MTS Series
Brushed DC Motorized Translation Stages

User Guide

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Chapter 1 Introduction

1.1 Intended Use

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**.** It is for indoor use only, to be operated with the ambient temperature range of 5 °C to 40 °C and in an environment with maximum humidity below 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 product may only be used in accordance with the instructions described in this manual. Any other use will invalidate the warranty.

1.2 Explanation of Safety Warnings

⚠CAUTION Caution indicates a hazard with a low level of risk that, if not avoided, could result in minor or moderate injury.

NOTICE Indicates information considered important, but not hazard-related, such as possible damage to the product.

 Danger, Warning, or Caution

 Shock Warning

CE UK CA The CE/UKCA markings on the product are the manufacturer's declaration that the product complies with the essential requirements of the relevant European health, safety, and environmental protection legislation.

 The symbol on the product, the accessories or packaging indicates that this device must not be treated as unsorted municipal waste but must be collected separately.

1.3 Description

A brushed DC servo motor provides the drive power. A built-in Hall effect encoder provides 34,555 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 unit's parameters and prevents overdriving in both directions. MTS series stage are available with travel ranges of 25 mm, 50 mm, and 100 mm. The stages are configurable in XY, XZ, and XYZ in both left- and right-handed configurations using XY adapter plates (Item #s MT25B-Z8, MTS50B-Z8, and MTS100B-Z8) and Z-mounting angle brackets (MTS25C-Z8, MTS50C-Z8, and MTS100C-Z8), which are available separately. Base plates (MTS25A-Z8, MTS50A-Z8, and MTS100A-Z8) allow the stages to be bolted directly to an optical table. For added flexibility, all travel stages can be configured together. Please contact Tech Support for attachment to other fittings or stages.

For convenience, we also offer the KMTS25E(/M), KMTS50E(/M), and KMTS100E(/M) bundles which include a stage, KDC101 motor controller, and KPS101* power supply. The power supply you receive will be compatible with outlets in your region. Please contact Tech Sales prior to ordering if you require a different plug.

1.4 Technical Data

1.4.1 Stage Specifications

Item #	MTS25(/M)-Z8	MTS50(/M)-Z8	MTS100(/M)-Z8
Travel	25.0 mm (0.98")	50.0 mm (1.97")	100.0 mm (3.94")
Repeatability[a]	15 µm		
Backlash[b]	<6 µm		
Speed	2.4 mm/s Max		
Acceleration	4.5 mm/s^2 Max		
Theoretical Min Incremental Motion[c]	0.03 µm		
Minimum Incremental Motion[d]	0.8 µm		
Accuracy	60 µm	100 µm	100 µm
Homing Accuracy	±4.0 µm		
Vertical Load	Recommended[e]: <4.0 kg (<8.8 lbs); Max: 4.5 kg (10 lbs)		
Horizontal Load	Recommended[e]: <10 kg (<22 lbs); Max: 12 kg (25 lbs)		
Pitch	720 µrad	873 µrad	1300 µrad
Yaw	250 µrad	500 µrad	1000 µrad
Weight	0.31 kg (0.68 lbs)	0.35 kg (0.76 lbs)	0.43 kg (0.94 lbs)
Software Compatibility	Kinesis and XA		

a. The average of the repeatability when a set position is approached from both directions.
b. When a stage is moved to a position and then returned to its original position, some motion is lost due to the lead screw mechanism. This loss is known as backlash.
c. The measured minimum incremental motion that the stage can achieve, also referred to as the minimum step size. This represents 1 encoder count.
d. The minimum incremental motion that the stage can repeatedly achieve within its standard error.
e. Under continuous use.

1.4.2 Motor Specifications

Specification	Value
Motor Type	Brushed DC Servo
Motor Drive Voltage	6 VDC
Feedback	Hall Effect Encoder
Encoder Resolution	29 nm
Encoder Counts per Lead Screw Revolution	34,555
Planetary Gear Head Ratio	67.49:1
Cable Length	0.5 m (1.6 ft)
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).

