

MTS25-Z8 and MTS50-Z8 Brushed DC Motorized Translation Stages



Original Instructions

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Chapter 1 Overview

1.1 Introduction

The compact, motorized MTS Series stages feature a dual set of linear rails with continuously recirculating ball bearings on a moveable carriage. This mechanism provides smooth, low friction movement and ensures high load capacity.

The drive power is provided by a brushed DC servo motor. A built-in hall effect encoder provides 12,288 counts per revolution and a single encoder count represents 29 nm of motion; the actual minimum repeatable incremental movement of the stage itself is 0.8 μm .

The addition of limit switches on the stage ensures controlled motion within the parameters of the unit and prevents overdriving in both directions. Two travel ranges are available: 25 mm (1") and 50 mm (2"). The stages are configurable in XY, XZ, and XYZ in both left- and right-handed configurations using spacer plates (MTS25B-Z8 and MTS50B-Z8) and angle brackets (MTS25C-Z8 and MTS50C-Z8) available separately). Base plates (MTS25A-Z8 and MTS50A-Z8) allow the stages to be bolted directly to an optical table. For added flexibility, both sizes of travel stages can be configured together.

For attachment to other stages or fittings, please contact Tech Support.



Fig. 1.1 Typical MTS stage and driver set up

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**

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 absorbent tissue. Do not allow spilled fluid to enter the internal mechanism.

Chapter 3 Installation

Note

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



Caution

Once removed from its packaging, the stage can be easily damaged by mishandling. The unit should only be handled by its base, not by any attachments to the moving platform.

3.1 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.

3.2 Mounting

3.2.1 Invalidation of Warranty



Caution

The moving platform features a locking screw for the anti-backlash nut inside the stage. This locking screw, highlighted in Fig 3.1, is set during assembly at the factory and must not be removed or adjusted. Tampering with this screw will invalidate the warranty.

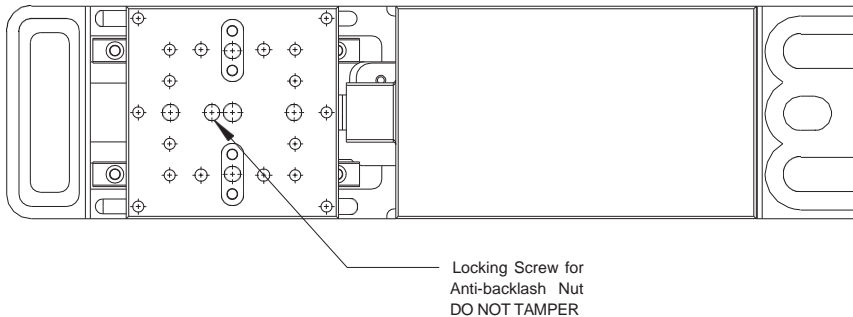


Fig. 3.1 Anti-backlash Nut Locking Screw

3.2.2 General

The MTS series stages can be mounted horizontally or vertically using the base plates, spacer plates and angle brackets previously mentioned - see Section 1.1. 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 is: MTS25 stages: 25 mm, MTS50 stages: 50 mm



Caution

The stages are set up and calibrated at the factory and no further adjustment is necessary.

Do not allow screws or other objects to protrude through the top platform as this could damage the internal mechanism.

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 MTS series stages can quickly be assembled into XY, XZ, YZ and XYZ configurations - see Section 3.2.4. and Section 3.2.5. The brackets and plates are supplied complete with dowels, which ensure an accurate, orthogonal assembly, and all bolts.

3.2.3 Connecting The Motor Driver

**Caution**

It is recommended that the MTS series stages be driven by the Thorlabs KDC101 DC Servo Motor Driver. If the stage is being driven by any other driver or controller, consult Section 6.1. for motor pin out details and Chapter 5 for details of the motor specification.

