Linear Long-travel Translation Stage

LNR50 Series

THORLABS

About the Company

Thorlabs has been an active member of the Photonics community for over 15 years.

We strive to be the ultimate resource for the photonics community-a place to find the products you need to enable your experiments, as well as the information you need to get your application working.

Thorlabs designs, develops, and manufactures building blocks for the photonics industry including equipment for opto-mechanics, motion control, nano-positioning, alignment, optical components, laser diodes, tunable lasers and vibration isolation systems. In addition to core photonics building blocks, we now provide system level solutions including complete OCT and imaging systems.

Trademarks

THORLABS is a registered trademark of Thorlabs Inc.

Product Warranty

Opto-Electronics, Control Electronics, Optics, and Nano-Positioning Product Lines.

Thorlabs offers a two year warranty on the above mentioned product lines, provided normal use and maintenance of the products and when properly handled and correctly installed.

Thorlabs shall repair or replace any defective or nonconforming product as detailed above. We ask that buyer contact Thorlabs for a Return Material Authorization number (RMA #) from our Customer Service/Returns department in order to most efficiently process the return and/or repair.

Products returned for repair that are not covered under warranty, a Thorlabs standard repair charge shall be applicable in addition to all shipping expenses. This repair charge will be quoted to the customer before the work is performed.

Revision History

Issue No.	Date	Summary
1	121101	Initial Issue
2	050907	DRV414
3	070110	Old Parts
4	240210	Motor Pin Out

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Chapter 1

Introduction

How to use this Handbook

This handbook contains all the information necessary to install, set up, and operate the Linear Long-travel Translation 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 LNR stage, together with a description of the various drives. 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 4, Operation, explains how to control the position of the stage using the different types of drive. Chapter 6 lists the specifications and Chapter 7 details the parts list.

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

Chapter 2

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.

This unit complies with the European Standard EN61010 as a POLLUTION DEGREE I, INSTALLATION CATEGORY II piece of equipment.

The Equipment, as described herein, is designed for use by personnel properly trained in the use and handling of mains powered electrical equipment. Only personnel trained in the servicing and maintenance of this equipment should remove its covers or attempt any repairs or adjustments.

Chapter 3

Getting Started

3.1 Linear Long-travel Translation Stage

The LNR50 single-axis linear long travel stage has been designed to integrate seemlessly into the Thorlabs modular electronic or benchtop nanopositioning systems. The unique combination of long-travel actuators and high-precision piezoelectric elements provides solutions to applications such as manipulation, alignment and assembly of photonics products, and microscope examination of large samples. When fitted with a piezoelectric actuator, the stage is compatible with the Thorlabs NanoTrak™ autoalignment module, allowing automated or semi-automated optical alignment systems to be constructed around customer specific applications.

Stages can be bolted together in and XY or XYZ configuration for applications where movement is required in more than one axis.

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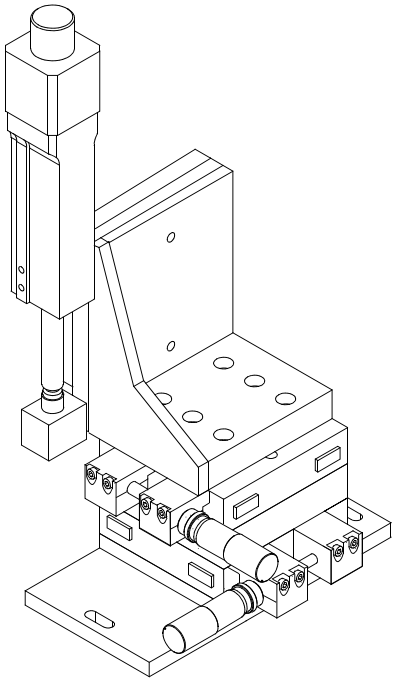


Fig. 3.1 LNR50 series linear long travel stage – typical XYZ configuration

3.1.1 Drives

Stages are supplied pre-configured with either manual or motor drives. However, various motorized drives and piezo drives are available, which can easily be fitter later, as the application needs change – see Table 3.1, Fig. 3.2, Fig. 3.3 and Section 3.1.2..

