

NANOROLL FLEXURE ROTATION STAGES

Model Number AMR001

THORLABS

About the Company

Thorlabs Ltd is an a leading manufacturer of motion control systems, vibration isolation systems, machine vision products and multi-element optical systems for fiber-optic, semiconductor and reprographic applications.

We offer customers an in-depth understanding of optical component manufacture, allowing us to quickly and confidently develop optimal positioning solutions.

As a part of Thorlabs inc., manufacturers of innovative photonics products, we are committed to providing the service, relationships and attention to detail that make businesses excel.

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Revision History

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1	050302	Initial Issue
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Introduction

How to use this Handbook

This handbook contains all the information necessary to install, set up, and operate the NanoRoll Rotational Flexure Stage. For the continuing safety of the operators of this equipment, and the protection of the equipment itself, read the Safety Information in Chapter 2 before using the equipment, and carefully heed all cautionary notes.

If you have any questions or comments about this manual please contact your local sales or service office or contact the factory at +44 (0) 1353 654440 and ask for Customer Service.

Alternatively, visit our website at www.thorlabs.com.

The Structure of this Manual

Chapter 1, Introduction, gives an overview of the handbook structure and draws attention to the importance of the safety information. Chapter 2, For Your Safety, provides critical information needed for the safe installation and operation of the equipment. Chapter 3, Getting Started, gives an overview of the NanoRoll, together with a description of the various drive and piezo actuator options. Chapter 4, Operation, explains how to control the position of the stage using the different types of drive. Chapter 5, Installation, provides instructions on siting the equipment, fitting and removing drives, and orienting the platform for left or right handed use, together with dimension details. Chapter 6 lists the specifications and Chapter 7 details the parts list.

If using a piezo actuated version of the NanoRoll, or using motor drives, refer to the handbooks for the appropriate Thorlabs controllers.

For Your Safety

2.1 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 on the equipment:



Read the operating instructions before use



Connection to Earth



High voltages present



Earth point

The following safety symbols may be used throughout the handbook:



Warning. An instruction which draws attention to the risk of injury or death.



Caution. An instruction which draws attention to the risks of damage to the product, process or surroundings.



Note. Clarification of an instruction or additional information.

Only personnel trained in the servicing and maintenance of this equipment should remove its covers or attempt any repairs or adjustments.

Getting Started

3.1 Description of the NanoRoll Flexure Rotation Stage

The NanoRoll is a rotational stage, providing ultrasmooth axial $\emptyset x$ angular rotation. It can be used as a standalone angular positioner, or as a goniometer when used with the AMA 023 tabletop mounting adaptor. It can also be attached to the MicroBlock, NanoBlock and NanoMax 300 stages (using Moving Platform Bracket AMA 011) to form a unified four-axis (x-y-z- $\emptyset x$) stage.

In addition, the NanoRoll can be directly attached to the stationary sides of the MicroBlock, NanoBlock and NanoMax stages, to obtain $\emptyset x$ precision rotation at the standard 75-mm optical height adjacent to the x-y-z platform.

When fitted with a precision differential micrometer drive (AMR001D) as shown in Fig. 3.1, the NanoRoll provides 12 degrees of manual motion and 10 arc minutes of ultrafine adjustment with a resolution of 1 arc second. In addition, the NanoRoll is available with an internal piezoelectric actuator (AMR001DP) that provides 45 arc seconds of rotation with a resolution of 0.1 arc second. It comes complete with a 1-m-long cable with SMC connectors and can be driven using any of the Thorlabs piezoelectric controllers. This configuration is ideal for use as a precision, remotely controlled goniometer and for fiber-launch applications into polarization-preserving fibers.

The NanoRoll motorized rotation stage (AMR001S) is equipped with a stepper motor actuator as shown in Fig. 3.2 and provides 8 degrees of hands-free rotation ($\emptyset x$) with a resolution of better than 100 μrad . Angular resolution may be improved by the addition of an open-loop piezo actuator (AMR001SP) and controller. This ultrafine resolution rotation stage is useful for the precise orientation of input or output fiber arrays to integrated optical devices. A control knob attached to the rear of the stepper actuator allows the rotational platform to be oriented manually.



Note. The AMR001S NanoRoll™ motorized stages must be used in conjunction with one of the Thorlabs NanoStep stepper motor controllers.

