

# **NANO-F450**

## **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-F450 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-F450 is a PZT actuated linear nanopositioning stage of exceptional resolution and stability. The 3-point quick mount system allows for simple installation. The Nano-F450 does not screw down onto the microscope, it simply locks into place on the quick-mount adapter which is first screwed onto the microscope. Using the 3-point quick mount system the Nano-F450 can be locked into place at any angle and can be used on regular or inverted microscopes. The Nano-F450 is available with RMS, M25, M26, or M32 threads, and the locking tool is included.

The Nano-F450 comes complete with a position sensitive detector for closed loop operation.

	<b>CLOSED LOOP</b>
TRANSLATION ( $\mu\text{m}$ )	450 $\pm$ 10%
VOLTAGE RANGE (V)	-20V to +150V
STIFFNESS (N/ $\mu\text{m}$ )	1 $\pm$ 20%
MAXIMUM LOAD (g)	380
INPLANE TILT ( $\mu\text{rad}$ )	10 (TYP)
CABLE LENGTH (ft)	6
CABLE CONNECTION	DB-9
LENS THREAD*	RMS,M25, M26, M32

\* Lens Thread dependent on model ordered. Additional lens threads may be ordered separately.

## 1.1 Unpacking the Nano-F450.

Before unpacking the Nano-F450 read this entire operation manual, paying special attention to the following section on “**Handling the Nano-F450**”. Check the contents of the package against the shipping list and notify Mad City Labs immediately if any items are missing.

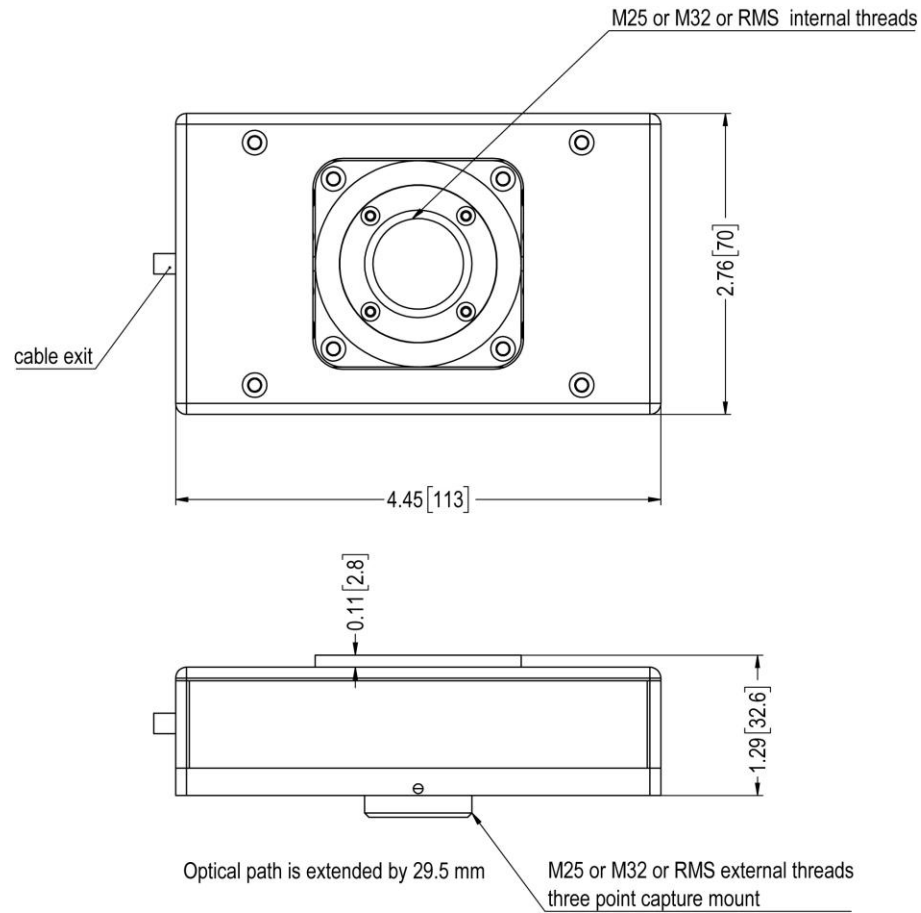
## 1.2 Handling the Nano-F450.