Note. The DRV013 and DRV014 trapezoidal stepper motor drives must be used in conjunction with the BSC101, BSC102, BSC103 or MST601 stepper motor controllers. The DRV414 DC motor drives should be used with a Thorlabs BDC001 DC motor controller.

Table 3.1 Drives

Drives Type	Travel (mm)	Resolution (µm)	Product Number
Trapezoidal stepper motor	25.0	0.05	DRV013
Trapezoidal stepper motor	50.0	0.05	DRV014
DC servo motor	50.0	0.3	DRV414

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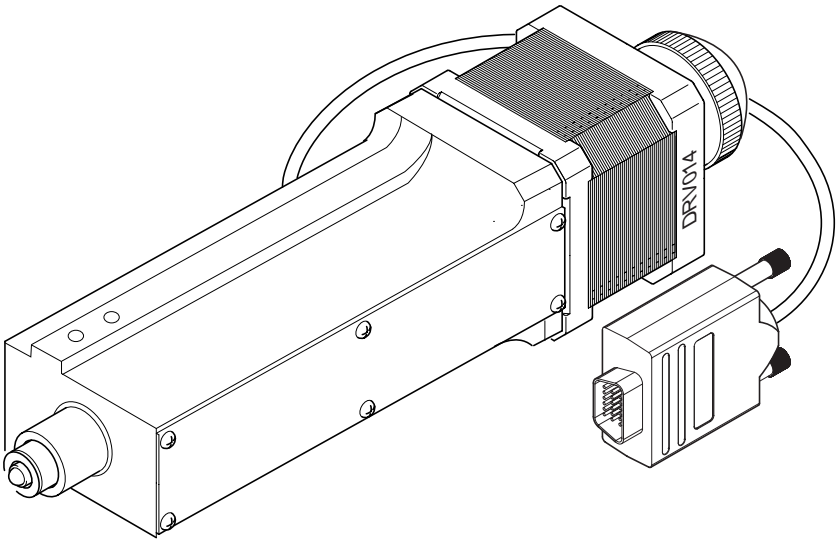


