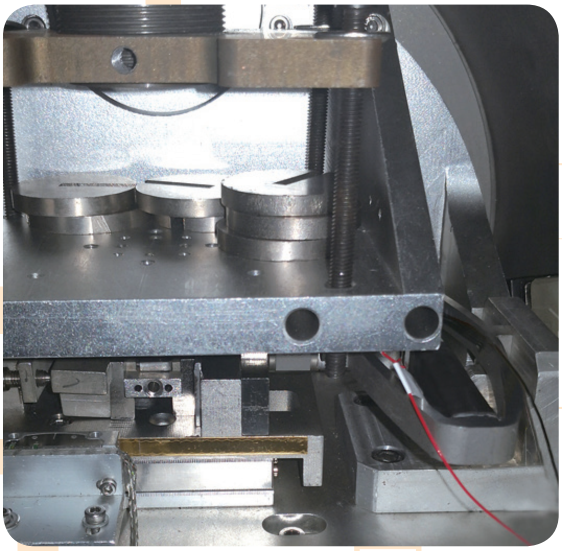
## Applications

• Optics: probe scanning, optical lens positioning, optical switch, shutter/shutter stabilization, micro-scanning, wafer testing, astronomy, focus positioning, laser cavity tuning, optical fiber coupling and deformation, FBG (fiber Bragg grating) deformation, chopper, interferometer, PDP crystal cutting, modulator, etc.

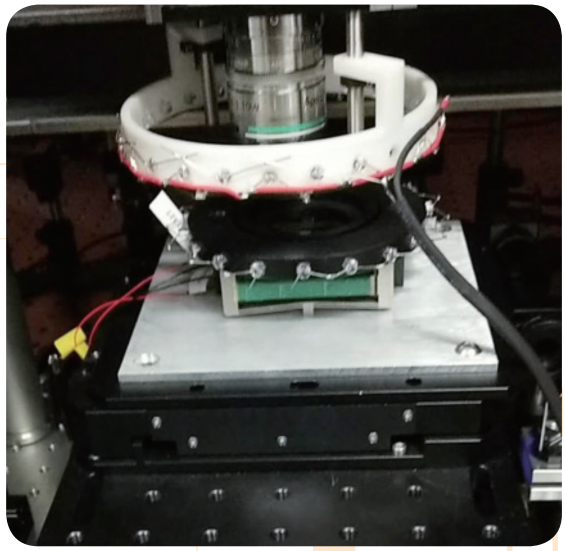
• Mechanics: fiber stretching, tool positioning, pick and place tools, diamond turning, elliptical piston processing, damping, dynamic control, new generation ultrasonic or sonic vibration, NDT, instrument fatigue monitoring, etc.

• Fluidics: proportional valves, pumps, flow measurement technology, inkjet technology, syringes, droplet generators, etc.

## Application Example

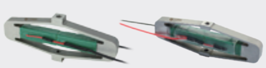
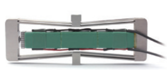
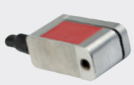
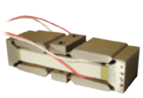
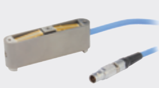


Friction Measurement



Microscopic Imaging

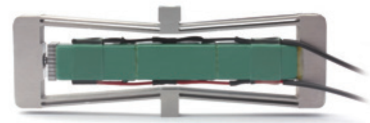
## Product List

| Type | Appearance | Mechanism | Axis | Displacement[μm] | Blocking force[N] | Driving voltage[V] | Page |
|---|---|---|---|---|---|---|---|
| A |  | Magnifying mechanism | Contract in X | 41~410 | 27~500 | 0~120 | 2 |
| |  | | Contract in X | 30~2000 | 6~540 | 0~120 | 4 |
| R |  | | Expand in X | 43~560 | 48~100 | 0~120 | 2 |
| P87.X38S |  | | X | 38 | - | 0~150 | 7 |
| AP |  | | Expand in X | 110~830 | 6~90 | 0~150 | 8 |
| NAC |  | | Expand in X | 300~950 | 250 | 0~200 | 9 |

# Amplified Piezo Actuators



xxAx



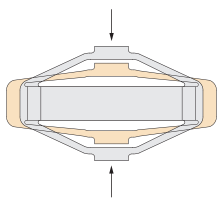
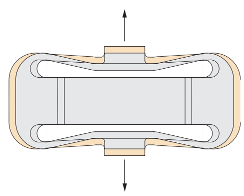
xxRx

The amplified piezo actuator is an actuator that amplifies and outputs the displacement generated by low-voltage piezo stacks preloaded by a mechanical amplifying structure.