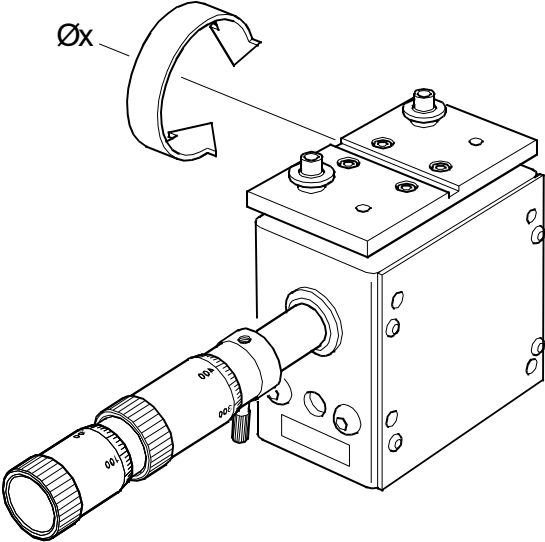


Fig. 3.1 NanoRoll with differential micrometer actuator (AMR001D and AMR001DP)

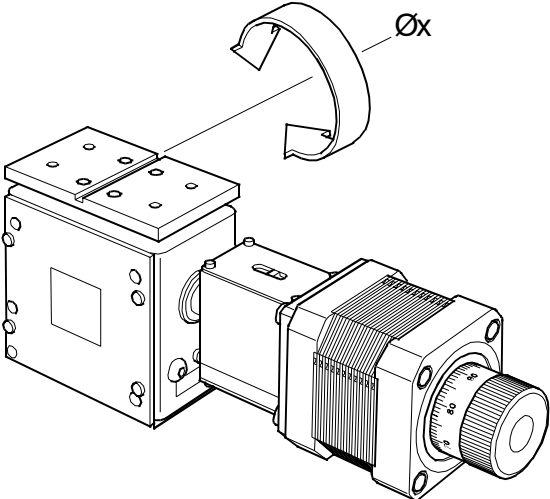


Fig. 3.2 NanoRoll with stepper motor actuator (AMR001S and AMR001SP)

4.1 NanoStep Motor Drives

The stepper motor operates a linear actuator. Electrical limit switches are incorporated which prevent the motor driving beyond its working limits. If a movement is programmed which takes the stage past its maximum travel, a limit switch trips and the motor is halted. Movement is possible only in the opposite direction until the switch is released.

When used together with one of the Thorlabs stepper motor controllers, the NanoStep motor drives allow fully automatic control of the NanoRoll.

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 NanoStep 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 Handbook *HA0104 ActiveX Drivers*.

Manual control of the NanoRoll can be achieved by switching off the drive to the motor.



Caution. The electrical limit switches do not operate when the motor is positioned by hand. Care must be taken to ensure that the drive is not forced into the limit switch. A 'flag' situated on top of the actuator gives an indication of the travel.

4.2 Piezo Actuators

Piezo actuators are used to give nanometric positioning of the top platform over a range of 45 arc seconds. They can also modulate the position of the platform at high frequency.

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

5.1 Unpacking



Note. Retain the packing in which the unit was shipped. For the warranty to be valid, the unit must be returned in the original packaging.



Caution. Once removed from its packaging, the NanoRoll 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.

5.2 Attaching to a Work Surface



Caution. The NanoRoll may move without warning. Ensure that the rotation of the moving platform over its full range of travel is not obstructed. If the moving platform is driven against a solid object, damage to the internal flexures could occur. The range of travel is 8 degrees total, that is ± 4 degrees about the nominal position. All cables should be routed to avoid the risk of them becoming entangled.

The NanoRoll can be configured as a standalone angular positioner using tabletop mounting adaptors, 75mm optical axis height AMA 023 or 125mm optical axis height AMA 015.

Alternatively, it can be bolted to a NanoMax 300, NanoBlock or MicroBlock stage using a moving platform bracket AMA 011 or attached directly to the stationary sides to obtain $\emptyset X$ precision rotation at the standard 75mm height adjacent to the x-y-z platform.

To minimize the risk of foreign objects becoming trapped in the drive mechanism, the NanoRoll should be mounted, using the four M3 cap head screws and washers provided, such that the open face (springs and flexures visible) is against the supporting bracket. Use fiber washers (supplied) where necessary to prevent the screws overdriving.

5.3 Motor Drives

5.3.1 Configuration of Motor Drives



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

When the motors are calibrated at the factory, the NanoStep control module and NanoRoll stage are configured in a certain manner. If the system is not configured in the same manner, the absolute accuracy may be affected. For calibration to be valid, the controller must be retained with the stage to which it is matched.

