MAX300 Series

NanoMax 3-Axis Flexure Stage

User Guide

Contents

Chapter 1 Safety

1.1 Safety Information

For the continuing safety of the operators of this equipment, and the protection of the equipment itself, the operator should take note of the **Warnings, Cautions** and **Notes** throughout this handbook and, where visible, on the product itself.

The following safety symbols may be used throughout the handbook and on the equipment itself.

Shock Warning

Given when there is a risk of injury from electrical shock.

Warning

Given when there is a risk of injury to users.

Caution

Given when there is a risk of damage to the product.

Note

Clarification of an instruction or additional information.

1.2 General Warnings

Warnings

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. In particular, excessive moisture may impair operation.

Spillage of fluid, such as sample solutions, should be avoided. If spillage does occur, clean up immediately using absorbant tissue. Do not allow spilled fluid to enter the internal mechanism.

Chapter 2   Introduction

2.1   Description of the NanoMax TS 3-Axis Flexure Stage

The NanoMax 3 axis flexure stage has been designed to integrate seemlessly into the Thorlabs Modular Electronic System and provide nanometric positioning on three orthogonal axes. It is suited to the alignment of optical fibres, waveguides, optoelectronic packages and any other high resolution alignment or positioning application including general purpose laboratory tasks. The innovative flexure design, combined with the system of modular drives, offers exceptional performance and flexibility.

Three types of drive are available, the DRV001 stepper motor drive, the DRV3 differential micrometer and the DRV004 thumbscrew. Also available are two external piezo actuators which increase the piezo travel to 40 µm or 100 µm.

2.2   Component Identification

2.2.1   NanoMax Stage

The NanoMax-TS 3 axis flexure stage is available in three versions; piezo-actuated with feedback on all axes, piezo-actuated without feedback and without piezo actuation, as shown in Fig. 2.1 to Fig. 2.4.

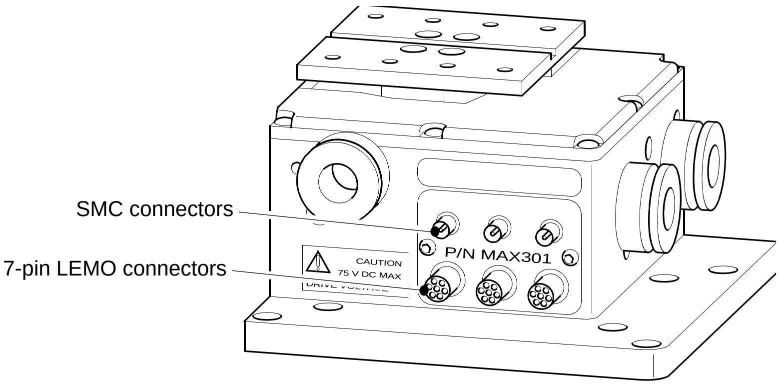


Fig. 2.1   MAX301 NanoMax piezo-actuated stage with feedback on all axes

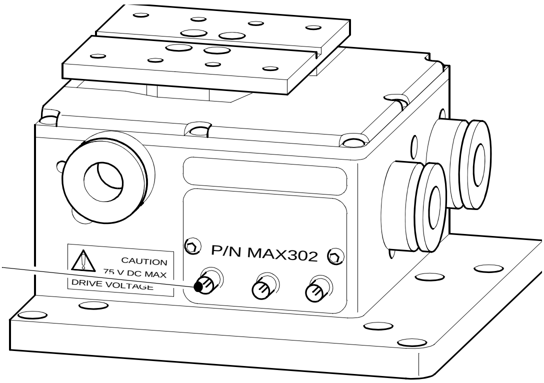
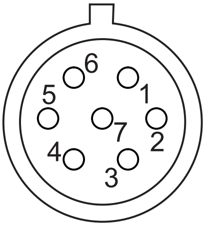


Fig. 2.2 MAX302 NanoMax piezo-actuated stage without feedback

The piezo-actuated models deliver 20 microns of travel, each piezo channel has a coaxial SMC connector (see Fig. 2.1 and Fig. 2.2). In addition, the NanoMax 301 has a 7-pin LEMO connector for each feedback channel (see Fig. 2.1). A corresponding number of leads for connection to the Thorlabs piezoelectric controllers are also supplied.The piezo-actuated models deliver 30 microns of travel, with a coaxial SMC connector for each piezo channel.

