

Piezo-Based Long-Travel Actuators for Special Environments

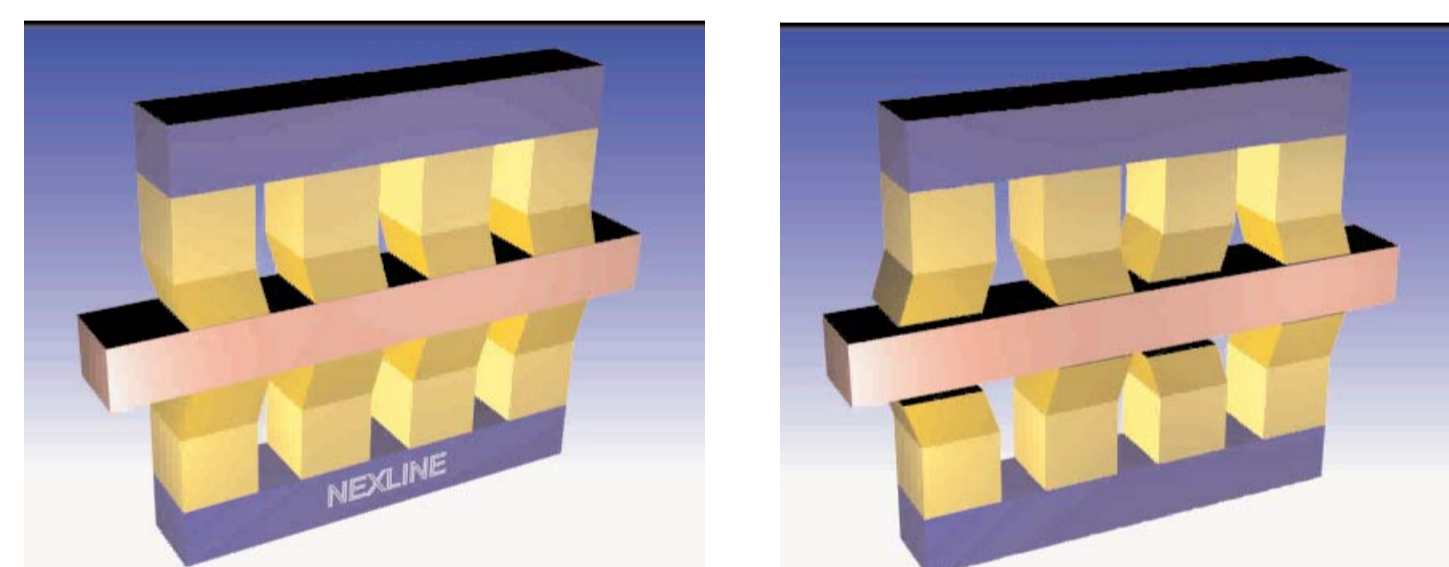
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PiezoWalk® precision drives are based on piezo actuators that generate motion through sequenced clamping, unclamping and shear motion. These linear, piezo stepping drives break the barriers of conventional nanopositioning actuators. They provide basically unlimited travel combined with picometer open-loop resolution and very high stiffness. Two PI product lines, NEXLINE® and NEXACT®, use different versions of the PiezoWalk® principle offering specific advantages.



PiezoWalk® Principle and Specifications

The actuator consists of four parts: two piezo modules, a mechanical housing with integrated mechanical preload force and a movable part as mechanical interface. Each piezo module consists of a base plate and a minimum of two stacks. These stacks are a combination of a longitudinal actuator acting perpendicular to the moving direction as clamp units and shear piezo layers acting parallel to the moving direction as drive units. The first basic logic function is the stepping mode. A step is realized by the stacks having alternating contact to the movable part. During the contact the shear piezos will be expanded to drive the movable part.

