

WFA4110 - FEB 7, 2022

Item # WFA4110 was discontinued on FEB 7, 2022. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

BODY ATTACHMENTS AND EXTENSIONS FOR DIY CERNA® SYSTEMS

- ▶ Use Thorlabs' Construction Systems with DIY Cerna® Systems
- ▶ Lens Tube, Cage System, and Dovetail Adapters
- ▶ Breadboard Mounting Surfaces and Motorized Z-Axis Translators

Application Idea

DIY Cerna System with 18.00" x 4.60" Breadboard Top and Fixed Arms. Note a previous-generation camera is shown.



OVERVIEW

Features

- Fixed Arms Position Lens Tubes and Cage Systems at 7.74" Throat Depth
- Manual and Motorized Modules Translate Lens Tubes and Cage Systems Along Optical Axis
- 95 mm Rail Mounting Platforms Attach User-Designed Modules to Microscope Body
- Breadboard Tops Support Home-Built Sample Viewing and Illumination Pathways
- Epi-Illuminator Module Integrates Filter Cubes with SM1 and 30 mm Cage Components
- Eyepiece Adapter for Mounting Detection Systems to Trinocular Eyepieces
- Dovetail Adapters Connect DIY Cerna® Components to Lens Tubes and Cage Systems

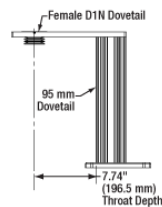
The items on this webpage integrate Thorlabs' lens tube systems, cage construction systems, and other optomechanics with our Cerna microscopy platform.

We offer several types of arms that center lens tubes and/or cage construction systems along an optical axis 7.74" away from the edge of a Cerna microscope body. Some arms can be directly attached to the vertical rail to provide structural support for these construction systems, while others can be connected to a manual or motorized module to enable 1" of travel along the optical axis.

In addition, we manufacture breadboard tops with optical ports centered on a male D1N dovetail. These breadboards provide 1/4"-20 (M6 x 1.0) tapped hole arrays that mount to the female D1N dovetail on a Cerna microscope body's epi-illumination arm, which can be used to create optomechanical setups. A version with a manual two-position slider is also offered that provides the ability to select between and combine optical paths.

Our 95 mm rail mounting platforms permit user-designed modules to be mounted anywhere along the sides of the vertical rail. An epi-illumination module that interfaces our SM1 lens tube and 30 mm cage system to a fluorescence filter cube is available. An eyepiece adapter and dovetail adapters that connect a wide range of DIY Cerna components to lens tubes and cage systems are also shown below.

The *Microscope Dovetails* tab gives additional information on the dovetails used throughout the Cerna microscopy platform, while the *Cage Overview* tab gives a brief overview of our cage construction systems.



Click to Enlarge

Our DIY Cerna Microscope Bodies with Epi-Illumination Arms offer a 95 mm wide dovetail for holding fixed and motorized arms, and a female D1N dovetail that sets a 7.74" throat depth.



Click to Enlarge

This DIY Cerna® system uses several body attachments and extensions to support a home-built sample viewing and epi-illumination apparatus.

Quick Links

Quick Links	
For 95 mm Dovetail	Fixed Arms Manual Translation Arms Motorized Translation Arms Mounting Platforms
For Epi-Illumination Arm	Breadboard Tops Breadboard Top with Two-Position Slider Epi-Illuminator Module for One Filter Cube
For Trinocular Eyepiece	Eyepiece Adapter
Dovetail Adapters	D1N, D2N, D2NB, D3N, and D3T

MICROSCOPE DOVETAELS

Introduction to Microscope Dovetails

Dovetails are used for mechanical mating and optical port alignment of microscope components. Components are connected by inserting one dovetail into another, then tightening one or more locking setscrews on the female dovetail. Dovetails come in two shapes: linear and circular. Linear dovetails allow the mating components to slide before being locked down, providing flexible positioning options while limiting unneeded degrees of freedom. Circular dovetails align optical ports on different components, maintaining a single optical axis with minimal user intervention.



[Click to Enlarge](#)
This photo shows the male 95 mm dovetail on the microscope body and the female 95 mm dovetail on the CSA1002 Fixed Arm.



[Click to Enlarge](#)
This photo shows the male D1N dovetail on the trinoculars next to the female D1N dovetail on the epi-illumination arm.

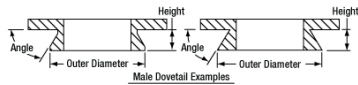
Thorlabs manufactures many components which use dovetails to mate with our own components or those of other manufacturers. To make it easier to identify dovetail compatibility, we have developed a set of dovetail designations. The naming convention of these designations is used only by Thorlabs and not other microscope manufacturers. The table to the right lists all the dovetails Thorlabs makes, along with their key dimensions.

In the case of Thorlabs' Cerna® microscopes, different dovetail types are used on different sections of the microscope to ensure that only compatible components can be mated. For example, our WFA2002 Epi-Illuminator Module has a male D1N dovetail that mates with the female D1N dovetail on the microscope body's epi-illumination arm, while the CSS2001 XY Microscopy Stage has a female D1Y dovetail that mates with the male D1Y dovetail on the CSA1051 Mounting Arm.