The stage is supplied with 0.5m (1.6 ft) of cable and is terminated in a 15 pin D-Type connector. This is compatible with the MOTOR drive terminal of the KDC101 K-Cube DC driver unit - see Fig. 3.2 below. A 2.5 m (8.2 ft) extension cable (PAA632) is available on request

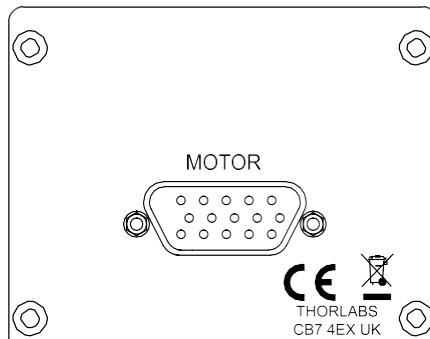


Fig. 3.2 KDC101 rear panel

3.2.4 Fitting and Removing the Base Plate

Referring to Fig. 3.3, proceed as follows:

- 1) Fit the dowels supplied to the base plate (MTS25A-Z8 or MTS50A-Z8).
- 2) Position the stage on the base plate, ensuring that the dowels locate correctly in the holes in the lower surface of the stage.
- 3) Fit the four bolts supplied M3 x 10 (4-40 x 1/2") through the holes in the underside of the base plate, and tighten to secure the stage in place.

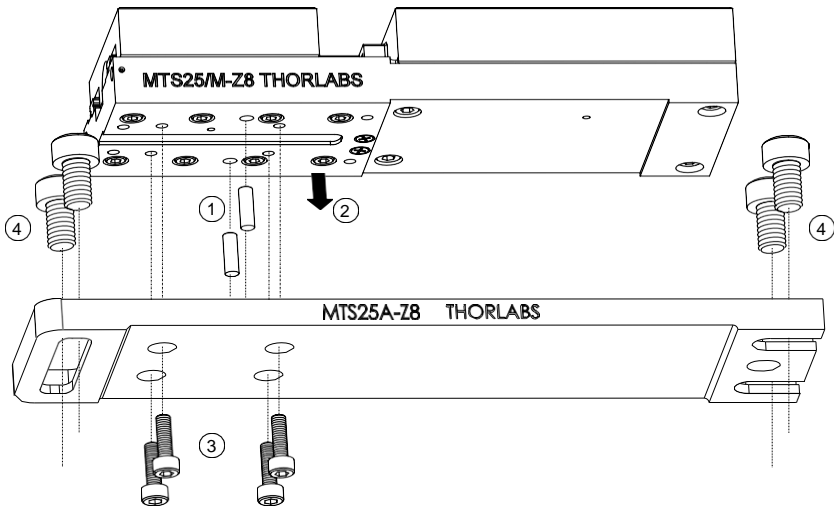


Fig. 3.3 Fitting the MTS25A-Z8 Base Plate

- 4) Fit two of the bolts supplied M6 x 10 (1/4-20 x 3/8") through each end of the base plate to fix the stage to the work surface.
- 5) To remove the base plate, reverse the procedure above.

3.2.5 Building an XY Configuration

Referring to Fig. 3.4, proceed as follows:

- 1) Fit the dowels supplied to the moving platform of the lower stage.
- 2) Note the orientation of the spacer plate in the drawing below, then fit the spacer plate (MTS25B-Z8 or MTS50B-Z8) to the moving platform of the lower stage, ensuring that the dowels locate correctly in the holes and protrude through the top surface of the spacer plate.
- 3) Fit the four bolts supplied M3 x 6 (4-40 x 1/4"), through the holes in the spacer plate, and tighten to secure the plate in place.
- 4) 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.