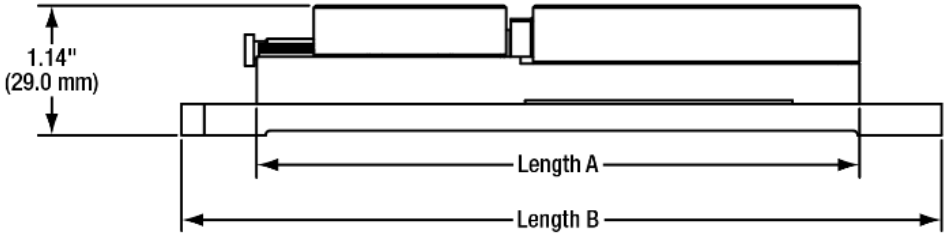
To calculate the linear displacement of the actuator per encoder count:

512 x 67.49 = 34,555 encoder counts per revolution of the lead screw

Linear displacement of the lead screw per encoder count is:

1.0 mm / 34,555 counts = 2.9 x 10^{-5} mm (29 nm).

1.4.3 Mechanical Dimensions



	MTS25x	MTS50x	MTS100x
Length A	5.31" (134.8 mm)	6.33" (160.8 mm)	8.89" (225.8 mm)
Length B	6.69" (170.0 mm)	7.68" (195.0 mm)	10.63" (270.0 mm)

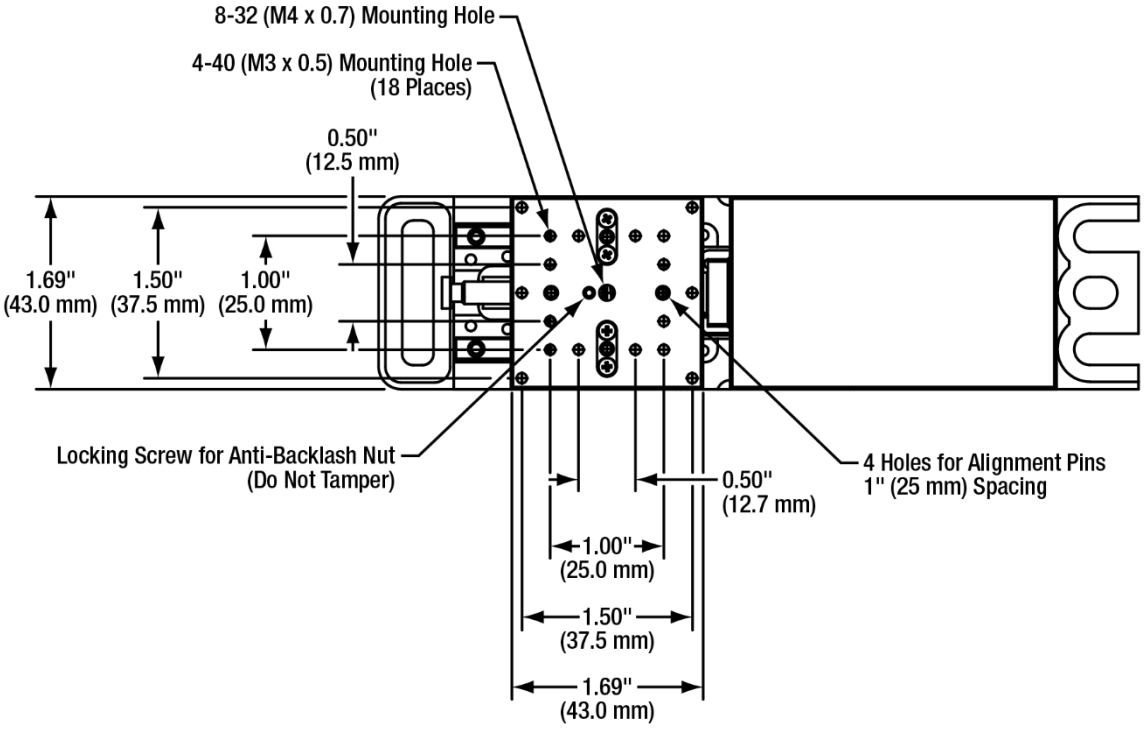


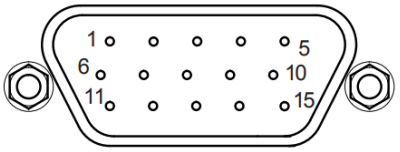
Figure 1 Mechanical Dimensions
(Metric in Parentheses; Shown with Baseplate, Sold Separately, Attached)

NOTICE

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.

1.5 Pin Diagrams

Motor Connector Pin-Out



Pin	Description	Pin	Description
1	Ground/Return	9	Reserved for Future Use
2	Forward Limit Switch	10	V_{CC}
3	Reverse Limit Switch	11	Encoder A
4	Not Used	12	Not Used
5	Motor -	13	Encoder B
6	Not Used	14	Ident
7	Motor +	15	Ident
8	Not Used		

Figure 2 Motor Connector Pin Descriptions

1.6 Stage Accessories

Each accessory fits both imperial and metric stage variants.