The pin functions for the Lemo connectorare detailed below.



Pin	Description
1	+15 V
2	Oscillator +
3	0 V
4	Sig Out -
5	Sig Out +
6	-15 V
7	Travel

Fig. 2.3 Feedback Lemo connector pin functions

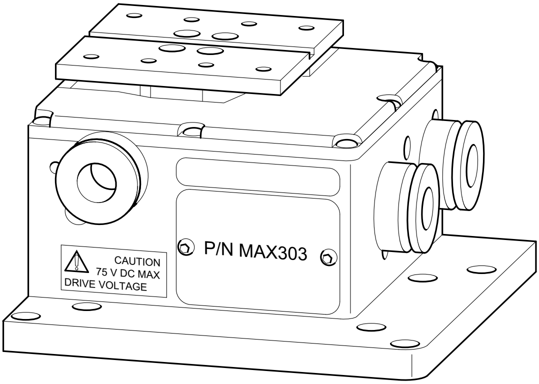
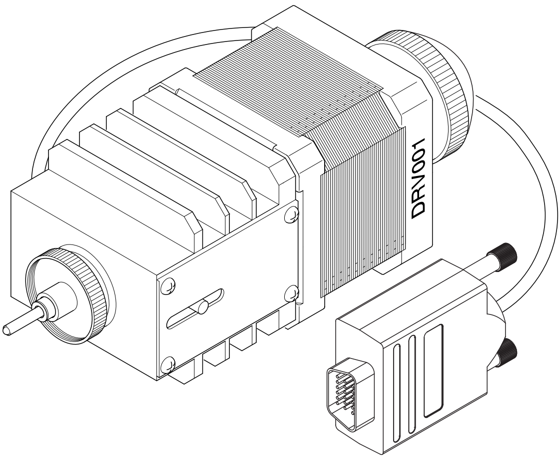


Fig. 2.4   MAX303 NanoMax without piezo-actuation

The NanoMax 303 has no electrical connections.

2.2.2   Drives and Actuators

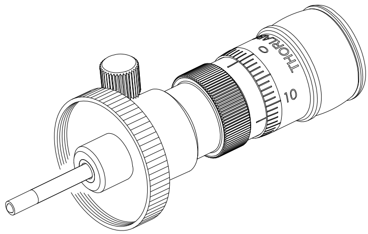
There are three types of drive available for the NanoMax, a motorized drive as shown in Fig. 2.5. and two manual drives as shown in Fig. 2.6. In addition, external piezo actuators are available to give an additional 20 µm or 80µm piezo travel – see Fig. 2.7..



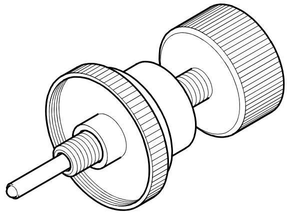
Note

The DRV001 stepper motor drive must be used in conjunction with the BSC benchtop driver or the MST601 control module. It cannot be driven by the TST001 T-Cube driver.

Fig. 2.5   DRV001 NanoStep motor drive



DRV3 differential micrometer drive



DRV004 thumbscrew drive

Fig. 2.6 Manual Drives

These external piezo actuators can be fitted in-line with the standard drives described on the previous page. The DRV120 provides an additional 20 µm of piezo travel. The DRV181 gives 80 µm of travel.

