

INSTALLATION AND OPERATION MANUAL
SPM3



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 SPM3 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.....	4
1.1	Unpacking the SPM3.....	4
1.2	Handling the SPM3.....	4
1.3	SPM3.....	5
2	INSTALLATION.....	5
2.1	No fixturing.....	6
2.2	Installing using the M3 bored holes.....	6
3	GROUND LOOPS.....	6
3.1	Prevention and Identification of ground loops.....	6
4	OPERATING THE SPM3.....	7
4.1	Operating in closed loop mode.....	7
4.2	Care during operation.....	7

1 INTRODUCTION

The SPM3 is a PZT actuated linear nanopositioning stage of exceptional resolution and stability. With its large distance of travel and high stability, the SPM3 is ideal for the most challenging SPM and positioning applications. The SPM3 comes complete with position sensitive detectors for closed loop operation.

TRANSLATION (μm) (XYZ)	30, 50 or 75 μm (XY), 5, 10, 30 or 50 μm (Z)
VOLTAGE RANGE (V)	-15V to +150V
RESONANT FREQUENCIES SPM3 UNLOADED X/Y Axis (Hz)	3000/2000
RESONANT FREQUENCIES UNLOADED Z Axis (Hz) 5/10/25/50 μm	12500/5500/5500/3500
MAXIMUM LOAD (hor/vert) (kg)	0.1/0.01
CABLE LENGTH (m)	>1.5m
CABLE CONNECTION	DB-9

1.1 Unpacking the SPM3

Before unpacking the SPM3 read this entire operation manual, paying special attention to the following section on “**Handling the SPM3**”. Remove the SPM3 from its box and place on flat surface. Check the contents of the package against the shipping list and notify PIEZOCONCEPT immediately if any items are missing.

1.2 Handling the SPM3

The SPM3 is a high precision scientific instrument and therefore requires special handling in order to ensure proper operation. Mishandling can cause permanent damage to the SPM3. 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, separate the moving portion of the stage from the stage frame, and form the amplifier. Severe damage may result if objects are inserted into these grooves.
- Always turn off the PIEZOCONCEPT controller before lifting 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 SPM3.
- Do not lift by the cables.
- The surface to which the SPM3 is mounted to should be flat and clean. Likewise, the bottom of the SPM3 should be free of particles and dust before mounting.

- Do not immerse in any liquid. If the SPM3 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 SPM3, there are no serviceable parts inside.

1.3 SPM3

The SPM3 is manufactured from a high performance Al alloy. PZT actuators are preloaded within the SPM3 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). EDM is also used to form integrated amplifiers that increase the range of motion of the PZT actuators for the X, Y and Z axis. The PZT actuators are oriented perpendicular to the stage motion direction and within these amplifiers. There are no serviceable parts in the SPM3 stage.

Two direction arrows are located on the side of this stage. These arrows indicate which direction the stage moves when a positive voltage is applied. The Z-axis moves upwards when a positive voltage is applied. Three DB-9 connectors, one for each axis of motion, are supplied with the SPM3. These connectors are labeled CHANNEL 1 (X), CHANNEL 2 (Y), or CHANNEL 3 (Z) for identification. This identification describes which driver axis that particular stage should be connected to.

Never disassemble the SPM3, there are no serviceable parts inside.

2 INSTALLATION

The SPM3 should be installed horizontally. It is always advisable to minimize the load carried by the SPM3. Heavier loads reduce the stage response time, can cause oscillations, and may cause fatigue and /or reduced motion.

There are two different ways to install the SPM3 into your application. These choices are: simply placing the SPM3 in the desired spot or using the mounting holes. The choice of installation depends on your specific application and on how often you wish to remove the SPM3.

Regardless of how you choose to install the SPM3

- 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 SPM3 to remove any particles or dust.
- c) Always lift the SPM3 by the bottom stage.
- d) Never lift, position, assemble, or disassemble the SPM3 with power applied.
- e) **IMPORTANT!** Check for ground loops (**Section 3**) between the SPM3 and the mounting surface.

2.1 No fixturing

The SPM3 can be mounted simply by placing it in the desired location. The mass of the SPM3 is enough to keep it in place during most scanning or positioning applications.

2.2 Installing using the M3 bored holes

The X and the Y portions of the stage has four holes for M3 screws, on a 106,6mm x 106,6mm square pattern. When securing the SPM3, the mounting surface must be flat and the mounting surface and bottom of the SPM3 must be clean.

The SPM3 is delivered assembled. The SPM3 is a stacked system, composed of an X axis with integrated Z axis (top portion), an intermediate plate and an Y axis (bottom portion). First of all, you have to unscrew the four M3 screws which are on 106,6mm square pattern of the X axis, in order to access the intermediate plate. Then you have to unscrew the 4 screws of the intermediate plate to access the Y portion.

Then here is the assembly procedure (reverse procedure when compared to above) :

1°) First of all, fix the Y axis of the SPM3 by using the four M3 screws (located on a 106,6mm x 106,6mm square pattern). Use a maximum torque of 0.5 Nm when securing the Y axis,

2°) Fix the intermediate plate on the Y axis by using the four M2.5 screw,

3°) Fix the X/Z assembly on the intermediate plate by using the M3 screws (located on a 106,6mm x 106,6mm square pattern). Use a maximum torque of 0.5 Nm when securing the X axis. Please pay special attention to the direction of the X axis during assembly.

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 SPM3, 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 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. The most effective and simplest method is to insulate the stage from the mounting surface (e.g. mylar or paper between the stage and mounting surface). The second method is to connect the PIEZOCONCEPT controller ground to the mounting surface. The stage is connected directly to the ground of the PIEZOCONCEPT controller, which in turn is connected to the ground of the AC power cord. Hence, attaching a braid between the ground of the AC power cord 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. In all cases, the mounting surface should never be used as the ground return 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. **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 SPM3

The SPM3 comes complete with position sensitive detectors 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 SPM3 comes with 9 pin D-type connectors and uses the PIEZOCONCEPT controller for complete positioning control. To operate in closed loop mode use the following procedure.

- a) Install the SPM3 as discussed in **Section 2**.
- b) Turn the PIEZOCONCEPT controller power off.
- c) Set the command signal to 0.0 Volts either on the analog interface or the digital interface.

4.2 Care during operation

The SPM3 is a high precision scientific instrument and should be handled with care during operation. Failure to do so may result in permanent damage.

- a) During operation ensure that there are no physical constraints on the moving stage or anything fixtured to the moving stage.
- b) Never apply a voltage greater than 150V or less than -15V to the PZT.
- c) Maintain a clean working environment to reduce the chance of particles or other substances from gathering in the EDM grooves.