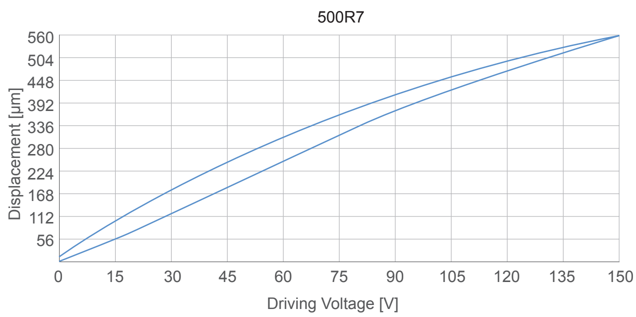
The amplified structure is an mechanical shell, and its material is generally steel. In addition to providing optimized pre-tightening force for piezo stacks, it also protects piezo stacks from tensile forces that can cause irreversible or even fatal damage to piezo stacks. The mechanical amplified structure also provides the user with mechanical interface, easy to integrate.

## Principle

Piezo stacks produce deformation and displacement along the main axis, that is, the long axis direction, and the elliptical mechanical structure amplifies and outputs the displacement along the short axis direction.

| Type A: xxAx | Type R: xxRx |
|---|---|
| Outward ellipse | Inward ellipse |
|  X Contraction |  X Elongation |

## Voltage vs Stroke




## Recommended Controller

E53.A

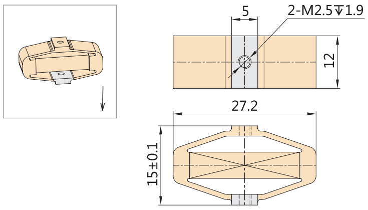
## Technical Data

| | Type | Max/stroke [µm]±15%* | Blocking force [N] | Stiffness [N/µm]±20% | El. capacitance [µF]±20% | Unloaded resonant frequency [Hz]±20% |
|---|---|---|---|---|---|---|
| Type A | 40A5 | 41/32 | 125 | 6.2 | 1.8 | 4100 |
| | 60A5 | 66/48 | 80 | 1.7 | 1.8 | 2700 |
| | 100A5 | 100/80 | 120 | 2.1 | 3.6 | 1900 |
| | 100A7 | 100/80 | 148 | 1.2 | 7.2 | 2000 |
| | 19071 | 100/80 | 500 | 5 | 10.8 | 1600 |
| | 150A5 | 157/120 | 65 | 0.7 | 3.6 | 1300 |
| | 200A5 | 217/160 | 40 | 0.4 | 3.6 | 800 |
| | 400A5 | 410/320 | 27 | 0.1 | 3.6 | 500 |
| Type R | 40R5 | 43/32 | 48 | 1.5 | 1.8 | 1300 |
| | 150R5 | 155/110 | 60 | 0.5 | 3.6 | 400 |
| | 500R7 | 560/400 | 100 | 0.25 | 10.8 | 230 |

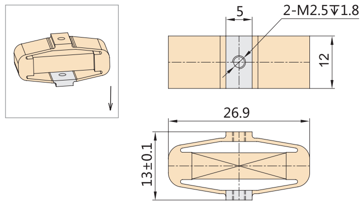
*Nominal Stroke at 0~150V, Max. stroke at -20~150V. Recommended voltage 0~120V for long-term and high-reliable operation.

