THORLABS
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MCM3003 - August 3, 2023

Item # MCM3003 was discontinued on August 3, 2023. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

COMPACT CONTROLLERS FOR MICROSCOPY

- ► Operate Motorized Microscopy Stages and Components
- ► Peak Power Output up to 7 W
- ► Hand-Operated Knobs for up to Three Channels

Knob Box

Controller Box

MCM3001

MCM3002 Used to Control the Cerna® Translating Platform

OVER VIEW

Features

- Knobs Provide Hand-Operated Control for up to Three Channels
- Each Axis can be Individually Disabled to Prevent Unintended Movements or to Retain a Position
- Adjust Translation Speed via Top-Located Knob
- Remotely Control Translation Using Standalone Software (Windows® 7 and 10 64-Bit)

Controller Front View

Knob Box

MCM3001 Being Used to Control Both Axes of the PLS-XY and one ZFM2020 Focusing Module

The MCM3000 Series Controllers consist of a hand-operated knob box and a separate controller. Each side face of the knob box includes a rotating knob and a push-button switch that are dedicated to a single channel. The push-button switch enables and disables the channel, and is lit in green when the channel is enabled. Disabling the channel lets the user preserve a position or prevent accidental movements. A smaller knob on the top face adjusts the amount of translation per rotation of the knob (see the *Specs* tab for details).

Each controller is designed to operate different stages: the MCM3001 is compatible with motorized Cerna® components with a travel range of 1", the MCM3002 is compatible with motorized Cerna components with a travel range of 2", and the MCM3003 is compatible with non-Cerna stages that utilize a stepper motor.

Since each controller has three channels, you only need to purchase enough channels for each of the modules 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. Because of the compatibility of the controllers, if you have a PMP-2XY Translating Platform and a ZFM2020 Focusing Module, you will need both the MCM3001 and MCM3002. Please contact Tech Support for controllers that will drive more than one type of stage.

Axis translation can also be adjusted remotely via software (see the *Software* tab for details). Alternatively, LabVIEW™ software development kit (SDK) and support documentation are available to integrate these controllers with custom imaging software.

Item #	MCM3001	MCM3002	MCM3003
Compatible Stages	PLS-X & PLS-XY Translation Stages for Rigid Stands	PMP-2XY(/M) Translating Platform	LNR50S(/M) Linear Translation Stage[a]
	ZFM2020 & ZFM2030 Focusing Modules	MMP-2XY Microscope Body Translator	DRV014 Stepper Motor[b]

a. The LNR50S(/M) stage is a previous-generation linear translation stage. The current-generation LNR502(/M) stage is not compatible with the MCM3003 controller.
b. The DRV014 actuator is a previous-generation stepper motor actuator. The current-generation DRV250 actuator is not compatible with the MCM3003 controller.

S P E C S

Item #	MCM3001	MCM3002	MCM3003
Motor Output			
Motor Drive Voltage	24 V		
Motor Drive Current	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	12,800	25,600	25,600
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 (W x D x H)	97.3 mm x 50.8 mm x 73.6 mm (3.83" x 2.00" x 2.90")		

Compatible Motor Specifications	
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

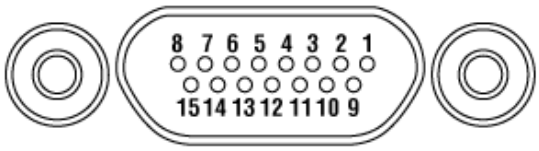
Compatible Stages	
MCM3001	ZFM2020 & ZFM2030 Focusing Modules
	PLS-X & PLS-XY Translation Stages for Rigid Stands
MCM3002	MMP-2XY Microscope Body Translator
	PMP-2XY(/M) Translating Platform
MCM3003	LNR50S(/M) Linear Translation Stage[a]
	DRV014 Stepper Motor[b]

a. The LNR50S(/M) stage is a previous-generation linear translation stage. The current-generation LNR502(/M) stage is not compatible with the MCM3003 controller.
b. The DRV014 actuator is a previous-generation stepper motor actuator. The current-generation DRV250 actuator is not compatible with the MCM3003 controller.

