

**INSTALLATION AND OPERATION MANUAL**  
**Z-STAGE NANOPositionER**



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## **IMPORTANT SAFETY INFORMATION**

The high voltage drivers can produce hazardous voltages and currents. Use caution when operating the drivers and when handling the linear actuators. Piezoactuators have large capacitance and are capable of storing hazardous amounts of electrical energy over long periods of time. Various conditions such as load and temperature changes can also cause piezoactuators to accumulate charge.

Before disconnecting the DB-9 connector from the PIEZOCONCEPT controller, first set the command voltage to 0.0V, then turn the AC power to the PIEZOCONCEPT controller off, and finally wait one minute before disconnecting.

The Z-STAGE has no user serviceable parts. Only trained service personnel should perform service.

### **IMPORTANT**

All Technical Information, recommendations, and examples related to PIEZOCONCEPT Products made in this manual are based on information believed to be correct. The purchaser or user should determine the suitability of each product before using. The purchaser or user assumes all risks and liability whatsoever in connection with the use of any and all PIEZOCONCEPT products or services.

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## 1 INTRODUCTION

The Z-STAGE is PZT actuated linear nanopositioner of exceptional resolution and stability. It comes complete with a position sensitive detector for closed loop operation, with either 5, 10, 30 or 50 $\mu$ m travel range.

TRANSLATION ( $\mu$ m) (X)	5, 10, 30 or 50 $\mu$ m
VOLTAGE RANGE (V)	-5V to +150V
RESONANT FREQUENCY	12500/5500/5500/3500 (Hz)
STIFFNESS (N/ $\mu$ m)	40,1/7,7/7,7/2,7 (N/ $\mu$ m)
MAXIMUM LOAD (hor/vert) (kg)	0,01/0,1
CABLE LENGTH (m)	>1.5m
CABLE CONNECTION	DB-9

### 1.1 Unpacking the Z-STAGE

Before unpacking the Z-STAGE, read this entire operation manual, paying special attention to the following section on “**Handling the Z-STAGE**”. Check the contents of the package against the shipping list and notify PIEZOCONCEPT immediately if any items are missing.

### 1.2 Handling the Z-STAGE

The Z-STAGE is a high precision scientific instrument and therefore requires special handling in order to ensure proper operation. Mishandling can cause permanent damage to the nanopositioning stage. To ensure a long and useful life the following guidelines should be strictly followed.

- **Never insert anything into the EDM grooves.** The EDM grooves are the cuts that form the flexure hinges and separate the moving portion of the stage from the stage frame. Severe damage may result if objects are inserted into these grooves.
- Do not move the translation stage by pushing on it with your hands or any other object.
- Avoid applying a torque between the moving stage and the frame.
- Do not drop, treat roughly, or physically shock the Nanopositioning stage.
- Do not lift by the cable.

- The surface to which the Z-STAGE is mounted to should be flat and clean. Likewise, the bottom of the Z-STAGE should be free of particles and dust before mounting.
- Do not immerse in any liquid. If the Z-STAGE requires cleaning slightly dampen a lint free cloth with iso-propanol or ethanol and lightly wipe the surface. Do not get any liquid or lint into the EDM grooves.
- Never disassemble the nanopositioning stage, there are no serviceable parts inside.

## **1.3 Z-STAGE**

The Z-STAGE is manufactured from a high performance Al 7075 alloy. The piezoactuator is preloaded within the Z-STAGE and supply the driving force for stage movement. The flexure hinges, which form the guidance mechanism, are cut into the stage using electric discharge machining (EDM). There are no serviceable parts in the Z-STAGE stage.

The Z-axis moves upwards when a positive voltage is applied. One DB-9 connectors is supplied with the Z-STAGE.

## **2 INSTALLATION**

The Z-STAGE may be installed either vertically or horizontally. When installed vertically the moving portion of the actuator should be oriented upward. Larger load may be carried when mounted in the vertical direction.

It is always advisable to minimize the load carried by the Z-STAGE. Heavier loads reduce the response time and may cause fatigue and /or reduced motion.

The Z-STAGE should only be subjected to axial forces, non axial forces such as tilting or shear forces, may damage the PZT material inside.