## Drawings

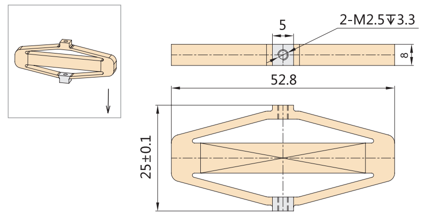
40A5



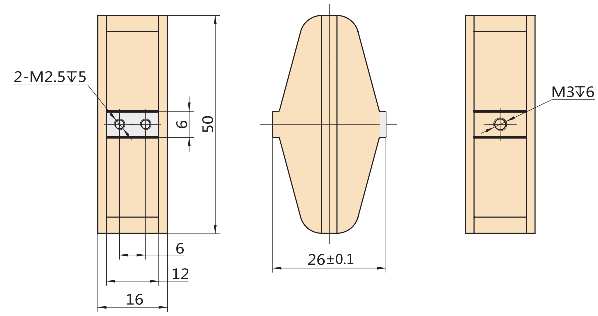

60A5



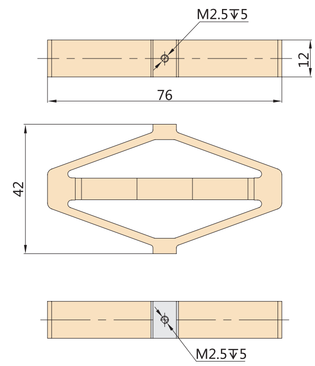

100A5



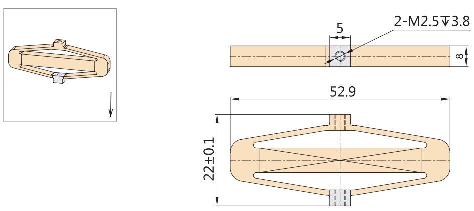

100A7



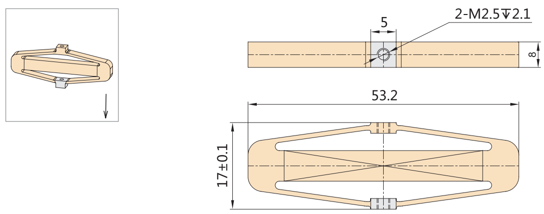

19071



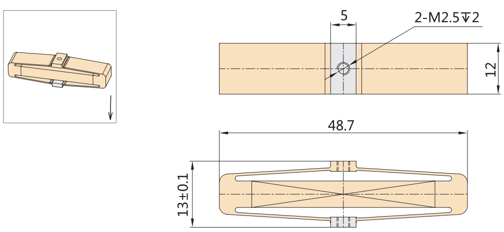

150A5



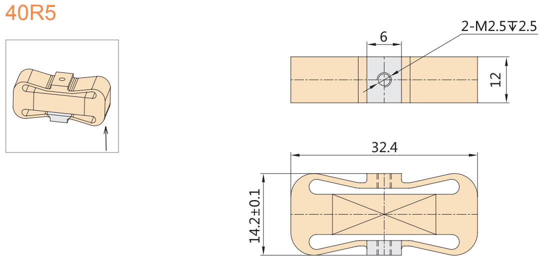

200A5



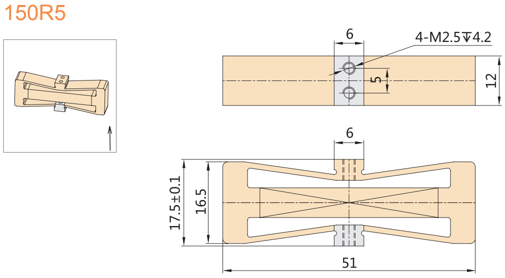

400A5



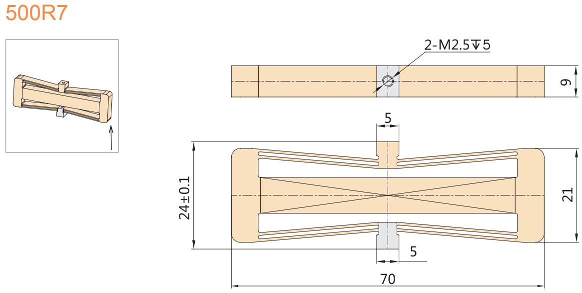

40R5




150R5




500R7



# Amplified Piezo Actuator



## ▸ Characteristics

- 30μm to 2mm travel
- Blocking force to 540N
- Unloaded resonant frequency to 3150Hz
- Nanoscale resolution

## ▸ Application

Probe scanning, optical mirrors positioning, optical switch, shutter, wafer testing, astronomy, focus positioning, laser cavity tuning, fiber coupling and deformation, FBG deformation, chopper, interferometer, piston machining, damping, dynamic control, valves,inkjet technology, droplet generators, etc.

