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Piezo Actuators - Mounting and Handling Guidelines

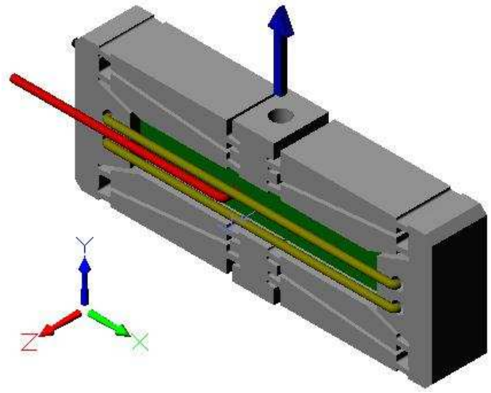
Improper use includes the following but is not limited to applications such as the following :

- DO NOT: introduce static compressive loads exceeding an actuator's blocked force rating
- DO NOT: drive the actuator in a way that creates impacts between the actuator and other rigid surfaces. Avoid dropping the actuator.
- DO NOT: cycle the actuator beyond 80% of the first natural frequency of the mass loaded condition
- DO NOT: introduce loading conditions that create bending moments in the actuator's frame
- DO NOT: introduce lateral or transverse loading of the actuator's output pad or mounting point that exceeds 5% of the actuator's force rating
- DO NOT: drive an actuator with a step input or square wave. (If rapid response is required, DSM recommends using a half-sinusoidal transition with frequency not exceeding 50% of the actuators first natural frequency of the loaded condition.)
- Accidental, extreme voltage changes may damage the piezo material within the actuator. Extreme voltage changes may occur if a plug power plug is pulled or a piezo amplifier overvoltages or undervoltages the actuator. DSM recommends using only DSM piezo amplifiers with DSM piezo actuators.
- DO NOT: introduce tensile loading into actuator frame. Prying or twisting of the actuator frame may damage the mechanism.
- DO NOT: allow the piezo within the actuator to come in contact with water. All water and alcohol liquid must be removed prior to operation. Humidity levels must be reduced to the level recommended in section 11. Note that isopropyl alcohol may have high levels of water and should not come in contact with the actuator.

Proper Uses

Amplified piezoelectric actuators may be loaded only through their output plates in the direction co-axial with the output displacement. All loading must be applied uniformly and axially through the mechanism. The applied forces must be centered very well on the mounting face.

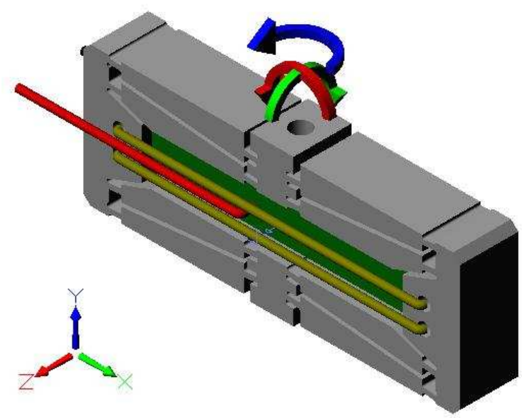
Tilting and shearing loads must be avoided or else they will damage the actuator. Lateral or transverse loads and bending loads may cause damage to the actuator ceramics and frame. Lack of parallelism between mounting faces can be a principal cause of actuator failure. This type of failure can be prevented by using ball tips, flexible tips, adequate guiding mechanisms etc.



Appropriate loading direction for an FPA

This limitation applies to both static and dynamic loading and any combination of the two. Care should be applied to verify that any dynamic loading (operating at high frequency with an attached mass) does not exceed the recommended load.

The flat output surfaces of the actuator should be mounted to a precision flat and smooth-ground, non-rotating surface. The FPA actuator should not be expected to carry moments and transverse forces. Supplemental guidance like bearings or flexures should be used if loads greater than 5% of the product of the actuator stiffness and stroke must be supported.



Avoid Applied or Reaction Moments to the Output of the FPA Piezoelectric Actuator

X-axis, Y-axis, and Z-axis moments if applied to the output plate of the FPA can cause damage to the guiding

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actuator flexures. Mis-alignments between the mounting surface and the moving surface can lead to failures during mounting and electrical operation of the actuator. If a moment remains on the mounting surface when the actuator is energized, the moment applies an additive stress to the actuator flexures and the piezoceramic. The additional mounting stress can cause the stress in the actuator flexures to exceed the design stress.

Use of a plain-faced mounting to the plain face of the actuator should only be attempted if a proper application analysis verifies that the X-axis and Z-axis moment loads are minimal. Otherwise, use a spherical coupling or flexure hinges to decouple the moment loads from the actuator. Consider having DSM analyze your mounting and loading conditions if you have questions about your application.

Mounting Recommendations

1. When attaching the actuator to a mounting surface, use a clamp or wrench to support the actuator output block while leaving the opposite end of the actuator free to prevent the Y-axis twisting moment from damaging the actuator.
2. Use a spherical coupling or flexure coupling to prevent X-axis and Z-axis moments from damaging the actuator during electrical operation or actuator motion.
3. Apply a linear guidance bearing to the moving output to carry any moment loads that may be present and to prevent them from damaging the actuator.
4. If using adhesive to mount actuators, use ground surfaces. During curing, do not exceed the operational temperature range of the actuator.
5. The environment of all actuators should be as dry as possible. The combination of high electric DC fields and high relative humidity values should be avoided with all piezoelectric actuators.
6. Because the piezoelectric ceramics in the actuator can develop a charge when handled and under temperature loading, it is important to keep the actuator leads short circuited during mounting and handling.
7. Piezo actuators are sensitive to moisture, high relative humidity, liquids and contact with any other electrically conductive materials. Avoid operating actuators under these environmental conditions since they can cause dielectric breakdown.

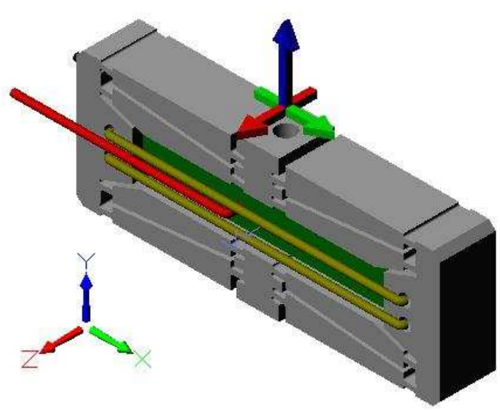
Actuator Force Output and Available Stroke

The magnitude of the applied load should not exceed the "blocked force" rating of the actuator. The blocked force rating is a product of the stroke and the stiffness of the actuator.

Example:

DSM's FPA-0100E-S-0518-150-SS has a rated stiffness of 1.8 N/micron and a rated displacement of 100 microns over the standard –30 to +150V range. Therefore, the maximum recommended load (block force) is 180 N for this model.

DSM defines a piezo actuator's "blocked force" as being that force which is required to compress/extend a fully extended/contracted actuator back to its zero position. In most cases, DSM designs the actuator's flexures such that the blocked force corresponds to the flexures' maximum design stress. Even under a static load equal to an actuator's blocked force, the actuator will be able to move through its full range of motion and will respond rapidly to changes in the applied voltage field. The static load simply shifts the actuator's static position. An analogous situation is to think of the piezo actuator as a spring that has a static load placed upon it. The static load compresses the spring (piezo) to a new static position. Subsequent changes in temperature (voltage) cause the spring (piezo) to change dimensions.



Sample FPA Piezoelectric Actuator with Transverse Mounting Loads (Orange and Green) to Avoid