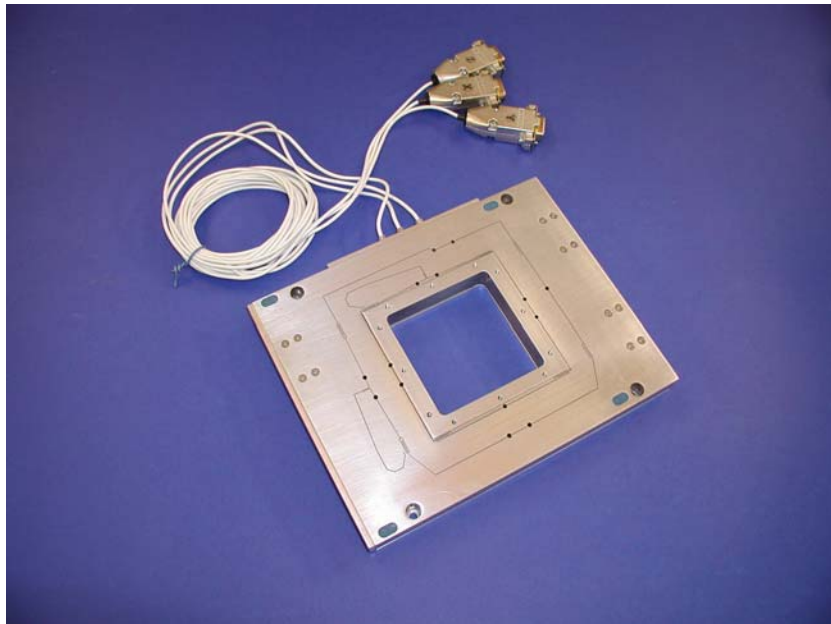


NANO-LP100

INSTALLATION AND OPERATION MANUAL



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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 Nano-Drive™, first set the command voltage to 0.0V, then turn the AC power to the Nano-Drive™ off, and finally wait one minute before disconnecting.

The Nano-LP100 has no user serviceable parts. Only trained service personnel should perform service.

IMPORTANT

All Technical Information, recommendations, and examples related to Mad City Labs 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 Mad City Labs, Inc. products or services.

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1 INTRODUCTION

The Nano-LP100 is a PZT actuated linear nanopositioning stage of exceptional resolution and stability. The 2.6"x2.6" hole in the stage center is ideal for applications involving transmitted beams, multiple probes, or inverted optics. With its large distance of travel and high stability, the Nano-LP100 is ideal for the most challenging microscopy and positioning applications. The Nano-LP100 comes complete with position sensitive detectors for closed loop operation.

	CLOSED LOOP
TRANSLATION (μm) (XY)	100 \pm 10%
TRANSLATION (μm) (z)	100 \pm 10%
VOLTAGE RANGE (V)	-15V to +150V
RESONANT FREQUENCY UNLOADED X-Axis (Hz)	350 \pm 20%
RESONANT FREQUENCY UNLOADED Y-Axis (Hz)	250 \pm 20%
RESONANT FREQUENCY UNLOADED Z-Axis (Hz)	1000 \pm 20%
STIFFNESS (N/ μm)	1.0 \pm 20%
MAXIMUM LOAD (hor/vert) (kg)	0.5/0.25
MASS (g)	1000
CABLE LENGTH (ft)	6
CABLE CONNECTION	DB-9

1.1 Unpacking the Nano-LP100

Before unpacking the Nano-LP100 read this entire operation manual, paying special attention to the following section on "**Handling the Nano-LP100**".

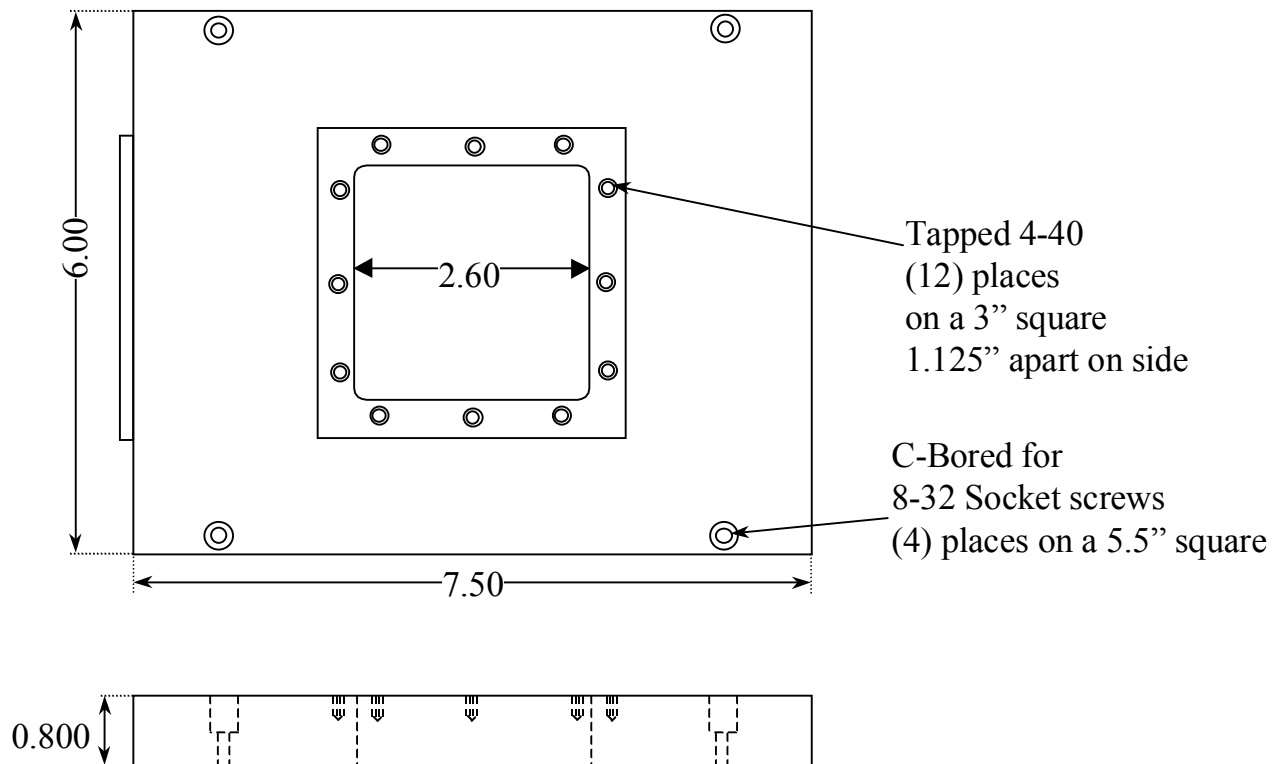
Remove the Nano-LP100 from its box and place on flat surface. Remove the cable ties. An assortment of hardware, including 8-32 socket screws is included for each Nano-LP100. Check the contents of the package against the shipping list and notify Mad City Labs immediately if any items are missing.