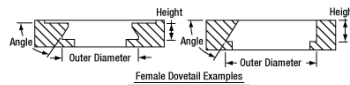
To learn which dovetail type(s) are on a particular component, consult its mechanical drawing, available by clicking on the red Docs icon (📄) below. For adapters with a female dovetail, the drawing also indicates the size of the hex key needed for the locking setscrew(s). It is important to note that mechanical compatibility does not ensure optical compatibility. Information on optical compatibility is available from Thorlabs' web presentations.

For customers interested in machining their own dovetails, the table to the right gives the outer diameter and angle (as defined by the drawings below) of each Thorlabs dovetail designation. However, the dovetail's height must be determined by the user, and for circular dovetails, the user must also determine the inner diameter and bore diameter. These quantities can vary for dovetails of the same type. One can use the intended mating part to verify compatibility.

In order to reduce wear and simplify connections, dovetails are often machined with chamfers, recesses, and other mechanical features. Some examples of these variations are shown by the drawings below.



[Click to Enlarge](#)
Two examples of how circular male dovetails can be manufactured.



[Click to Enlarge](#)
Two examples of how circular female dovetails can be manufactured.

Thorlabs Dovetail Reference ^a			
Type	Shape	Outer Dimension	Angle
95 mm	Linear	95 mm	45°
D1N	Circular	Ø2.018"	60°
D2N ^b	Circular	Ø1.50"	90°
D2NB ^b	Circular	Ø1.50"	90°
D3N	Circular	Ø45 mm	70°
D5N	Circular	Ø1.58"	90°
D6N	Circular	Ø1.90"	90°
D7N	Circular	Ø2.05"	90°
D1T	Circular	Ø1.50"	60°
D3T	Circular	Ø1.65"	90°
D1Y	Circular	Ø107 mm	60°
D2Y	Circular	Ø2.32"	50°
D3Y	Circular	Ø1.75"	90°
D4Y	Circular	Ø56 mm	60°
D5Y	Circular	Ø46 mm	60°
D6Y	Circular	Ø41.9 mm	45°
D1Z	Circular	Ø54 mm	60°
D2Z	Circular	Ø57 mm	60°
D3Z	Circular	Ø54 mm	45°

- These dovetail designations are specific to Thorlabs products and are not used by other microscope manufacturers.
- D2N and D2NB dovetails have the same outer diameter and angle, as defined by the drawings below. The D2N designation does not specify a height. The D2NB designation specifies a dovetail height of 0.40" (10.2 mm).

DIY CERNA INTERFACES

Standard Mechanical Interfaces on DIY Cerna® Components

The table below gives the dovetail, optical component threads, and cage system interfaces that are present on each DIY Cerna component. If a DIY Cerna component does not have one of the standard interfaces in the table, it is not listed here. Please note that mechanical compatibility does not ensure optical compatibility. Information on optical compatibility is available from Thorlabs' web presentations.

Item #	Microscope Dovetails										Optical Component Threads ^a				Cage Systems ^t	
	95 mm	D1N	D2N	D2NB	D3N	D5N	D1T	D3T	D1Y	D5Y	C-Mount ^c (1.00"-32)	SM1 ^d (1.035"-40)	SM30 (M30.5x0.5)	SM2 ^e (2.035"-40)	30 mm ^d	60 mm
2CM1												Internal & External		Internal		Yes
2CM2												Internal & External		Internal	Yes	
BSA2000 ^f					Female											
CEA1350	Male	Female														Yes
CEA1400	Male	Female														Yes
CEA1500	Male	Female														Yes
CEA1600	Male	Female														Yes
CFB1500	Male															
CSA1000	Female															
CSA1001	Female											Internal			Yes	
CSA1002	Female													Internal		Yes
CSA1003		Female														Yes
CSA1051	Female								Male							
CSA1200 ^{f,g}																Yes
CSA1400 ^f							Female									Yes
CSA1500 ^{f,h}																
CSA2000 ^f					Female									Internal		Yes
CSA2001					Female									External		
CSA2100 ^f														Internal		Yes
CSA3000(M)		Male														
CSA3010(M)		Male													Yes	Yes
Item #	95 mm	D1N	D2N	D2NB	D3N	D5N	D1T	D3T	D1Y	D5Y	C-Mount	SM1	SM30	SM2	30 mm	60 mm
CSC1001					Male											
CSC1002					Male											
CSC2001					Male											
CSD1001		Male & Female		Female												
CSD1002		Male & Female									External					
CSE2000		Male & Female														Yes
CSE2100		Male & Female						Female				Internal			Yes	Yes
CSE2200		Male & Female						Female				Internal			Yes	Yes
CSN100 ^{f,i}																Yes
CSN200 ^j							Male									
CSN210 ^j							Male									
CSN12019 ⁱ																
CSN12029 ^j																
CSS2001									Female							
LAURE1		Male	Female													
LAURE2		Male	Female													
LCPN1					Male								Internal		Yes	Yes
LCPN2		Male											Internal		Yes	Yes
LCPN3		Male								Female			Internal			Yes
Item #	95 mm	D1N	D2N	D2NB	D3N	D5N	D1T	D3T	D1Y	D5Y	C-Mount	SM1	SM30	SM2	30 mm	60 mm