The Nano-F450 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.

- a) **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.
- b) Do not move the translation stage by pushing on it with your hands or any other object.
- c) Avoid applying a torque between the moving stage and the frame.
- d) Do not drop, treat roughly, or physically shock the Nanopositioning stage.
- e) Do not lift by the cable.
- f) The surface to which the Nano-F450 is mounted to should be flat and clean. Likewise, the bottom of the Nano-F450 should be free of particles and dust before mounting.
- g) Do not immerse in any liquid. If the Nano-F450 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.
- h) Never disassemble the nanopositioning stage, there are no serviceable parts inside.

### 1.3 Nano-F450.



*All dimensions in inches [millimeters]*

The Nano-F450 is manufactured from a high performance Al alloy. PZT actuators are preloaded within the Nano-F450 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 Nano-F450 stage.

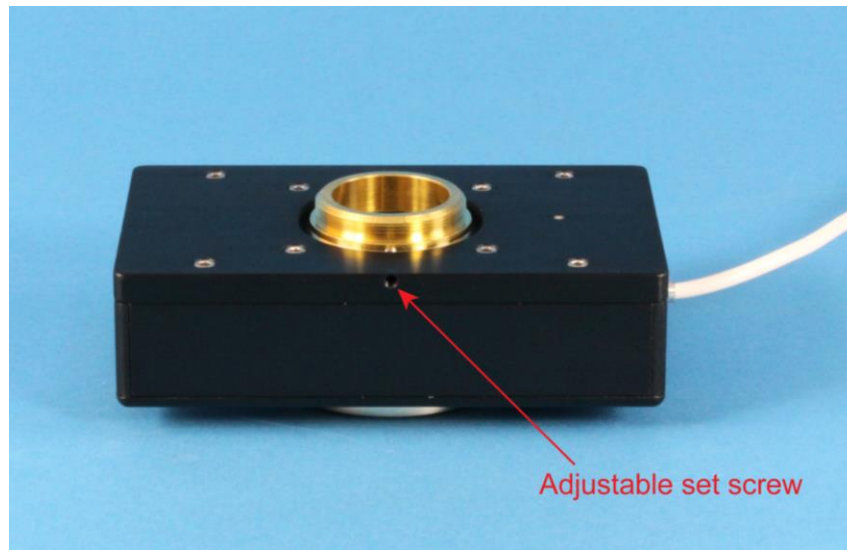
The Nano-F450 is fitted with a male brass insert for either RMS, M25, M26, or M32 threads. The Nano-F450 was delivered with the appropriate female threaded insert in place.

The male threaded brass insert forms the base of the 3-point quick mount system. The male threaded brass insert is first screwed into the objective lens

holder of the microscope. Next, the 0.05" hex wrench is used to loosen the brass tipped 4-40 set screw located on the Nano-F450. The Nano-F450 is then placed onto the male threaded brass insert at the appropriate angle and the setscrew is tightened. There is only one adjustable set screw indicated in Figure 2 below. Do not adjust any other setscrew.



*Figure 1: Nosepiece side of the Nano-F450 showing the male brass insert in place (for illustration purposes) and held by 3 set screws. The male brass insert should be installed in the nosepiece.*



*Figure 2: Location of the adjustable set screw for fixing the Nano-F450 to the male brass insert.  
Do not loosen or adjust any other set screws on the Nano-F450.*

## 2 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-F450, and in some cases the oscillations may be severe enough to permanently damage the piezoactuators.

### 2.1 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 AC 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.**



### 3 OPERATING THE NANOPositionING STAGE

The Nano-F450 comes complete with a position sensitive detector 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.

#### 3.1 Operating in closed loop mode

The Nano-F450 comes with a 9 pin D-type connector and uses the Nano-Drive® for complete positioning control. To operate in closed loop mode use the following procedure.

- a) Install the Nano-F450 as discussed in **Section 1**.
- 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 connector to the Nano-Drive®, secure the two screws.
- e) Turn the power switch on.
- f) The command voltage now controls the position of the nanopositioning stage.
- 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**”.

#### 3.2 Care during operation

The Nano-F450 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.