Stage Item #	MTS25(/M)-Z8	MTS50(/M)-Z8	MTS100(/M)-Z8
Base Plate	MTS25A-Z8	MTS50A-Z8	MTS100A-Z8
XY Adapter Plate	MTS25B-Z8	MTS50B-Z8	MTS100B-Z8
Right Angle Bracket	MTS25C-Z8	MTS50C-Z8	MTS100C-Z8
60 mm Cage System Adapter	MTS25CSA	MTS50CSA	N/A

1.7 Simplified Declaration of Conformity

EU Declaration of Conformity

Manufacturer: Thorlabs LTD

Address: 204 Lancaster Way, Ely, CB6 3NX

We hereby declare under our sole responsibility that:

Product: **MTS Series**

Product description: **Motorised 25, 50 or 100mm (1", 2" or 4") Travel Stage with or w/o KDC101 Controller.**

is/are in conformity with the following directive(s):

2014/30/EU	Electromagnetic Compatibility (EMC) Directive
2011/65/EU	Restriction of Use of Certain Hazardous Substances (RoHS), including 2015/863
2006/42/EC	Machinery Directive (MD)

and (harmonized) standards / technical specifications :

EN 61326-1	Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements	2013
EN IEC 63000	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances	2018
EN ISO 12100	Safety of Machinery. General Principles for Design. Risk Assessment and Risk Reduction	2010

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

Name: Keith Dhese *On:* 2/25/2025

Position: General Manager

CE

Chapter 2 Safety

⚠CAUTION

Risk of Electrical Shock
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.

NOTICE

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. 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

3.1 Warranty Information

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

This precision device is only serviceable if returned and properly packed into the complete original packaging including the complete shipment plus the cardboard insert that holds the enclosed devices. If necessary, ask for replacement packaging. Refer servicing to qualified personnel.

3.2 Packing List

Lists of items:

- Motorized Translation Stage

3.3 Installation Instructions

3.3.1 General

The MTS series stages can be mounted horizontally or vertically using the base plates, XY adapter plates, and angle brackets. 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 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.

The range of travel for each stage is 25 mm for MTS25(/M)-Z8 stages, 50 mm for MTS50(/M)-Z8 stages, and 100 mm for MTS100(/M)-Z8 stages.

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

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

Any MTS stage can be stacked in any combination of MTS25/50/100 stages since each stage can be stacked to another using its corresponding XY adapter plate. The purpose of the adapter plate is to accommodate the stage that is on top. Therefore, an MTS25 accessory is required when mounting an MTS25 stage, and so on.

The stage on the top of the multi-axis assembly limits the mounted load capacity:

- MTS25(/M)-Z8 stage on top: standard load capacity which is 10 kg excluding the stage's weight
- MTS50(/M)-Z8 stage on top: max 1.7 kg load capacity on the top stage excluding the stage's weight
- MTS100(/M)-Z8 stage on top: max 1 kg load capacity on the top stage excluding the stage's weight

3.3.2 Connecting the Motor Controller

It is recommended that the MTS series stages be driven by the Thorlabs KDC101 DC Servo Motor Controller. If the stage is being driven by any other driver or controller, refer to the motor pin-out details in section 1.5 and the motor specifications details in section 1.4.2.

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

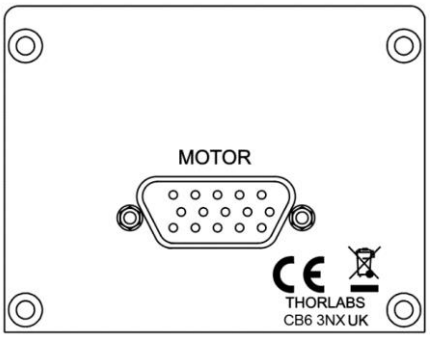


Figure 3 KDC101 Rear Panel

3.3.3 Fitting and Removing Base Plate

Referring to Figure 4, proceed as follows:

1. Fit the supplied dowel pins to the base plate (MTS25A-Z8, MTS50A-Z8, or MTS100A-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 4-40 x ½" (M3 x 10 mm) through the holes in the underside of the base plate and tighten to secure the stage in place.