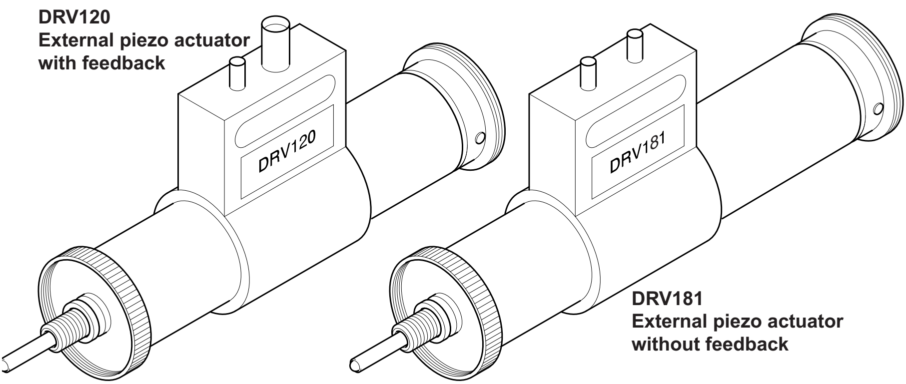


Fig. 2.7 External piezo actuators

Chapter 3 Operation

3.1 Manual Differential Drives and Differential Micrometer Drives

3.1.1 Adjusting Micrometer Drives

Turn the coarse adjustment clockwise until the platform of the NanoMax begins to move. By use of the fine adjustment, sub-micron resolution is now achievable.

3.1.2 Reading Micrometer Drives

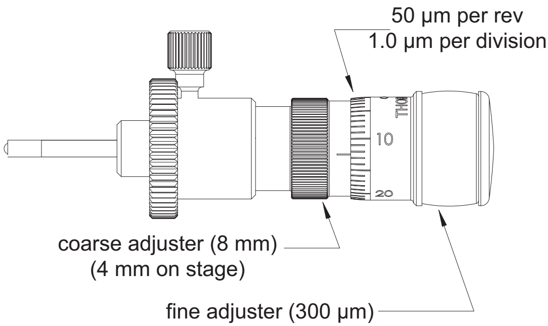


Fig. 3.1 Reading micrometer drives

3.2 NanoStep Motor Drives

When used together with a Thorlabs stepper motor Controller, the NanoStep motor drives allow fully automatic control of the NanoMax.

Basic steps in controlling the stage are as follows:

1) Set commands to configure each axis (setting velocities, accelerations etc.) – see the handbook for relevant stepper motor controller.
2) Move each axis to its home position, to establish a zero datum.
3) Set commands to move each axis by relative and absolute amounts – see *APTServer* Helpfile.

A default configuration is set at the factory and stored in the non-volatile memory of the motor controller – see Table 3.1.

Table 3.1 Standard configurations for motor drives

Parameter	Value
Maximum Velocity	2.5 mm s^{-1}
Minimum Velocity	1 mm s^{-1}
Slope	1 mm s^{-2}
Backlash control	1
Backlash distance	–0.01 mm
Mode	Linear
Microsteps to units	40000
Offset	3 mm
Minimum position	0.00 mm
Maximum position	4.00 mm

Notes

The NanoStep modular drives have no +ve limit switch. The drive reaches a mechanical stop at a position dependent on the axis to which it is attached. The design is such that occasional driving into the stop will not cause any damage.

If the axis is driven towards the –ve limit switch, at a certain position the platform stops moving while the drive itself continues to move until the limit switch is reached. The drive must then be moved positively by a certain distance before the platform begins to move. This distance is just less than the offset.

When creating a program to control the NanoMax, it is preferable to avoid running into the +ve limit.

3.3 Piezo Actuators

Piezo actuators are used to give nanometric positioning of the top platform over a range of 20 microns (40 µm or 100 µm if external piezo actuators are used). They can also modulate the position of the platform at high frequency.

On a piezo-actuated NanoMax, position feedback may be incorporated on the linear axes to enhance the repeatability and linearity of piezo motion.

The piezo-actuated NanoMax should be used together with one of the Thorlabs piezoelectric controllers – see the handbook for the relevant piezoelectric controller.

The NanoMax monitors the ambient temperature using thermistors and applies small movements to the stage to compensate for the expansion and contraction of metals within the stage. Note that this compensation is active only when the associated piezo controller is set to ‘closed loop’ (feedback on) mode – see the *relevant piezo controller handbook* for more details on the operation of piezo actuators.

