THORLABS

LNR502(/M) Linear Long-travel Translation Stage with Stepper Motor Actuator

User Guide

Original Instructions

Contents

Chaper 1 Safety 3
1.1 Safety Information 3
1.2 General Warnings 3

Chaper 2 Getting Started 4
2.1 Linear Long-travel Translation Stage 4

Chaper 3 Operation 8
3.1 Manual Differential Drives and Differential Micrometer Drives 8
3.2 Motor Drives 8
3.3 Piezo Actuators 10

Chaper 4 Installation 11
4.1 Unpacking 11
4.2 Mounting 11
4.3 Fitting and Removal of Drives 17
4.4 Reconfiguring the Actuator Position 18
4.5 Mounting Equipment to the Stage 21
4.6 Transportation 21
4.7 Dimensions 22

Chaper 5 Specifications 26
5.1 General Specifications 26
5.2 Piezoactuated Stage Specifications 26
5.3 Stepper Motor Stage Specifications 26
5.4 DC Motor Stage Specifications 26
5.5 Stepper Motor Connector Pin Out 27
5.6 DC Motor Connector Pin Out 27

Chaper 6 Parts and Consumables 28
6.1 Parts List 28

Chaper 7 Regulatory 29
7.1 Declarations Of Conformity 29
7.2 Waste Electrical and Electronic Equipment (WEEE) Directive 30

Chaper 8 Thorlabs Worldwide Contacts 32

Chapter 1 Overview

1.1 Linear Long-travel Translation Stage

The LNR502 single-axis linear long travel stage has been designed to integrate seemlessly into the Thorlabs modular electronic or benchtop positioning 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, XZ or XYZ configurations for applications where movement is required in more than one axis..

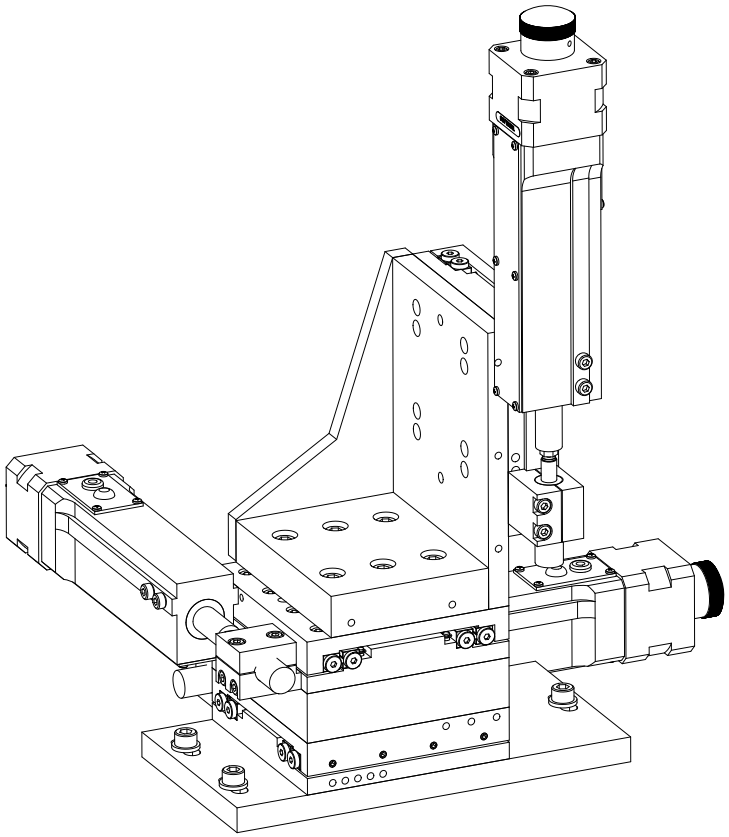


Fig. 1.1 LNR502 linear long travel stage – typical XYZ configuration

Chapter 2 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 throughout the handbook and on the equipment itself.



Warning: Risk of Electrical Shock

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.

2.2 General Warnings



Warning

These Motorized Actuators can generate high forces. If handled improperly, they may cause injury. Be aware that failure of the motor controller may drive the unit into a hard stop and cause damage to the unit.

To avoid injury never put anything in the gap between the Actuator and any rigid structure.

Because it can be software controlled it should be noted that this device could begin to move unexpectedly for a person within its envelope of operation, who had not programmed the move.



Warning

If this equipment is used in a manner not specified in the handbook, 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.

The equipment is for indoor use only.



Caution

If the actuator encounters a hard stop while still in the middle of its range (i.e. a translation stage at the end of its travel range), the motor should be stopped as soon as possible to prevent damage and to keep the unit from overheating



Caution

When storing these units, be sure to fully retract the lead screw to protect the threads from damage. Improper connection of the motor will result in permanent damage. All power supplied to the motor should be turned off before altering any connections to the motor. Check all connections before supplying power to the motor.

Chapter 3 Operation

3.1 Selecting the Stage Type

To ensure that a particular stage is driven properly by the system, a number of parameters must first be set. These parameters relate to the physical characteristics of the stage being driven (e.g. min and max positions, leadscrew pitch, homing direction etc.).

To assist in setting these parameters correctly, it is possible to associate a specific stage type and axis with the motor controller channel. Once this association has been made, the server applies automatically, suitable default parameter values on boot up of the software.

Note

To ensure correct operation, it is important to select the correct stage and axis type as described above. Selecting an incompatible stage/axis type could result in reduced velocity and/or resolution, and in the worst case could cause the motor to run into the end stops or home incorrectly.