Fig. 3.2 A typical stepper motor drive

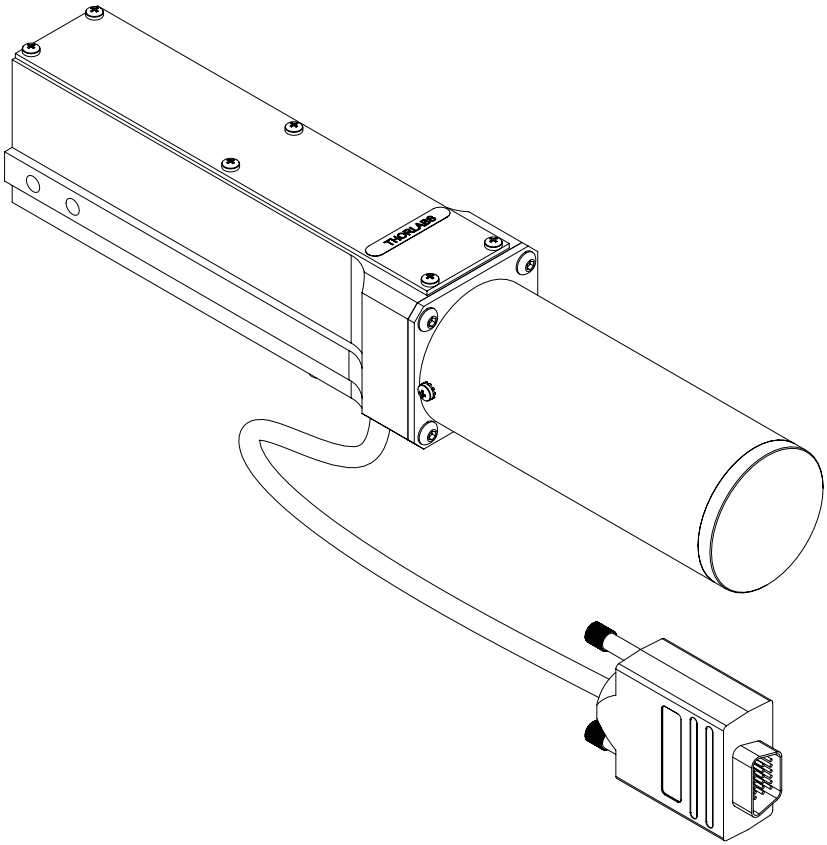


Fig. 3.3 DC servo motor drive

3.1.2 Piezo Actuators

Piezoelectric actuators have been developed for optical and fiber-optical applications, to provide linear motions up to 100 µm – see Table 3.2 and Fig. 3.4.

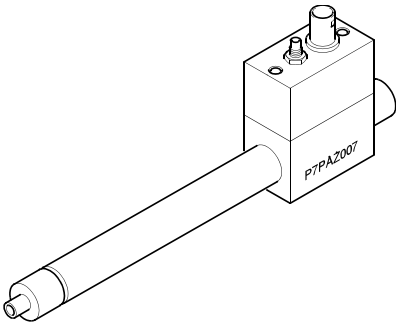


Fig. 3.4 A typical piezo actuator.

Table 3.2 Piezoelectric actuators

Extension (µm at 75V dc, zero load)	Standard actuator	Feedback actuator
20	PAS020	PAZ020
40	PAS040	PAZ040
100	PAS100	PAZ100

Note. The push blocks fitted to the linear stage use drive ball type end fittings. If the actuator is to be used with stages by other manufacturers, the actuator tip should be replaced with one compatible with the push block – see Table 3.3.

Table 3.3 Piezoelectric actuator tips

End Type	Thread	Product Number
Flat end	–	PAA001
Drive ball end	–	PAA005
Threaded	M4	PAA007
Threaded	8 - 32 UNC	PAA013

Chapter 4

Operation

4.1 Manual Differential Drives and Differential Micrometer Drives

4.1.1 Adjusting Micrometer Drives

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

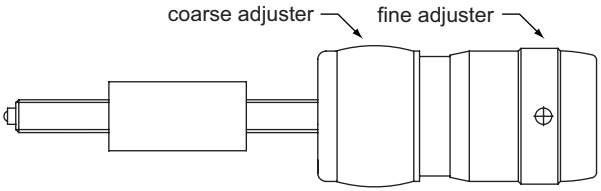


Fig. 4.1 Adjusting a differential drive

4.2 Motor Drives

When used together with the associated Thorlabs Motor Controller the stepper motor and DC motor drives allow fully automatic control of the stage.

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 the *APTServer* helpfile supplied with the APT server for more information.

A default configuration is set at the factory and stored in the non-volatile memory of the NanoStep controller – see and Table 4.2 on the next page.

Notes.

- If the axis is driven towards the –ve limit, 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 stage, it is preferable to avoid running into the limit switches.

Table 4.1 Standard Configuration for Stepper Motor Drives

ActiveX Parameter	Value
Maximum speed	2.5 mm s^{-1}
Minimum speed	1 mm s^{-1}
Slope	1 mm s^{-2}
Backlash control	1
Backlash distance	–0.01 mm
Mode	Linear
Microsteps to units	20000
Offset	3 mm
Minimum position	0.00 mm
Maximum position	50.00 mm

Table 4.2 Standard Configuration for DC Motor Drives

ActiveX Parameter	Value
Maximum speed	100 mm s^{-1}
Minimum speed	0 mm s^{-1}
Slope	100 mm s^{-2}
Backlash control	1
Backlash distance	–0.01 mm
Encoder counts per rev	4096*
Offset	1.0 mm
Minimum position	0.00 mm
Maximum position	50.00 mm

* i.e. for a 1024 count encoder

4.3 Piezo Actuators

Piezo actuators are used to give nanometric positioning of the platform over a range of 20 to 100 microns – see Table 3.2. They can also modulate the position of the platform at high frequency.