Chapter 4 Installation

4.1 Unpacking

Note

Retain the packing in which the unit was shipped, for use in future transportation.

Caution

Once removed from its packaging, the NanoMax is easily damaged by mishandling. The unit should only be handled by its base, not by the top platform or any attachments to the top platform.

4.2 Attaching to a Work Surface

The base of the NanoMax is provided with a number of fixing holes and slots for attachment to metric or inch optical tables, as supplied by Thorlabs and other manufacturers. Bolting the unit down minimizes the risk of damage from dropping.

When mounting the NanoMax close to other equipment, ensure that the travel of the moving platform is not obstructed. If the moving platform is driven against a solid object, damage to the internal flexures could occur. The range of travel on each axis is 4 mm total, that is ± 2 mm about the nominal position.

4.3 Calibration of Motor Drives

Note

This section is applicable only to motor drives when a calibration has been requested.

Calibration enables the server to correct for any mechanical errors inherent in the system. Mechanical components, such as the leadscrew and linkages, can be machined only within a certain tolerance, e.g. the leadscrew may be nominally 1mm but actually 1.0005mm, giving a 0.5 micron error. In practice, these errors accumulate from a number of sources, however they are repeatable and therefore, can be compensated.

During calibration, the total positional error is measured at a large number of points and these errors are stored as a look up table (LUT). The LUT is saved as a calibration file, one file for each axis on a particular stage. These files are then linked to the appropriate axis as part of the Stage association process performed using the APT Config utility. Whenever the stage is moved, the LUT is consulted to ascertain the precise movement required to achieve the demanded position.

When the stage is calibrated at the factory, the stepper motor controller, channel number, motor, stage and axis are configured in a certain manner. For the calibration to be effective, it is important to re-assemble the stage with the motors fitted to the same axis for which they were calibrated. This information is contained in the table below.

Furthermore, the correct calibration files must be associated with the correct stage axis. In this regard, it is important to confirm what stage axes are connected to particular channels on particular motor units. It is then a simple task to use the APT Config utility to associate the correct calibration file with a particular serial numbered hardware unit and channel.

The use of a calibration file is optional. Without it, the repeatability and resolution of the stage are unaffected, but no compensations are made to enhance the accuracy

Details on assigning a calibration file are contained in the *APTConfig On Line Helpfile.*

Table 4.1 Calibration details

NanoMax serial number			
Axis	Motor Serial number	Calibration File	Remarks
X			
Y			
Z			

4.4 Fitting and Removal of Drives

This section is applicable only to Part Numbers MAX301, MAX302 and MAX303.

The following procedure details how to fit a drive to the NanoMax 300 stage. A micrometer drive is shown for illustration purposes but the procedure is equally applicable to motor or thumbscrew actuators.

1) For manual drives, rotate the coarse adjuster *counter-clockwise* a few turns to retract the drive rod. For motor drives, retract the drive rod by turning the manual adjuster *clockwise*.

Then, referring to Fig. 4.1 on the next page...

2) Insert the drive into the mounting bush.
3) Tighten the knurled locking ring until finger tight.

Note

To remove a drive reverse the above procedure.

When removing a motor drive, rotate only the locking ring, do not rotate the motor body.

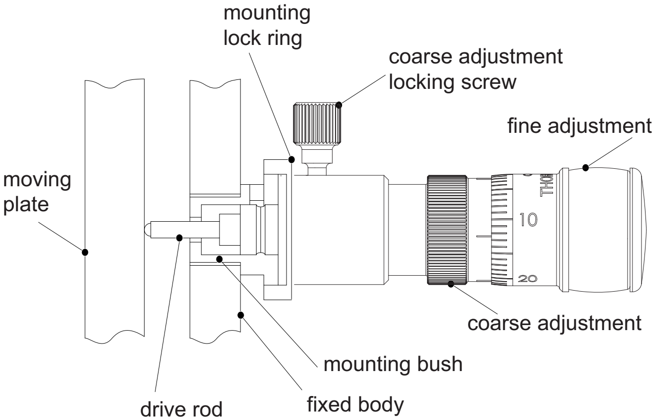


Fig. 4.1 Micrometer drive inserted into mounting bush

4.5 Orienting the Moving Platform

The stage is normally oriented such that the X axis is the optical axis. If it is necessary to change the orientation for left or right-handed use, the Y axis becomes the optical axis as shown in Fig. 4.2 (The Z axis is always vertical).