Using Kinesis Software

1) Install the electronic hardware and connect the modules to the relevant axes of the associated stages (see the handbooks for the associated controller).
2) For each Stepper Motor Controller in your system, fit the interlock plug (supplied) to the MOTOR CONTROL connector on the rear panel.
3) Ensure that the device is connected to the PC and powered up.
4) Run the Kinesis software - Start/All Programs/Thorlabs/Kinesis/Kinesis.
5) On start-up, the 'Actuator/Startup Settings' window is displayed This window allows the correct actuator to be selected.

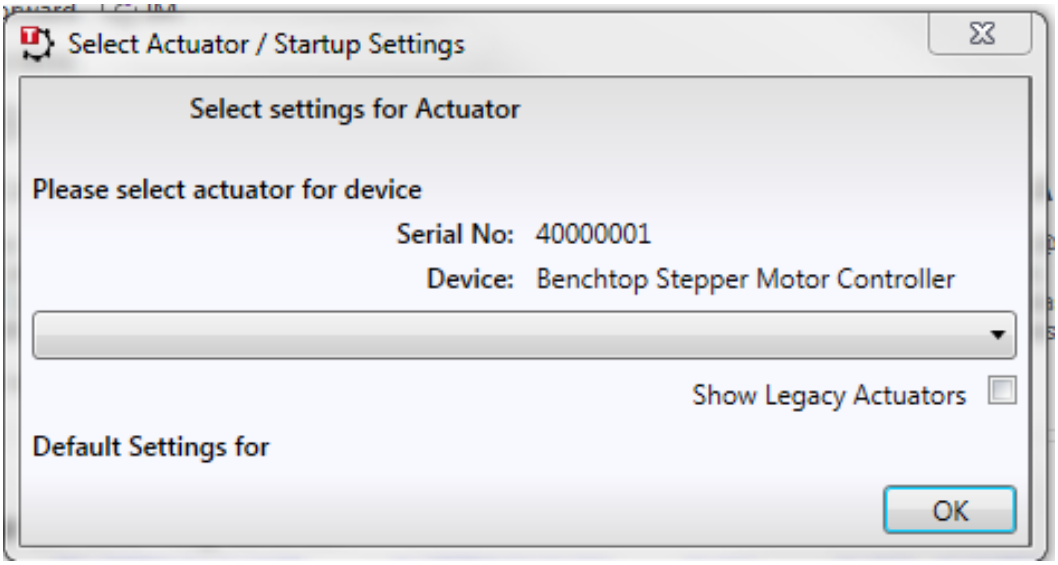


Fig. 3.1 Select Actuator Stage Settings Window - 1

6) Click the arrow to the right of the window, and select your actuator type (e.g. DRV225 or DRV250) from the list displayed.

