THORLABS

MCM3000 Series
3-Axis Controller

User Guide

Table of Contents

Chapter 1   Warning Symbols and Definitions

Below is a list of warning symbols you may encounter in this manual or on your device.

Symbol	Description
	Direct Current
	Alternating Current
	Both Direct and Alternating Current
	Earth Ground Terminal
	Protective Conductor Terminal
	Frame or Chassis Terminal
	Equipotentiality
	On (Supply)
	Off (Supply)
	In Position of a Bi-Stable Push Control
	Out Position of a Bi-Stable Push Control
	Caution: Risk of Electric Shock
	Caution: Hot Surface
	Caution: Risk of Danger
	Caution: Laser Radiation
	Caution: Spinning Blades May Cause Harm

Chapter 2   Safety

All statements regarding safety of operation and technical data in this user guide will only apply when the unit is operated correctly. Please read the following warnings and cautions carefully before operating the device.

⚠️	**WARNING**	⚠️
	DO NOT use the device for anything other than its intended use. If the device is used in a manner not specified by Thorlabs, the protection provided by the equipment may be impaired.	

⚠️	**WARNING**	⚠️
	DO NOT operate in a wet, damp, or explosive environment.	

Chapter 3   Description

The MCM3000 Series 3-Axis Stepper Motor Controller with Encoder feedback consists of a hand-operated knob box and a separate controller box. Each side face of the knob box includes a rotating knob and a push-button switch that are dedicated to a single axis. The push-button switch enables and disables the axis. The switch turns green when the axis is enabled. Disable the axis to preserve a position or prevent accidental movements. A smaller knob on the top face adjusts the amount of translation per rotation of the knob.

Since each MCM3000 Series Controller has three axes, you only need to purchase enough controllers for each of the stages you intend to drive. For example, a Cerna® microscope equipped with a ZFM2020 Motorized Focusing Module (which has one axis) and a PLS-XY Translation Stage (two axes) would only require one MCM3001 controller.

The MCM3001 is compatible with motorized Cerna components that have a travel range of 1", such as our Motorized Focusing Modules and Translation Stages for Rigid Stands. For components with a 2" travel range, such as Thorlabs' Translating Platforms, the MCM3002 controller should be used instead. The MCM3003 is compatible with LNR Series Stepper Motor stages without encoders that have a travel range of 2". The software allows you to configure the controller to more than one type of stage. The MCM3002 and MCM3003 controller come with different cables to attach to the stages.

The following table shows the different stages compatible with the MCM3000 Series Controller:

Item Number	MCM3001	MCM3002	MCM3003
Compatible Stages	Focusing Modules ZFM2020 and ZFM2030	Microscope Body Translator MMP-2XY	Physiology Stage PHYS24M(/M)
			Microscope Translator MTM-FN1
	Translation Stages for Rigid Stands PLS-X and PLS-XY	Translating Platform PMP-2XY(/M)	Linear Translation Stage LNR50S(/M)
			Stepper Motor DRV014

3.1.   Features at a Glance

- Designed for Cerna Components with Motorized Travel: Objective Focusing Module, Condenser Focusing Module, Translation Stages for Rigid Stands, and Translating Platform

- Knobs Provide Hand-Operated Control for up to Three Axes

- Option to Disable Each Channel to Prevent Unintended Movements or to Retain a Position

- Adjust Translation Speed via Top-Located Knob

Chapter 4   Getting Started

4.1.   Unpacking and Inspection

Open the package, and carefully remove the MCM3000 Series and its accessories. The table lists the standard accessories shipped with the device.

Name	Quantity		
	MCM3001	**MCM3002**	**MCM3003**
3-Axis Knob Box	1	1	1
3-Axis Controller Box	1	1	1
Joystick Controller Cable (3m)	1	1	1
Hex Stand Off	-	12	6
M6 x 12 mm SHCS	2	2	2
1/4"-20 X 1/2" SHCS	2	2	2
24V 90W AC/DC Power Supply	1	1	1
Power Cord	1	1	1
USB Male A to Male B (RoHS Complaint)	1	1	1
Adapter Cable for 2" Cerna Stages (Component Item # MCM3000-CAB1)	-	3	-
Adapter Cable for Non-Cerna Stages (Component Item # MCM3000-CAB2)	-	-	3
MCM3000 Software CD	1	1	1

Inspect the device and its accessories for any missing parts or damage. If there is any problem, please contact our nearest office (see ***Thorlabs Worldwide Contacts Chapter on Page 25*** for details).

4.2.   Setting Up MCM3000 Series

4.2.1.   Minimum Computer Requirements

Operating System	64 Bit, Windows 7 (Not compatible for Windows 10)
Driver	MCM3000.inf
Other Software	Visual C++ Redistributable Package (2012), Microsoft .NET 4.5.2 or later

4.2.2.   Preparation

We recommend you to mount the 3-Axis Controller Box on an optical table/breadboard using the two included screws (M6 for metric, 1/4"-20x1/2" for imperial). This prevents any damage to the Controller Box from accidental fall.

1. Use the Joystick Controller cable to connect the 3-Axis Controller Box to the 3-Axis Knob Box.
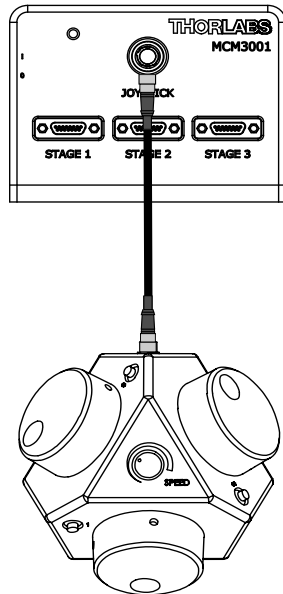
Figure 4–1 Connecting the Controller Box to the Knob Box