OPX2400(M)		Male & Female													Internal		Yes
SM1A70												External	Internal				
SM1A58			Male	Male								Internal			External	Yes	
SM2A56									Male						External		
TC1X			Male														
WFA0150	Female																
WFA1000																	Yes
WFA1010												Internal					Yes
WFA1020												Internal					Yes
WFA1051												Internal					Yes
WFA1100																	Yes
WFA2001		Male & Female										Internal & External					
WFA2002		Male & Female										Internal					Yes
WFA4002		Male				Female											
WFA4100		Male										External	Internal				
WFA4101		Male										External	Internal				
WFA4102		Male										External	Internal				
WFA4110		Male													External		
WFA4111		Male													External		
WFA4112				Male								External					
Item #	95 mm	D1N	D2N	D2NB	D3N	D5N	D1T	D3T	D1Y	D5Y	C-Mount	SM1	SM30	SM2	30 mm	60 mm	
XT95RC1(M)	Female																
XT95RC2(M)	Female																
XT95RC3(M)	Female																
XT95RC4(M)	Female																
XT95P12(M)	Female																
ZFM1020	Female																
ZFM1030	Female																
ZFM2020	Female																
ZFM2030	Female																

- Thorlabs' optical component thread adapters can be used to convert between C-Mount threads, SM1 threads, SM2 threads, and virtually every other optical thread standard.
- Our cage system size adapters and drop-in adapter can be used to convert between 16 mm, 30 mm, and 60 mm cage systems.
- C-Mount and CS-Mount standards feature the same 1.00"-32 threads, but C-Mounts have a 5 mm longer flange-to-sensor distance.
- Our 30 mm cage plates can convert between SM1 lens tubes and 30 mm cage systems.
- Our 60 mm cage plates can convert between SM2 lens tubes and 60 mm cage systems.
- Attach to a ZFM focusing module to add a female 95 mm dovetail.
- The CSA1200 mounting arm is compatible with the CSN1201 and CSN1202 nosepieces.
- This blank arm is designed for custom DIY machining for non-standard components, threads, and bores..
- This nosepiece directly accepts M32 x 0.75 objective threads.
- This nosepiece directly accepts M25 x 0.75 objective threads.
- This nosepiece directly accepts RMS (0.800"-36) objective threads.

CAGE OVERVIEW

Cage System Overview

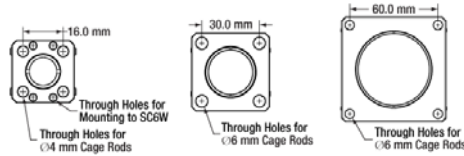
The Cage Assembly System provides a convenient way to construct large optomechanical systems with an established line of precision-machined building blocks designed for high flexibility and accurate alignment.

16 mm, 30 mm, and 60 mm Cage System Standards

Thorlabs offers three standards defined by the center-to-center spacing of the cage assembly rods (see image below). The 16 mm cage, 30 mm cage, and 60 mm cage standards are designed to accommodate Ø1/2", Ø1", and Ø2" optics, respectively. Specialized cage plates that allow smaller optics to be directly inserted into our larger cage systems are also available.

Standard Threads

The flexibility of our Cage Assembly System stems from well-defined mounting and thread standards designed to directly interface with a wide range of specialized products. The three most prevalent thread standards are our SM05 Series (0.535"-40 thread), SM1 Series (1.035"-40 thread), and SM2 Series (2.035"-40 thread), all of which were defined to house the industry's most common optic sizes. Essential building blocks, such as our popular lens tubes, directly interface to these standards.



An example of the standard cage plate measurements determining cage system compatibility.

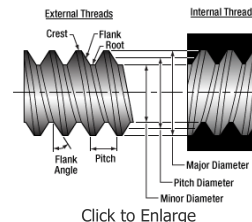
Standard Cage System Measurements			
Cage System	16 mm	30 mm	60 mm
Thread Series	SM05	SM1	SM2
Rod to Rod Spacing	16 mm (0.63")	30 mm (1.18")	60 mm (2.36")
Total Length	25 mm (0.98")	41 mm (1.60")	71.1 mm (2.8")

Cage Components		
Cage Rods	16 mm	These rods are used to connect cage plates, optic mounts, and other components in the cage system. The SR Series Cage Rods are compatible with our 16 mm cage systems, while the 30 mm and 60 mm cage systems use ER Series Cage Rods.
	30 mm	
	60 mm	
Cage Plates	16 mm	These serve as the basic building blocks for a cage system. They may have SM-threaded central bores, smooth bores sized for industry standard optics or to accommodate the outer profile of our SM Series Lens Tubes, or specialized bores for other components such as our FiberPorts.
	30 mm	
	60 mm	
Optic Mounts	16 mm	Thorlabs offers fixed, kinematic, rotation, and translation mounts specifically designed for our Cage Systems.
	30 mm	
	60 mm	
Cage Cubes	16 mm	These cubes are useful for housing larger optical components, such as prisms or mirrors, or optics that need to sit at an angle to the beam path, such as beamsplitters. Our cage cubes are available empty or with pre-mounted optics.
	30 mm	
	60 mm	
Post and Breadboard Mounts and Adapters		Mounting options for cage systems can be found on our Cage System Construction pages. Cage Systems can be mounted either parallel or perpendicular to the table surface.
Size Adapters		Cage System Size Adapters can be used to integrate components from different cage system and threading standards.
Specialized Components		Thorlabs also produces specialized cage components, such as Filter Wheels, a HeNe Laser Mount, and a FiberPort Cage Plate Adapter, allowing a wide range of our products to be integrated into cage-mounted optical systems. Explore our Cage Systems Visual Navigation Guide to see the full range of Thorlabs' cage components.