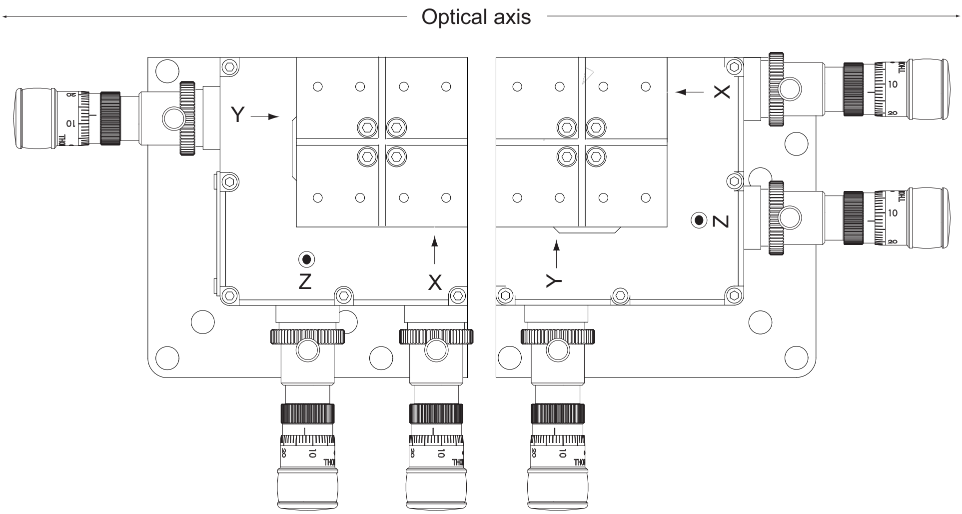


Fig. 4.2 Platform orientation

4.6 Mounting Equipment.

Caution

When attaching accessories (e.g. fiber holders) to the top platform or angle brackets (e.g. AMA007 and AMA009) to the side of the unit, do not use long bolts which protrude into the internal mechanism as this could cause damage to the internal flexures.

The weight attached to the moving platform must not exceed 1 kg.

Do not apply excessive forces to the moving platform.

Thorlabs manufacture a variety of fibre chucks, holders and fixtures to fit the NanoMax stage. However, custom hardware can be designed using a tongue-in-groove arrangement and the cleats provided, see Fig. 4.3 for a typical fixture.