2. Use the USB cable to connect the 3-Axis Controller Box to the computer.

Note: This step is optional. Connect the USB port only if you want to use the software to control the position of the stages. The 3-Axis Controller Knob or the software can control the position of the stages. You can move the stage manually even after connecting the USB port to the computer.
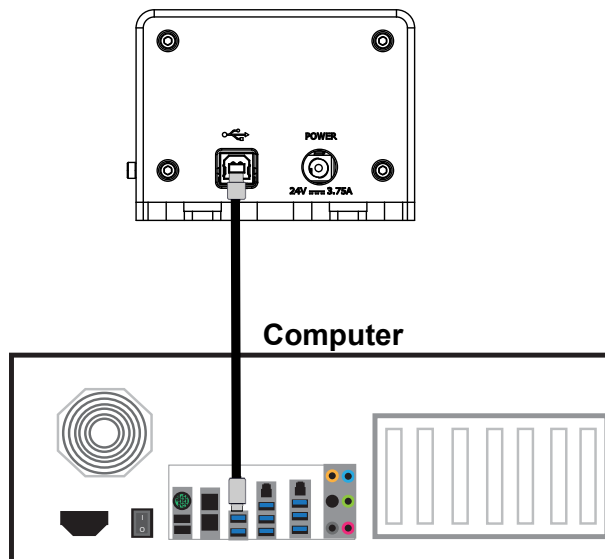
Figure 4–2 Connecting the Controller Box to the Computer

3. Connect one end of the power supply to the 3-Axis Controller Box and the other end to a standard power outlet.

4. Connect the cables from the required stages to the 3-Axis Controller Box.

   The 3-Axis Controller Box can control up to three axes. For example, the below diagram shows a MCM3001 controller connected to a PLS-XY translation stage and a ZFM2030 focusing module.
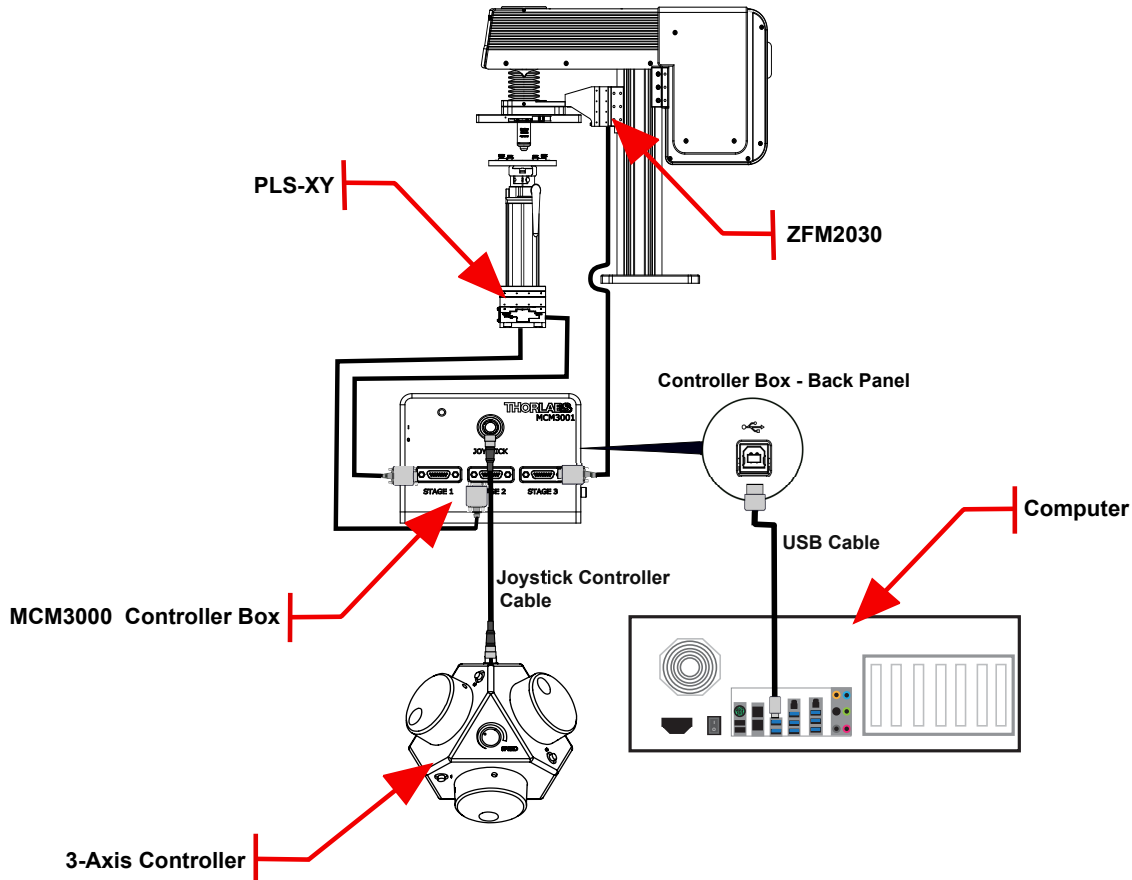
Figure 4–3 Connecting the Controller Box to Different Stages

Note: The MCM3002/MCM3003 controller is shipped with adapter cables to connect the device to the stages (as shown in the diagram below) .
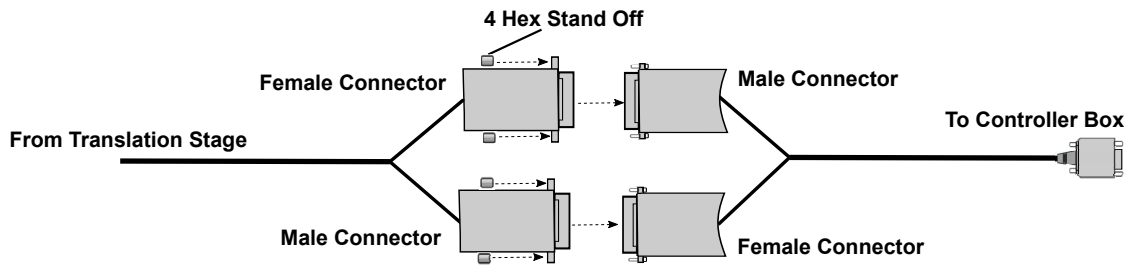
Figure 4–4 Connecting the Adapter Cable

5. Slide the Power switch on the 3-Axis Controller Box to the On position.
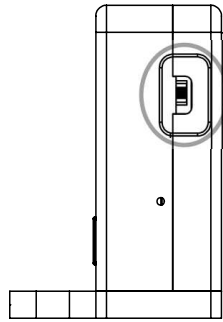
Figure 4–5 Power Switch on the 3-Axis Controller Box

6. If you do not want to control the stages via USB, go to Step 10. To control the stages via USB, install the required software/driver on your computer as described in the ***Software Chapter on Page 8***.