PIN DIAGRAMS

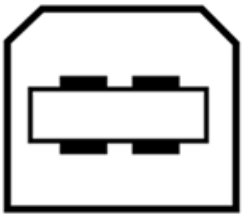
MCM3001

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



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+	-	-

Computer Connection
USB 2.0 Type B



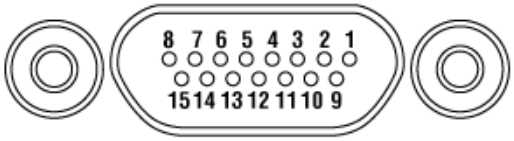
USB Type B to Type A Cable Included

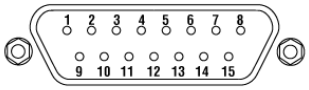
MCM3002

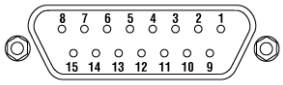
Adapter Cable Connector for Controller I/O
Micro-D 15 Pin Female

Adapter Cable Connector for Motor Drive
D-Sub 15 Pin Male

Adapter Cable Connector for Encoder Drive
D-Sub 15 Pin Female



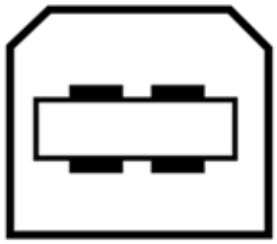




Pin	Description
1	Stepper Motor Phase A+
2	Stepper Motor Phase A-
3	Not Used
4	Not Used
5	5 V
6	Ground
7	UL
8	Encoder Phase B+
9	Stepper Motor Phase B+
10	Stepper Motor Phase B-
11	Not Used
12	Ground
13	5 V
14	LL
15	Encoder Phase A+

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-

Computer Connection
USB 2.0 Type B

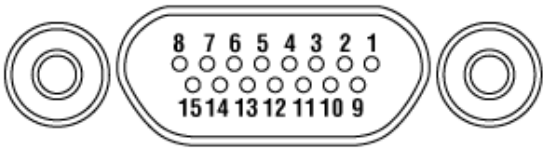


USB Type B to Type A Cable Included

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

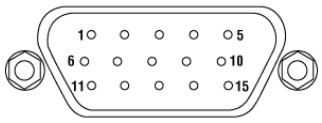
MCM3003

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



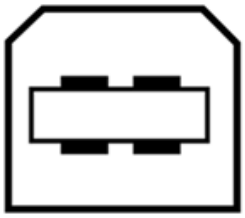
Pin	Description	Pin	Description
1	Stepper Motor Phase A+	9	Stepper Motor Phase B+
2	Stepper Motor Phase A-	10	Stepper Motor Phase B-
3	Not Used	11	Not Used
4	Not Used	12	Not Used
5	5 V	13	5V
6	Ground	14	LL
7	UL	15	Encoder Phase A+
8	Encoder Phase B+	-	-

Adapter Cable Connector for
Motor Drive
HD15 D-Sub Female



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

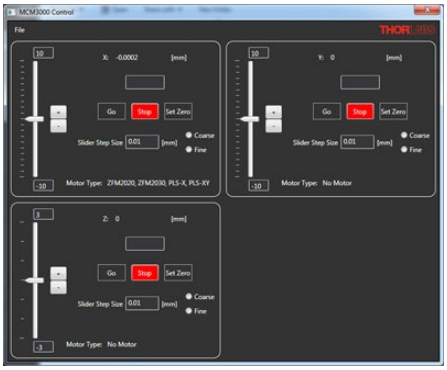
Computer Connection
USB 2.0 Type B



USB Type B to Type A Cable Included

SOFTWARE

Links to the latest versions of the MCM3000 series controllers software and firmware are below. The software download page offers a link to the GUI interface and driver. In addition, we provide a LabVIEW™ software development kit (SDK) and support documentation to allow any of the controllers to be controlled using custom imaging software.



MCM3000 Controller Software

Software

Version 4.0 (August 8, 2019)

The software package contains the installation files for the GUI interface, driver, SDK, and support documentation. The software is compatible with Windows® 7 and 10 (64-bit) systems.

Software

Firmware Update

Version 1.3 (August 8, 2019)

The latest firmware version for the MCM3000 Series Controllers. For installation instructions, consult the User's manual.

Firmware Updates

SHIPPIN G LIST

MCM3001 Contents

MCM3001

Each MCM3001 Includes the following:

- Knob Box
- Controller Box, with Joystick Controller Cable
- Power Supply, with Location-Specific Power Cord
- USB Cable (A to B)
- Two 1/4"-20 Cap Screws, 1/2" Long
- Two M6 Cap Screws, 12 mm Long

MCM3002

MCM3002 Contents

Each MCM3002 Includes the following:

- Knob Box
- Controller Box, with Joystick Controller Cable
- Power Supply, with Location-Specific Power Cord
- Three Motor Adapter Cables for Cerna® Translating Platforms
- USB Cable (A to B)
- Two 1/4"-20 Cap Screws, 1/2" Long
- Two M6 Cap Screws, 12 mm Long
- Twelve 4-40 Hex Stand-Offs to Secure Cables Out