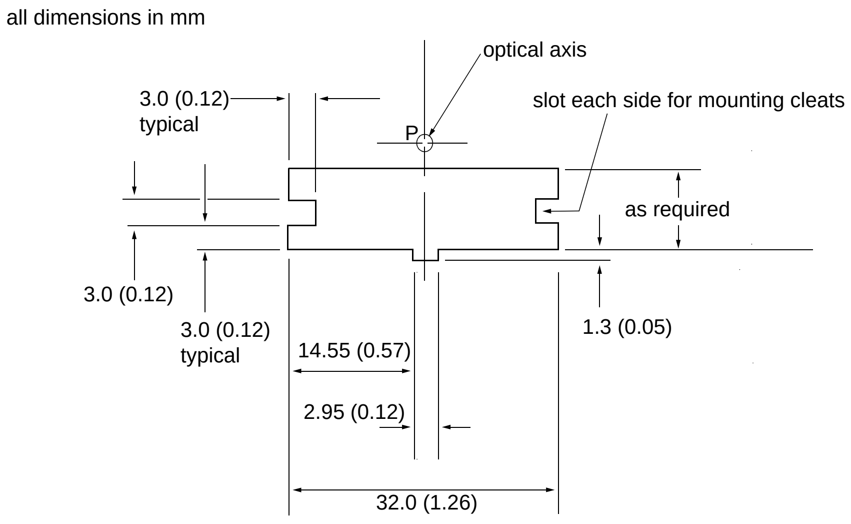


Fig. 4.3 Typical fixture, view along X-axis, length as required

4.7 Transportation.

Caution

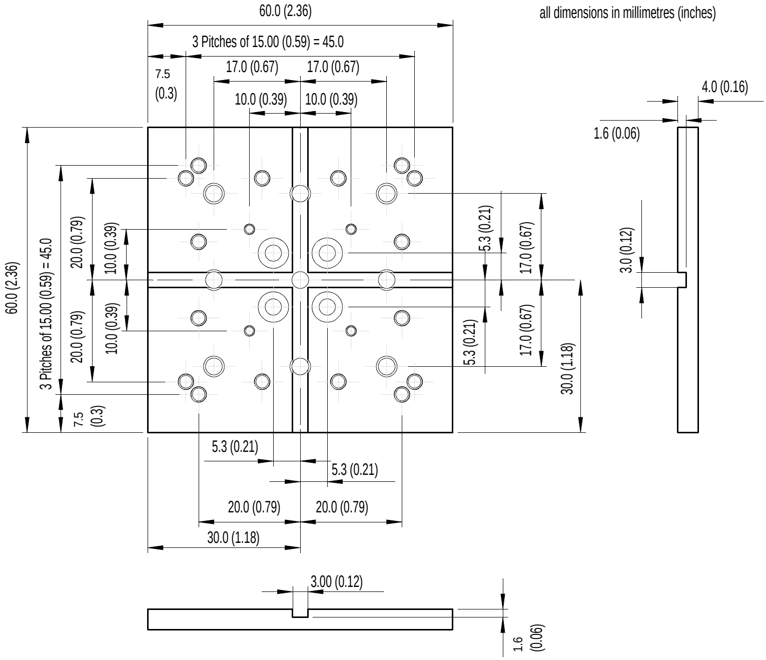
The drives should be removed before transporting the NanoMax.

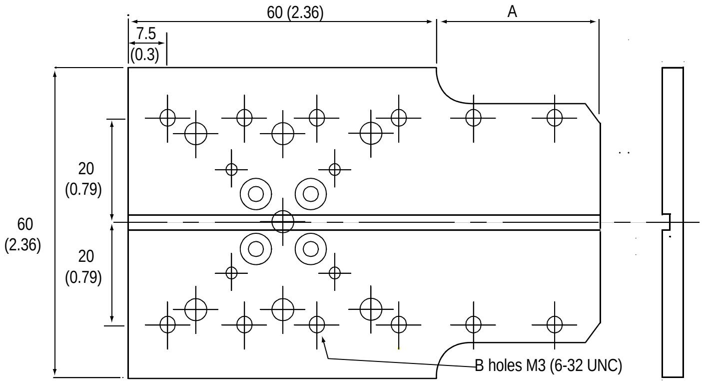
When packing the unit for shipping, use the original packing. If this is not available, use a strong box and surround the NanoMax with at least 100 mm of shock absorbent material.

4.8 Dimensions

4.8.1 Top Platform

all dimensions in millimetres (inches)





Product No	A	B
AMA001	28 (1.10	12 (0.47)
AMA003	35 (1.38)	12 (0.47)
AMA005	45 (1.77)	14 (0.55)

extended top platform

Fig. 4.4 Dimensions – top platform

4.8.2 External Piezo Actuators

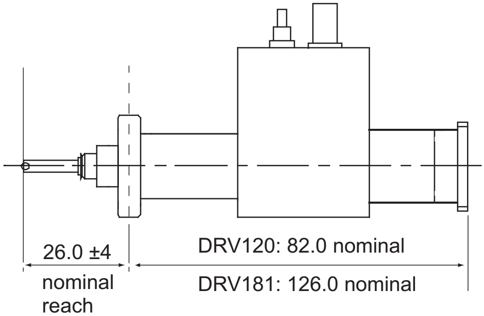


Fig. 4.5 External piezo actuators

4.8.3 Modular Drives

all dimensions in millimetres (inches)