7. After the software installation is complete, copy the *Application* folder from the CD to your local drive.

8. Open the MCM3000 software, and configure the axes (see ***Software Startup section on Page 12***).

9. Adjust the position of the required stage.

Use the software or the 3-Axis Knob Box to adjust the position of the stage.

To adjust the position using the software:

 a. On the *MCM3000 Control* window, enter the value for the respective axis in the text box corresponding to X/Y/Z. Click *Go*.

 b. Enter a value for the Slide Step Size in the text box. By default, this value is set to 0.01 mm.

   Select Coarse/Fine option to determine the slider step type.

 c. Use the mouse wheel or ± buttons to change the X/Y/Z position.

See ***MCM3000 GUI (Graphical User Interface) section on Page 14*** for details. Press the push-button switch on the 3-Axis Knob box to disable/enable the movement of the stage. The switch preserves the position and prevents accidental movement. To adjust the speed of the axes on the 3-Axis Knob Box, turn the Speed Control knob on the top face of the Knob Box.

Note: The Speed Control knob only adjusts the speed of translation per rotation of each knob when using the 3-Axis Knob Box to manually control a connected stage. The software cannot adjust the speed of the connected stage.

Chapter 5 Software

Verify if your computer has Visual C++ Redistributable Package (2012), Microsoft .NET 4.5.2 or later, and MCM3000.inf driver. If the computer does not have the driver/software or if the version needs an upgrade, follow the installation procedures described in this section.

5.1. Microsoft Visual C++ Redistributable Package (2012) Installation

1. Insert the MCM3000 Software Installation CD into the computer, and open the *Driver* folder.

2. Double click the **vcredist_x64** application to open the *Microsoft Visual C++ Setup* window.

Figure 5–1 Microsoft Visual C++ 2012 Window

3. Select *I agree to the license terms and conditions*, and click *Install*.

    Setup Successful message appears on the *Microsoft Visual C++ Setup* window.
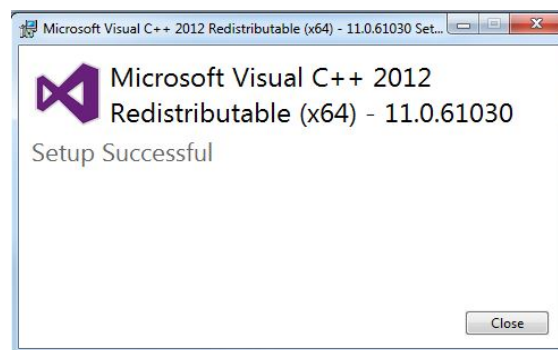
Figure 5–2 Microsoft Visual C++ 2012 Installation Complete

4. Click *Close* to exit the *Microsoft Visual C++ Setup* window.

Microsoft Visual C++ Redistributable Package (2012) setup is complete.

5.2.   Microsoft .NET 4.5.2 Installation

1. Insert the MCM3000 Software Installation CD into the computer, and open the *Driver* folder.

2. Double click the **NDP452-KB2901954-Web** application to open the *User Account Control* window.

3. Click *Yes* on the *User Account Control* window. The *.NET Framework 4.5.2 Setup* window appears.
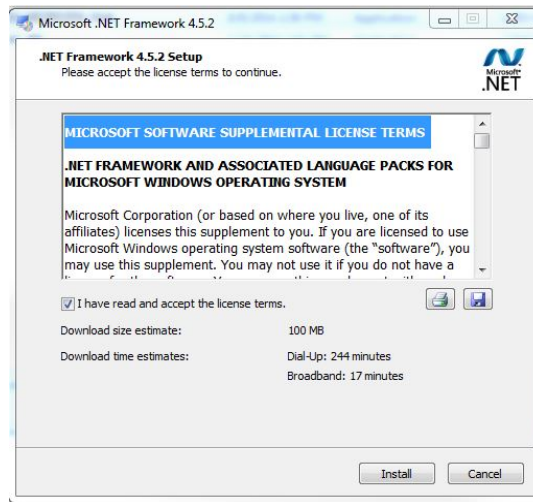
Figure 5–3 Microsoft .Net Framework 4.5.2 Window

4. Select *I have read and accept the license terms*, and click *Install*.

   Installation Is Complete message appears on the *.NET Framework 4.5.2 Setup* window.
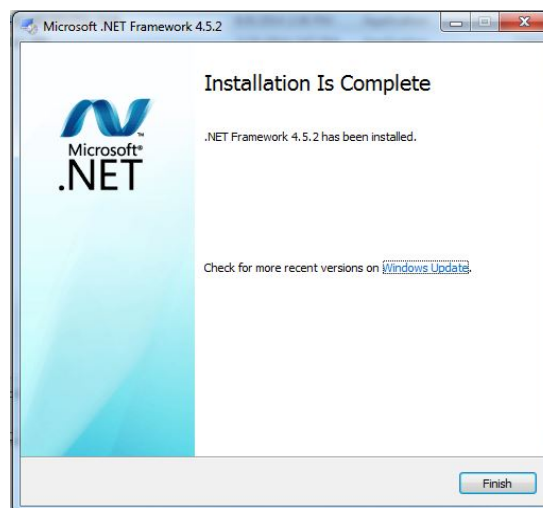
Figure 5–4 Microsoft .Net Framework 4.5.2 Installation Complete

5. Click *Finish* to exit the *Microsoft .NET Framework 4.5.2* window.

Microsoft .NET 4.5.2 software setup is complete.