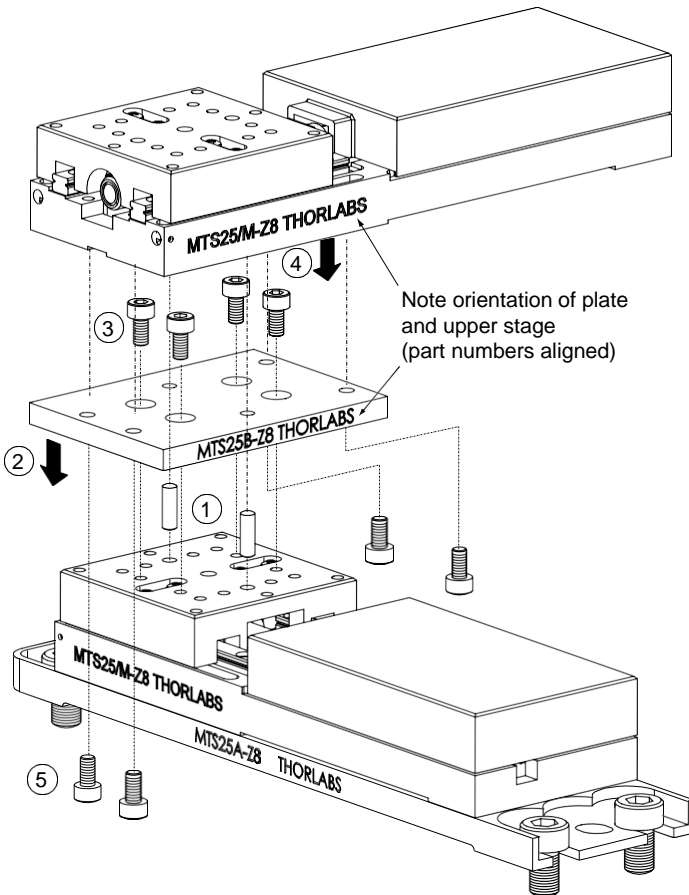


Fig. 3.4 Building an XY Configuration

- 5) Fit the four bolts supplied M3 x 6 (4-40 x 1/4") through the holes in the underside of the spacer plate and screw into the base of the upper stage.
- 6) Tighten the bolts to secure the stage in place.
- 7) Fit the base plate to the X-axis (lower) stage, and bolt the assembly to the worksurface as detailed in Section 3.2.4.

3.2.6 Building an XYZ Configuration

Assemble an XY configuration as detailed in Section 3.2.5. then, referring to Fig. 3.5, proceed as follows:

- 1) Fit the shorter dowels supplied, into the moving platform on the upper stage of the XY assembly.
- 2) Fit the angle bracket (MTS25C-Z8 or MTS50C-Z8) 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.

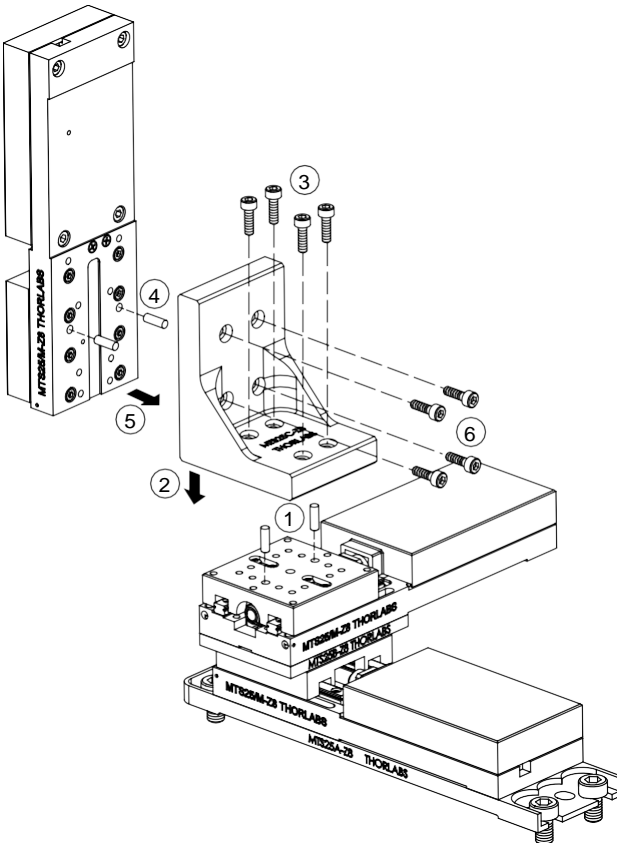


Fig. 3.5 Adding a Vertical Axis Stage

- 3) Fit the four bolts supplied M3 x 12 (4-40 x 1/2"), through the holes in the base of the angle bracket, and tighten to secure the bracket to the XY assembly.
- 4) Fit the longer dowels supplied to the underside of the base on the vertical-axis stage.
- 5) Fit the vertical-axis stage into place ensuring that the dowels fitted at item (4) locate correctly into the holes in the back surface of the angle bracket.
- 6) Fit the four bolts supplied M3 x 12 (4-40 x 1/2"), through the holes in the angle bracket, and screw into the base of the vertical-axis stage.
- 7) Tighten the bolts to secure the stage in place.
- 8) Fit the base plate to the X-axis (lower) stage, and bolt the assembly to the worksurface as detailed in Section 3.2.4.