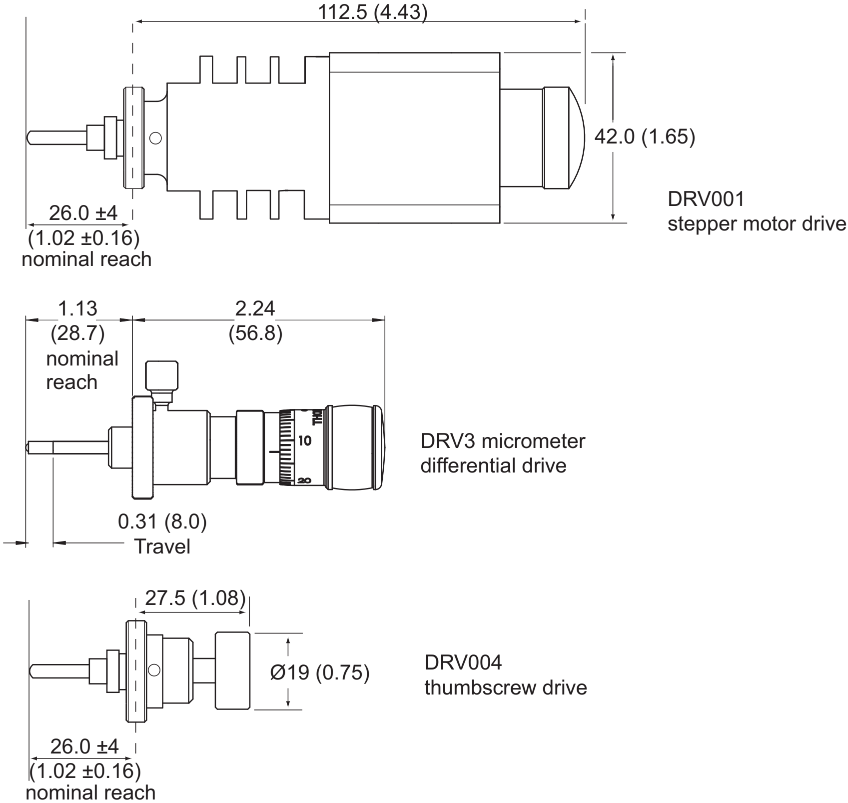
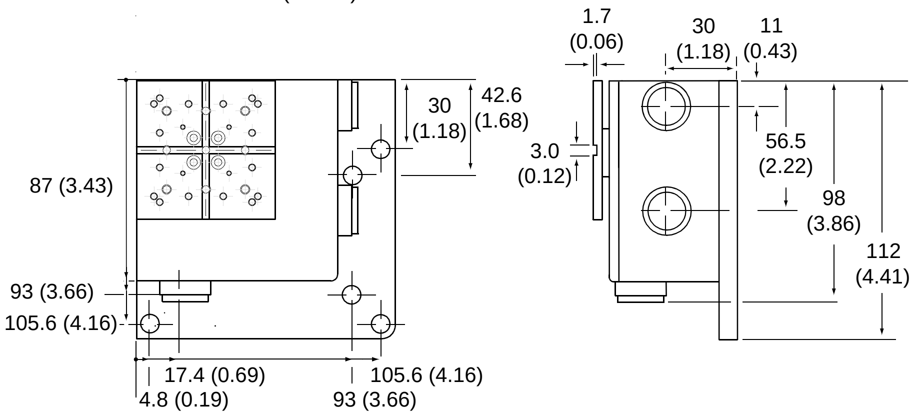


Fig. 4.6 Dimensions – modular drives

4.8.4 NanoMax 3-Axis Stage

all dimensions in millimetres (inches)