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

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

Chapter 5

Installation

5.1 Unpacking

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

Caution. Once removed from its packaging, the stage is easily damaged by mishandling.

Caution. The stage is shipped with a plate fitted to the side, which locks the carriage during transit. These plates should be removed before the stage is used. Retain the plates for future use.

5.2 Assembly

The base of the stage 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.

The LNR stage has a basic base and carriage mechanism, incorporating high precision, high load capacity cross-roller bearings. A spring return mechanism is incorporated which provides a positive return force of 30N.

When used in isolation, the stage can simply be bolted to the worksurface, to provide motion in a single axis. If multi axis movement is required, two or more stages can be bolted together – see Fig. 5.1, in which case spacers must be fitted between the stages as shown. The vertical mounting bracket can be used in either a right or left handed configuration to suit a variety of applications.

When mounting the stage 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 could occur. The range of travel on each axis is 50 mm total, that is ± 25 mm about the nominal position.

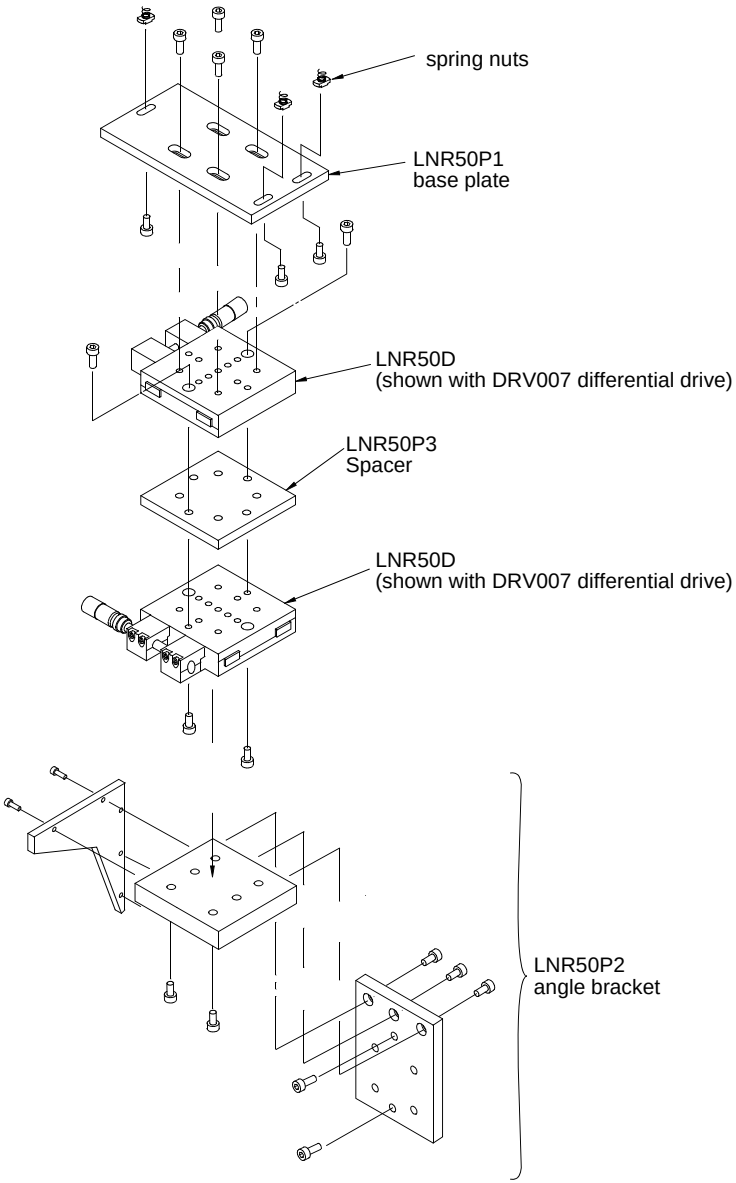


Fig. 5.1 Typical X-Y combination and accessories

5.3 Fitting and Removal of Drives

5.3.1 Fitting a Manual Drive

Referring to Fig. 5.2...

1) Ensure the micrometer drive rod is fully retracted.
2) Insert the drive into the mounting block.
3) Tighten the securing screws.