THREADING SPECS

Threading Specifications

The following is a general overview of screw threading. For more details regarding specifications and dimensions, please consult the *Machinery's Handbook*, available for purchase at many bookstores.



Features of a Thread

A thread consists of three repeating features: a crest, flank, and root (see drawing to the right). Except in special cases, threads have symmetrical sides inclined at equal angles when a vertical line is drawn through the center of a crest or root. The distance between corresponding points on adjacent threads is known as the pitch of the thread. The flank angle is defined as the angle the flank makes with a perpendicular ray drawn from the screw axis. Unless otherwise stated, threads have a flank angle of 30°, resulting in a total angle between flanks of 60°. Each feature is shown in the diagram to the right.

The major diameter is taken from the crests of a thread while the minor diameter is taken from the roots. For most screws, crests and roots do not terminate at a sharp point, so crest and root truncation values are included in the definitions of major and minor diameter. The pitch diameter is approximately halfway between the major and minor diameters.

Thread Form

A thread form is a set of rules that define the features' scale relative to one another. Common thread forms include the Unified Screw Thread Form, used in the United States of America and measured in imperial units, and the ISO Metric Screw Thread Form, used in many parts of the world and measured with the International System of Units. There are many thread forms in the Unified screw thread standard designated by either UN, which defines a flat root contour, or UNR, which defines a round root contour. These can be further described by appending more letters. For example, an extremely fine thread with a flat root contour is designated UNEF. Those forms which are not standardized by the Unified screw thread system are designated UNS.

Thread Series

Most screws are identified by their thread series. Thread series are denoted by the major diameter and density of threads. Unified threads specify density in threads per inch, while Metric threads specify the thread pitch. For example, in the Unified nomenclature, a 1/4"-20 cap screw has a 1/4" diameter barrel and the pitch is 20 threads per inch (TPI). In metric nomenclature, an M4 x 0.7 cap screw has a 4 mm barrel and the pitch is 1 thread per 0.7 mm. The term M4 x 0.7 is often shortened to just M4.

Thread Class

The tolerances and allowances on a thread series are given by a thread class. Unified thread classes are alphanumeric identifiers starting with a number from 1 through 3, where 1 is the loosest tolerance and 3 is the tightest, and either A for external threading or B for internal threading.

Unified Thread Class Tolerancing			
Location	Loose	Optimal	Strict
Internal	1B	2B	3B
External	1A	2A	3A

Metric Thread Tolerance Positions			
Location	Loose	Optimal	Strict
Internal	-	G	H
External	e or f	g	h

Metric Thread Tolerance Grades		
Dimension	Location	Tolerance Grades ^a
Minor Diameter	Internal	4, 5, <u>6</u> , 7, 8
Major Diameter	External	4, <u>6</u> , 8
Pitch Diameter	Internal	4, 5, <u>6</u> , 7, 8
	External	3, <u>4</u> , 5, <u>6</u> , 7, 8, 9

- The tolerance becomes looser as the grade increases. The underlined grades are used with normal lengths of thread engagement.

Metric threads have a slightly more complex tolerancing method that uses tolerancing grades, designated by a number 3 through 9; and tolerancing positions, which use letters e through h. Grades provide a measure of the tolerance itself: the smaller the number, the tighter the tolerance. Positions denote the distance of the tolerance from the pitch diameter. Uppercase positioning letters indicate internal threads while lowercase positioning letters indicate external threads.

Upper case positioning letters indicate internal threads while lowercase positioning letters indicate external threads.

Quoting from the *Machinery's Handbook, 29th Edition*, p. 1885: "To designate the tolerance class, the grade and position of the pitch diameter is shown first followed by that for the major diameter in the case of the external thread or that for the minor diameter in the case of the internal thread, thus 4g6g for an external thread and 5H6H for an internal thread. If the two grades and positions are identical, it is not necessary to repeat the symbols, thus 4g, alone, stands for 4g4g and 5H, alone, stands for 5H5H."

Thorlabs' SM Series Threads

Threading specifications for our SM threads, utilized in our lens tube and cage system components, are given below so that you can machine mating components to suit your application. Most SM series threads utilize a non-standard Unified thread form, indicated by the letters UNS, with a 30° flank angle and a thread class of 2A and 2B. The exception is our SM30 series thread, which is a Metric thread form with a 30° flank angle and a tolerance of 6H/6g. We also offer products with C-Mount and RMS threads, and the specifications for these threads are given below for reference. Please note that other manufacturers may have different tolerances for C-Mount and RMS threads. For other thread specifications that are not listed here, please contact Tech Support.