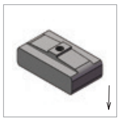
## ▸ Technical Data

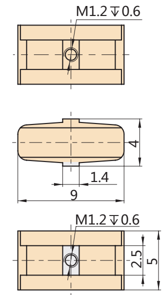
| Type | Active axes | Stroke [μm±20%] | Unloaded resonant frequency[Hz±20%] | Blocking force [N] | Stiffness [N/μm±20%] | El. capacitance [μF±20%] | Material |
|---|---|---|---|---|---|---|---|
| 30A2 | X | 30 | 3150 | 6 | 0.2 | 0.075 | steel |
| 35A2 | X | 35 | 1900 | 9 | 0.26 | 0.17 | steel |
| 50A2 | X | 50 | 2000 | 7 | 0.14 | 0.125 | steel |
| 70A5 | X | 70 | 900 | 49 | 0.7 | 1.8 | steel |
| 80A5 | X | 80 | 700 | 32 | 0.4 | 1.8 | steel |
| 95A10 | X | 95 | 350 | 540 | 5.7 | 21.6 | steel |
| 115A10 | X | 115 | 1050 | 253 | 2.2 | 21.6 | steel |
| 120A14 | X | 120 | 400 | 54 | 0.45 | 29 | steel |
| 125A5 | X | 125 | 1150 | 25 | 0.2 | 3.6 | steel |
| 130A5 | X | 130 | 900 | 7.8 | 0.06 | 1.8 | steel |
| 180A5 | X | 180 | 750 | 18 | 0.1 | 3.6 | steel |
| 200A10 | X | 200 | 600 | 60 | 0.3 | 21.6 | steel |
| 230A10 | X | 230 | 580 | 230 | 1 | 43 | steel |
| 240A5 | X | 240 | 600 | 12 | 0.05 | 3.6 | steel |
| 300A10 | X | 300 | 423 | 53 | 0.17 | 21.6 | steel |
| 400A7 | X | 400 | 370 | 25 | 0.06 | 10.8 | steel |
| 450A5 | X | 450 | 394 | 12 | 0.026 | 3.6 | steel |
| 500A10 | X | 500 | 188 | 20 | 0.042 | 43.2 | steel |
| 550A14 | X | 550 | 243 | 136 | 0.25 | 130 | steel |
| 600A7 | X | 600 | 190 | 3 | 0.005 | 7.2 | steel |
| 700A7 | X | 700 | 280 | 14 | 0.02 | 10.8 | steel |
| 800A7 | X | 800 | 220 | 5 | 0.006 | 7.2 | steel |
| 900A10 | X | 900 | 250 | 60 | 0.07 | 43 | steel |
| 1000A14 | X | 1000 | 200 | 130 | 0.13 | 130 | steel |
| 1500A10 | X | 1500 | 150 | 30 | 0.02 | 43 | steel |
| 2000A10 | X | 2000 | 110 | 20 | 0.01 | 43 | steel |

Note: Stroke at 0~150V, max driving voltage of -20V~150V. Recommended voltage 0~120V for long-term and high-reliable operation.

