

NANO-3D200

INSTALLATION AND OPERATION MANUAL



2524 Todd Drive Madison WI 53713 USA
Tel: +1 608 298-0855 Fax: +1 608 298-9525
sales@madcitylabs.com www.madcitylabs.com

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-3D200 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-3D200 is a PZT actuated linear nanopositioning stage with nanometer precision. The Nano-3D200 has been designed for a compact footprint and long range of motion without compromising high precision. The Nano-3D200 comes complete with position sensitive detectors for closed loop operation.

	CLOSED LOOP
TRANSLATION (μm) (XYZ)	200
VOLTAGE RANGE (V)	-20V to +150V
X-AXIS RESONANT FREQUENCY (unloaded)	150 Hz \pm 20%
Y-AXIS RESONANT FREQUENCY (unloaded)	150 Hz \pm 20%
Z-AXIS RESONANT FREQUENCY (unloaded)	350 Hz \pm 20%
STIFFNESS (N/ μm)	1.0
CABLE LENGTH (ft)	6
CABLE CONNECTION	DB-9

1.1 Unpacking the Nano-3D200

Before unpacking the Nano-3D200 read this entire operation manual, paying special attention to the following section on “**Handling the Nano-3D200**”.

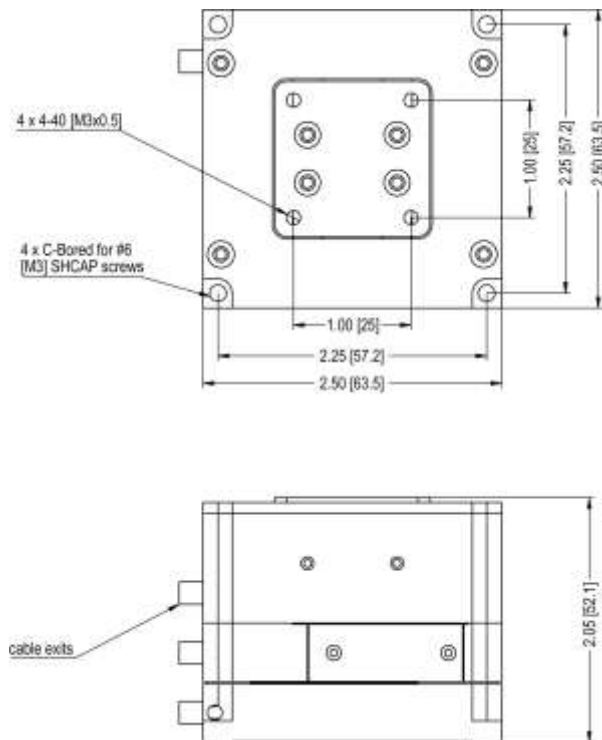
Remove the Nano-3D200 from its box and place on a flat surface. Remove the cable ties. Check the contents of the package against the shipping list and notify Mad City Labs immediately if any items are missing.

1.2 Handling the Nano-3D200

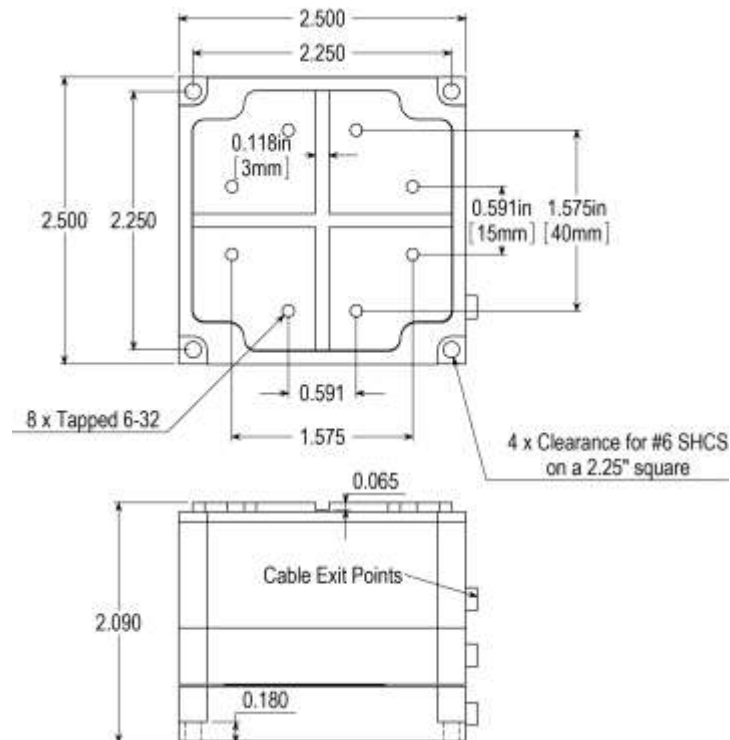
The Nano-3D200 is a high precision scientific instrument and therefore requires special handling in order to ensure proper operation. Mishandling can cause permanent damage to the Nano-3D200. To ensure a long and useful life the following guidelines should be strictly followed.

- 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) When lifting or positioning the Nano-3D200 always hold on to the bottom 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-3D200
- f) Do not lift by the cable.
- g) The surface to which the Nano-3D200 is mounted should be flat and clean. Likewise, the bottom of the Nano-3D200 should be free of particles and dust before mounting.
- h) Do not immerse in any liquid. If the Nano-3D200 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-3D200, there are no user serviceable parts inside.

1.3 Nano-3D200



Technical drawing of the Nano-3D200FT. Dimensions in inches [millimeters].



Technical drawing of the Nano-3D200GT. Dimensions in inches [millimeters].

The Nano-3D200 is manufactured from a high performance aluminum alloy. PZT actuators are preloaded within the Nano-3D200 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 strokes of the PZTs are increased by an amplifier that is integrated into the stage by EDM. There are no user serviceable parts in the Nano-3D200 stage.

Each stage section represents an axis of motion. They are stacked to form the Nano-3D200. The bottom stage section is always the Y-axis. The top stage section of the Nano-3D200 is the Z axis. A DB-9 connector, one for each axis of motion, is supplied with the Nano-3D200 stage. These connectors are labeled X, Y, or Z for identification. This identification describes which driver axis that particular stage should be connected to.

2 INSTALLATION

It is recommended that the Nano-3D200 be installed horizontally. It is always advisable to minimize the load carried by the Nano-3D200. Heavier loads reduce the stage response time and may cause fatigue and /or reduced motion. When installing:

- 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-3D200 to remove any particles or dust.
- c) Always lift the Nano-3D200 by the bottom axis.
- d) Never lift, position, assemble, or disassemble the Nano-3D200 with power applied.
- e) **IMPORTANT!** Check for ground loops (**Section 3**) between the Nano-3D200 and the mounting surface.

The Nano-3D200 has four C-bored holes for #6 [M3] Socket screws. These holes are on a 2.25" x 2.25" [57.2mm x 57.2mm] square and are used to secure the Nano-3D200. Use a maximum torque of 0.5 Nm when tightening the screws.

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-3D200, 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. 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 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 power cord. The Nano-Drive® enclosure is also at ground potential. Attaching a grounding wire between any of the Nano-Drive® 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 MAD CITY LABS FOR TECHNICAL ASSISTANCE.**

4 OPERATING THE NANO-3D200

The Nano-3D200 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-3D200 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-3D200 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-3D200.
- 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-3D200 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 -20V to the PZT.
- c) Maintain a clean working environment to reduce the chance of particles or other substances from gathering in the EDM grooves.