5.3.   Driver Installation

1. Insert the MCM3000 Software CD into the computer, and save the *Application* and *Driver* folder on your computer.

2. On the computer, navigate to *Device Manager>Other Devices*. Right click on *Unknown Device* and select *Update Driver Software*.

    The *Update Driver Software - Unknown Device* window appears.
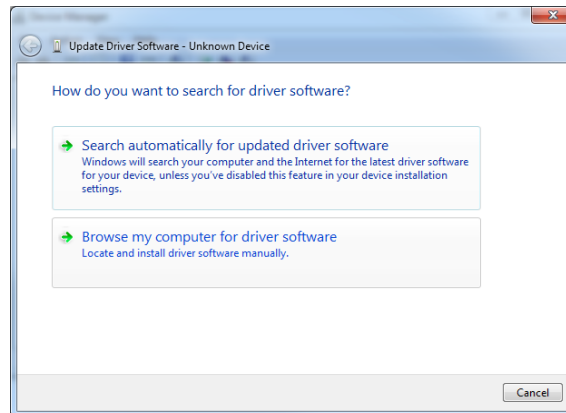
Figure 5–5 Update Driver Software Window

3. Select *Browse my computer for driver software*, and browse to the *Driver* folder. Click *Next*.

    The *Windows Security* warning message appears.
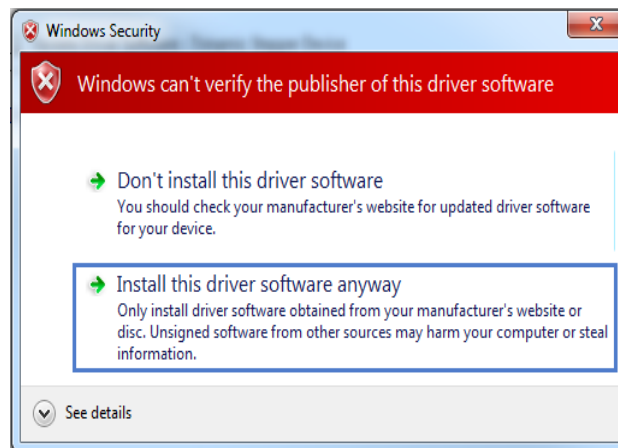
Figure 5–6 Windows Security

4. Click *Install this driver software anyway*.

    Windows has successfully updated your driver software message appears. Click *Close*. The MCM3000 driver installation is complete.
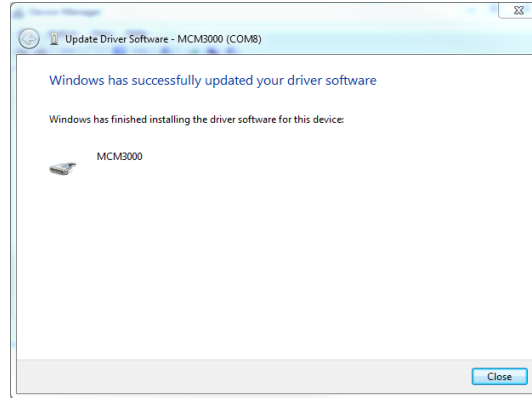
Figure 5–7 Driver Software Installation Complete

5. Check *Device Manager>Port(COM&LPT)* on your computer to verify the COM port of MCM3000 driver. Make sure the COM Port Number is set to COM32.

To change the COM Port Number to COM32:

  a. Right click on MCM3000 driver, and click on *Properties* to open the *MCM3000 Properties* window.
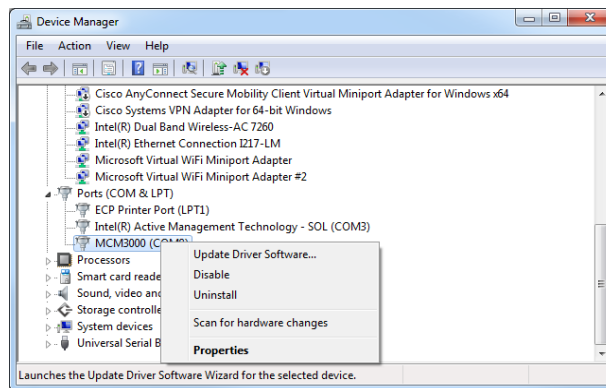
Figure 5–8 Device Manager

  b. On the *Port Settings* tab, click *Advanced* to open the *Advanced Settings* window.
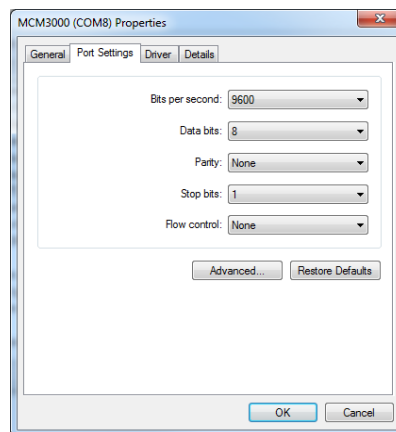
Figure 5–9 MCM3000 (COMx) Properties Window

c.   Select COM32 from the drop-down menu next to COM Port Number, and click *OK*.
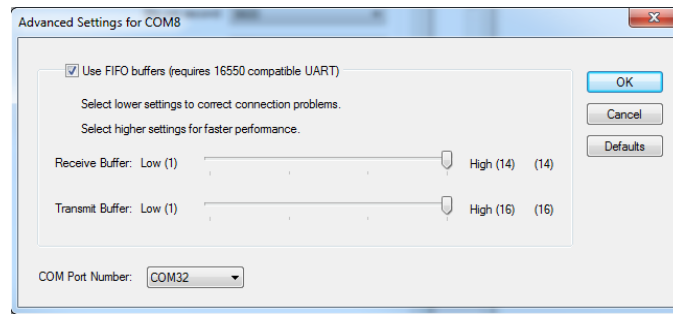
Figure 5–10 Advanced Settings Window

d.   Click *OK* on the *MCM3000 Properties* window.