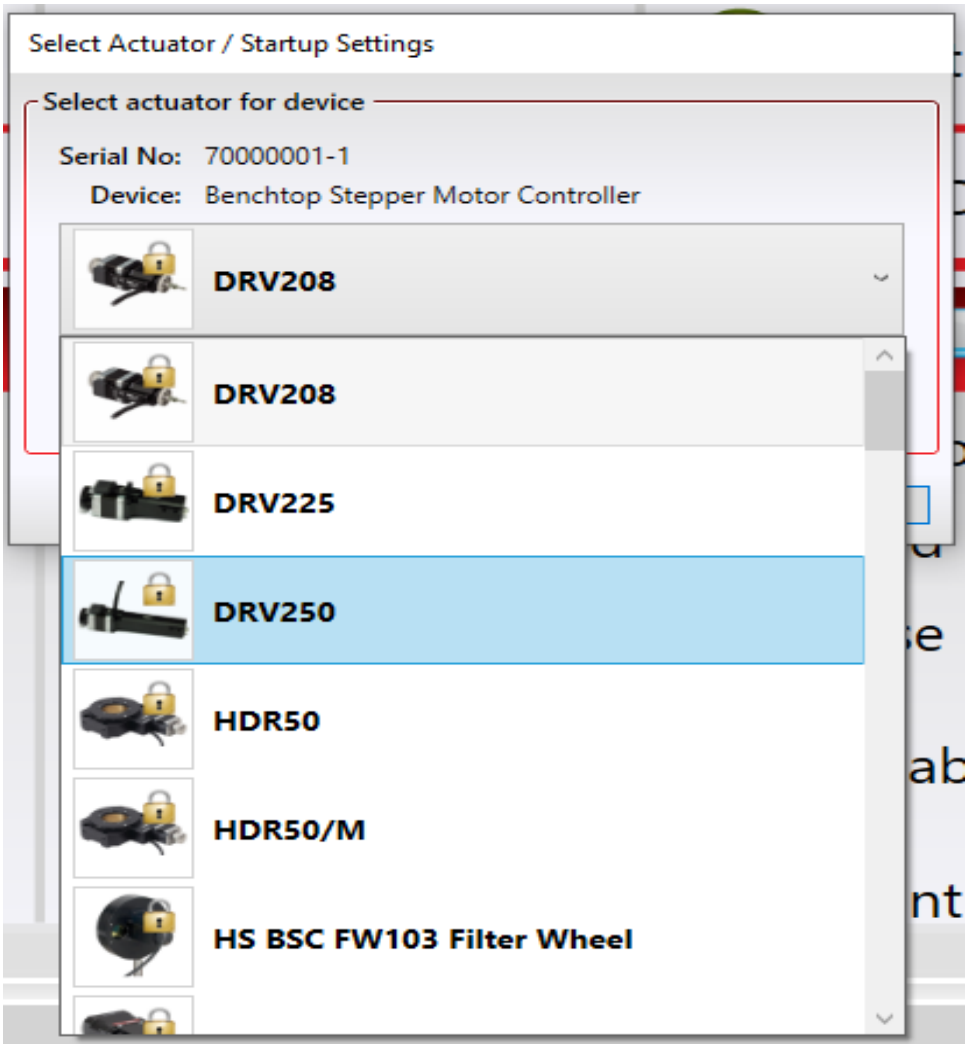


Fig. 3.2 Select Actuator Stage Settings Window - 2

7) Click OK.
8) The server reads in the stage and controller information automatically.
refer to the handbook for the associated controller for more information on driving the actuator/stage.

3.2 Maintenance

Note

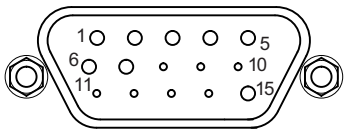
No customer serviceable parts. Return to manufacturer for service.

After prolonged use, and particularly in applications where small movements are continually repeated, the grease on the drive shaft may build up. This may cause rough or noisy movement, vibration and excessive heating.

It is good practise to run the motor periodically from one end of travel to the other several times in order to redistribute the grease.

3.3 Pin Assignments

Pin assignments for the male D-Type connector on the motor flying lead are described below..



Pin	Description	Pin	Description
1	Limit Ground *	**9**	Reserved for Future Use
2	CCW Limit Switch	**10**	Reserved for Future Use
3	CW Limit Switch	**11**	Reserved for Future Use
4	Motor Phase B -	**12**	Reserved for Future Use
5	Motor Phase B +	**13**	Reserved for Future Use
6	Motor Phase A -	**14**	Reserved for Future Use
7	Motor Phase A +	**15**	Ground
8	Reserved for Future Use		

Note * The limit switch ground wire is connected to the motor body.

Fig. 3.3 Output Connector

3.4 Extension Cables

The motor is supplied with a 0.5m flying lead and a 3 m (PAA613) extension cable. Additional extension cables are available separately - see www.thorlabs.com for more details.

Chapter 4 Installation

4.1 Unpacking

Caution

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

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.

Note

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

4.2 Environmental Conditions

Warning

Operation outside the following environmental limits may adversely affect operator safety.

Location	Indoor use only
Maximum altitude	2000 m
Temperature range	5°C to 40°C
Maximum Humidity	Less than 80% RH (non-condensing) at 31°C

To ensure reliable operation the unit should not be exposed to corrosive agents or excessive moisture, heat or dust.

If the unit has been stored at a low temperature or in an environment of high humidity, it must be allowed to reach ambient conditions before being powered up.

The unit must not be used in an explosive environment.

4.3 Mounting

4.3.1 General

The LNR502 series stages are mounted to the work surface as shown using a base plate. For additional versatility, an angle bracket is available for use in vertical mounting configurations - see Section 4.3.4. When mounting the stage close to other equipment, ensure that the travel of the moving platform is not obstructed. If equipment mounted on the moving platform is driven against a solid object, damage to the internal mechanism could occur.

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

The stage is shipped with the drives configured for right handed use, however they can be repositioned for applications where left handed use is more convenient - see Section 4.5. for more details.

Caution

When mounting components, or fitting the stage within an application, do not apply excessive pressure to the moving platform as this may damage the bearing mechanism.

Note

The LNR series stages can quickly be assembled into XY, XZ, YZ and XYZ configurations - see Section 3.3.3. and Section 3.3.4. The brackets and plates are supplied complete with dowels, which ensure an accurate, orthogonal assembly.

4.3.2 Mounting to the Work Surface

Referring to Fig. 4.1, proceed as follows:

1) Turn the motor knob to position the moving carriage central in its range of travel, and ensure that the mounting holes in the base are clearly visable through the holes in the top plate.
2) Fit the dowels supplied to the base plate (LNR50P4).
3) Position the stage on the base plate, ensuring that the dowels locate correctly in the holes in the lower surface of the stage.
4) Fit two bolts (M6 x 12 or 1/4-20 x 1/2”, not supplied) through the holes in the top plate and into the base plate. Tighten to secure the stage in place.

