



MBT401D(/M) & MBT402D(/M)

4-Axis Translation Stages

User Guide

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## Chapter 1 Overview

### 1.1 Introduction of the Micro Block 4-Axis Waveguide Manipulator

The MBT401D waveguide manipulator is a compact, multi-axis positioner designed for precise orientation of integrated optics requiring four independent degrees of freedom:  $y$ ,  $z$ ,  $\phi_y$  (pitch), and  $\phi_z$  (yaw). The two rotations  $\phi_y$  and  $\phi_z$  rotate about axes normal to each other. The stage's linear movement retains a standard system optical axis height of 75 mm, 12.5 mm above the platform surface, but  $\phi_y$  and  $\phi_z$  rotations will not keep the position in the space of this optical axis. An optical component can be translated into the  $y$ - $z$  plane and then gimbaled about a point in the plane.

The four-axis waveguide manipulator is equipped with differential drives on all axes, which provide  $\pm 5^\circ$  degrees of backlash-free flexure rotational adjustment in both  $\phi_y$  and  $\phi_z$  with a setting sensitivity of 1 arcsecond. The vertical ( $z$ ) flexure adjustment range is 6 mm, and the horizontal ( $y$ ) fine ball bearing stage adjustment range is 13 mm. The longer horizontal range allows easy adjustment across the full width of a waveguide device.

The Micro Block has been developed as a cost-effective auxiliary device manipulator for end-fire and butt-coupling applications where relatively large translations are required for prepositioning components while maintaining precise control of the rotational adjustment about a point in free space.

The MBT402D low-profile manipulator has been designed for applications where the saddle configuration of the MBT401D may restrict the device's positioning.