MCM3003

MCM3003 Contents

Each MCM3003 Includes the following:

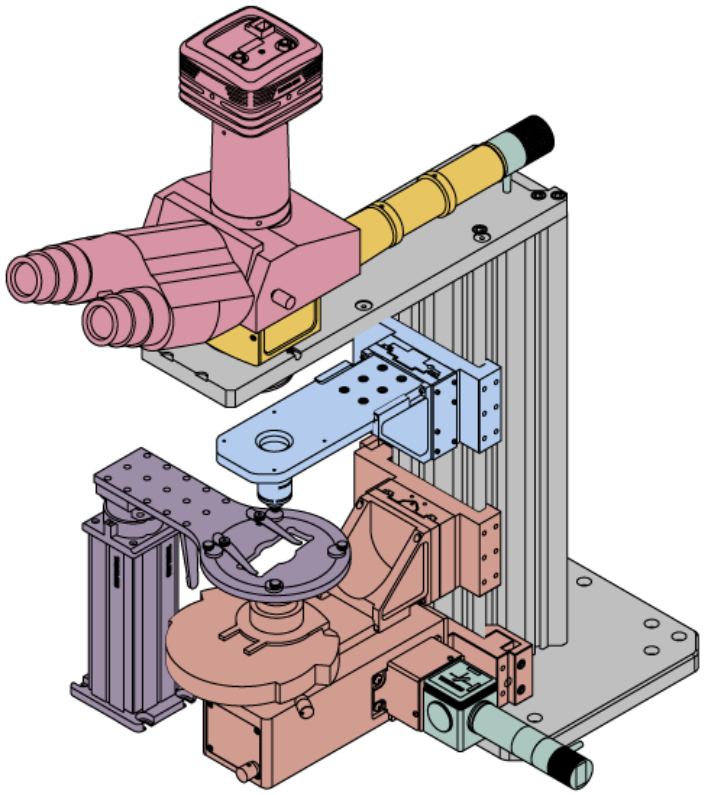
- Knob Box
- Controller Box, with Joystick Controller Cable
- Power Supply, with Location-Specific Power Cord
- Three Motor Adapter Cables for Non-Cerna Stages
- USB Cable (A to B)
- Two 1/4"-20 Cap Screws, 1/2" Long
- Two M6 Cap Screws, 12 mm Long
- Six 4-40 Hex Stand-Offs to Secure Cables Out

MICROSCOPE GUIDE

Elements of a Microscope

This overview was developed to provide a general understanding of a Cerna® microscope. Click on the different portions of the microscope graphic to the right or use the links below to learn how a Cerna microscope visualizes a sample.

- Terminology
- Microscope Body
- Illumination
- Sample Viewing/Recording
- Sample/Experiment Mounting



Terminology

Arm: Holds components in the optical path of the microscope.

Bayonet Mount: A form of mechanical attachment with tabs on the male end that fit into L-shaped slots on the female end.

Bellows: A tube with accordion-shaped rubber sides for a flexible, light-tight extension between the microscope body and the objective.

Breadboard: A flat structure with regularly spaced tapped holes for DIY construction.

Dovetail: A form of mechanical attachment for many microscopy components. A linear dovetail allows flexible positioning along one dimension before being locked down, while a circular dovetail secures the component in one position. See the *Microscope Dovetails* tab or here for details.

Epi-Illumination: Illumination on the same side of the sample as the viewing apparatus. Epi-fluorescence, reflected light, and confocal microscopy are some examples of imaging modalities that utilize epi-illumination.

Filter Cube: A cube that holds filters and other optical elements at the correct orientations for microscopy. For example, filter cubes are essential for fluorescence microscopy and reflected light microscopy.

Köhler Illumination: A method of illumination that utilizes various optical elements to defocus and flatten the intensity of light across the field of view in the sample plane. A condenser and light collimator are necessary for this technique.

Nosepiece: A type of arm used to hold the microscope objective in the optical path of the microscope.

Optical Path: The path light follows through the microscope.

Rail Height: The height of the support rail of the microscope body.

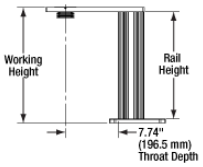
Throat Depth: The distance from the vertical portion of the optical path to the edge of the support rail of the microscope body. The size of the throat depth, along with the working height, determine the working space available for microscopy.

Trans-Illumination: Illumination on the opposite side of the sample as the viewing apparatus. Brightfield, differential interference contrast (DIC), Dodt gradient contrast, and darkfield microscopy are some examples of imaging modalities that utilize trans-illumination.