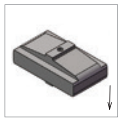
## Drawings

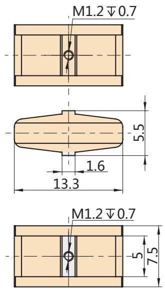
### 30A2



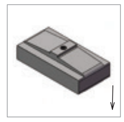


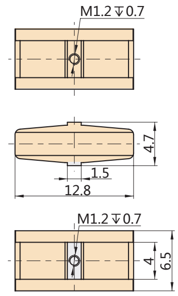

### 35A2



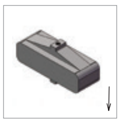


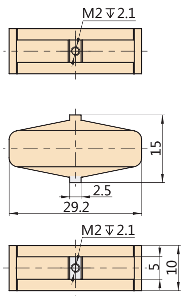

### 50A2



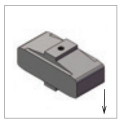


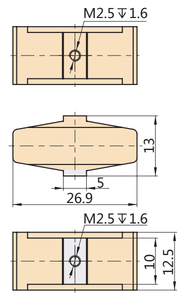

### 70A5



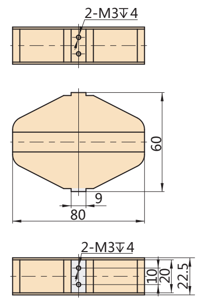



### 80A5

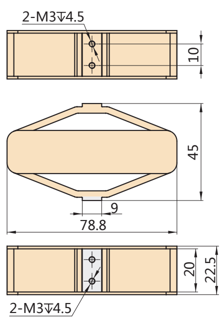




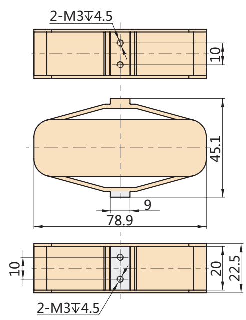

### 95A10



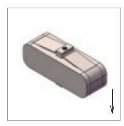

### 115A10

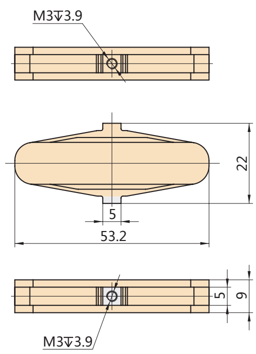



### 120A14

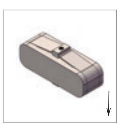


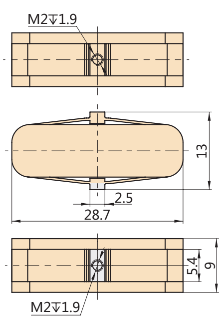

### 125A5



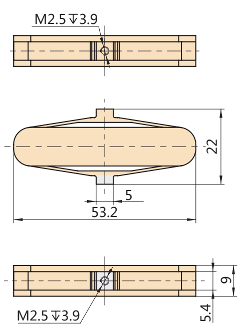



### 130A5



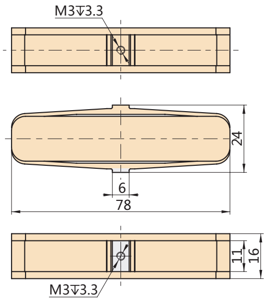



### 180A5

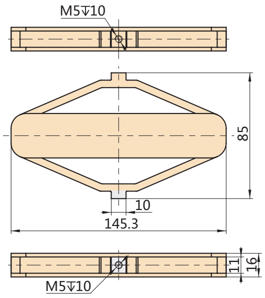


## Drawings

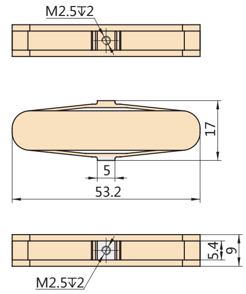
200A10



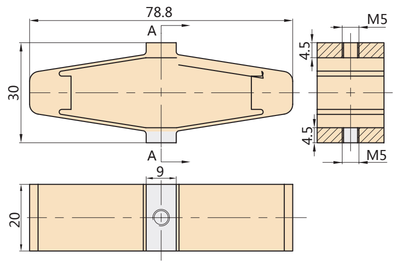

230A10



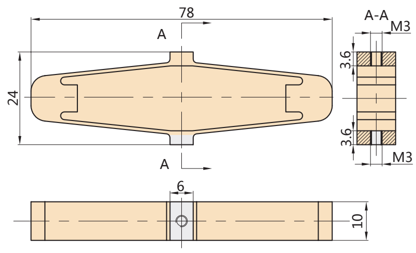

240A5



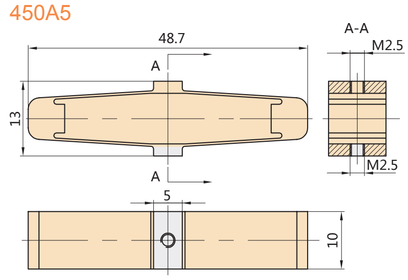

300A10




400A7




450A5

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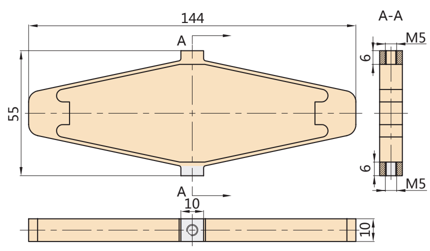


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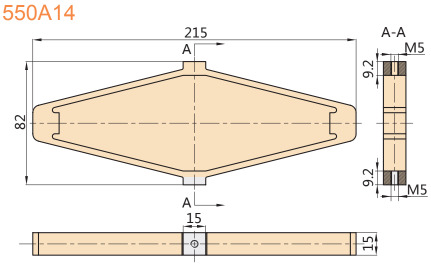
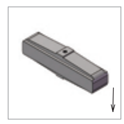
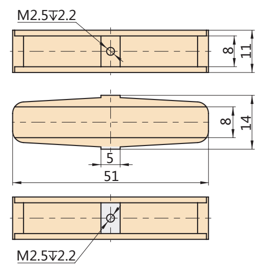
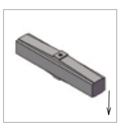


