

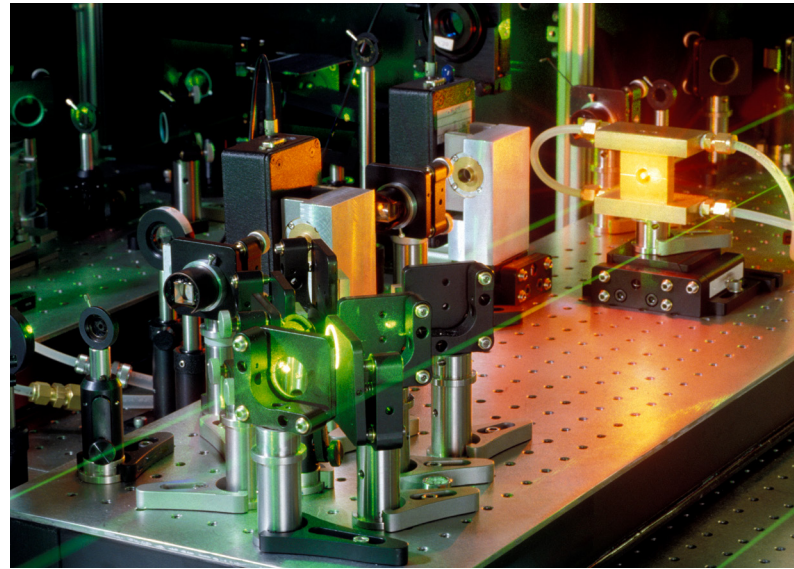
# Actuators for Micropositioning

## Linear Actuators for Micropositioning

Long-range micropositioners can move quickly over an extended area (ex: 20mm), as well as at a fine resolution in the sub-micron range. This cost-effective method of micropositioning can be used for both R&D and industrial purposes. Positioning devices have various applications, such as microfabrication and optics, when the smoothness of a flexure-guided table is not required. Both linear and rotary positioners are typically available, and can be combined in systems with two or more degrees of motion.

### HOW IT WORKS

Long-range micropositioning relies on motors. The piezoelectric actuator is activated several times, with each successive displacement building up to generate a large motion. This stage can be driven by various types of motors, such as stick slip, standing wave, or legged.



Piezo micropositioning stages are used extensively to precisely align optical elements in a laser system.

The stick-slip motor is most commonly used, which places the piezoelectric actuator in frictional contact with a movable table or stage. When gradually increasing voltage is applied, the actuator expands, pushing the table forward (stick). The voltage is then lowered rapidly, making the piezo contract. Due to the inertia of the table and acceleration of the actuator, the contact slides (slip). This results in little to no displacement of the table. When the process is repeated, the table can be moved over longer distances. It is also possible to adjust the voltage on the actuator in DC to fine-tune the position within a step, achieving nanometer resolution.

### WHICH PIEZO ELEMENTS CAN BE USED FOR MOTORIZED STAGES?

The design of the piezo element varies greatly depending on the motor technology employed. For direct-acting stick slip motors, a step size of only a few microns is common. This can be achieved in a cost-effective manner by using a single multilayer actuator, such as our NAC2002.

### CTS Linear Actuator - Plate Actuator

CTS tape cast multilayer piezoelectric linear actuators provide the precise and fast movement required for motorized stages. CTS plate actuators feature high linear displacement at very low operating voltages. The table below lists some relevant performance parameters for three products picked up from our standard range of plate actuators, that are typically applied in stick-slip motors.

Features of multilayer plate actuators:

Standard part reference	NAC2001	NAC2002	NAC2003
Cross-section	2mm *2mm	3mm *3mm	5mm *5mm
Height	2mm		
Large signal stiffness	56N/ $\mu$ m	126N/ $\mu$ m	350N/ $\mu$ m
Small signal capacitance	150nF	400nF	1080nF
Nominal operating voltage	60V		
Nominal free displacement	3 $\mu$ m		

## ACTUATORS FOR MICROPOSITIONING

- Displacement up to 3.3 $\mu$ m
- Very low operating voltages (down to 60V)
- Very high force generation
- High stiffness for short response times (<1ms)
- Non-magnetic
- Ultra-high vacuum compatible



Depending on the motor technology used and performance requirements, some systems may use stacks. Higher displacements can be achieved by stacking several multilayer plate actuators, resulting in longer step size and higher performance, particularly at low temperatures.

## CTS CUSTOM CAPABILITIES

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Each company that CTS partners with has unique needs that require custom solutions. Our internal team of engineers and subject matter experts work directly with customers, designing solutions that meet demanding specifications. Typical customization opportunities for multilayer actuators in micropositioning applications are:

- Operating voltage. By adjusting the thickness and number of active ceramic layers, the nominal operating voltage of the actuator can be customized between 45V and 200V in order to match the voltage and current capabilities of existing drive electronics.
- Narrow height tolerance. A tighter tolerance allows for better control of the assembly process and of the mechanical preload in a compact system.
- Chamfering. Chamfering facilitates the integration of the actuator and, by limiting the extent of the surface electrodes, helps prevent short-circuits when mounting the actuator against conductive metallic surfaces in a tight enclosure.
- UHV preparation. For use in ultra-high vacuum (UHV) applications.

Custom design inquiries can be discussed with our team.

## ABOUT CTS

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CTS is a leading designer and manufacturer of products that Sense, Connect, and Move. We manufacture sensors, actuators, and electronic components in North America, Europe, and Asia, and provide solutions to OEMs in the in the aerospace & defense, medical, industrial, communications, information technology, and transportation industries.

## PIEZOELECTRIC EXPERTISE

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A leading developer and manufacturer of high-performance piezoelectric materials and components, CTS' piezo products come in a variety of compositions, geometries, and dimensions with high quality standards to meet demanding requirements. Our portfolio encompasses bulk and multilayer ceramics, single crystal, as well as sub-assemblies, composites, and transducers based on these products.

## CONTACT INFORMATION

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