6.   Slide the Power switch on the Controller Box to Off position, and then switch it on again.

The Com Port Number for MCM3000 must appear as COM32.

 Note: The COM Port Number changes if you connect the USB cable to a different USB port each time you connect to the computer. You must assign COM32 as the COM Port Number for MCM3000.

5.4.   Software Startup

The MCM3000 software can control up to three modules.

1.   Double click the *MCM3000_Control.exe* file from the *Application* folder.

The *MCM3000 Com Port Selection* window appears.
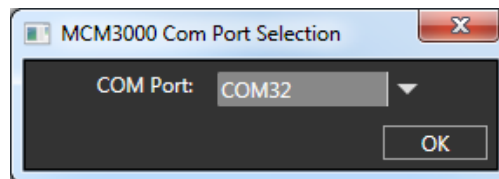
Figure 5–11 MCM3000 Com Port Selection Window

2.   In the *MCM3000 Com Port Selection* window, select *COM32* from the drop-down menu and click OK.

The *MCM3000 Control* window appears.

3.   In the *MCM3000 Control* window, click *File>Configure Axes* to configure the axes to the required stages.

The *Configure Axes* window appears.

4.   In the *Configure Axes* window, select the Motor Type for each axis from the drop-down menu. Enter the Min, Max, and Threshold values for each axis in the text box. Select Invert if you need to reverse the slider axis orientation. Click *OK*.

The following table shows the axes that correspond to the Controller Box Ports:

Axis	Controller Box Port
X	Stage 1
Y	Stage 2
Z	Stage 3
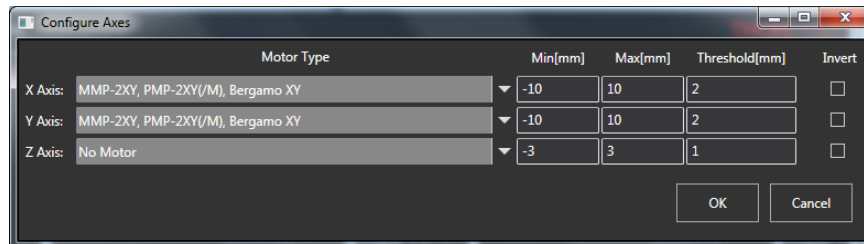
Figure 5–12 Configure Axes Window

⚠	**CAUTION**	⚠
	Make sure to configure the correct Motor Type to each axis. Failure to do so may result in damage to the stage due to overtravel.	

5.5.   MCM3000 GUI (Graphical User Interface)

The MCM3000 GUI consists of the menu and display area.
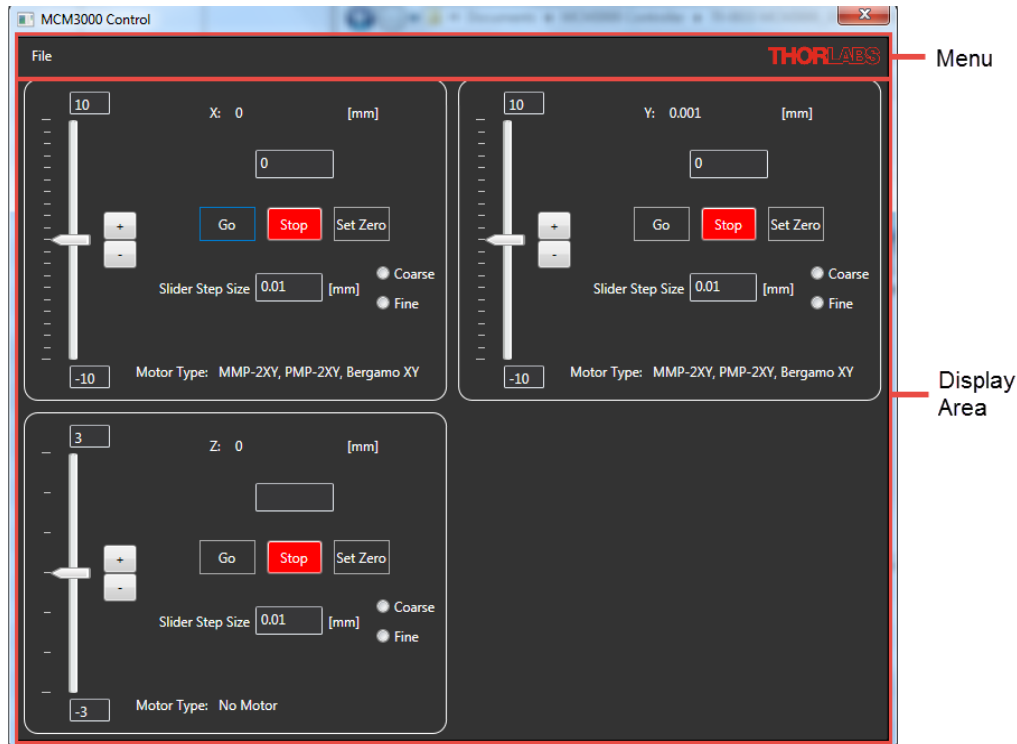
Figure 5–13 MCM3000 Control Window

5.5.1. Display Area

The display area controls the movement of the modules, which are connected to the Controller Box.

- **Slider:** use the mouse wheel or ± buttons to change the X/Y/Z position. The application does not allow any movement through the software if the current position of the module is outside the slider's limits. You must set a new zero value or set the module within the allowable range of movement. To change the slider's limits, see *Menu section on Page 15* .