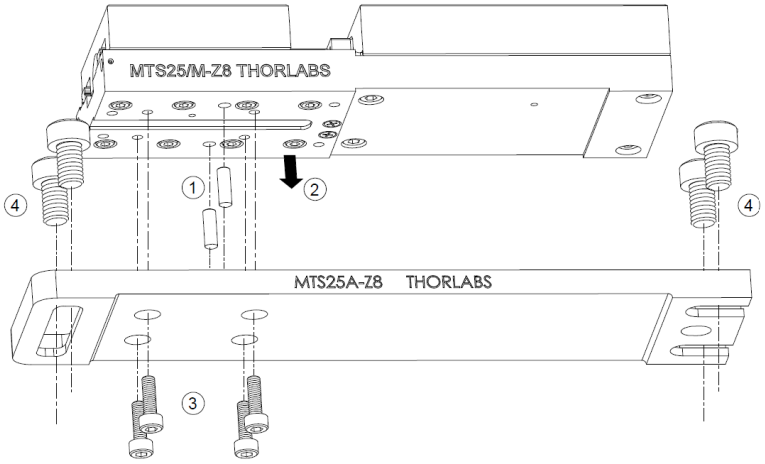


Figure 4 Fitting the MTS25A-Z8 Base Plate

4. Fit two of the bolts supplied 1/4"-20 x 3/8" (M6 x 10 mm) 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.

3.3.4 Building an XY Configuration

Referring to Figure 5, proceed as follows:

1. Fit the dowels supplied to the moving platform of the lower stage.
2. Note the orientation of the adapter plate in the drawing below, then fit the adapter plate (MTS25B-Z8, MTS50B-Z8, or MTS100B-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 adapter plate.
3. Fit the four bolts supplied 4-40 x ¼" (M3 x 6 mm), through the holes in the adapter plate, and tighten to secure the plate in place.
4. Fit the Y-axis stage into place ensuring that the dowels in the adapter plate locate correctly in the holes in the lower surface of the stage.

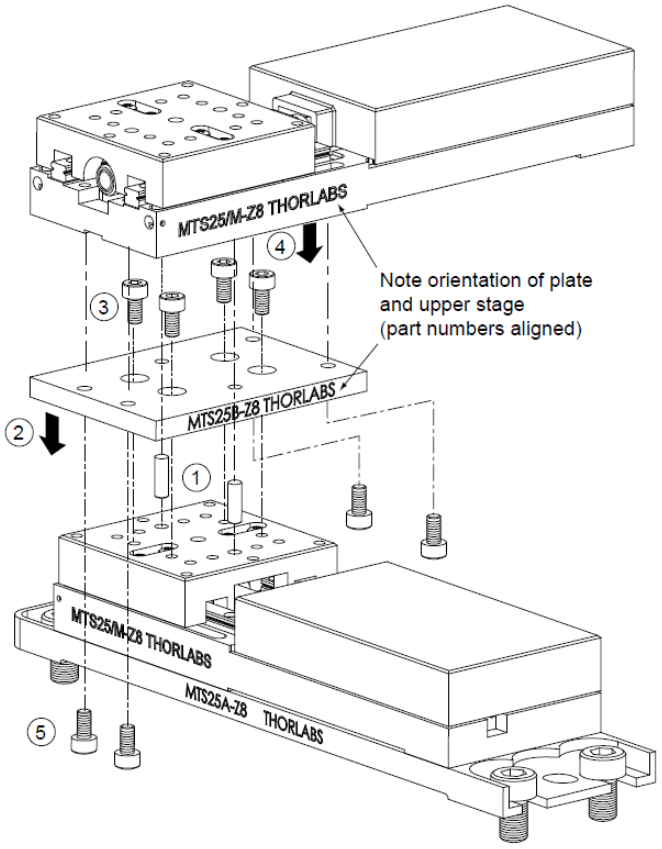


Figure 5 Building an XY Configuration

5. Fit the four bolts supplied 4-40 x ¼" (M3 x 6 mm) through the holes in the underside of the adapter 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 thework surface as detailed in Section 3.3.3.

3.3.5 Building an XYZ Configuration

Assemble an XY configuration as detailed in Section 3.3.4 then, referring to Figure 6, 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, MTS50C-Z8, or MTS100C-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.