SM05 Threading: Ø1/2" Lens Tubes, 16 mm Cage Systems			
External Thread, 0.535"-40.0 UNS-2A		Internal Thread, 0.535"-40.0 UNS-2B	
Max Major Diameter	0.5340"	Min Major Diameter	0.5350"
Min Major Diameter	0.5289"	Min Pitch Diameter	0.5188"
Max Pitch Diameter	0.5178"	Max Pitch Diameter	0.5230"
Min Pitch Diameter	0.5146"	Min Minor Diameter (and 83.3% of Thread)	0.508"
Max Minor Diameter	0.5069"	Max Minor Diameter (and 64.9% of Thread)	0.514"

RMS Threading: Objective, Scan, and Tube Lenses	
External Thread, 0.800"-36.0 UNS-2A	Internal Thread, 0.800"-36.0 UNS-2B

RMS Threading: Objective, Scan, and Tube Lenses			
Max Major Diameter	0.7989"	Min Major Diameter	0.8000"
Min Major Diameter	0.7934"	Min Pitch Diameter	0.7820"
Max Pitch Diameter	0.7809"	Max Pitch Diameter	0.7866"
Min Pitch Diameter	0.7774"	Min Minor Diameter (and 83.3% of Thread)	0.770"
Max Minor Diameter	0.7688"	Max Minor Diameter (and 64.9% of Thread)	0.777"

C-Mount Threading: Machine Vision Lenses, CCD/CMOS Cameras			
External Thread, 1.000"-32.0 UN-2A		Internal Thread, 1.000"-32.0 UN-2B	
Max Major Diameter	0.9989"	Min Major Diameter	1.0000"
Min Major Diameter	0.9929"	Min Pitch Diameter	0.9797"
Max Pitch Diameter	0.9786"	Max Pitch Diameter	0.9846"
Min Pitch Diameter	0.9748"	Min Minor Diameter (and 83.3% of Thread)	0.966"
Max Minor Diameter	0.9651"	Max Minor Diameter (and 64.9% of Thread)	0.974"

SM1 Threading: Ø1" Lens Tubes, 30 mm Cage Systems			
External Thread, 1.035"-40.0 UNS-2A		Internal Thread, 1.035"-40.0 UNS-2B	
Max Major Diameter	1.0339"	Min Major Diameter	1.0350"
Min Major Diameter	1.0288"	Min Pitch Diameter	1.0188"
Max Pitch Diameter	1.0177"	Max Pitch Diameter	1.0234"
Min Pitch Diameter	1.0142"	Min Minor Diameter (and 83.3% of Thread)	1.008"
Max Minor Diameter	1.0068"	Max Minor Diameter (and 64.9% of Thread)	1.014"

SM30 Threading: Ø30 mm Lens Tubes			
External Thread, M30.5 x 0.5 – 6H/6g		Internal Thread, M30.5 x 0.5 – 6H/6g	
Max Major Diameter	30.480 mm	Min Major Diameter	30.500 mm
Min Major Diameter	30.371 mm	Min Pitch Diameter	30.175 mm
Max Pitch Diameter	30.155 mm	Max Pitch Diameter	30.302 mm
Min Pitch Diameter	30.059 mm	Min Minor Diameter (and 83.3% of Thread)	29.959 mm
Max Minor Diameter	29.938 mm	Max Minor Diameter (and 64.9% of Thread)	30.094 mm

SM1.5 Threading: Ø1.5" Lens Tubes			
External Thread, 1.535"-40 UNS-2A		Internal Thread, 1.535"-40 UNS-2B	
Max Major Diameter	1.5339"	Min Major Diameter	1.535"
Min Major Diameter	1.5288"	Min Pitch Diameter	1.5188"
Max Pitch Diameter	1.5177"	Max Pitch Diameter	1.5236"
Min Pitch Diameter	1.5140"	Min Minor Diameter (and 83.3% of Thread)	1.508"
Max Minor Diameter	1.5068"	Max Minor Diameter (and 64.9% of Thread)	1.514"

SM2 Threading: Ø2" Lens Tubes, 60 mm Cage Systems			
External Thread, 2.035"-40.0 UNS-2A		Internal Thread, 2.035"-40.0 UNS-2B	
Max Major Diameter	2.0338"	Min Major Diameter	2.0350"
Min Major Diameter	2.0287"	Min Pitch Diameter	2.0188"
Max Pitch Diameter	2.0176"	Max Pitch Diameter	2.0239"
Min Pitch Diameter	2.0137"	Min Minor Diameter (and 83.3% of Thread)	2.008"
Max Minor Diameter	2.0067"	Max Minor Diameter (and 64.9% of Thread)	2.014"

SM3 Threading: Ø3" Lens Tubes			
External Thread, 3.035"-40.0 UNS-2A		Internal Thread, 3.035"-40.0 UNS-2B	
Max Major Diameter	3.0337"	Min Major Diameter	3.0350"
Min Major Diameter	3.0286"	Min Pitch Diameter	3.0188"
Max Pitch Diameter	3.0175"	Max Pitch Diameter	3.0242"
Min Pitch Diameter	3.0133"	Min Minor Diameter (and 83.3% of Thread)	3.008"
Max Minor Diameter	3.0066"	Max Minor Diameter (and 64.9% of Thread)	3.014"

SM4 Threading: Ø4" Lens Tubes			
External Thread, 4.035"-40 UNS-2A		Internal Thread, 4.035"-40.0 UNS-2B	
Max Major Diameter	4.0337"	Min Major Diameter	4.0350"
Min Major Diameter	4.0286"	Min Pitch Diameter	4.0188"
Max Pitch Diameter	4.0175"	Max Pitch Diameter	4.0245"

SM4 Threading: Ø4" Lens Tubes			
Min Pitch Diameter	4.0131"	Min Minor Diameter (and 83.3% of Thread)	4.008"
Max Minor Diameter	4.0066"	Max Minor Diameter (and 64.9% of Thread)	4.014"

CERNA VIDEOS

Building a Cerna® Microscope

The Cerna microscopy platform's large working volume and system of dovetails make it straightforward to connect and position the components of the microscope. This flexibility enables simple and stable set up of a preconfigured microscope, and provides easy paths for later upgrades and modification. See below for a couple examples of the assembly of some DIY Cerna microscopes.