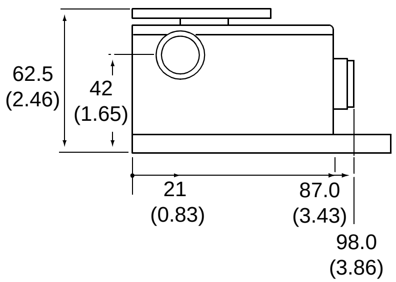


Fig. 4.7 Dimensions – NanoMax 3-axis stage

Chapter 5 Specifications

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Parameter	Value
Weight (without drives):	800 g
Load capacity:	1 kg
Travel	Manual (coarse) and motor4 mm Manual (fine)300µm Piezo20 micron
Resolution	Manual (coarse)0.5mm per revolution Manual (fine)50µm per revolution Motor0.06 µm min incremental movement Piezo (without feedback)20 nm Piezo (with feedback)5 nm
Arcuate displacement (maximum):	80 micron

Note

The resolution of a manual drive corresponds to a 0.5 degree adjustment of the thimble; the actual resolution obtained depends on the skill of zthe user. The resolution of the motor drives is the smallest step that can be executed (i.e. 1 microstep). The resolutions of the piezo actuators are those typically obtained using Thorlabs controllers.

Power supply	
Piezoactuated NanoMax	Nominal maximum input voltage:75 V Absolute maximum input voltage:100 V
Stepper Motor	Maximum input voltage:24 V

Caution

The NanoMax should only be used in conjunction with the appropriate Thorlabs Piezoelectric Controllers.

Chapter 6 Parts and Consumables

6.1 Parts List

Part Number	Description
MAX316D and MAX316D/M	NanoMax stage with differential micrometer drives
MAX315D and MAX315D/M	NanoMax stage with piezo actuator and differential micrometer drives
MAX314D and MAX314D/M	NanoMax stage with feedback piezo actuator and differential micrometer drives.
MAX343 and MAX343/M	NanoMax stage with stepper motor drives.
MAX342 and MAX342/M	NanoMax stage with piezo actuator and stepper motor drives.
MAX341 and MAX341/M	NanoMax stage with feedback piezo actuator and stepper motor drives.
MAX303 and MAX303/M	NanoMax stage only
MAX302 and MAX302/M	NanoMax stage with piezo actuator
MAX301 and MAX301/M	NanoMax stage with feedback piezo actuator.
166038	SMC connector lead
134667	LEMO connector lead
131030	Mounting cleat
120992	Cable clamp
ha0094T	Handbook

Chapter 7 Regulatory

7.1 Declarations Of Conformity

7.1.1 For Customers in Europe

This equipment has been tested and found to comply with the EC Directives 89/336/EEC ‘EMC Directive’ and 73/23/EEC ‘Low Voltage Directive’ as amended by 93/68/EEC.

Compliance was demonstrated by conformance to the following specifications which have been listed in the Official Journal of the European Communities:

Safety	EN61010: 2001 Installation Category II, Polution Degree II.
EMC	EN61326: 1997

7.1.2 For Customers In The USA

This equipment has been tested and found to comply with the limits for a Class A digital device, persuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by the company could void the user’s authority to operate the equipment.

7.2 Waste Electrical and Electronic Equipment (WEEE) Directive

7.2.1 Compliance

As required by the Waste Electrical and Electronic Equipment (WEEE) Directive of the European Community and the corresponding national laws, we offer all end users in the EC the possibility to return "end of life" units without incurring disposal charges.

This offer is valid for electrical and electronic equipment

- sold after August 13th 2005
- marked correspondingly with the crossed out "wheelie bin" logo (see Fig. 1)
- sold to a company or institute within the EC
- currently owned by a company or institute within the EC
- still complete, not disassembled and not contaminated

Fig. 7.1 Crossed out "wheelie bin" symbol

As the WEEE directive applies to self contained operational electrical and electronic products, this "end of life" take back service does not refer to other products, such as

- pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- components
- mechanics and optics
- left over parts of units disassembled by the user (PCB's, housings etc.).

If you wish to return a unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

7.2.2 Waste treatment on your own responsibility

If you do not return an "end of life" unit to the company, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

7.2.3 Ecological background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.

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