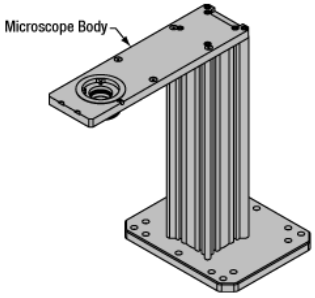
Working Height: The height of the support rail of the microscope body plus the height of the base. The size of the working height, along with the throat depth, determine the working space available for microscopy.

Microscope Body

The microscope body provides the foundation of any Cerna microscope. The support rail utilizes 95 mm rails machined to a high angular tolerance to ensure an aligned optical path and perpendicularity with the optical table. The support rail height chosen (350 - 600 mm) determines the vertical range available for experiments and microscopy components. The 7.74" throat depth, or distance from the optical path to the support rail, provides a large working space for experiments. Components attach to the body by way of either a linear dovetail on the support rail, or a circular dovetail on the epi-illumination arm (on certain models). Please see the *Microscope Dovetails* tab or here for further details.



Body Details

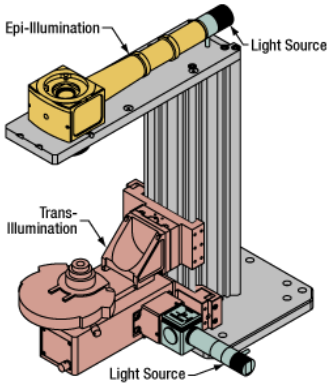


Cerna Microscope Body

	
Microscope Bodies	Microscope Translator

Illumination

Using the Cerna microscope body, a sample can be illuminated in two directions: from above (epi-illumination, see yellow components to the right) or from below (trans-illumination, see orange components to the right).



Illumination with a Cerna microscope can come from above (yellow) or below (orange). Illumination sources (green) attach to either.

Epi-illumination illuminates on the same side of the sample as the viewing apparatus; therefore, the light from the illumination source (green) and the light from the sample plane share a portion of the optical path. It is used in fluorescence, confocal, and reflected light microscopy. Epi-illumination modules, which direct and condition light along the optical path, are attached to the epi-illumination arm of the microscope body via a circular D1N dovetail (see the *Microscope Dovetails* tab or here for details). Multiple epi-illumination modules are available, as well as breadboard tops, which have regularly spaced tapped holes for custom designs.

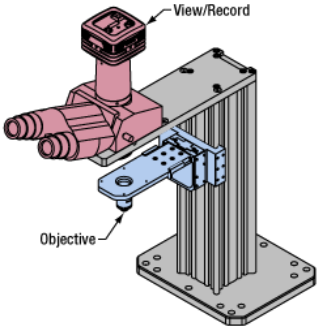
Trans-illumination illuminates from the opposite side of the sample as the viewing apparatus. Example imaging modalities include brightfield, differential interference contrast (DIC), Dodt gradient contrast, oblique, and darkfield microscopy. Trans-illumination modules, which condition light (on certain models) and direct it along the optical path, are attached to the support rail of the microscope body via a linear dovetail (see *Microscope Dovetails* tab or here). Please note that certain imaging modalities will require additional optics to alter the properties of the beam; these optics may be easily incorporated in the optical path via lens tubes and cage systems. In addition, Thorlabs offers condensers, which reshape input collimated light to help create optimal Köhler illumination. These attach to a mounting arm, which holds the condenser at the throat depth, or the distance from the optical path to the support rail. The arm attaches to a focusing module, used for aligning the condenser with respect to the sample and trans-illumination module.

							
Epi-Illumination Modules	Breadboards & Body Attachments	Brightfield	DIC	Dodt	Condensers	Condenser Mounting	Light Sources

Sample Viewing/Recording

Once illuminated, examining a sample with a microscope requires both focusing on the sample plane (see blue components to the right) and visualizing the resulting image (see pink components).

A microscope objective collects and magnifies light from the sample plane for imaging. On the Cerna microscope, the objective is threaded onto a nosepiece, which holds the objective at the throat depth, or the



Light from the sample plane is collected through an objective (blue) and viewed using trinocs or other optical ports (pink).

distance from the optical path to the support rail of the microscope body. This nosepiece is secured to a motorized focusing module, used for focusing the objective as well as for moving it out of the way for sample handling. To ensure a light-tight path from the objective, the microscope body comes with a bellows (not pictured).