5.3.2 Electrical Connections

The motor is connected to the controller via a flying lead terminated in a LEMO connector.



Caution. The NanoStep controller must be switched off before connecting or disconnecting the NanoRoll. Failure to remove the power supply could result in damage to the controller, the NanoRoll or both.

5.4 Mounting Equipment to the Moving Platform



Caution. To avoid damaging the internal flexures:

- The weight attached to the moving platform must not exceed 500g.
- Do not apply excessive forces to the moving platform.

Thorlabs manufacture a variety of fibre chucks, holders and fixtures to fit the NanoRoll stage. However, custom hardware can be designed using a tongue-in-groove arrangement and the cleats provided, see Fig. 5.1 for a typical fixture.

all dimensions in mm

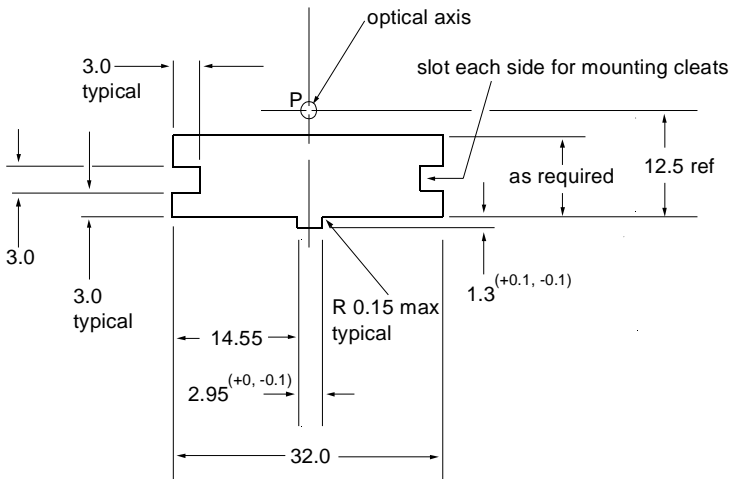


Fig. 5.1 Typical fixture, view along X-axis, length as required

5.5 Transportation



Caution.