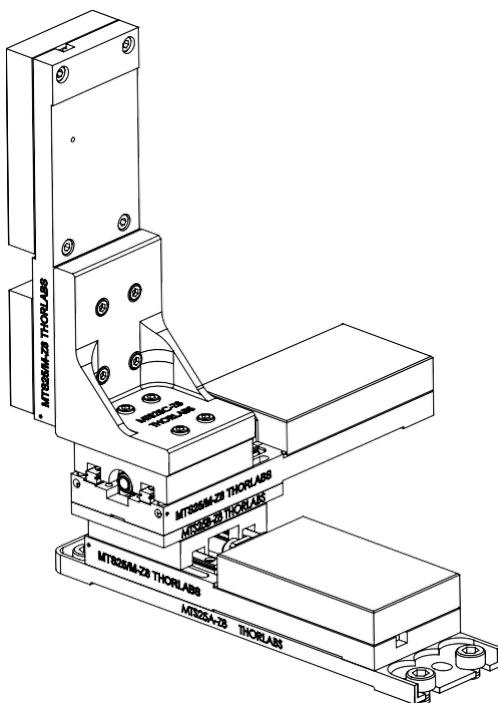


Fig. 3.6 Typical XYZ configuration

3.3 Transportation



Caution

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

3.4 Dimensions

3.4.1 MTS Dimensions

All dimensions are given in the format: inches (mm)

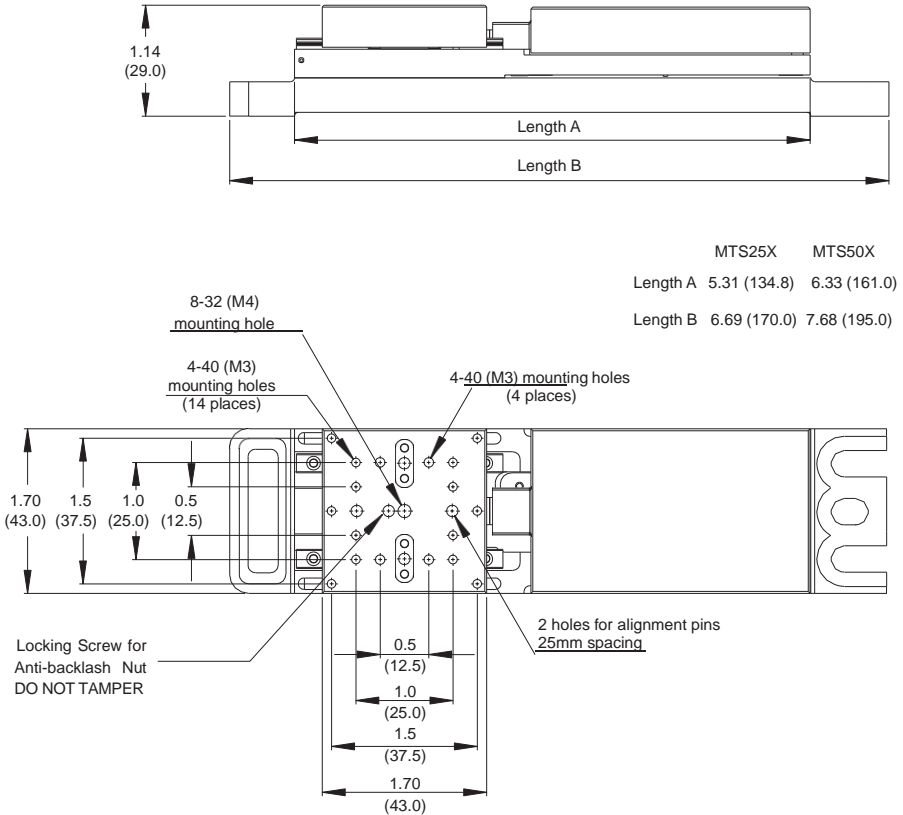


Fig. 3.7 Dimensions



Caution

The stages are set up and calibrated at the factory and no further adjustment is necessary. Do not allow screws or other objects to protrude through the top platform as this could damage the internal mechanism.

Chapter 4 Operation

4.1 General



Caution

The MTS series stages form part of the Thorlabs Nanopositioning system. We recommend they are driven by the Thorlabs KDC101 K-Cube Brushed DC Servo Motor Driver. If the stage is being driven by any other driver or controller, consult Section 6.1. for motor pin out details and Chapter 5 for details of the motor specification.

The stages are set up and calibrated at the factory and no further adjustment is necessary. Do not allow screws or other objects to protrude through the top platform as this could damage the internal mechanism.

The stages are connected to the controller via a flying lead terminated in a D-type connector.



Warning

The controller must be switched OFF before the stages are plugged in or unplugged. Failure to switch the controller off may result in damage to either the controller, the stage, or both.