5.3.2 Fitting a Stepper Motor Drive

Referring to Fig. 5.2...

1) Remove the manual drive attachment block (if fitted).
2) Ensure the drive rod is fully retracted.
3) Fit the drive to the stage using the bolts provided.
4) Tighten the bolts.

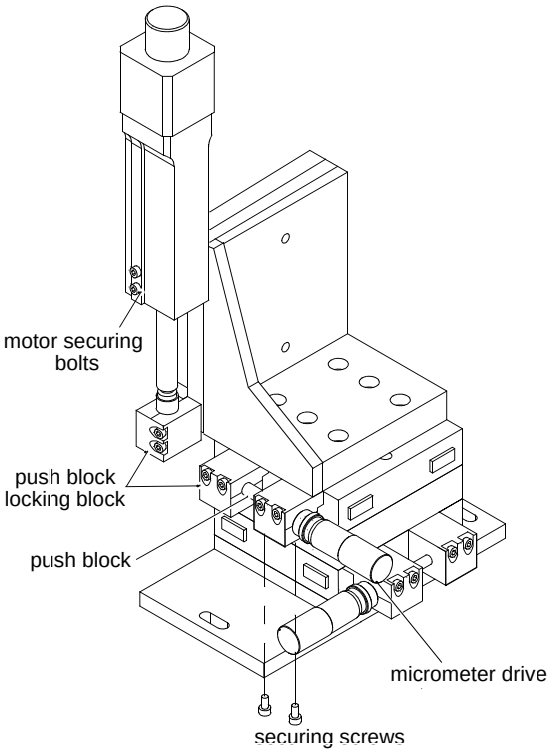


Fig. 5.2 Fitting a drive

5.4 Mounting Equipment to the Stage

Caution.

- The weight attached to the moving platform must not exceed 10 kg.
- Do not apply excessive forces to the moving platform.

Thorlabs manufacture a variety of fibre chucks, holders and fixtures to fit the linear stage. All of these accessories are mounted to the stage via a top platform, see Fig. 5.3.

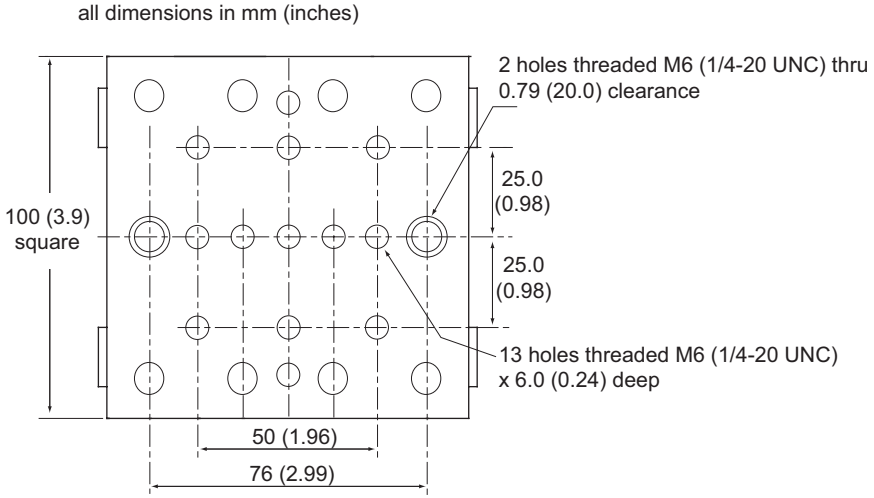


Fig. 5.3 Top platform

5.5 Transportation

Caution.

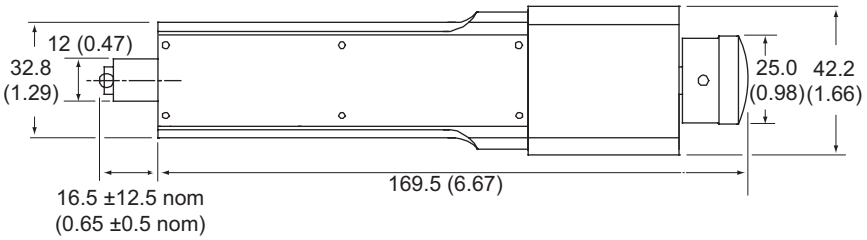
- The drives should be removed before transporting the stage.
- When packing the unit for shipping, use the original packing. If this is not available, use a strong box and surround the stage with at least 100 mm of shock absorbent material.