### 1.2 Axis Identification

#### 1.2.1 MBT401D Micro Block Waveguide Manipulator

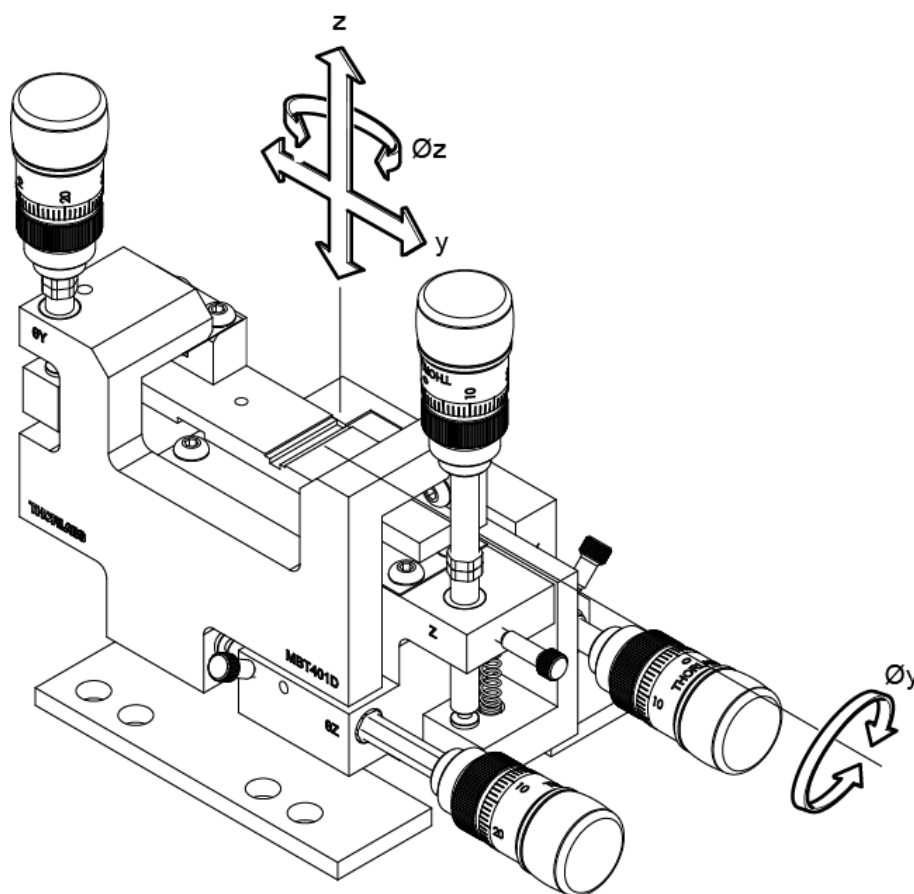


**Figure 1** Standard Waveguide Manipulator

### 1.2.2 MBT402D Micro Block Low Profile Waveguide Manipulator

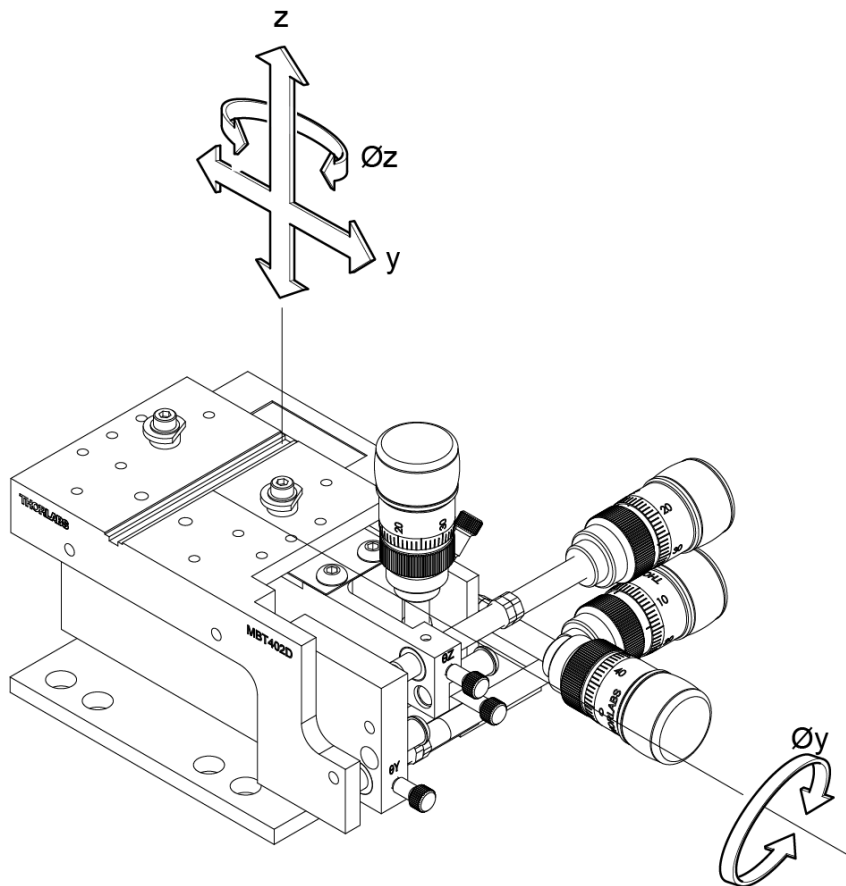


**Figure 2** Low Profile Waveguide Manipulator

## Chapter 2      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.

**Warning**

Given when there is a risk of injury to users.

**Caution**

Given when there is a possibility of damage to the product.

**Note**

Clarification of an instruction or additional information.

### 2.1 General Warnings and Cautions

**Warning**

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 General Operation

### 3.1 Environmental Conditions



#### Warning

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

The unit is designed for indoor use only.

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

The unit is not designed to be used in explosive environments.