When a free object is mounted vertically, it is best for the moving portion of the actuator to be on top. If the moving part must be located downwards, keep the mass of the load less than 100g.

Object of less than 50g can be horizontally translated with the Z-stage.

Regardless of how you choose to install the Z-STAGE :

- a) Make sure the surface to be mounted to is clean, flat, and free of burs.
- b) Using a lint free cloth, gently wipe off the bottom of the Z-STAGE to remove any particles or dust.

- c) Always lift the Z-STAGE by the bottom stage.
- d) Never lift, position, assemble, or disassemble the Z-STAGE with power applied.
- e) **IMPORTANT!** Check for ground loops (**Section 3**) between the Z-STAGE and the mounting surface.

The Z-STAGE has 4 holes for M3 screws at the bottom and an external M27 thread. When securing the Z-STAGE the mounting surface must be flat and the mounting surface and bottom of the Z-STAGE must be clean. Use a maximum torque of 0.5 Nm when securing the Z-STAGE.

### **3 PREVENTION AND IDENTIFICATION OF GROUND LOOPS**

The single greatest danger to your nanopositioning system is a ground loop between the stage and the mounting surface. Ground loops can be the source of noise in the Z-STAGE, and in some cases the oscillations may be severe enough to permanently damage the piezoactuators.

Ground loops may sometimes be detected by a DVM and can usually be detected by using the differential mode of a dual channel oscilloscope.

Prevention of ground loops can be achieved in two ways. An effective and simple method is to insulate the stage from the mounting surface (e.g. mylar or paper between the stage and the mounting surface combined with non-conductive mounting screws). The second method is to connect the PIEZOCONCEPT's controller ground to the mounting surface. The stage is connected directly to the ground of the PIEZOCONCEPT's controller, which in turn is connected to the ground of the AC power cord. The PIEZOCONCEPT's controller enclosure is also at ground potential. Attaching a grounding wire between any of the PIEZOCONCEPT's controller enclosure screws and the mounting surface may short-circuit the ground loop. In a few cases, this may not be an effective method. When this occurs, please identify high current sources returning to ground through your mounting surface. Mounting surfaces should never be used as the electrical ground current path for any instrumentation (such as vacuum pumps, computers, etc.).

Should you observe unexpected oscillations in your nanopositioning stage after you have switched on the power, this likely indicates the continued presence of a ground loop or excessive sample mass (see Section 2). **SWITCH THE SYSTEM OFF IMMEDIATELY AND SEARCH FOR THE SOURCE OF THE GROUND LOOP. SHOULD THE PROBLEMS CONTINUE PLEASE CONTACT PIEZOCONCEPT FOR TECHNICAL ASSISTANCE.**

### **4 OPERATING THE NANOPositionING STAGE**

The Z-STAGE comes complete with a position sensitive detector for closed loop operation. In closed loop operation, achieved using the PIEZOCONCEPT's controller,

the effects of creep and hysteresis are removed and the position is held constant at the command position.

## 4.1 Operating in closed loop mode

The Z-STAGE comes with a 9 pin D-type connector and uses the PIEZOCONCEPT's controller for complete positioning control. To operate in closed loop mode use the following procedure.

1. Install the Z-STAGE as discussed in **Section 1**.
2. Turn the PIEZOCONCEPT's controller power off.
3. Set the command signal to 0.0 Volts either on the analog interface or the digital interface.
4. Connect the 9 pin D-type connector to the PIEZOCONCEPT's controller, secure the two screws.
5. Turn the power switch on.
6. The command voltage now controls the position of the nanopositioning stage.

Never disconnect the 9-Pin connector with the power on. Always set the command voltage to zero and turn the power off before disconnecting. Allow 1 minute for the PZT actuators to discharge before disconnecting.

## 4.2 Care during operation

The Z-STAGE is a high precision scientific instrument and should be handled with care during operation. Failure to do so may result in permanent damage.

During operation ensure that there are no physical constraints on the moving stage or anything fixtured to the moving stage.

Never apply a voltage greater than 150V or less than -5V to the PZT.

Maintain a clean working environment to reduce the chance of particles or other substances from gathering in the EDM grooves.