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

5.6 Dimensions

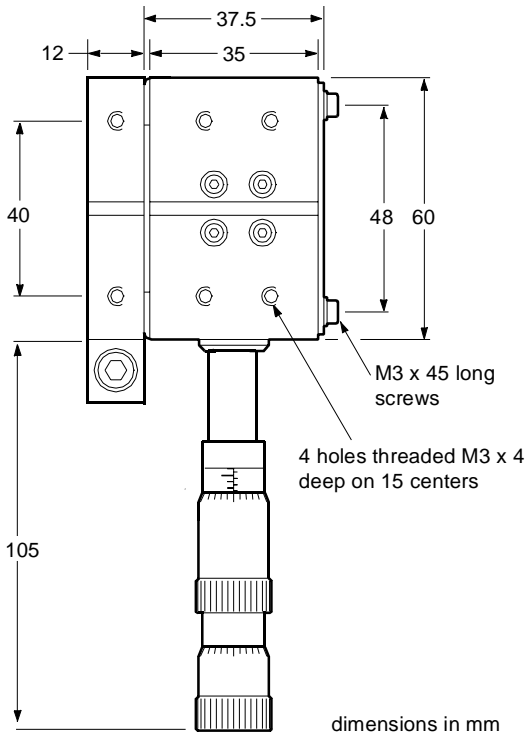


Fig. 5.2 Dimensions – differential actuator models

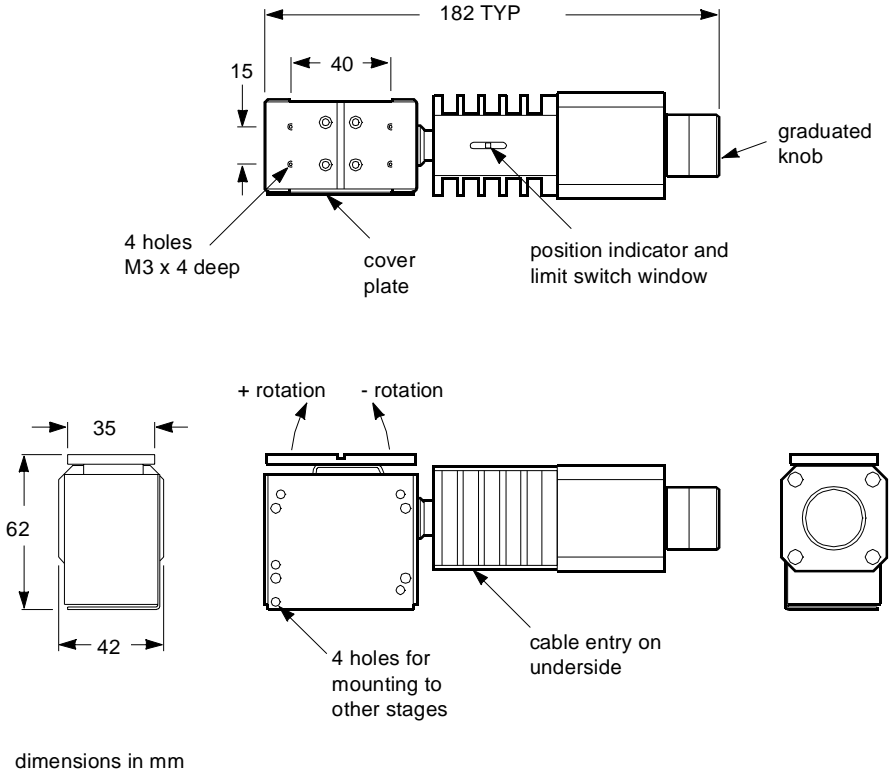


Fig. 5.3 Dimensions – stepper motor models

Specifications

Stages with Motorized Drives

Weight:		750 g – AMR001S 775 g – AMR001SP
Load capacity:		500 g
Travel:		
	Motor	8 degrees
	Piezo actuator	45 arc seconds
Resolution:		
	Motor	100 μ rad
	Piezo actuator	0.1 arc seconds

Stages with Differential Drives

Weight:		325 g – AMR001DP 350 g – AMR001D
Load capacity:		500 g
Travel:		
	Fine thread	12 degrees
	Differential	10 arc minutes
	Piezo actuator	45 arc seconds
Resolution:		
	Fine thread	10 arc seconds
	Differential	1 arc second
	Piezo actuator	0.1 arc seconds



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 the 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.

Environmental Limits (all Models)

Operating temperature	15 to 31°C
Storage temperature	– 10 to 50°C

Power supply (Piezoactuated Models)



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

Nominal maximum input voltage:	75 V
Absolute maximum input voltage:	100 V

Parts and Consumables

7.1 Parts List

Description	Part Number
SMC connector lead (for AMR001DP and AMR001SP)	PAA101
3m extension cable (for AMR001S and AMR001SP)	PAA107
Replacement cleat kit	AMA010
Cable clamp	120992
Tabletop mounting adaptor	AMA023
Moving platform bracket	AMA011
Handbook	HA0036T

Products and Customer Support

A Comprehensive Product Range

Optical Components,

Singlets, Doublets and Triplets; Cylindrical Optics, Mirrors, Prisms and Retroreflectors, Beamsplitters, Polarization Components, Filters, High Energy Laser Optics, Diode Laser Optics, UV Optics, Machine Vision.

Opto-mechanical Hardware

'MicroLab System, Micro-optics, Lens, Filter and Polarizer Mounts, Mirror/ Beamsplitter Mounts and Prism Tables.

Nanopositioning

Stages, Mechanical Accessories, Piezo-electric and Stepper-motor Controllers, Autoalignment, Modular System Controllers.

Optical Tables, Breadboards and Vibration Isolators

Optical Table-tops, Vibration-isolation and support systems, Optical Breadboards and Baseplates, Workstations.

Lasers

Diode-pumped Solid State, Ion, Helium Cadmium, Helium Neon, Diode Laser Assemblies, Laboratory Diode Laser Drivers, Accessories.

Laser Measurement Instrumentation

Laser-beam characterization, Photodiodes, Power and Energy Meters.

Lab Accessories

Technical Support

Thorlabs provide a comprehensive after sales service. Contact us through your local representative, or at the address below:

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Product Warranty

All Thorlabs products are covered by a manufacturers warranty against faulty workmanship and materials, valid for 12 months from the date of original purchase. All products returned under warranty must be returned in their original packaging.

Prior to installation, the equipment referred to in this handbook must be stored in a clean, dry environment, in accordance with any instructions given. Periodic checks must be made on the equipment's condition.

Customer Feedback

It is always helpful to have detailed and accurate information about any problems encountered by customers

We welcome comments or suggestions about any aspect of the equipment and instruction handbooks.

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