5.6 Dimensions

5.6.1 Motors

all dimensions in mm (inches)

DRV013 trapezoidal screw drives



DRV014 trapezoidal screw drives

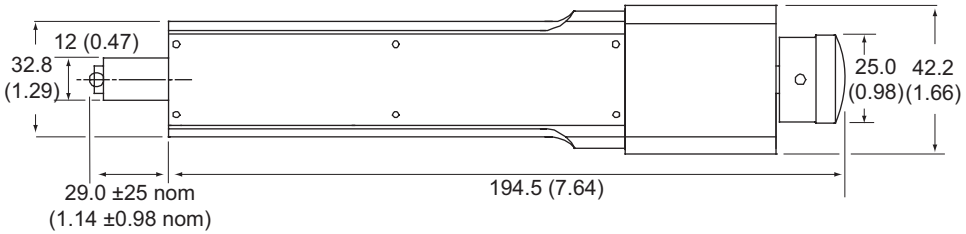


Fig. 5.4 Dimensions – stepper motor drives

all dimensions in mm (inches)

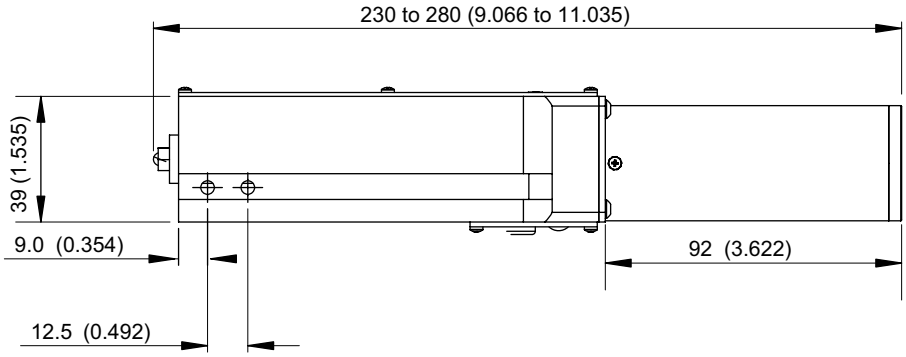
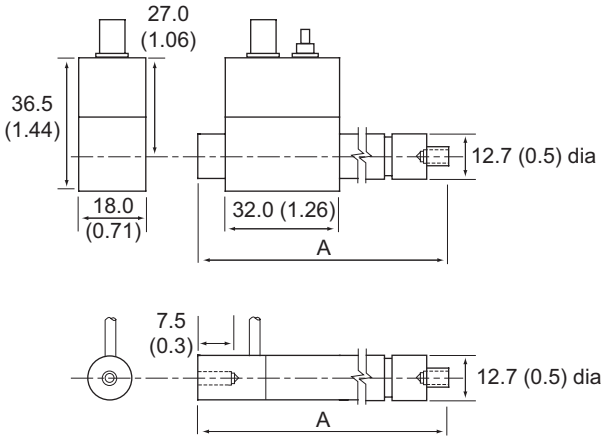


Fig. 5.5 Dimensions – DC motor drives

5.6.2 External Piezo Actuators

all dimensions in mm (inches)



Standard actuator	Length A mm (in.)	Feedback actuator	Length A mm (in.)
PAS020	42 (1.65)	PAZ020	60 (2.36)
PAS040	60 (2.36)	PAZ040	78 (3.07)
PAS100	114 (4.49)	PAZ100	132 (5.2)

Fig. 5.6 Dimensions – piezo actuators

dimensions in mm (inches)