Various modules are available for sample viewing and data collection. Trinoculars have three points of vision to view the sample directly as well as with a camera. Double camera ports redirect or split the optical path among two viewing channels. Camera tubes increase or decrease the image magnification. For data collection, Thorlabs offers both cameras and photomultiplier tubes (PMTs), the latter being necessary to detect fluorescence signals for confocal microscopy. Breadboard tops provide functionality for custom-designed data collection setups. Modules are attached to the microscope body via a circular dovetail (see the *Microscope Dovetails* tab or here for details).

Objectives & Accessories

Objective Mounting

Sample Viewing

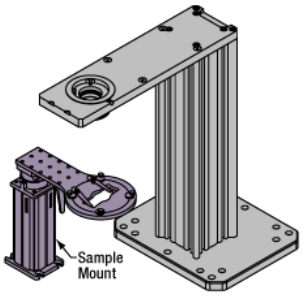
Cameras

PMTs

Breadboards & Body Attachments

Sample/Experiment Mounting

Various sample and equipment mounting options are available to take advantage of the large working space of this microscope system. Large samples and ancillary equipment can be mounted via mounting platforms, which fit around the microscope body and utilize a breadboard design with regularly spaced tapped through holes. Small samples can be mounted on rigid stands (for example, see the purple component to the right), which have holders for different methods of sample preparation and data collection, such as slides, well plates, and petri dishes. For more traditional sample mounting, slides can also be mounted directly onto the microscope body via a manual XY stage. The rigid stands can translate by way of motorized stages (sold separately), while the mounting platforms contain built-in mechanics for motorized or manual translation. Rigid stands can also be mounted on top of the mounting platforms for independent and synchronized movement of multiple instruments, if you are interested in performing experiments simultaneously during microscopy.



The rigid stand (purple) pictured is one of various sample mounting options available.

Translating Platforms

Rigid Stands

Translation Stages for Rigid Stands

Motorized XY Stages

Manual XY Stage

For sample viewing, Thorlabs offers trinoculars, double camera ports, and camera tubes. Light from the sample plane can be collected via cameras, photomultiplier tubes (PMTs), or custom setups using breadboard tops. Click here for additional information about viewing samples with a Cerna microscope.

Product Families & Web Presentations

Sample Viewing

Breadboards & Body Attachments

Cameras

PMTs

Microscope objectives are held in the optical path of the microscope via a nosepiece. Click here for additional information about viewing a sample with a Cerna microscope.

Product Families & Web Presentations

Objectives

Objective Thread Adapters

Parfocal Length Extender

Piezo Objective Scanner

Objective Mounting

Large and small experiment mounting options are available to take advantage of the large working space of this microscope. Click here for additional information about mounting a sample for microscopy.

Product Families & Web Presentations

Translating Platforms

Rigid Stands

Translation Stages for Rigid Stands

Motorized XY Stages

Manual XY Stage

Thorlabs offers various light sources for epi- and trans-illumination. Please see the full web presentation of each to determine its functionality within the Cerna microscopy platform.

Product Families & Web Presentations

Trans-Illumination Kits

Solis™ High-Power LEDs

Mounted LEDs

X-Cite® Lamps

Other Light Sources

Epi-illumination illuminates the sample on the same side as the viewing apparatus. Example imaging modalities include fluorescence, confocal, and reflected light microscopy. Click here for additional information on epi-illumination with Cerna.

Product Families & Web Presentations

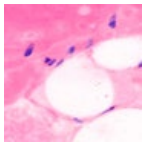
Epi-Illumination

Body Attachments

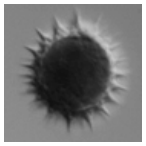
Light Sources

Trans-illumination illuminates from the opposite side of the sample as the viewing apparatus. Example imaging modalities include brightfield, differential interference contrast (DIC), Dodt gradient contrast, oblique, and darkfield microscopy. Click here for additional information on trans-illumination with Cerna.

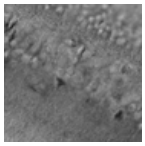
Product Families & Web Presentations



Brightfield



DIC



Dodt

Condensers

Condenser Mounting

Illumination Kits

Other Light Sources

The microscope body provides the foundation of any Cerna microscope. The 7.74" throat depth provides a large working space for experiments. Click here for additional information about the Cerna microscope body.

Product Families & Web Presentations

Microscope Bodies

Microscope Translator

Part Number	Description	Price	Availability
MCM3001	Three-Channel Controller and Knob Box for 1" Cerna Travel Stages	$3,625.50	7-10 Days
MCM3002	Three-Channel Controller and Knob Box for 2" Cerna Travel Stages	$4,190.34	Lead Time
MCM3003	Three-Channel Controller and Knob Box for 2" Stages with Stepper Motor	$4,190.34	Lead Time