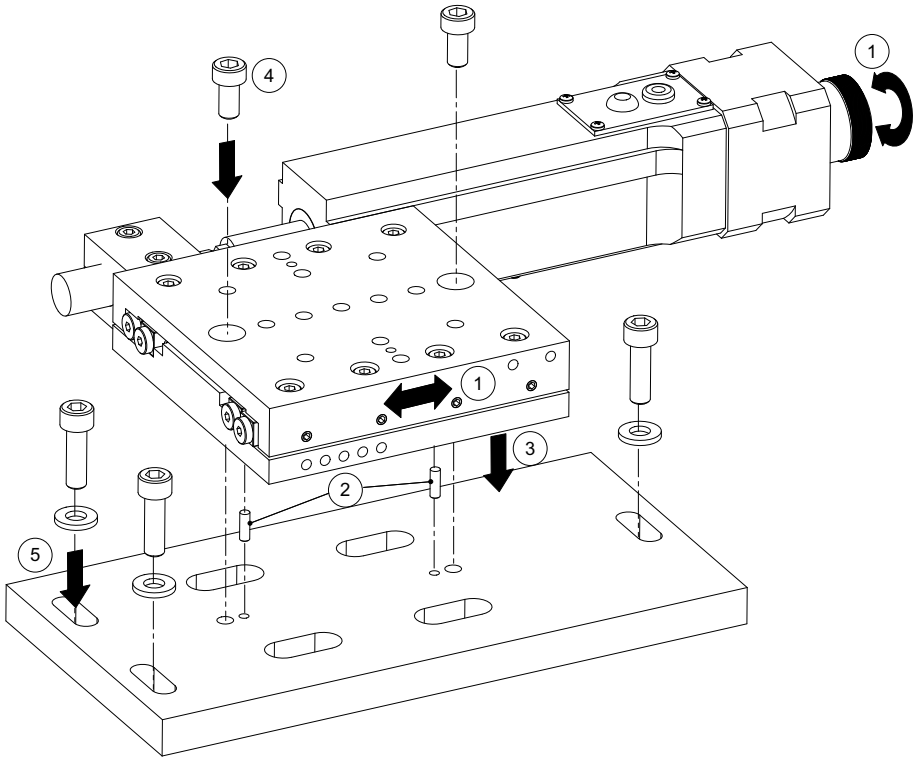


Fig. 4.1 Fitting the base plate

5) Fit three bolts (M6 or 1/4-20, not supplied) through each end of the base plate to fix the stage to the work surface.
6) To remove the base plate, reverse the procedure above.

4.3.3 Building an XY Configuration

Bolt the X-axis stage to the work surface as detailed in Section 4.3.2. then, referring to Fig. 4.2, proceed as follows:

1) Fit the dowels supplied to the moving platform of the lower stage.
2) Fit the spacer plate (LNR50P3) into place as shown below, ensuring that the dowels in the lower stage locate correctly in the holes in the bottom surface of the spacer plate.
3) Fit a bolt (M6 x 12 or 1/4-20 x 1/2", not supplied) through the hole in the center of the spacer plate and into the top platform of the lower stage. Tighten the bolt to secure the plate in position.

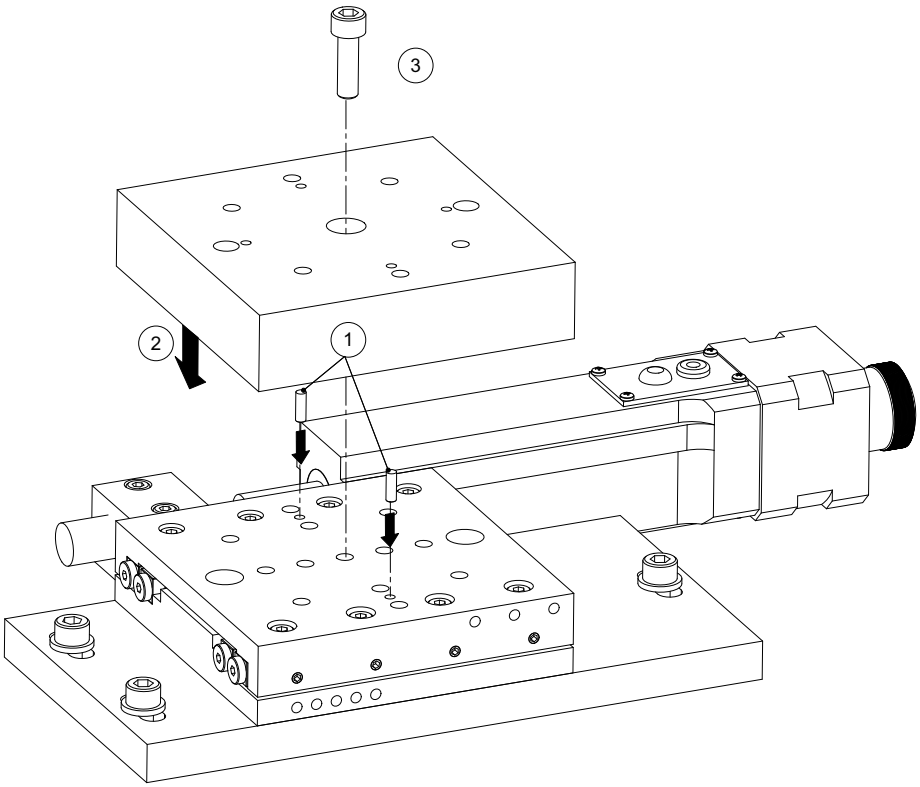


Fig. 4.2 Fitting a Spacer Plate

4) Fit the dowels supplied to the top surface of the spacer plate.
5) Fit the Y-axis stage into place ensuring that the dowels in the spacer plate locate correctly in the holes in the lower surface of the stage.
6) Fit two bolts (M6 x 12 or 1/4-20 x 1/2”, not supplied) through the holes in the upper stage and tighten to secure the stage to the spacer plate beneath.

Caution

Use only bolts of the stated length. Longer bolts will protude into the stage and damage the internal mechanism.