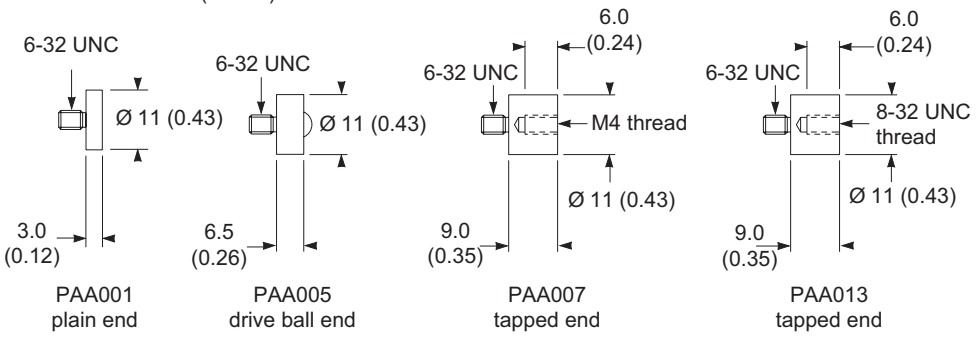
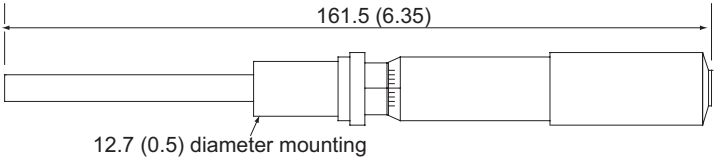


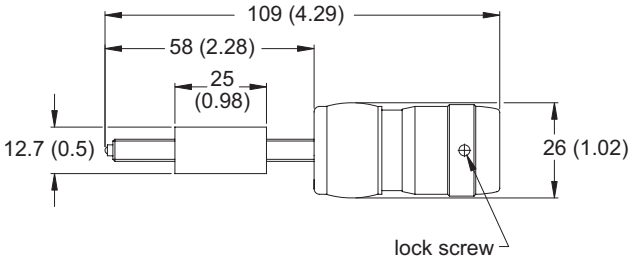
Fig. 5.7 Dimensions – end tips

5.6.3 Manual Drives

all dimensions in mm (inches)