DIY Cerna Design and Assembly

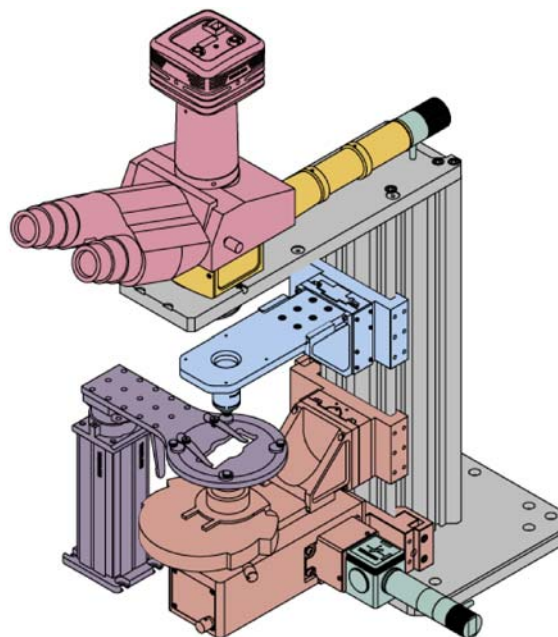
MICROSCOPE GUIDE

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

Click on the different parts of the microscope to explore their functions.

**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.

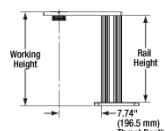
Throat Depth: The distance from the vertical portion of the optical path to the edge of the support rail of the microscope body. The size of the throat depth, along with the working height, determine the working space available for microscopy.

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.

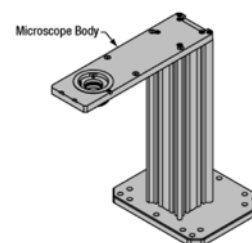
Working Height: The height of the support rail of the microscope body plus the height of the base. The size of the working height, along with the throat depth, determine the working space available for microscopy.

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.



Click to Enlarge
Body Details



Enlarge

Click to

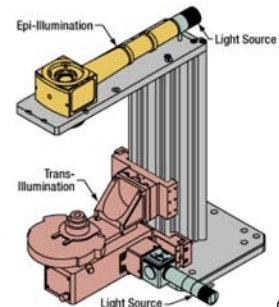
	
Microscope Bodies	Microscope Translator

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).

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.



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

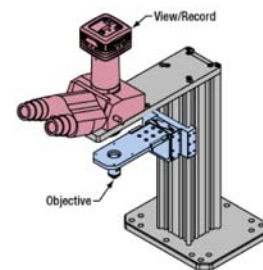
							
Epi-Illumination Modules	Breadboards & Body Attachments	Brightfield	DIC	Dodt	Condensers	Condenser Mounting	Light Sources

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 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).



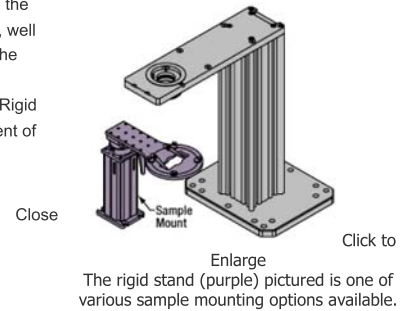
Click to Enlarge
Light from the sample plane is collected through an objective (blue) and viewed using trinocs or other optical ports (pink).

					
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

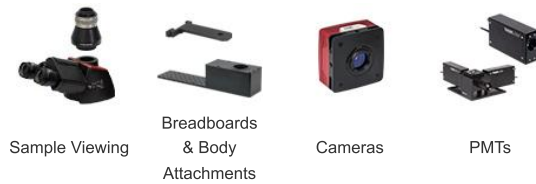
through holes. Small samples can be mounted on rigid stands (for example, see the purple component to the right), which have holders for different methods of sample preparation and data collection, such as slides, well plates, and petri dishes. For more traditional sample mounting, slides can also be 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.



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



Close

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



Close

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.

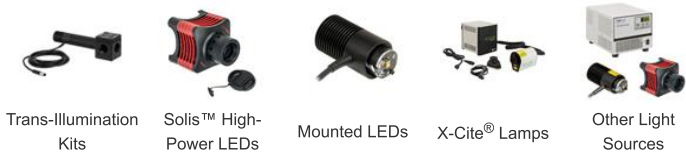
Product Families & Web Presentations



Close

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

Close

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

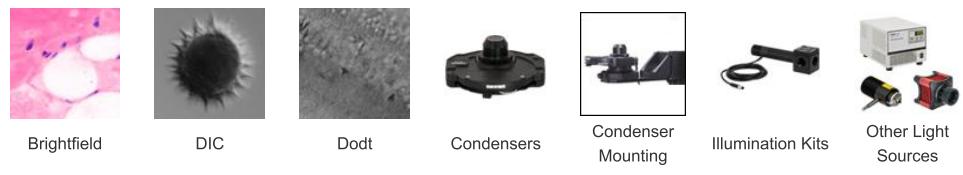


Epi-Illumination Body Attachments Light Sources

Close

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

Close

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.](#)