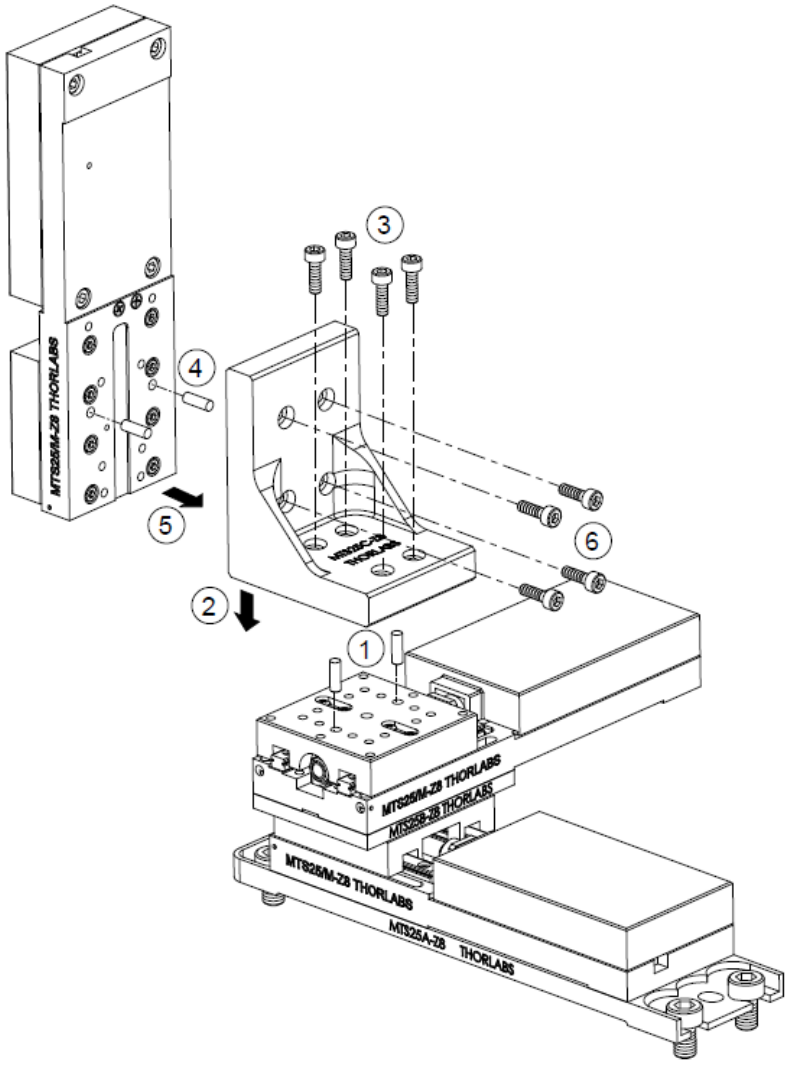


Figure 6 Adding a Vertical Axis Stage

3. Fit the four bolts supplied 4-40 x ½" (M3 x 12 mm), 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 4-40 x ½" (M3 x 12 mm), 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 thework surface as detailed in 3.3.3.