Micrometer drive

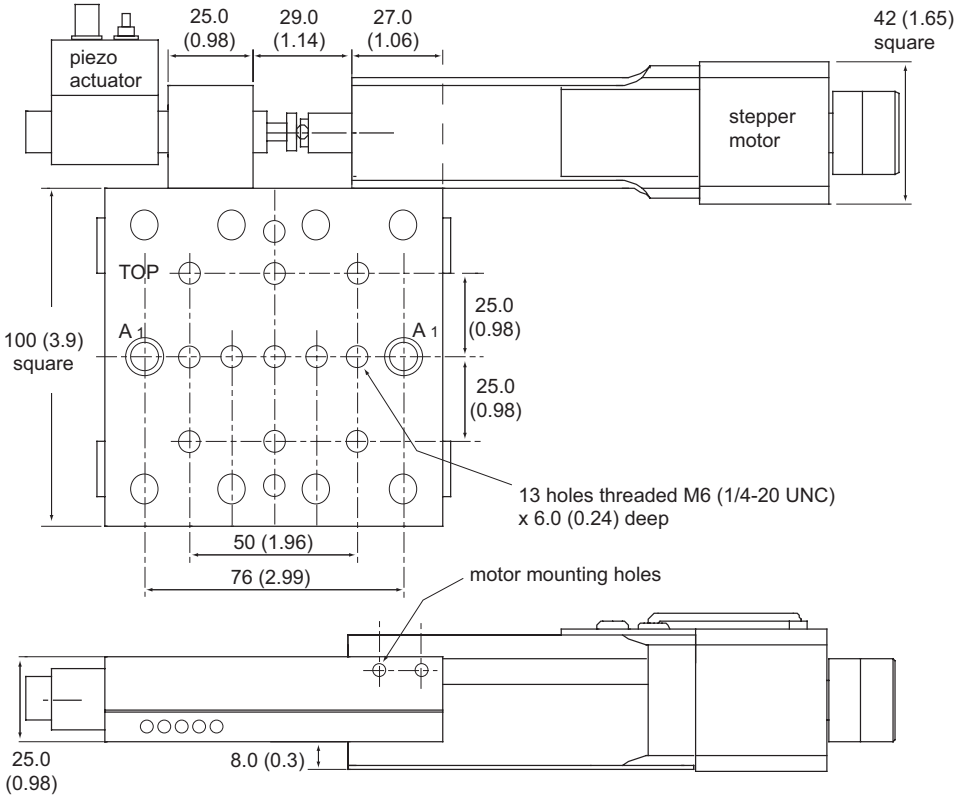


Differential drive

Fig. 5.8 Dimensions – manual drives

5.6.4 LNR50 Linear Stage

all dimensions in mm (inches)



Notes.

1) 2 holes 'A' (M6 or 1/4in.) 20mm clearance for mounting stages to tables or for X-Y and X-Y-Z configurations.
2) Spacer plates are required between and below stages when fitting stepper motor drives.

Fig. 5.9 Dimensions – LNR50 series linear stage (shown with stepper motor drive fitted)

Chapter 6

Specifications

6.1 General Specifications

Travel	2" (50 mm)
Max Horizontal Load Capacity	66 lb (30 kg)
Weight (without drives):	3.96 lb (1.8 kg)

6.2 Piezoactuated Stage Specifications



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

Maximum Input Voltage	75 V
Operating Temperature	–20°C to 80°C

6.3 Stepper Motor Stage Specifications

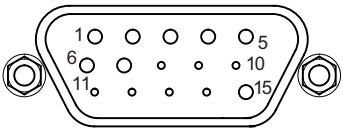
Max Velocity	8 mm/sec
Min Incremental Movement:	0.05 µm
Backlash	<6 µm
Absolute On-axis Accuracy	10 µm
Bidirectional Repeatability	0.5 µm
Home Switch Accuracy:	± 1µm

6.4 DC Motor Stage Specifications

Max Velocity	50 mm/sec
Min Incremental Movement:	0.2 µm
Absolute On-axis Accuracy	83 µm
Backlash	<11 µm
Bidirectional Repeatability	5 µm
Home Switch Accuracy:	<10 µm

6.5 Stepper Motor Connector Pin Out

The 'Motor' connector provides connection to the Stepper motor controller. The pin functions are detailed in Fig. 6.1.

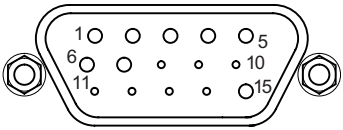


Pin	Description	Pin	Description
1	Ground/Return	6	Encoder A -
2	CCW Limit Switch	7	Encoder A +
3	CW Limit Switch	8 to14	Not Used
4	Encoder B -	15	Braid/Screen
5	Encoder B +		

Fig. 6.1 Stepper Motor Connector Pin Descriptions

6.6 DC Motor Connector Pin Out

The 'Motor' connector provides connection to the Stepper motor controller. The pin functions are detailed in Fig. 6.2.



Pin	Description	Pin	Description
1	Ground/Return	9	Encoder A +
2	CCW Limit Switch	10	Encoder A -
3	CW Limit Switch	11	Encoder B +
4	Motor +	12	Encoder B -
5	Motor -	13	5V
6	Encoder A -	14	
7	Encoder A +	15	Braid/Screen
8			

Fig. 6.2 DC Motor Connector Pin Descriptions

Parts and Consumables

7.1 Parts List

Description	Part Number
Base plate	LNR50P1
Angle bracket	LNR50P2
Spacer (to allow x-y mounting)	LNR50P3
SMC connector lead	166038
LEMO connector lead	134667
Mounting cleat	131030
Cable clamp	120992
25mm Travel Stepper motor	DRV013
50mm Travel Stepper motor	DRV014
50mm Travel DC Servo Motor	DRV414
Piezo Actuators	See Section 3.1.2.
Handbook	ha0106T

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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.

THORLABS

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