For a complete tutorial on using the stage with a motor controller, see the relevant controller manual. Basic steps in controlling the stage are as follows:

- 1) Perform the mechanical installation as detailed in Section 3.2.
- 2) Connect the stage to the DC motor driver - see Section 3.2.3.
- 3) Connect the driver to the main supply and switch 'ON'.
- 4) Connect the driver unit to your PC.

Note

The USB cable should be no more than 3 meters in length. Communication lengths in excess of 3 meters can be achieved by using a powered USB hub.

- 5) When using the stages in conjunction with the recommended Thorlabs KDC101 controllers, two software options are available: Kinesis[®] and APT[™]. The initial start up routine is essentially the same in both cases, using the respective GUIs shown in Figure 4.1 and 4.2. These are activated by running:

Start/Programs/Thorlabs/APT User/APT User	for the APT GUI
Start/Programs/Thorlabs/Kinesis/Kinesis	for the Kinesis GUI

- 6) Check that the correct stage/actuator has been read, as displayed on the GUI (bottom right for Kinesis; bottom left for APT). If it hasn't, the stage may not operate correctly, and a manual intervention will be required (for details, refer to the relevant KDC101 controller handbook).



Fig. 4.1 APTUser GUI screen

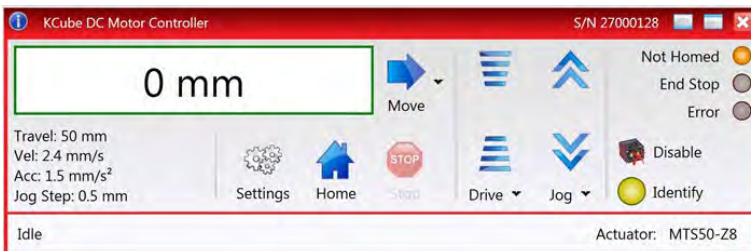


Fig. 4.2 Kinesis GUI screen

- 7) Move the stage to its home position by pressing “Home” on the GUI, to establish the zero-datum point. Pay special attention to the Caution note below with regards to **not** using the jog buttons for this operation.



Caution

During item (7) the stage should be homed using the button on the GUI panel. Do not jog the stage to the zero-position using the jog buttons as this could establish a false zero datum; there is also a risk that the stage could overshoot its end stops and become stuck.

The stage is now ready for use and/or implementation of parameter changes, as detailed in the relevant Kinesis/APT manual for the KDC101 controller.

Chapter 5 Specifications

5.1 Stage Specifications

Parameter	Value	
	MTS25(M)	MTS50(M)
Stage		
Travel Range	25 mm (1")	50 mm (2")
Bidirectional Repeatability	±0.8 µm	
Backlash	<6 µm	
Maximum Acceleration	4.5 mm/s ²	
Maximum Velocity	2.4 mm/s	
Max Vertical On-Axis Load Capacity	4.5 kg (10 lbs)	
Max Horizontal On-Axis Load Capacity	12 kg (25 lbs)	
Min Theoretical Incremental Movement ^a	0.03 µm	
Min Repeatable Incremental Movement	0.8 µm	
Absolute On-axis Accuracy	145 µm	290 µm
Maximum Percentage Accuracy	0.3%	0.7%
Home Location Accuracy	± 4.0 µm	
Pitch	±0.02°	±0.025°
Yaw	±0.025°	±0.03°
Weight	0.31 kg	0.34 kg
Software Compatibility	APT: Server CDM621 V2.9.0 or later. Kinesis: V1.14.28 or later.	

a. This represents 1 encoder count.

5.2 Motor Specifications

Parameter	Value
Motor Type	Brushed DC Servo
Motor Drive Voltage	6 V
No load speed	6560 rpm
No load current	7.43 mA
Nominal speed	1050 rpm
Nominal torque (max. continuous torque)	1.26 mNm
Nominal current (max. continuous current)	0.156 A
Stall torque	1.54 mNm
Starting current	0.184 A
Max. efficiency	65%
Terminal resistance	32.7 Ω
Terminal inductance	0.607 mH
Torque constant	8.38 mNm/A
Speed constant	1140 rpm/V
Speed / torque gradient	4450 rpm/mNm
Mechanical time constant	13.9 ms
Rotor inertia	0.298 gcm ²
Recommended Thorlabs controller	KDC101

How to Calculate the Linear Displacement per Encoder Count

For the Z8 series motors, there are 512 encoder counts per revolution of the motor.