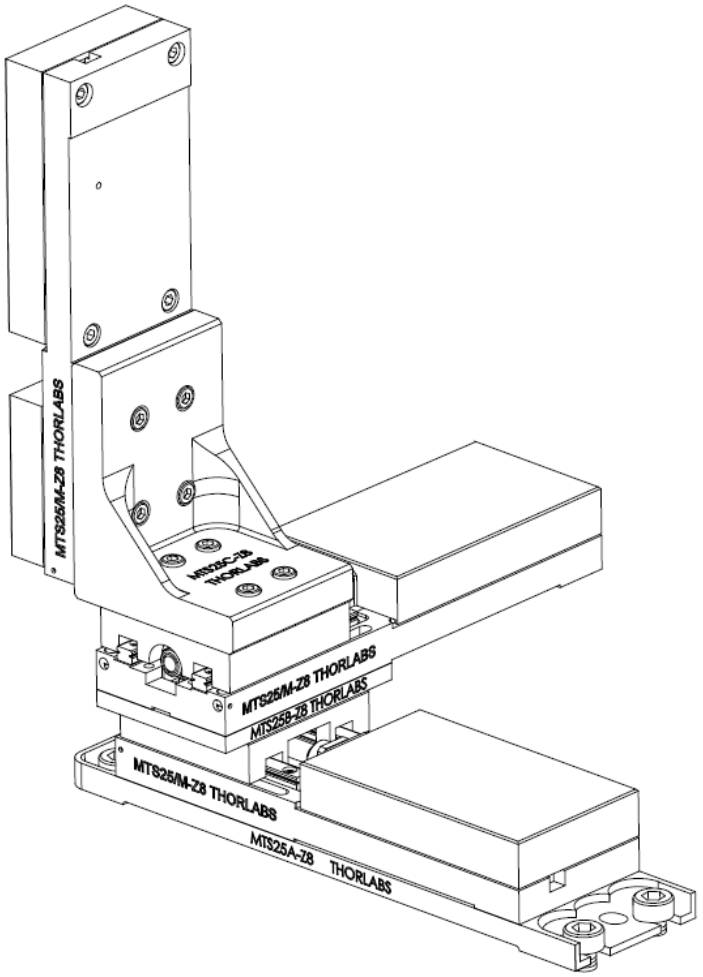


Figure 7 Typical XYZ Configuration

3.3.6 Mounting Thread Adapter Plate

The MTSA1(/M) adapter plate fixes to the top platform of MTS series stages. It has an array of seven 1/4"-20 (M6 x 1.0) and six 8-32 (M4 x 0.7) mounting holes to adapt the stage for use with general purpose accessories and components.

Using the four 4-40 x 3/8" (M3 x 0.5 x 10 mm) screws supplied, fit the MTSA1(/M) plate to the MTS series stage. The moving world of the stage will be 7.5 mm higher with the adapter plate attached.

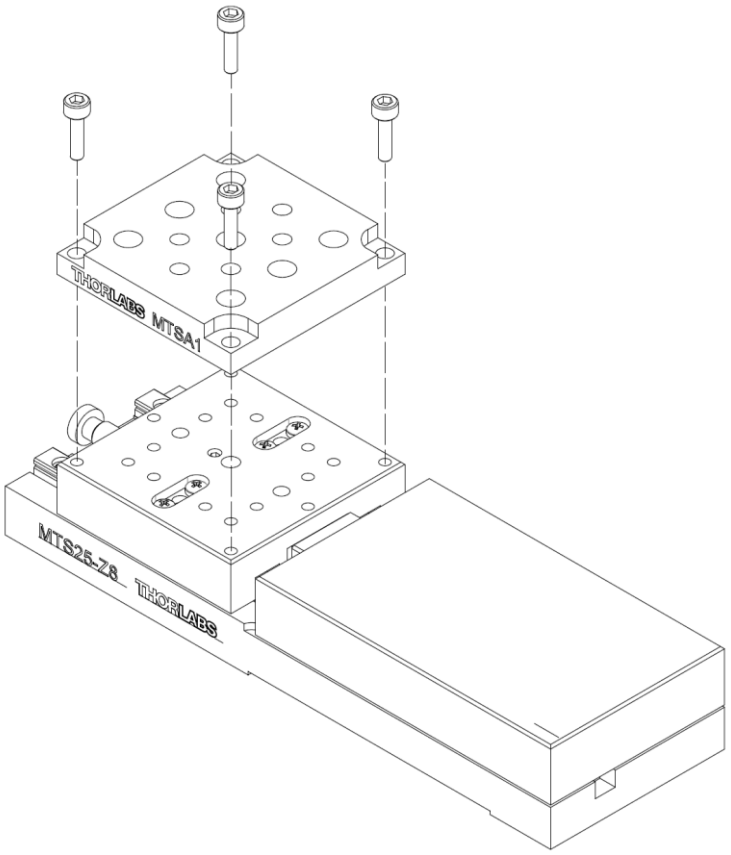


Figure 8 MTSA1 Adapter Plate Installation

Chapter 4 Operation

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 Controller. If any other driver or controller is driving the stage, refer to motor pin-out details in section 1.5 and motor specifications in section 1.4.2.

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.

NOTICE

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.

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

1) Perform the mechanical installation.
2) Connect the stage to the DC motor controller.

3) Connect the controller to the main supply and switch 'ON'.
4) Connect the controller unit to your PC.

NOTICE

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

5) Run the desired software package. The steps below show the example of running Thorlabs' Kinesis software, but the recommended KDC101 controller is fully supported by our Kinesis and XA software packages. For more information about the XA software package, please refer to the XA User Guide.
   The initial start-up routine is shown in the respective GUI which is activated by running:

   Start>Thorlabs>Kinesis

6) Check that the correct stage/actuator has been read, as displayed on the GUI (bottom right for Kinesis). If it hasn't, the stage may not operate correctly and must be manually selected using the controller (refer to the relevant KDC101 controller handbook).

Figure 9 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.

NOTICE

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 manual for the KDC101 controller.

Chapter 5 Transportation

Retain the packing in which the unit was shipped, for use in future transportation. If this is not available, use a strong box and surround the unit with at least 100 mm of shock absorbent material. 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.

Chapter 6 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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