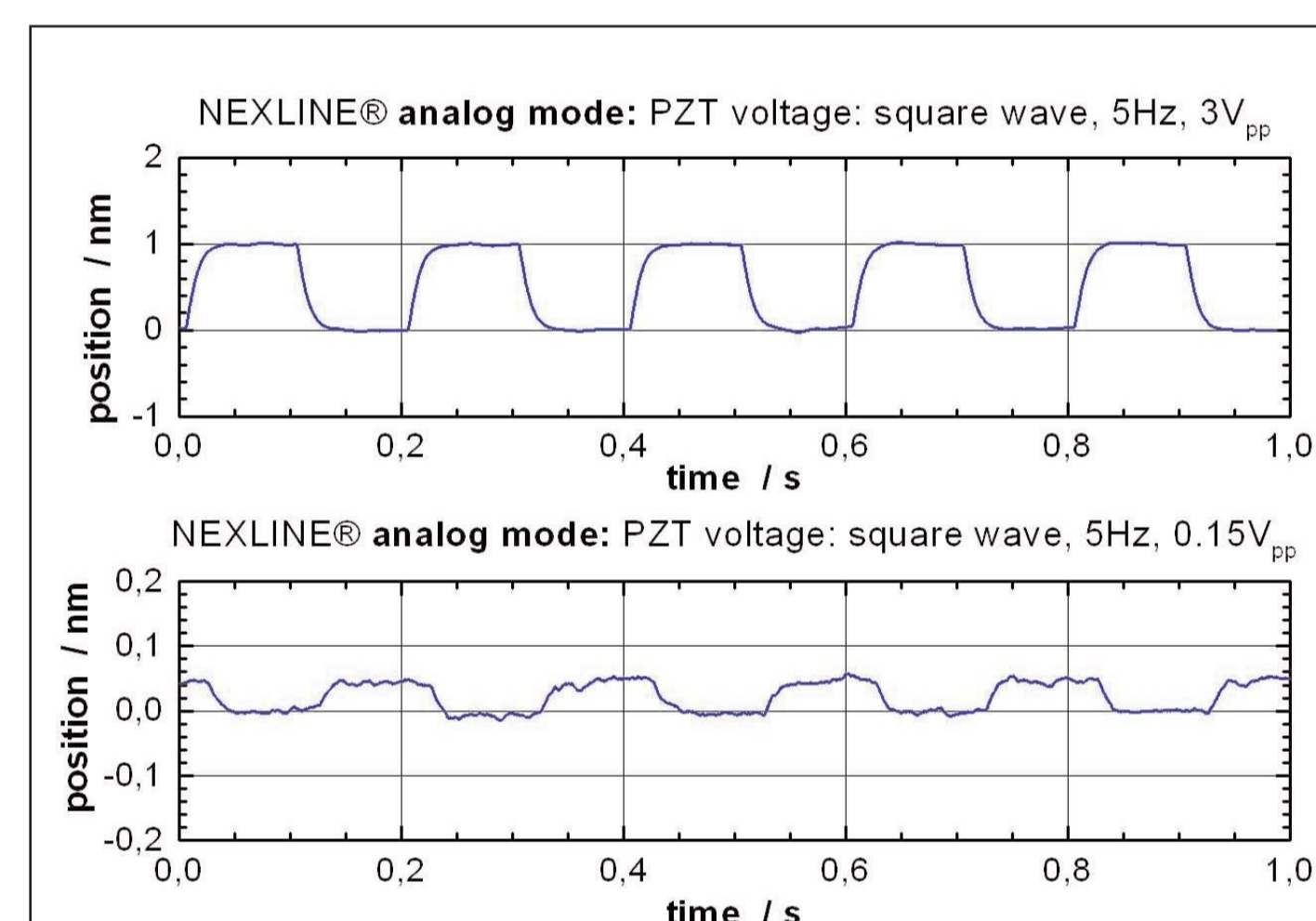


NEXLINE® analog mode for high dynamics over a shorter range

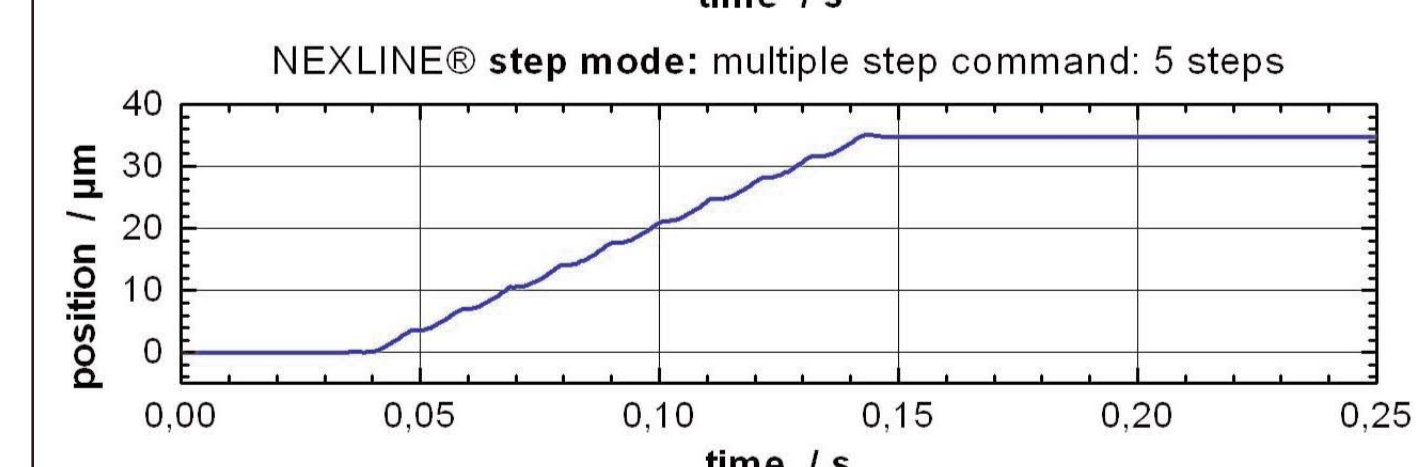
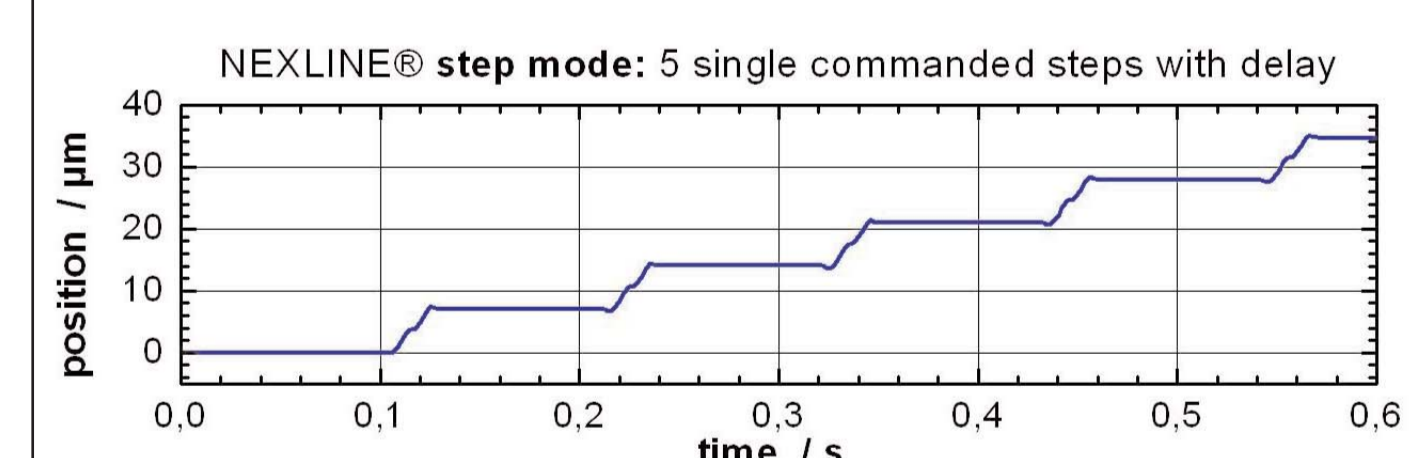
NEXLINE® step mode for long travel

Two different technologies offer specific advantages: The NEXLINE® technology is based on high-voltage ceramics. The drives using this technology provide high pushing and holding forces of up to 600 N with maximum velocities of up to 2 mm/s combined with high stiffness and resonant frequencies of hundreds of hertz. The NEXACT® technology is based on low-voltage piezo modules to enable operation at less than 50 V. The drives provide push/pull forces to 15 N with maximum velocities of more than 10 mm/s.