### 3.2 Operation

#### 3.2.1 Reading Micrometer Drives

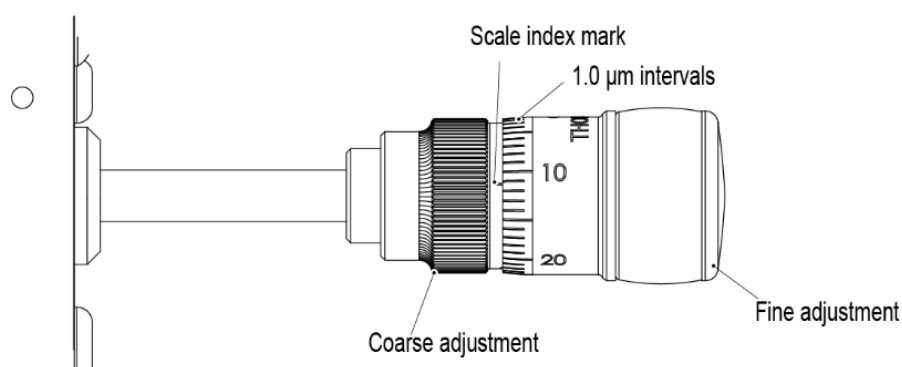


**Figure 3 Reading Micrometer Drives**

The micrometer has a 1.0 μm graduated scale. The travel per revolution is not the same for each axis, see Section 5.1 for more details.

#### 3.2.2 Typical Application

For applications such as waveguide end-fire coupling or butt-coupling, the system in Figure 4 could be used. In these types of application, it is common to configure a three-axis stage to orient the fiber array in the orthogonal axes, with a four-axis manipulator between them to orient the integrated optical device in the rotational axes.

The MBT401D is shown as an example, but MBT402D should be used for applications where the saddle configuration could restrict the device positioning.

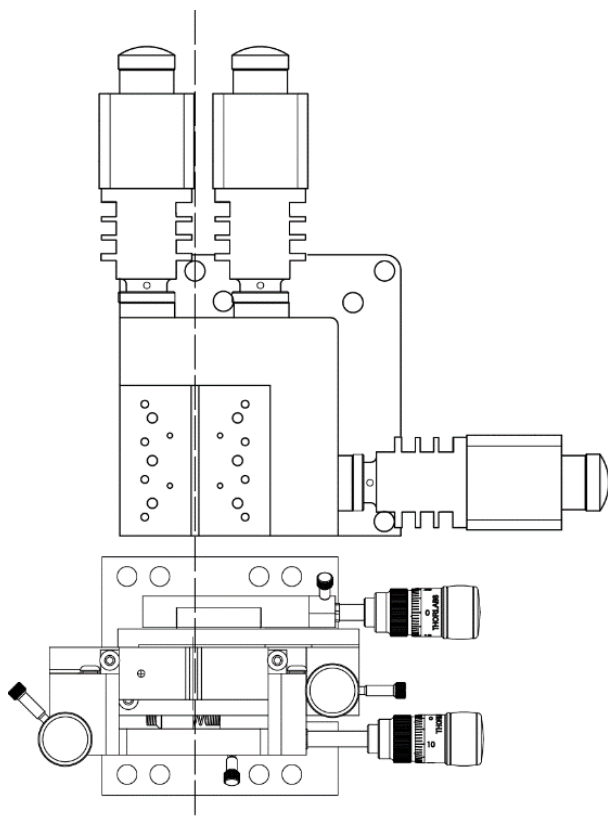


**Figure 4** Typical System Configuration

## Chapter 4 Installation

### 4.1 Unpacking

**Caution**

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

**Note**

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

### 4.2 Attaching to a Work Surface

The base of each Micro Block manipulator is provided with several fixing holes and slots for attachment to metric or inch optical tables, as supplied by Thorlabs and other manufacturers.

When mounting the manipulator 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, internal damage could occur. The range of travel on the orthogonal axes is 13mm horizontal (i.e.,  $\pm 6.5$  mm about the nominal position) and 6 mm vertical (i.e.,  $\pm 3.0$  mm about the nominal position). The range of travel on each rotational axis is 10 degrees, that is  $\pm 5$  degrees about the nominal position.

### 4.3 Mounting Equipment to the Moving Platform

**Caution**

To avoid damaging the internal mechanism, the weight attached to the moving platform must not exceed 0.5 kg. Do not apply excessive forces to the moving platform.

Thorlabs manufacture a variety of fibre chucks, holders and fixtures to fit the stage, which are mounted on the top platform - see [www.thorlabs.com](http://www.thorlabs.com) for more details.

