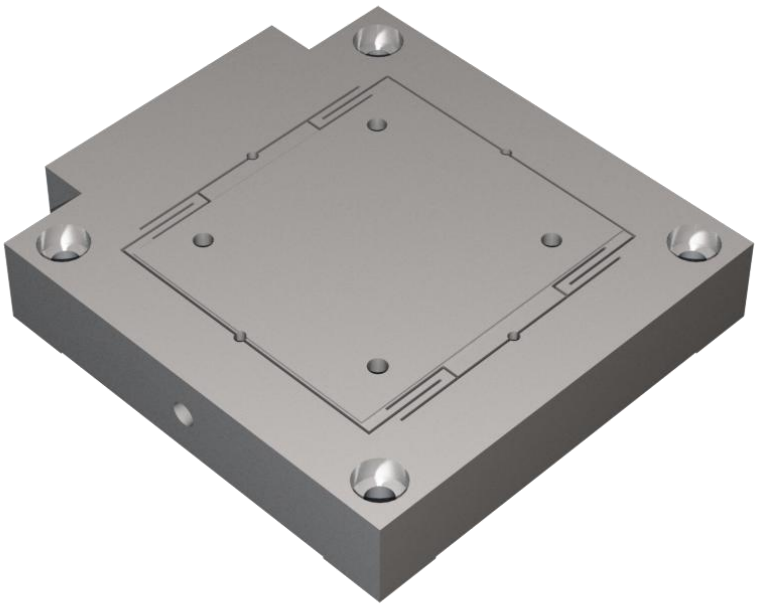
INSTALLATION AND OPERATION MANUAL

HS1 WITH NO APERTURE



PIEZOCONCEPT
15 Rue du Bocage
69008 LYON
France

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 HS1 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.

CONTENTS

1 INTRODUCTION

The HS1 is a PZT actuated linear nanopositioning stage of exceptional resolution and stability. Two HS1's can be stacked to form a high performance XY or XYZ nanopositioning system. The HS1 comes complete with a position sensitive detector for closed loop operation.

TRANSLATION (µm) (X)	30, 50 or 70µm
VOLTAGE RANGE (V)	-15V to +150V
RESONANT FREQUENCY UNLOADED (Hz)	4000±20%
STIFFNESS (N/µm)	3.0±20%
MAXIMUM LOAD (hor/vert) (kg)	1/0.5
CABLE LENGTH (m)	>1.5m
CABLE CONNECTION	DB-9

1.1 Unpacking the HS1

Before unpacking the HS1 read this entire operation manual, paying special attention to the following section on **"Handling the HS1"**. Check the contents of the package against the shipping list and notify PIEZOCONCEPT immediately if any items are missing.

1.2 Handling the HS1.

The HS1 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
- 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 HS1 is mounted to should be flat and clean. Likewise, the bottom of the HS1 should be free of particles and dust before mounting.
- Do not immerse in any liquid. If the HS1 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 HS1.

The HS1 is manufactured from a high performance Aluminium 7075 alloy. PZT actuators are preloaded within the HS1 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). The PZT actuators are oriented parallel to the stage motion direction. There are no serviceable parts in the HS1 stage.

A stage direction arrow is located on the side of the stage. This arrow indicates which direction the stage moves when a positive voltage is applied. For XY or XYZ systems, an identification label of either X (CHANNEL 1) or Y (CHANNEL 2) or Z (CHANNEL 3) is located near the direction arrow. This identification, X, Y or Z, describes which driver axis that particular stage should be connected to.

2 INSTALLATION

The HS1 may be installed either vertically or horizontally. When installed vertically the stage direction arrow should be pointing upward. Larger loads may be carried when mounted in the horizontal direction. It is always advisable to minimize the load carried by the Nanopositioning stage. Heavier loads reduce the stage response time and may cause fatigue and /or reduced motion.

2.1 Installing a single axis HS1 unit.

To install a single axis HS1 use the following steps.

- On the surface that the HS1 is to be mounted on, tap M3 holes on a 52,50X52,50mm square.
- Make sure the surface to be mounted to is clean, flat, and free of burs.
- Using a lint free cloth, gently wipe off the bottom of the HS1 to remove any particles or dust.
- Use M3 Socket screws to secure the stage. Use a maximum torque of 0.5 Nm. Attempt to minimize the torque between the moving and fixed part of the stage during tightening.