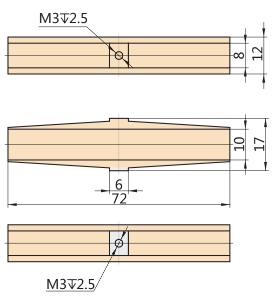

600A7



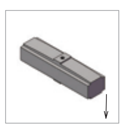


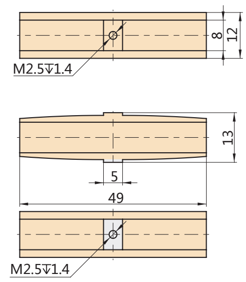

700A7



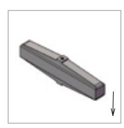


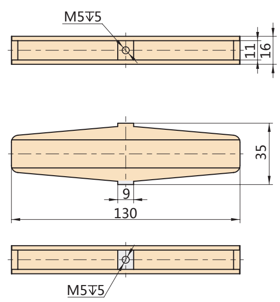

800A7



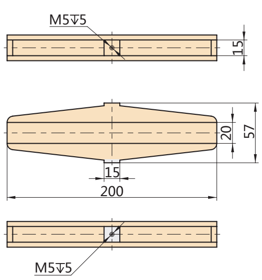



900A10

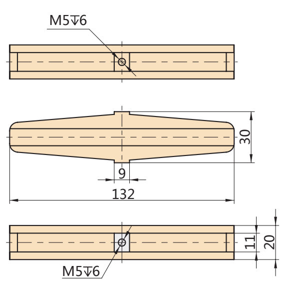




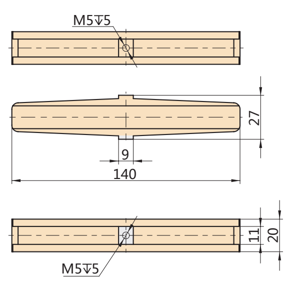

1000A14




1500A10




2000A10



# P87 Amplified Piezo Actuators

P87 amplified piezo actuator is specially designed for space-limited applications. It is compact, small size, and equipped with closed-loop sensors. It is ideal for high-precision, space-limited applications, such as small-volume fiber end-face detectors.

## ▸ Characteristics

- Displacement to 38μm
- Closed-loop sensor
- Small size
- Suitable for fiber end detection

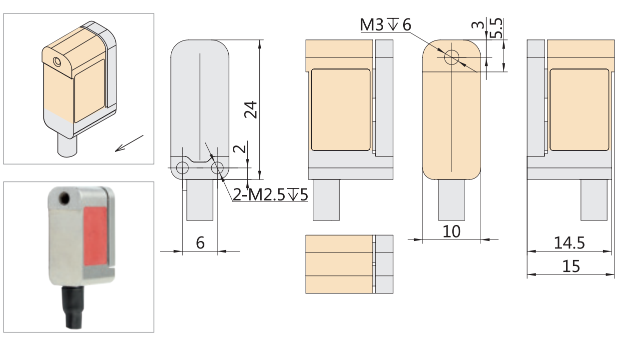
## ▸ Technical Data

| Type | P87.X38S | Units |
|---|---|---|
| Travel range | 38 | μm±10% |
| Driving voltage | 0~150 | V |
| Sensor | SGS | |
| Closed-loop resolution | 1.3 | nm(5mV ripple) |
| Unload resonant frequency | 1200 | Hz±20% |
| Capacitance | 0.8 | μF±20% |
| Material | stainless steel, aluminium | |

*Nominal Stroke at 0~150V, Max. stroke at -20~150V. Recommended voltage 0~120V for long-term and high-reliable operation.

## ▸ Drawing

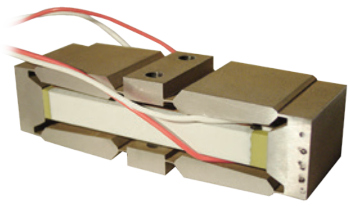
P87.X38S




## ▸ Recommended Controllers

| E00/E01 | E70 | E53 |
|---|---|---|
|  |  |  |
| 1~3 channels<br>Digital analog<br>Open/closed loop<br>Ave. current:291mA/58mA | 3 channels<br>Digital analog<br>Open/closed loop<br>Ave. current:70mA | 1 channel<br>Digital analog<br>Open/closed loop<br>Ave. current:60mA |
| Note: Please see "Piezo Controller" for detailed information. | | |

# AP Piezo Amplified Actuator



AP piezoelectric displacement actuator, which adopts advanced flexure mechanism and high performance electric ceramic stack, can provide a very large range of motion, fast response. Its resolution can reach the sub-nanometer level. The double-hinge flexure mechanism has higher rigidity, mechanical efficiency and resonance frequency. The double hinge flexure design also makes the size more compact. The product parameters can be customized. The applications of AP piezoelectric displacement actuators include nanopositioning, biomedicine, microscope, precision machining, vibration control, high-speed valve, optics, etc.