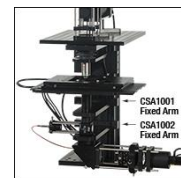
Product Families & Web Presentations



Microscope Bodies Microscope Translator

Fixed Arms

- ▶ Optical Ports for 7.74" Throat Depth of DIY Cerna Systems
- ▶ CSA1001: Internal SM1 (1.035"-40) Threads and Four 4-40 Taps for 30 mm Cage System
- ▶ CSA1002: Internal SM2 (2.035"-40) Threads and Four 4-40 Taps for 60 mm Cage System
- ▶ 95 mm Dovetail Clamp on Back Connects to Microscope Body



Click to Enlarge
User-Built Cerna System with
Trans-Illumination Using Fixed
Arms

When installed on a Cerna microscope body, our Fixed Arms are designed to position an optical apparatus 7.74" away from the edge of the vertical rail. Designed to provide structural support for user-built optical paths, each has a 95 mm dovetail clamp on the back that can be secured anywhere along the microscope body's linear dovetail surface by tightening two 4 mm hex setscrews.

These fixed arms are offered in three versions. The CSA1001 arm has internal SM1 (1.035"-40) through threads for Ø1" lens tubes and four 4-40 through taps for 30 mm cage systems, while the CSA1002 arm has internal SM2 (2.035"-40) through threads for Ø2" lens tubes and four 4-40 through taps for 60 mm cage systems. The image to the right uses one of each to support a home-built trans-illumination apparatus.

In order to provide additional mounting configurations, the 95 mm dovetail clamp can be separated from the plate that contains the optical port by removing four 3/32" hex cap screws. This 0.50" thick plate can be attached to the 1.00" thick clamp such that the surface of the plate is in the same plane as either the top or the bottom of the clamp. This flexibility permits the fixed arm to be mounted in whatever manner makes the most efficient use of space, while keeping the dovetail clamp's securing setscrews on the same side of the microscope body. Locating dowel pins that ensure proper alignment between the plate and the dovetail are included.

For applications that would benefit from motorized translation, please consider the CSA2100 Nosepiece (sold below).

Part Number	Description	Price	Availability
CSA1001	Fixed Arm, Internal SM1 Threads, 30 mm Cage Compatible	\$321.66	Today
CSA1002	Fixed Arm, Internal SM2 Threads, 60 mm Cage Compatible	\$334.97	Today

Manual Translation Arms

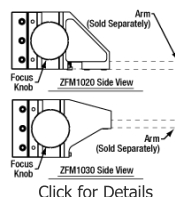


Click to Enlarge

- ▶ Manually Translate Home-Designed Optical Systems Along the Microscope Body's Optical Axis
- ▶ Manual Translation Modules
 - ▶ 1" of Travel Along Optical Axis
 - ▶ 95 mm Dovetail Clamp on Back Connects to Microscope Body
 - ▶ Include Six M4 Cap Screws for Attaching an Arm
 - ▶ Translation Stage Adjusted Using Focusing Knobs
- ▶ Arms that Attach to a Manual Translation Module
 - ▶ CSA2100: Internal SM2 (2.035"-40) Threads and Four 4-40 Taps for 60 mm Cage System
 - ▶ CSN100: Internal M32 x 0.75 Threads and Four 4-40 Taps for 60 mm Cage System
 - ▶ CSA1500: Blank Arm with Alignment Mark for Custom Machining

Manual Focusing Module Specifications	
Travel Range	1" (25.4 mm)
Distance per Degree Turn of Focus Knob ^a	~2 mm / 30°
Load Capacity	
Stage Mounted to Vertical Rail	Recommended: ≤6.6 lbs (3 kg) Maximum: 11 lbs (5 kg)
Stage Mounted to Horizontal Rail	Recommended: ≤22 lbs (10 kg) Maximum: 33 lbs (15 kg)

- The angular distance between each groove on the focus knob is 30°.



Click for Details

When using the ZFM1020 module, the surface of the arm will be flush with the bottom (or top) of the module.

When using the ZFM1030 module, the bottom surface of the arm will be at the middle of the

Our manual translation modules and arms permit Ø2" lens tubes, 60 mm cage systems, optics, and custom assemblies to be mounted at the 7.74" throat depth of a DIY Cerna system and translated along the optical axis over a 1" range.

Manual Translation Modules

Our Manual Focusing Modules consist of a 95 mm dovetail clamp that connects to the microscope body, a manual translation stage, and a mounting bracket that connects to an arm. We offer two versions of these manual focusing modules to allow the user to choose whichever module makes the most efficient use of space. As shown in the drawing on the right, an arm that is mounted to the ZFM1020 Focusing Module will have one surface in the same plane as the edge of the module. This module can be secured to the microscope with the holder facing up or down. By comparison, an arm that is mounted to the ZFM1030 Focusing Module will have one surface in the plane that bisects the module, which is 1.5" away from the module's edge.

For applications requiring high-precision translation of arms along the optical axis, we recommend using the motorized translating modules below.