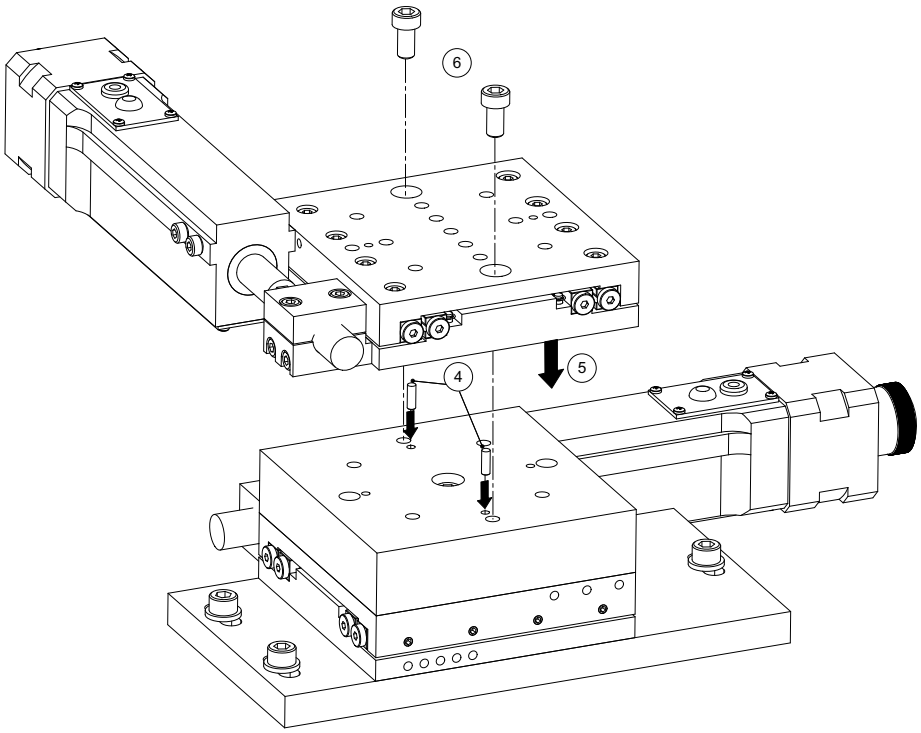


Fig. 4.3 Fitting the Y-Axis Stage

4.3.4 Building an XYZ Configuration

Assemble an XY configuration as detailed in Section 4.3.3. then, referring to Fig. 4.4, and Fig. 4.5 proceed as follows:

1) Fit the dowels supplied, into the moving platform on the upper stage of the XY assembly.
2) Fit the angle bracket (LNR50P2) onto the moving platform of the stage, ensuring that the dowels fitted at item (1) locate correctly in the holes on the underside of the angle bracket..

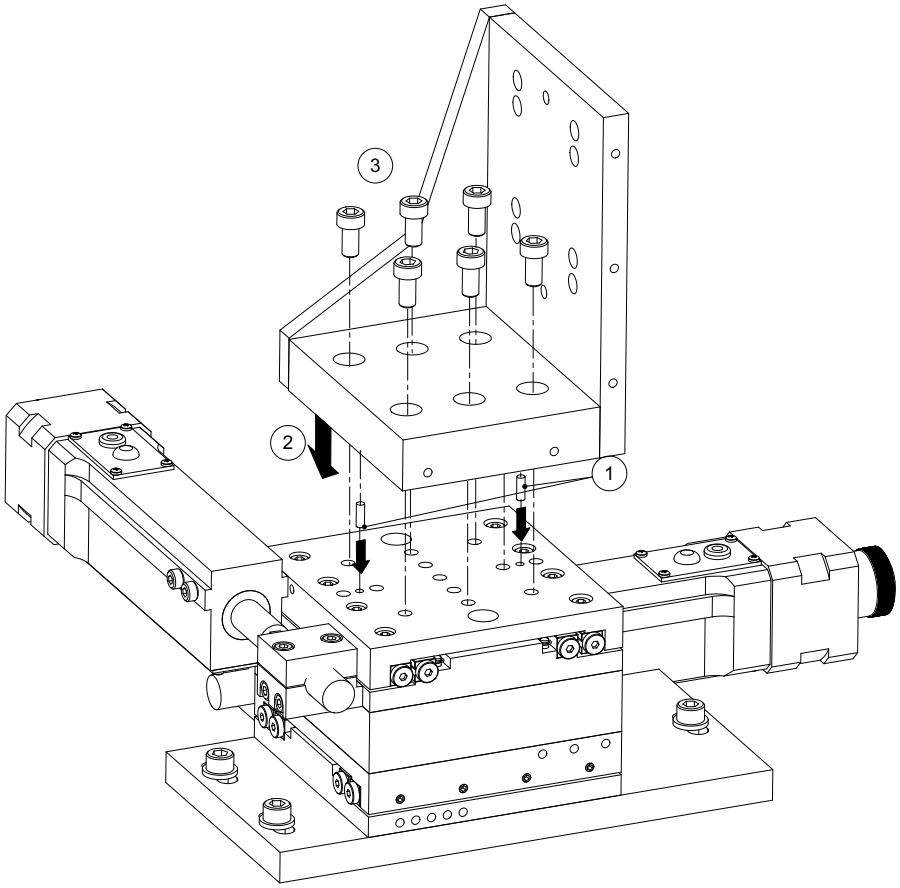


Fig. 4.4 Fitting the Angle Bracket

3) Fit six bolts (M6 x 16 or 1/4-20 x 5/8”, not supplied), through the holes in the base of the angle bracket, and tighten to secure the bracket to the XY assembly.

Caution

Use only bolts of the stated length. Longer bolts will protrude into the stage and damage the internal mechanism.