- **X/Y/Z:** enter the value for the respective axis in the text box, and click *Go*. The stages move according to the incremental value set in the text box. Click *Set Zero* to reset the axis to zero. Click *Stop* to stop the module.

- **Slider Step Size:** set the step size of the slider in mm. Coarse/Fine options determine the slider step type.

- **Motor Type:** shows the type of motor configured to the axis via the *Configure Axes* window.

Note: The MCM3000 software has a safety feature to prevent large, unintended movements of the stages through the GUI. Accordingly, the software does not allow movement beyond the hardware configured limits presented at the end of the X/Y/Z slider. In addition, if you attempt to move the

X/Y/Z position at a distance greater than the threshold value in the *Configure Axes* window, a message appears to request confirmation of the movement.
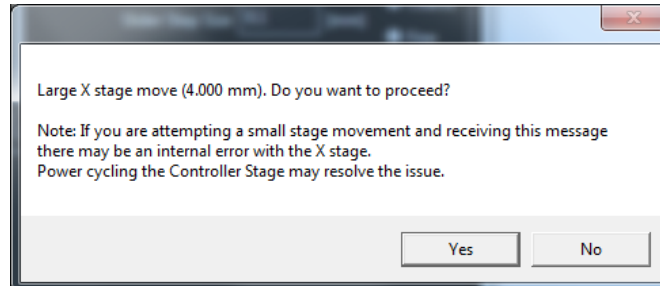
Figure 5–14 Software Warning Message

5.5.2. Menu

The Menu consists of the File menu. Use the File menu to configure the axes to the modules or to exit from the application.

- Click *File>Configure Axes* to open the *Configure Axes* window. Select the Motor Type for each axis you need to configure from the drop-down menu. Min/Max are the travel limits on the axis. Change the Min/Max values to update the travel limits. Threshold value is the software threshold and depends on the module that the axis drives. Select the Invert function to reverse the slider axis orientation.
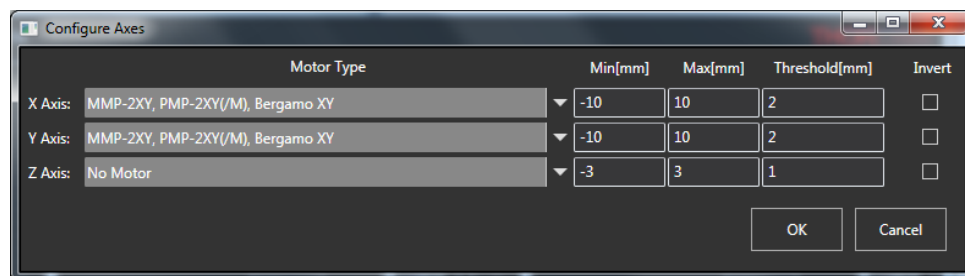
Figure 5–15 Configure Axes Window

- Click *File>Exit* to close the *MCM3000 Control* window.

Chapter 6   Maintaining the MCM3000 Series

Protect the MCM3000 Series from adverse weather conditions. The MCM3000 Series is not water resistant.

The unit does not need a regular maintenance. If you suspect a problem with the MCM3000 Series, please contact our nearest office (see ***Thorlabs Worldwide Contacts Chapter on Page 25*** for details) for assistance from an applications engineer.

> ⚠️ **CAUTION** ⚠️
> **DO NOT open or tamper the unit. No part of this unit is customer serviceable.**

6.1.   Cleaning

Use a damp lint-free cloth to clean the unit.
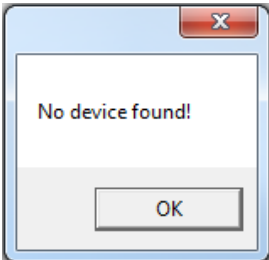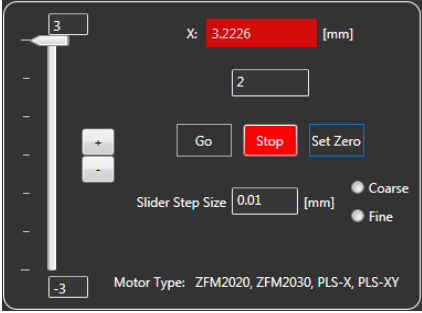
> ⚠️ **CAUTION** ⚠️
> **DO NOT expose the unit to spray, liquids, or solvents. This may damage the unit.**

6.2.   Troubleshooting

| Problem	Solution
No device found! dialog box	• Check the cables connection. • Unplug and replug the power and USB connections. • Check *Device Manager>Port (COM & LPT)* on your computer. Make sure the COM port for the MCM3000 is set to 32.
Software Not Responding	Check the cable connections. If the software is still not responding, please call Thorlabs' Technical Support.
Stage Moving Too Slow	Check the Speed Control knob on the 3-Axis Controller Knob. Software cannot control the speed of the stage.
Stage Not Moving	Check if the push-button corresponding to the stage on the 3-Axis Controller Knob has been enabled. This prevents the movement of the stage.

Problem	Solution
Push-Button Switch Does Not Turn Green	• Check the Joystick cable connection. • Unplug and replug the power and USB connections. • Press and release the push-button switch a couple of times.
Push-Button Switch Flashing Green	• Make sure the stage connected to the respective axis is not at the end of its travel limit. Rotate the knob in either direction to move the stage. **Note:** Do not use the software to move the stage when the push-button switch flashes green. • Check the cable connection from the stage to the Controller Box.
X/Y/Z Value Flashing Red 	Check if the stage connected to the respective axis has traveled beyond the configured limit (Min/Max value) on the slider. To move the stage back to its position: 1. Rotate the knob of the respective stage in either direction to move the stage to its zero position. 2. Click *Set Zero* on the *MCM3000 Control* window. **Note:** Do not use the software to move the stage when the X/Y/Z value is flashing red. The software cannot move the stage to its zero position if it has traveled beyond the configured limit.