1.2 Handling the Nano-LP100

The Nano-LP100 is a high precision scientific instrument and therefore requires special handling in order to ensure proper operation. Mishandling can cause permanent damage to the Nano-LP100. To ensure a long and useful life the following guidelines should be strictly followed.

- a) **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.
- b) Always turn off the Nano-Drive™ before lifting the stage.
- c) Do not move the translation stage by pushing on it with your hands or any other object.
- d) Avoid applying a torque between the moving stage and the frame.
- e) Do not drop, treat roughly, or physically shock the Nano-LP100.
- f) Do not lift by the cables.
- g) The surface to which the Nano-LP100 is mounted to should be flat and clean. Likewise, the bottom of the Nano-LP100 should be free of particles and dust before mounting.
- h) Do not immerse in any liquid. If the Nano-LP100 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.
- i) Never disassemble the Nano-LP100, there are no serviceable parts inside.

1.3 Nano-LP100



The Nano-LP100 is manufactured from a high performance Al alloy. PZT actuators are preloaded within the Nano-LP100 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 Nano-LP100 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 Nano-LP100. These connectors are labeled X, Y, or Z for identification. This identification describes which driver axis that particular stage should be connected to.

Never disassemble the Nano-LP100, there are no serviceable parts inside

2 INSTALLATION

The Nano-LP100 should be installed horizontally. It is always advisable to minimize the load carried by the Nano-LP100. 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 Nano-LP100 into your application. These choices are: simply placing the Nano-LP100 in the desired spot or using the C-Bored 8-32 holes. The choice of installation depends on your specific application and on how often you wish to remove the Nano-LP100.

Regardless of how you choose to install the Nano-LP100

- 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 Nano-LP100 to remove any particles or dust.
- c) Always lift the Nano-LP100 by the bottom stage.
- d) Never lift, position, assemble, or disassemble the Nano-LP100 with power applied.
- e) **IMPORTANT!** Check for ground loops (**Section 3**) between the Nano-LP100 and the mounting surface.

2.1 No fixturing

The Nano-LP100 can be mounted simply by placing it in the desired location. The mass of the Nano-LP100 is enough to keep it in place during most scanning or positioning applications.

2.2 Installing using the 8-32 C-bored holes

The XY stage has four C-Bored holes for low head 8-32 Socket screws. These holes are on a 5.5" x 5.5" square and can be used to secure the Nano-LP100. When securing the Nano-LP100 the mounting surface must be flat and the mounting surface and bottom of the Nano-LP100 must be clean. Use a maximum torque of 0.5 Nm when securing the Nano-LP100. Be careful that the head of the 8-32 socket head cap screw does not interfere with the Z-axis motion.

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 Nano-LP100, 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 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. 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 Nano-Drive™ ground to the mounting surface. The stage is connected directly to the ground of the Nano-Drive™, which in turn is connected to the ground of the AC power cord. A stud at the back of the Nano-Drive™ is provided for connecting the Nano-Drive™ ground to other devices. Hence,

attaching a braid between this stud 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 MAD CITY LABS FOR TECHNICAL ASSISTANCE.**

4 OPERATING THE NANO-LP100

The Nano-LP100 comes complete with position sensitive detectors for closed loop operation. In closed loop operation, achieved using the Mad City Labs Nano-Drive™, 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 Nano-LP100 comes with 9 pin D-type connectors and uses the Nano-Drive™ for complete positioning control. To operate in closed loop mode use the following procedure.

- a) Install the Nano-LP100 as discussed in **Section 2**.
- b) Turn the Nano-Drive™ power off.
- c) Set the command signal to 0.0 Volts either on the analog interface or the digital interface.

- d) Connect the 9 pin D-type connectors to the appropriate axis of the Nano-Drive™, secure the connection using the screws.
- e) Turn the power switch on.
- f) The command voltage now controls the position of the Nano-LP100.
- g) 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 “**NANO-DRIVE OPERATION MANUAL**”.

4.2 Care during operation

The Nano-LP100 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.