4) Fit the dowels supplied into the holes in the back surface of the angle bracket.
5) Fit the vertical-axis stage into place ensuring that the dowels fitted at item (4) locate correctly in the holes on the underside of the stage.

6) Fit two bolts (M6 x 12 or 1/4-20 x 1/2”, not supplied), through the holes in the top plate, and screw into the rear face of the angle bracket.

Caution

Use only bolts of the stated length. Longer bolts will protude into the stage and damage the internal mechanism.

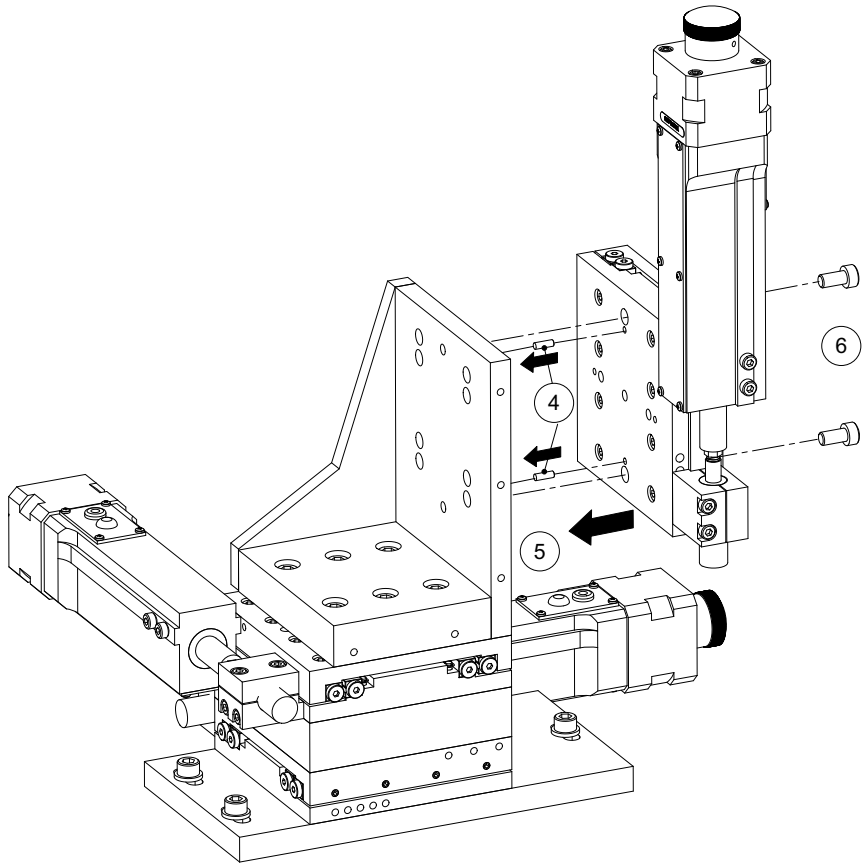


Fig. 4.5 Adding a Vertical Axis Stage

4.4 Fitting and Removal of Drives

1) Remove the motor mounting bolts.
2) Remove the exisiting drive.
3) Fit the replacement drive.
4) Refit the motor mounting bolts.

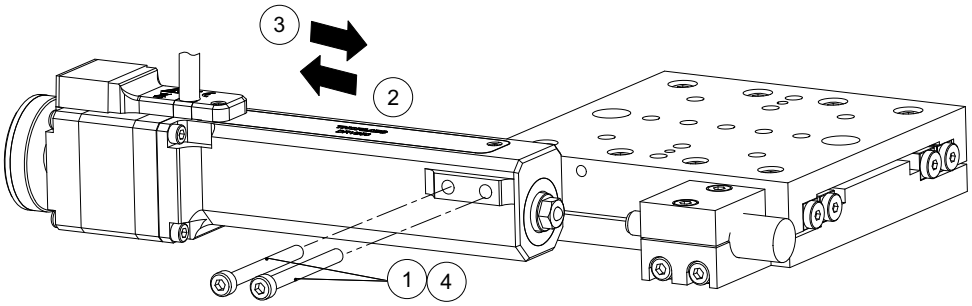


Fig. 4.6 Fitting/removing a motor drive

4.5 Reconfiguring the Actuator Position

The stage is shipped with the drives configured for a right handed configuration, however they can be repositioned for left handed use. This is achieved by swapping the position of the actuator clamp and the push block as follows:

Referring to Fig. 4.7:

1) Remove the actuator as detailed in Section 4.4.
2) Loosen the push block pinch bolts.
3) Remove the push block.
4) Undo the push block mounting bolts and remove the push block mounting block.

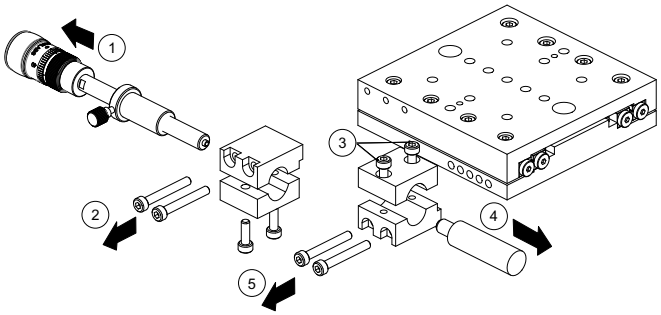


Fig. 4.7 Removing the Actuator Clamp and Push Block

Referring to Fig. 4.8 on the next page:

5) Refit the push block mounting block on the opposite side of the stage as shown in Fig. 4.8 and tighten the attachment bolts.
6) Refit the push block pinch bolts but do not tighten.
7) Refit the push block, then tighten the push block pinch bolts.
8) Refit the motor actuator, and tighten the mounting bolts.
9) Turn the motor knob until 25 mm of drive shaft is protruding.
10) Loosen the push block pinch bolts and position the push block such that the stage is in its center of travel.
11) Tighten the push block pinch bolts.