PiezoWalk® Performance

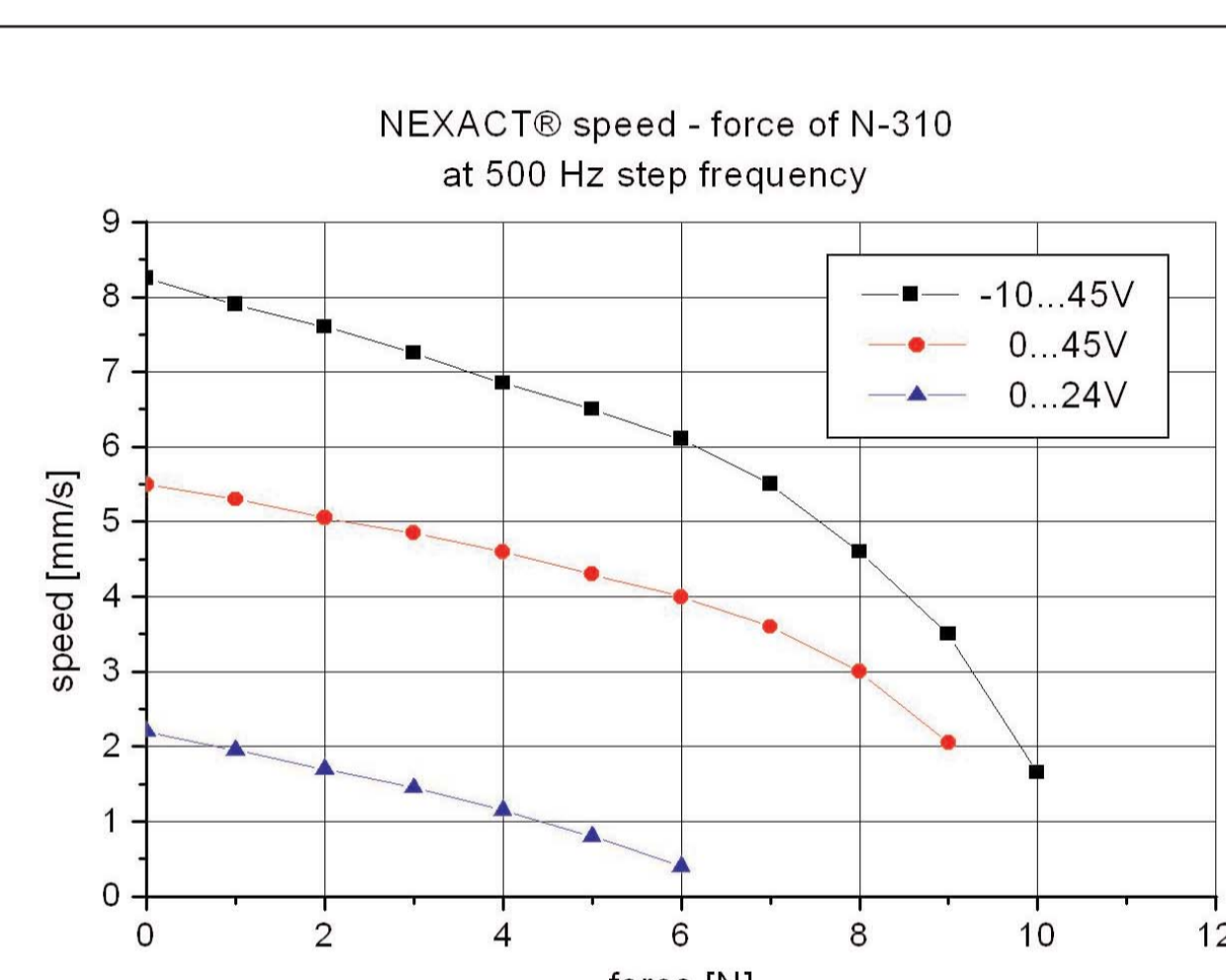


NEXLINE® analog (shear) mode provides picometer position resolution



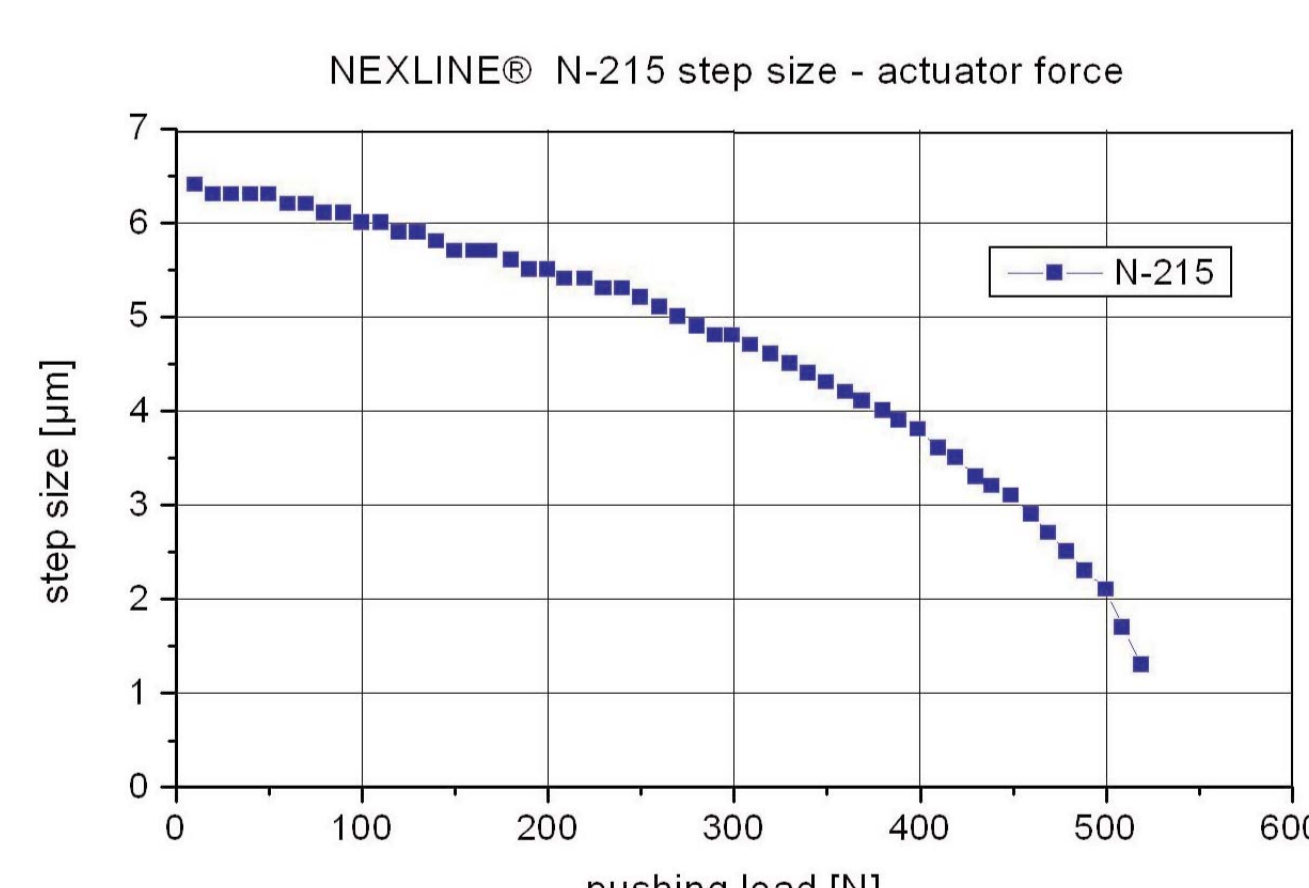
Characteristic NEXLINE® motion behavior in stepping mode. Step size ranges from 10 nm to 10 µm

PiezoWalk® Motor Characteristics



Relation between the NEXACT® speed and force generation (normal driving voltage is -10 to 45 V)

The holding force is significantly higher than the pushing force (factor 1.5 to 2).



Relation between step size and generated force for a N-215 NEXLINE® actuator

Use in Special Environments

PiezoWalk® drives can be designed to work under difficult environmental conditions. The following modifications can be made to meet the requirements:

Space-Based Applications

- Fully integrated cold redundant actuator design for maximum lifetime with no maintenance. The piezo modules consist of two independent clamp and shear segments. The actuator motion characteristics are identical for both driving units in regard to step size and force
- Specially adapted drive design to withstand the vibration during launch

Ultra-High Vacuum

- Specially adapted piezo actuator design
- Vacuum-compatible polymers: PEEM, Kapton
- Electro-polished metals

High Magnetic Fields

- Optimized piezoceramics for <10 nT residual magnetism after exposure
- Fully non-magnetic/non-magnetizable design
- Ceramic joints for multi-axis stages

Cryogenic Temperatures

- Specially adapted piezo drive design
- Compatible casing material

Alternate Atmospheres (e.g. He)

- Specially adapted piezo actuator design
- Electric circuitry designed for reduced sparking voltage

Radiation

- Compatible casing material
- Capacitive sensors

Advantages of PiezoWalk® Stepping Drives

- Open-Loop Resolution in the Picometer Range
- Closed-Loop Applications with High-Resolution Incremental and Capacitive Sensor
- Very Compact Dimensions
- High Drive Forces, from 10 N (NEXACT®) up to 600 N (NEXLINE®)
- High-Dynamics Performance with Sub-Millisecond Response
- Self-Locking at Rest: No Holding Current for Position Stability in the Nanometer Range
- Basically Unlimited Travel
- Zero Backlash: No Mechanical Components Like Gears/Leadscrews, No Wear or Maintenance
- Non-Magnetic and Vacuum-Compatible Operating Principle
- Integration in Multi-Axis Systems