Chapter 7   Specifications

7.1.   Controller Specifications

Specification	Value		
Item #	MCM3001	MCM3002	MCM3003
Motor Output			
Motor Drive Voltage	24 V		
Motor Drive Voltage	7.0 A (Peak) 3.0 A (RMS)		
Motor Drive Type	12-Bit PWM Control		
Control Algorithm	Open-Loop Microstepping		
Stepping	64 Microsteps per Full Step	128 Microsteps per Full Step	128 Microsteps per Full Step
Encoder Resolution	0.212 µm	0.5 µm	N/A
Total Steps per Revolution	12800	25600	25600
Maximum Stepping Velocity	4577 steps/s	793 steps/s	793 steps/s
Position Feedback	Quadrature Encoder (QEP) Input 5 V		
Encoder Feedback Bandwidth	16 MHz		
Position Counter	32-Bit		
Operating Modes	Position and Velocity		
Velocity Profile	Trapezoid		
Motor Drive Connector			
Mechanical Specifications	15 Position D-Type, Micro-D Plug, Male Pin Connector		
Motor Drive Outputs	200		
Quadrature Encoder (QEP) Input	Single Ended		
Limit Switch Inputs	Forward, Reverse, Index		
Encoder Supply	5 V		
Input Power Requirements			
Voltage	24 VDC		
Current	3.75 A (Peak)		
General			
Computer Connection	USB 2.0		
Housing Dimensions	97.3 mm x 50.8 mm x 73.6 mm (3.82" x 2.00" x 2.90")		

7.2. Compatible Motor Specifications

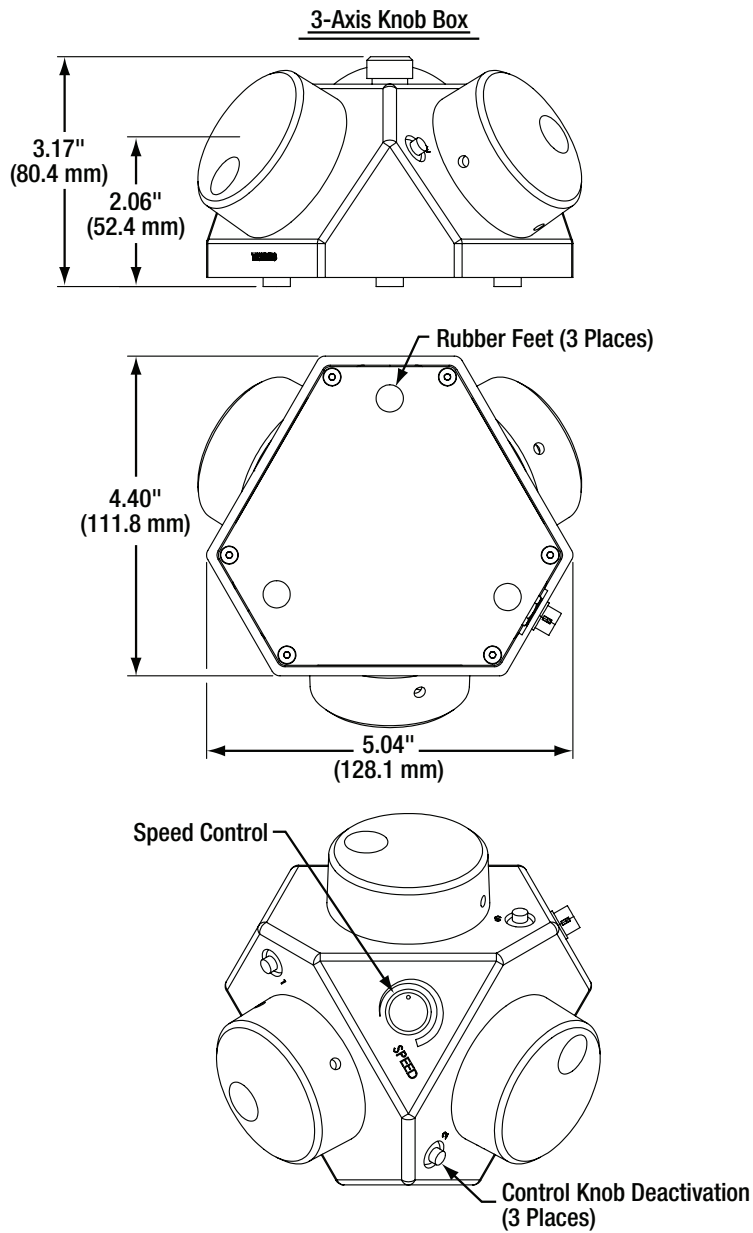| Specification	Value
Motor Type	2-Phase Bi-Polar Stepper
Rated Phase Current	Up to 7 A Peak
Step Angle Range	1.8° to 20°
Motor Drive Mode	Current
Coil Resistance (Nominal)	5 to 20 Ω
Coil Inductance (Nominal)	2 to 5.5 mH
Position Control	Open or Closed loop

