

Improving Piezo based Stages/Actuators Lifetime and Reliability

The Following Tech Note is a collection of tips and best practices when working with ASI's Piezos to maximize their lifetime and reliability.

Piezo ON Time and Life

Most Piezo manufactures spec there Piezo Life in Hours at Maximum Rated Voltage. In usage ASI Piezo rarely go up to the maximum rated voltage, however hours spent at any voltage will decrease the Piezo life.

Applying extreme and/or static voltages to the piezo actuators for long periods can pre-maturely degrade performance and ultimately can lead to actuator failure, particularly in humid environments.¹⁾

To maximize piezo lifetime they should to be turned off when not in use, or else apply only a small voltage across them.

Auto Sleep Timer

In MS2000/RM2000 controllers starting with firmware version **9.2g**, and TG-1000 controller starting with firmware version **3.10**, an Auto Sleep timer has been added to the Piezo Firmware module. After a user-specified time without any input, the controller will automatically drop the voltage applied to the piezo to 20% of the rated voltage, and it will automatically wake again and return to the pre-sleep position as soon as the user interacts with it.

In more detail: Every time the piezo is moved (via joystick/wheel, serial command, or TTL) the sleep timer is reset to zero. Whenever the sleep timer reaches the set amount (e.g. 5 minutes) the piezo is moved to a "sleep position" where a safe voltage (20% of travel) is being applied. The next time the piezo is moved it "wakes up" by moving to the previous position first. Because the move to the sleep position occurs without direct user intervention you don't want that happening in the middle of imaging. Most often you are moving the piezo during imaging anyway and it's not a problem. If you are doing imaging with the piezo stationary for long periods you can periodically request a relative move of 0 microns (this resets the sleep timer without moving the piezo), and then when imaging finishes you stop sending the 0 relative move and the piezo will fall asleep after the configured delay.

By Default this timer is disabled except for SPIM-specific firmware. Users can set the time in minutes thru the [PZ F command](#).

The auto-sleep function only works in internal input mode. In external input mode, 2 volts is a good input voltage to use when the piezos are resting for long periods.

[piezo, tech note](#)

¹⁾

The piezo actuator is a stack of thin dielectric layers of piezoceramic material with alternating

electrodes across which a voltage is applied (generally -20V to 120V). The main failure mechanism is electromigration of the electrode material through the piezoceramic leading to shorts. Electromigration is proportional to at least the square of the applied voltage and worsens with humidity. It is believed that fixed voltages are worse because self-heating during movement prevents the build-up of moisture. See also CeramTec's Monolithic Multilayer Actuators Brochure, Page 9 https://www.ceramtec.com/files/mf_brochure-mma.pdf

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