### 4.4 Transportation

**Caution**

When packing the unit for shipping, use the original packaging. If this is unavailable, use a strong box and surround the stage with at least 100 mm of shock-absorbent material.

## Chapter 5 Specifications and Parts List

### 5.1 Specifications

| Item #                                           | MBT401D(/M)                                                                                                                               |                   | MBT402D(/M)                               |                   |
|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------------------------------|-------------------|
| <b>Travel<br/>(Coarse)</b>                       | <b>Horizontal Axis (y)</b>                                                                                                                | 13 mm             | <b>Horizontal Axis (y)</b>                | 13 mm             |
|                                                  | <b>Vertical Axis (z)</b>                                                                                                                  | 6 mm              | <b>Vertical Axis (z)</b>                  | 6 mm              |
|                                                  | <b>Pitch Axis (<math>\theta_y</math>)</b>                                                                                                 | $\pm 5^\circ$     | <b>Pitch Axis (<math>\theta_y</math>)</b> | $\pm 5^\circ$     |
|                                                  | <b>Yaw Axis (<math>\theta_z</math>)</b>                                                                                                   | $\pm 5^\circ$     | <b>Yaw Axis (<math>\theta_z</math>)</b>   | $\pm 5^\circ$     |
| <b>Coarse Drive Adjustment</b>                   | 500 $\mu\text{m}$ per revolution                                                                                                          |                   |                                           |                   |
| <b>Travel<br/>(Differential)</b>                 | <b>Horizontal Axis</b>                                                                                                                    | 300 $\mu\text{m}$ | <b>Horizontal Axis</b>                    | 300 $\mu\text{m}$ |
|                                                  | <b>Vertical Axis</b>                                                                                                                      | 300 $\mu\text{m}$ | <b>Vertical Axis</b>                      | 300 $\mu\text{m}$ |
|                                                  | <b>Pitch Axis</b>                                                                                                                         | 30 arcmin         | <b>Pitch Axis</b>                         | 12 arcmin         |
|                                                  | <b>Yaw Axis</b>                                                                                                                           | 30 arcmin         | <b>Yaw Axis</b>                           | 30 arcmin         |
| <b>Differential Drive Adjustment</b>             | 50 $\mu\text{m}$ per revolution                                                                                                           |                   |                                           |                   |
| <b>Theoretical Resolution<br/>(Differential)</b> | <b>Horizontal Axis</b>                                                                                                                    | 0.5 $\mu\text{m}$ | <b>Horizontal Axis</b>                    | 0.5 $\mu\text{m}$ |
|                                                  | <b>Vertical Axis</b>                                                                                                                      | 0.5 $\mu\text{m}$ | <b>Vertical Axis</b>                      | 0.5 $\mu\text{m}$ |
|                                                  | <b>Pitch Axis</b>                                                                                                                         | 3.96 arcsec       | <b>Pitch Axis</b>                         | 3.96 arcsec       |
|                                                  | <b>Yaw Axis</b>                                                                                                                           | 3.96 arcsec       | <b>Yaw Axis</b>                           | 1.44 arcsec       |
| <b>Deck Height</b>                               | 62.5 mm to the mounting surface of the moving platform. The accessory beam height is 75 mm measured from the bottom surface of the stage. |                   |                                           |                   |
| <b>Load Capacity</b>                             | 500 g (1.1 lbs)                                                                                                                           |                   | 500 g (1.1 lbs)                           |                   |
| <b>Weight</b>                                    | 950 g (2.09 lbs)                                                                                                                          |                   | 900 g (1.98 lbs)                          |                   |

### 5.2 Parts and Consumables

| Item #      | Description                    |
|-------------|--------------------------------|
| MBT401D(/M) | Standard 4-axis manipulator    |
| MBT402D(/M) | Low profile 4-axis manipulator |
| AMA007(/M)  | Short L Bracket                |
| AMA009(/M)  | Long L Bracket                 |

## Chapter 6 Thorlabs Worldwide Contacts

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



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