Chapter 8   Mechanical Drawing

3-Axis Knob Box

Figure 8–1 3-Axis Knob Box
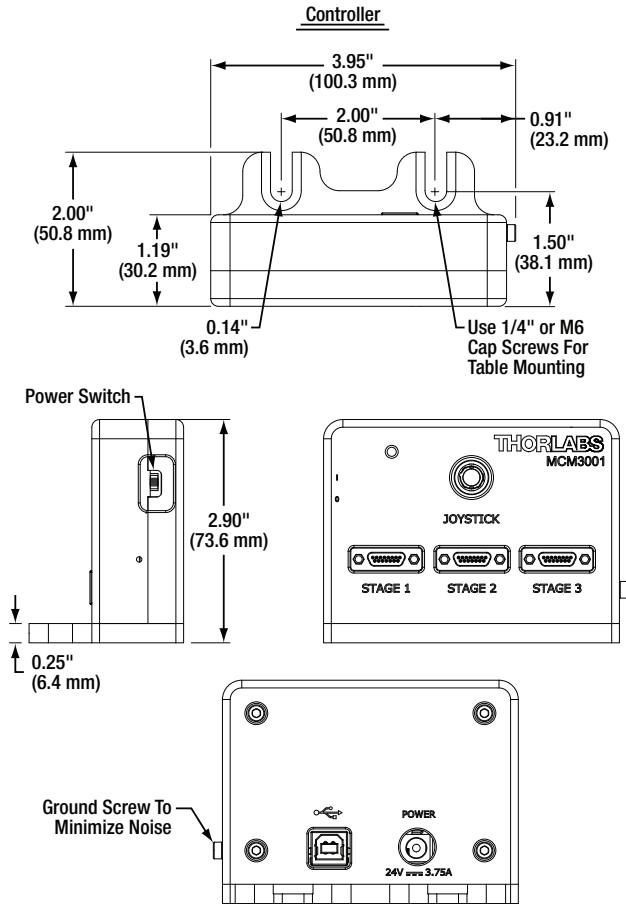
Figure 8–2 Controller Box

Pin	Description	Pin	Description
1	Stepper Motor Phase A+	**9**	Stepper Motor Phase B+
2	Stepper Motor Phase A-	**10**	Stepper Motor Phase B-
3	Not Used	**11**	Not Used
4	Not Used	**12**	Ground
5	5 V	**13**	5 V
6	Ground	**14**	LL
7	UL	**15**	Encoder Phase A+
8	Encoder Phase B+	**-**	-

Figure 8–3 MCM3001 Pin Diagram

Adapter Cable Connector for Controller I/O
Micro-D 15 Pin Female

Pin	Description
1	Stepper Motor Phase A+
2	Stepper Motor Phase A-
3	Not Used
4	Not Used
5	5 V
6	Ground
7	UL
8	Encoder Phase B+
9	Stepper Motor Phase B+
10	Stepper Motor Phase B-
11	Not Used
12	Ground
13	5 V
14	LL
15	Encoder Phase A+
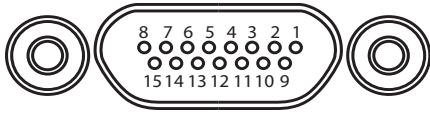
Adapter Cable Connector for Motor Drive
D-Sub 15 Pin Male

Pin	Description
1–6	Not Used
7	Stepper Motor Phase A+
8	Stepper Motor Phase B+
9–13	Not Used
14	Stepper Motor Phase A-
15	Stepper Motor Phase B-

Adapter Cable Connector for Encoder Drive
D-Sub 15 Pin Female
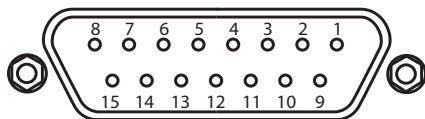
Computer Connection
USB 2.0 Type B
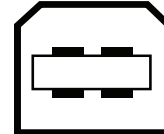
Pin	Description	Pin	Description
1	Not Used	9	Ground
2	Ground	10	LL
3	Not Used	11	UL
4	Not Used	12	Not Used
5	Encoder Phase B-	13	Encoder Phase B+
6	Encoder Phase A-	14	Encoder Phase A+
7	5 V	15	Not Used
8	5 V	-	-

Figure 8–4 MCM3002 Pin Diagram

Adapter Cable Connector for Controller I/O
Micro-D 15 Pin Female

8 7 6 5 4 3 2 1
15 14 13 12 11 10 9

Adapter Cable Connector for Motor Drive
HD15 D-Sub Female

1   5
6   10
11   15
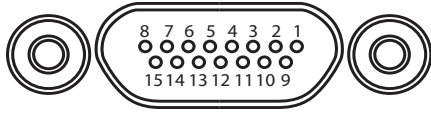
Pin	Description
1	Stepper Motor Phase A+
2	Stepper Motor Phase A-
3	Not Used
4	Index
5	5 V
6	Ground
7	UL
8	Encoder Phase B+
9	Stepper Motor Phase B+
10	Stepper Motor Phase B-
11	Not Used
12	Not Used
13	5 V
14	LL
15	Encoder Phase A+
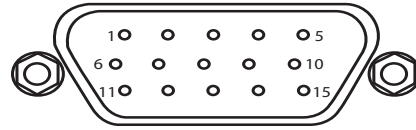
Pin	Description
1	Ground
2	Counter-Clockwise Limit Switch Output
3	Clockwise Limit Switch Output
4	Stepper Motor Phase B-
5	Stepper Motor Phase B+
6	Stepper Motor Phase A-
7	Stepper Motor Phase A+
8–14	Not Used
15	Not Used

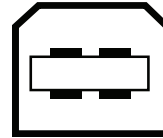Computer Connection
USB 2.0 Type B

Figure 8–5 MCM3003 Pin Diagram

Chapter 9　Regulatory

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return "end of life" units without incurring disposal charges.

This offer is valid for Thorlabs electrical and electronic equipment:

- Sold after August 13, 2005
- Marked correspondingly with the crossed out "wheelie bin" logo (see right)
- Sold to a company or institute within the EC
- Currently owned by a company or institute within the EC
- Still complete, not disassembled and not contaminated

Wheelie Bin Logo

As the WEEE directive applies to self-contained operational electrical and electronic products, this end of life take back service does not refer to other Thorlabs products, such as:

- Pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- Components
- Mechanics and optics
- Left over parts of units disassembled by the user (PCB's, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

9.1.　Waste Treatment is Your Own Responsibility

If you do not return an "end of life" unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

9.2.　Ecological Background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.

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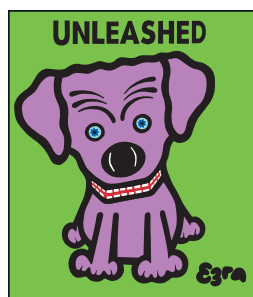www.thorlabs.de
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