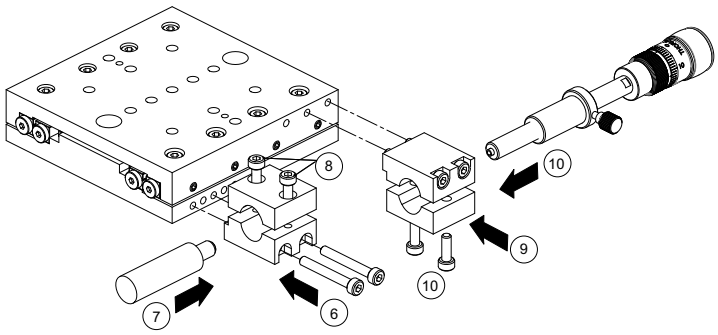


Fig. 4.8 Reconfiguring the Actuator Position

4.6 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. 4.9.

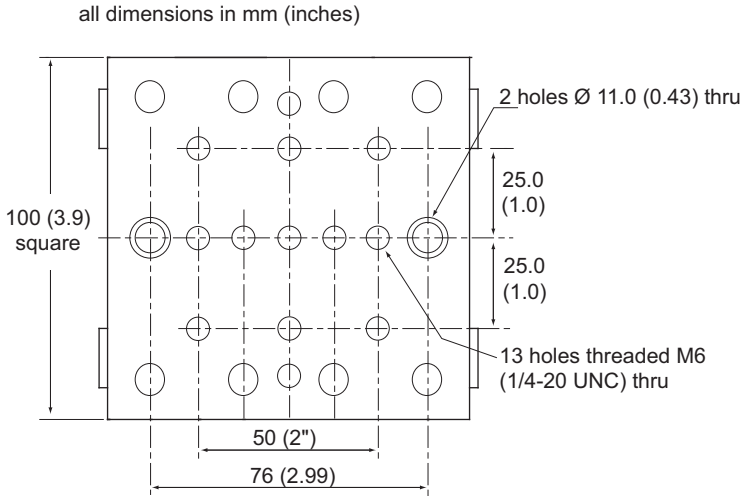


Fig. 4.9 Top platform

4.7 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.

4.8 Preventive Maintenance

Warning

The equipment contains no user servicable parts. There is a risk of severe electrical shock if the equipment is operated with the covers removed. Only personnel authorized by Thorlabs Ltd and trained in the maintenance of this equipment should attempt any repairs or adjustments. Maintenance is limited to scleaning as described in the following sections.

Chapter 5 Specifications

5.1 Specifications

Specification	DRV250
Travel Range	50 mm
Backlash	<6 µm
Lead Screw	1 mm Pitch, Trapezoidal
Bidirectional Repeatability	±3.9 µm
Full Step Angle	1.8°
Microsteps per Revolution	409,600
Step Angle Accuracy	5%
Rated Phase Current	1 A
Resistance/ Phase	3.6 Ohms
Inductance / Phase	4.6 mH
Holding Torque	23.1 N•cm
Detent Torque	1.7 N•cm
Rotor Inertia	32 g•cm^2
Max Vertical Load Capacity	10 kg
Max Horizontal Load Capacity	25 kg
Max Speed[a]	20.0 mm/sec
Min. Incremental Movement[b]	50.0 nm
Motor Type	2 Phase Stepper
Insulation Class	B
Limit Switches	Hall Effect
Weight	3.96 lb (1.8 kg)
Compatible Controllers	BSC201, BSC202, BSC203, MST602

a.This is the maximum speed set by default when used with one of our stepper motor controllers. By adjusting settings on the controller, the maximum speed may be set to as high as 50 mm/s.

b.Valid if used with one of our stepper motor controllers.

5.2 How to Calculate the Linear Displacement

The DRV series motors have 200 full steps per revolution and when driven by the BSC20x or MST602 drivers there are 2048 microsteps per full step, giving 409,600 microsteps per revolution of the motor lead screw. The lead screw pitch is 1.0 mm