IMPORTANT! Check for ground loops (**Section 3**) between the HS1 and the mounting surface.

Items can be attached to the scanning stage using one or more of the M2.5 holes that are tapped on the moving part of the stage. These M2.5 holes are on a 29mm square. To attach an item to the scanning stage, use the following procedure.

- Using a lint free cloth, gently wipe off the top of the HS1 to remove any particles or dust.
- Make sure the item to be attached is flat and free of particles or dust.
- Locate the item to be attached and ensure that it does not come into contact with any portion of the stage other than the moving portion. Ensure that the item being attached does not come into physical contact with any other item.
- Tighten the M2.5 screws, using a maximum torque of 0.5 Nm. Attempt to minimize the torque between the moving part and fixed part of the stage during tightening.

2.2 Installing a two axis HS1 unit

Two nanopositioning stages can be used to form an XY scanning stage. An adapter plate is used to connect the top stage to the bottom. The XY scanner can be installed either horizontally or vertically. When installed vertically the first stage mounted should be oriented with the direction arrow pointing upward. The second stage is then mounted to this stage with the direction arrow in the horizontal plane. Larger loads may be carried when mounted in the horizontal direction. It is always advisable to minimize the load carried by the nanopositioning stage. Heavier loads reduce the stage response time and may cause fatigue and /or reduced motion.

If a two axis system was purchased the stages are shipped assembled as a two axis system. The convention used is that the bottom stage is the Y-axis (CHANNEL 2) and the top stage is the X-axis (CHANNEL 1).

Before installing the two axis system the stages must be taken apart using the following steps.

1. While holding on to the top or X axis loosen the four M3 socket head cap screws. Do not hold on to the bottom or Y-axis while loosening. Holding onto the Y-axis will induce a torque between moving part and stationary parts of the stage
2. While holding on to the adapter plate loosen the four M2.5 flat head screws. Do not hold on to the bottom or Y-axis while loosening

To install a two axis HS1 system use the following steps :

1. Install the first or bottom HS1 (Y-axis) using the procedures described above in **Section 2.1**.
2. Using a lint free cloth, gently wipe off the top of the installed HS1 and the bottom of the adapter plate to remove any particles or dust.
3. Using four M2.5 screws (provided) bolt the adapter plate to the installed Nanopositioning stage. Use a maximum torque of 0.5 Nm. Minimize the torque between the fixed and moving part of the stage during installation.
4. Using a lint free cloth, gently wipe off the top of the adapter plate and the bottom of the remaining HS1 to remove any particles or dust.
5. Using four M3 socket screws (provided) bolt the top stage (X-axis) to the adapter plate. Use a maximum torque of 0.5 Nm. The provided socket screws do not touch the bottom stage and therefore do not interfere with motion. **Do not use longer screws to secure the top axis to the adapter plate. Longer screws may interfere with the motion and damage the stages.** Minimize the torque between the stages and the fixed and moving parts of the stages during installation.

IMPORTANT! Check for ground loops (**Section 3**) between the HS1 and the mounting surface.

2.3 Installing a three axis HS1 unit

If a three axis system was purchased, the convention used is that the bottom stage is the Y-axis (CHANNEL 3) which holds the X-axis (CHANNEL 2), which holds the fastest axis, the Z-axis (CHANNEL 1).

3 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 HS1, and in some cases the oscillations may be severe enough to permanently damage the piezoactuators.

3.1 Prevention and identification of ground loops

Ground loops may sometimes be detected by a digital Voltmeter 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 HS1 comes complete with a position sensitive detector for closed loop operation. In closed loop operation, achieved using the PIEZOCONCEPT 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 HS1 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 :

- Install the HS1 as discussed in **Section 2**.
- Turn the PIEZOCONCEPT's controller power off.

- Set the command signal to 0.0 Volts either on the analog interface or the digital interface.
- Connect the 9 pin D-type connector to the PIEZOCONCEPT's controller, secure the two screws.
- Turn the power switch on.

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. For more information see the **"PIEZOCONCEPT CONTROLLER OPERATION MANUAL"**.

4.2 Care during operation

The HS1 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.