## ▶ Technical Data

| Type | Max./stroke [μm]±20% | Blocking force[N] | Unloaded resonant frequency[Hz]±20% | Stiffness [N/μm]±20% | El. capacitance [nF]±20% |
|---|---|---|---|---|---|
| AP120 | >120/110 | 11 | 900 | 0.10 | 400 |
| AP350B | >350/320 | 6 | 400 | 0.019 | 900 |
| AP340 | >340/310 | 16 | 460 | 0.052 | 780 |
| AP350 | >350/320 | 18 | 480 | 0.057 | 900 |
| AP830 | >830/750 | 90 | 230 | 0.12 | 8300 |

Note: The maximum stroke is under -15V~150V, and the nominal stroke is under 0~150V. When used to drive the spring, the displacement range is reduced to $K_a/(K_a+K_L)$, where $K_a$ is stiffness of the piezoelectric ceramic and $K_L$ is that of load.

## ▶ Drive Current Calculation

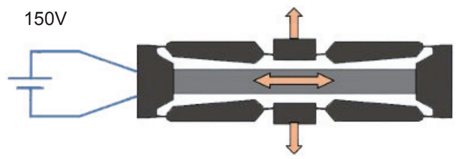
The required current I=CdV/dt, where I is the current, C is the effective capacitance, dV/dt is the change in voltage. For a sine wave, the required peak current $I_p=\pi fCV_{p\text{-}p}$ Where $V_{p\text{-}p}$ is the peak voltage. When using triangular wave drive, the required peak current is $I_p=2CfV_{p\text{-}p}$.

## ▶ Capacitance

The capacitance of the actuator is measured at small signal and room temperature. Due to the hysteresis, the effective capacitance increases with the applied voltage. When working at full amplitude, the effective capacitance is approximately twice that of the small-signal capacitance. The capacitance also increases with increasing temperature, and a temperature increase of about 50°C will double the effective capacitance.

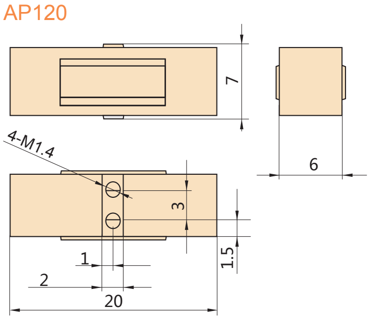
## ▶ Installation and Movement Direction

You can mount AP piezo amplified actuators by threaded hole in a single-ended or non-fixed configuration. When power is applied, proportional expansion occurs in the vertical direction, as shown below.

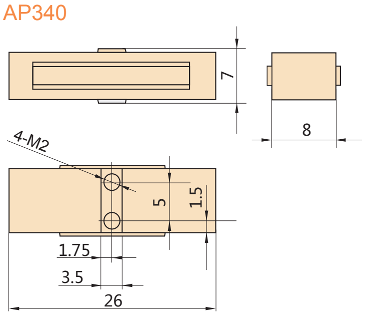



## ▶ Drawings

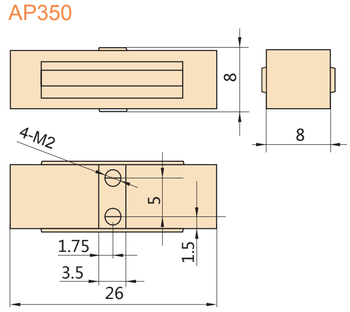
AP120



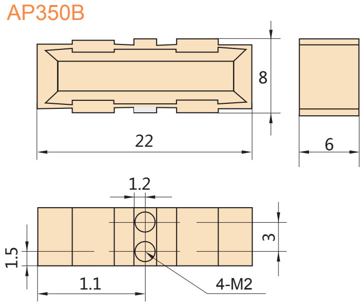

AP340



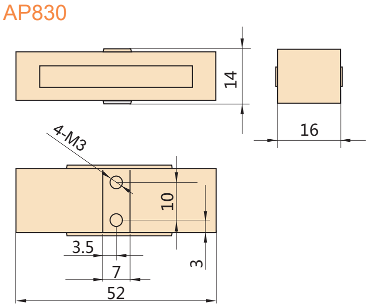

AP350




AP350B




AP830



# NAC Piezo Amplified Actuators

NAC piezo amplified actuators are very suitable for systems that require lighter actuators with temperature stability and high resonance frequencies. The unique structure makes the actuator more compact.