The output shaft of the motor goes into a 67.49:1 planetary gear head. This requires the motor to rotate 67.49 times to rotate the 1.0 mm pitch lead screw once (i.e. advance the position by 1.0 mm).

To calculate the linear displacement of the actuator per encoder count:

$$512 \times 67.49 = 34,555 \text{ encoder counts per revolution of the lead screw}$$

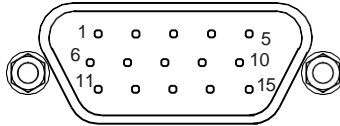
Linear displacement of the lead screw per encoder count is:

$$1.0 \text{ mm} / 34,555 \text{ counts} = 2.9 \times 10^{-5} \text{ mm (29 nm)}$$

Chapter 6 Motor Pin Out Details & Associated Parts

6.1 Motor Connector Pin Out

The Motor cable is terminated in a 15 way D-type connector, which provides connection to the DC motor controller. The pin functions are detailed in Fig. 6.1.



Pin	Description	Pin	Description
1	Ground/Return	9	Ident
2	Forward Limit Switch	10	Vcc
3	Reverse Limit Switch	11	Encoder A
4		12	
5	Motor -	13	Encoder B
6		14	
7	Motor +	15	
8			

Fig. 6.1 Motor Connector Pin Descriptions

6.2 Associated Products

Product Name	Part Number
Base Plate for MTS25-Z8 Stages	MTS25A-Z8
Base Plate for MTS50-Z8 Stages	MTS50A-Z8
XY Adapter Plate for MTS25-Z8 Stages	MTS25B-Z8
XY Adapter Plate for MTS50-Z8 Stages	MTS50B-Z8
Right Angle Bracket for MTS25-Z8 Stages	MTS25C-Z8
Right Angle Bracket for MTS50-Z8 Stages	MTS50C-Z8
MTS25-Z8 60mm cage system adapters	MTS25CSA
MTS50-Z8 60mm cage system adapters	MTS50CSA

Note. All the above parts fit both imperial and metric products.

Chapter 7 Regulatory

7.1 Declarations Of Conformity

7.1.1 For Customers in Europe


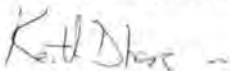

See Section 7.2.

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, 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.

7.2 CE Certificates

		<h1>THORLABS</h1>	
		www.thorlabs.com	
<h2>EU Declaration of Conformity</h2> <p><i>in accordance with EN ISO 17050-1:2010</i></p>			
We:	Thorlabs Ltd.		
Of:	1 St. Thomas Place, Ely, CB7 4EX, United Kingdom		
<i>in accordance with the following Directive(s):</i>			
2006/42/EC	Machinery Directive (MD)		
2004/108/EC	Electromagnetic Compatibility (EMC) Directive		
2011/65/EU	Restriction of Use of Certain Hazardous Substances (RoHS)		
 <i>hereby declare that:</i>			
Model:	MTS Series		
Equipment:	Motorised 25 or 50mm (1" or 2") Travel Stage, with or w/o TDC001 Controller		
 <i>is in conformity with the applicable requirements of the following documents:</i>			
EN ISO 12100	Safety of Machinery, General Principles for Design, Risk Assessment and Risk Reduction		2010
EN 61326-1	Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements		2013
 <i>and which, issued under the sole responsibility of Thorlabs, 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:</i>			
<p>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</p>			
 <i>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.</i>			
Signed:		On:	05 November 2013
Name:	Keith Dhese		
Position:	General Manager	EDC - MTS Series -2013-11-05	

Chapter 8 Thorlabs Worldwide Contacts

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



USA, Canada, and South America

Thorlabs, Inc.
sales@thorlabs.com
techsupport@thorlabs.com

Europe

Thorlabs GmbH
europe@thorlabs.com

France

Thorlabs SAS
sales.fr@thorlabs.com

Japan

Thorlabs Japan, Inc.
sales@thorlabs.jp

UK and Ireland

Thorlabs Ltd.
sales.uk@thorlabs.com
techsupport.uk@thorlabs.com

Scandinavia

Thorlabs Sweden AB
scandinavia@thorlabs.com

Brazil

Thorlabs Vendas de Fotônicos Ltda.
brasil@thorlabs.com

China

Thorlabs China
chinasales@thorlabs.com

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 disassembled 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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