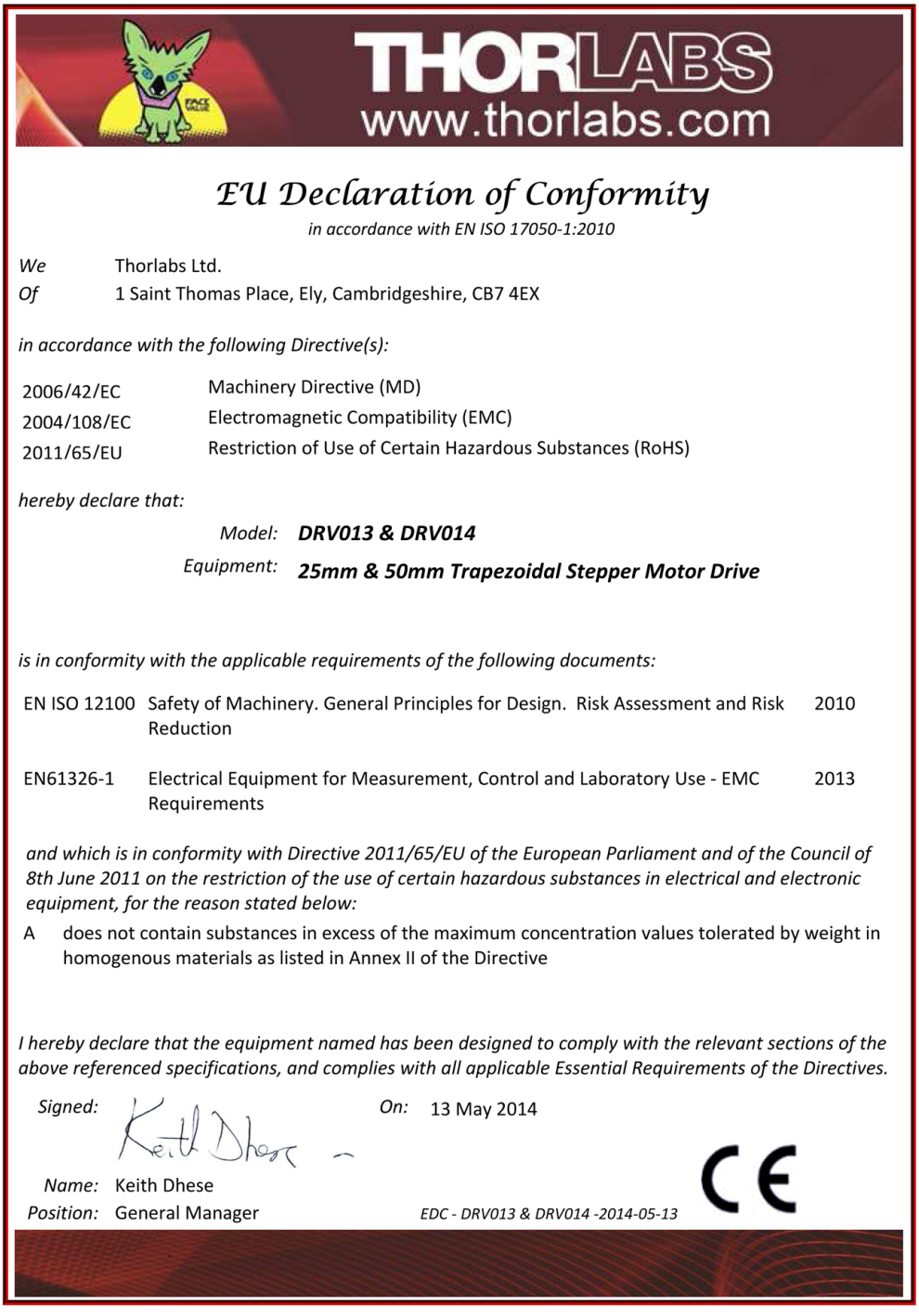
The linear displacement of the lead screw per microstep:

1 / 409600 = 2.4 x 10^{-6} mm

Chapter 6 Regulatory

6.1 Declarations Of Conformity

6.1.1 For Customers in Europe



THORLABS
www.thorlabs.com

EU Declaration of Conformity

in accordance with EN ISO 17050-1:2010

We Thorlabs Ltd.
Of 1 Saint Thomas Place, Ely, Cambridgeshire, CB7 4EX

in accordance with the following Directive(s):

2006/42/EC	Machinery Directive (MD)
2004/108/EC	Electromagnetic Compatibility (EMC)
2011/65/EU	Restriction of Use of Certain Hazardous Substances (RoHS)

hereby declare that:

Model: ***DRV013 & DRV014***

Equipment: ***25mm & 50mm Trapezoidal Stepper Motor Drive***

is in conformity with the applicable requirements of the following documents:

EN ISO 12100	Safety of Machinery. General Principles for Design. Risk Assessment and Risk Reduction	2010
EN61326-1	Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements	2013

and which is in conformity with Directive 2011/65/EU of the European Parliament and of the Council of 8th June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, for the reason stated below:

A does not contain substances in excess of the maximum concentration values tolerated by weight in homogenous materials as listed in Annex II of the Directive

I hereby declare that the equipment named has been designed to comply with the relevant sections of the above referenced specifications, and complies with all applicable Essential Requirements of the Directives.

Signed: Keith Dhese *On:* 13 May 2014

Name: Keith Dhese
Position: General Manager

CE

EDC - DRV013 & DRV014 -2014-05-13

6.1.2 For Customers In The USA

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant 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.

Chapter 7 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at www.thorlabs.com/contact for our most up-to-date contact information.



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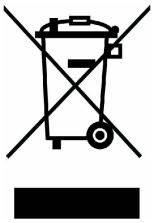
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Thorlabs verifies our compliance with the WEEE (Waste Electrical and Electronic Equipment) directive of the European Community and the corresponding national laws. Accordingly, all end users in the EC may return "end of life" Annex I category electrical and electronic equipment sold after August 13, 2005 to Thorlabs, without incurring disposal charges. Eligible units are marked with the crossed out "wheelie bin" logo (see right), were sold to and are currently owned by a company or institute within the EC, and are not dissembled or contaminated. Contact Thorlabs for more information. Waste treatment is your own responsibility. "End of life" units must be returned to Thorlabs or handed to a company specializing in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.





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