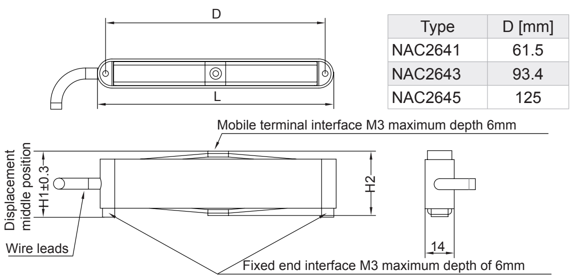
## Characteristics

- High resonance frequency and thus large operating bandwidth
- Light weight, optimized rigidity
- Temperature stability

## Temperature Stability

Generally, when the temperature changes, the different thermal expansion between the ceramic and the material of the structural component will result in a change in the force distribution. This will result in a change in internal preload. However, the NAC piezo amplified actuators will not cause changes in output displacement due to changes in temperature.

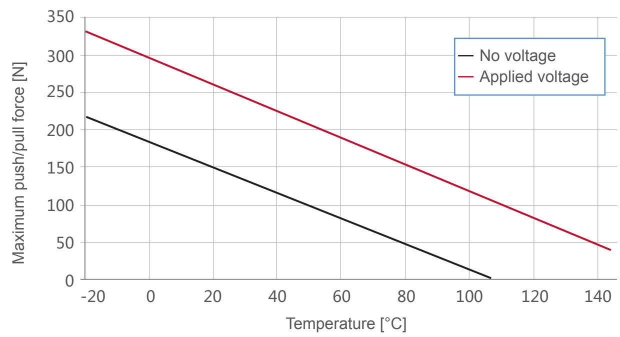
## Drawing




| Type | D [mm] |
|---|---|
| NAC2641 | 61.5 |
| NAC2643 | 93.4 |
| NAC2645 | 125 |

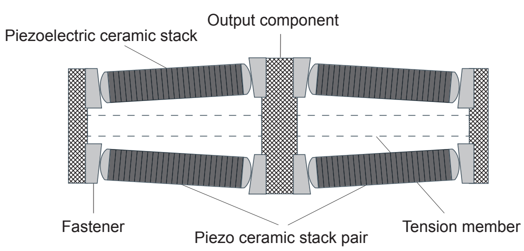
Note: Because H2>H1 of NAC2645, the middle position of the lower end must be suspended during installation, otherwise the displacement output will be blocked.

## Load Capacity Curve




## Principle

NAC piezo amplified actuators are based on four piezo stacks, in pairs connection. Each piezo stack is hinged at its end at a small angle. When the voltage applied to one pair of piezo stacks increases, the other pair voltage on the piezo stack decreases. This facilitates the movement of the output member in one direction. Be aware that in the case of free displacement, the tension in the piezo stack and the tension member remain almost constant. This means that the strain is directly derived from the piezo stack to the output. In addition, the structure will not withstand high bending forces, because it is not easy to fatigue.

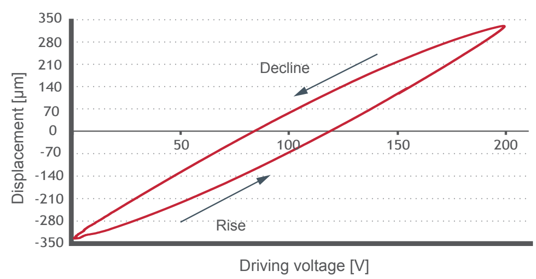



Warning: Avoid putting extra pressure on the actuator, for example:

- Push/pull and bend between two points of the fixed interface
- Lateral force and bend on the moving surface

## Stroke vs Voltage

NAC2643




## Technical Data

| Type | NAC2641 | NAC2643 | NAC2645 | Unit |
|---|---|---|---|---|
| Wide W×Leight L | 14×70.5 | 14×102.4 | 14×134.2 | mm±0.1 |
| Height H1/H2 | 26.1/24.2 | 28/24.2 | 29.5/30.6 | mm±0.3 |
| Operating voltage | 200 | 200 | 200 | V |
| Displacement | ±150 | ±312.5 | ±475 | μm±15% |
| Stiffness(in the middle position, up to 250N) | 1.3 | 0.9 | 0.7 | N/μm±15% |
| Blocking force | 250 | 250 | 250 | N |
| Mass (mechanism + lead) | 84+60 | 122+60 | 160+60 | g±10% |
| Unloaded resonant frequency | 1700 | 1100 | 850 | Hz |
| El. capacitance | 2×3.6 | 2×6.5 | 2×10 | μF±15% |
| Operating temperature | -20~+150 | -20~+150 | -20~+150 | °C |

Note: Specified for room temperature and static operating.

Challenge the Limits of Nano Motion and Control Technology...

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