Arms

When installed on a manual translation module, these arms are designed to position an optical port 7.74" away from the edge of the vertical rail. The CSA2100 arm has internal SM2 (2.035"-40) through threads for Ø2" lens tubes and four 4-40 through taps for 60 mm cage systems. The CSN100 nosepiece has internal M32 x 0.75 threads and four 4-40 through taps for 60 mm cage systems. We also offer microscope thread adapters to convert M32 x 0.75 threads to other industry-standard objective threads. For alternate thread and mounting options, the CSA1500 blank arm features a center mark to align custom machining with the optical path. Custom machining can be done on your own or you can contact Tech Support to request a specific thread.

Part Number	Description	Price	Availability
ZFM1020	Manual Condenser Focusing Module with 1" Travel for Edge-Mounted Arms	\$1,734.44	7-10 Days
ZFM1030	Manual Condenser Focusing Module with 1" Travel for Middle-Mounted Arms	\$1,734.44	7-10 Days
CSA2100	Arm, Internal SM2 Threads, 60 mm Cage Compatible	\$157.68	Today
CSN100	Nosepiece for 1 Objective, M32 x 0.75 Threads, 60 mm Cage Compatible	\$112.00	Today
CSA1500	Arm, Blank with Alignment Mark	\$157.68	Today

Motorized Translation Arms



Click to Enlarge

- ▶ Translate Home-Designed Optical Systems Along the Microscope Body's Optical Axis
- ▶ Motorized Modules (Operated by MCM3001, Sold Separately)
 - ▶ 1" of Fine Travel Along Optical Axis
 - ▶ 95 mm Dovetail Clamp on Back Connects to Microscope Body
 - ▶ Include Six M4 Cap Screws for Attaching an Arm
- ▶ Arms that Attach to a Motorized Module
 - ▶ CSA2100: Internal SM2 (2.035"-40) Threads and Four 4-40 Taps for 60 mm Cage System
 - ▶ CSN100: Internal M32 x 0.75 Threads and Four 4-40 Taps for 60 mm Cage System
 - ▶ CSA1500: Blank Arm with Alignment Mark for Custom Machining

Our motorized modules and arms permit Ø2" lens tubes, 60 mm cage systems, optics, and custom assemblies to be mounted at the 7.74" throat depth of a DIY Cerna system and translated along the optical axis over a 1" range.

Motorized Modules

Our Motorized Focusing Modules consist of a 95 mm dovetail clamp that connects to the microscope body, a motorized translation stage, and a mounting bracket that connects to an arm. We offer two versions of these stepper motor modules in order to allow the user to mount the arm in whatever manner makes the most efficient use of space. As shown in the drawing below, an arm that is mounted to the ZFM2020

Motorized Module will have one surface in the same plane as the edge of the module. Since this module can be secured to the microscope body in either of two orientations, both of which are shown in the image below, the arm can be positioned at the top or the bottom. In comparison, an arm that is mounted to the ZFM2030 Motorized Module will have one surface in the plane that bisects the module, which is 1.5" away from the module's edge.

The ZFM2020 and ZFM2030 modules use the same motorized translation stage; its specifications are given to the table to the right. Both are operated by the MCM3001 3-Axis Controller (sold separately, see below).

Arms

When installed on a motorized module, these arms are designed to position an optical port 7.74" away from the edge of the vertical rail. The CSA2100 arm has internal SM2 (2.035"-40) through threads for Ø2" lens tubes and four 4-40 through taps for 60 mm cage systems. The CSN100 nosepiece has internal M32 x 0.75 threads and four 4-40 through taps for 60 mm cage systems. We also offer microscope thread adapters to convert M32 x 0.75 threads to other industry-standard objective threads. For alternate thread and mounting options, the CSA1500 blank arm features a center mark to align custom machining with the optical path. Custom machining can be done on your own or you can contact Tech Support to request a specific thread.



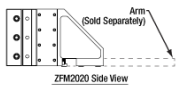
Click to Enlarge
Our motorized modules attach to our arms using six M4 cap screws.



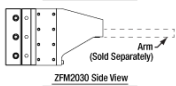
Click to Enlarge
The motorized module positions the optical port of the arm at a 7.74" throat depth. Here, the ZFM2020 module and CSA2100 arm are shown.



Click for Details
The ZFM2020 module has two possible orientations, creating space along the optical path for mounted optomechanical assemblies.



When using the ZFM2020 module, the surface of the arm will be flush with the bottom (or top) of the module.



When using the ZFM2030 module, the surface of the arm will be at the middle of the module.

Click for Details

Motorized Translation Stage Specifications ^a	
Travel Range	1" (25.4 mm)
Bidirectional Repeatability	1 µm
Backlash	1 µm
Minimum Achievable Incremental Movement	100 nm
Minimum Achievable Repeatable Movement	200 nm
Velocity (Max)	7 mm/s
Acceleration (Max)	11 mm/s ²
Cable Length	6' (1.8 m)
Pin Diagram	Click to View
Load Capacity	
Stage Mounted to Vertical Rail ^b	Recommended: ≤10 lbs (4.5 kg) Maximum: 10 lbs (4.5 kg)
Stage Mounted to Horizontal Rail	Recommended: ≤33.5 lbs (15.2 kg) Maximum: 42 lbs (19.1 kg)
Stepper Motor Specifications More [+]	

- The ZFM2020 and ZFM2030 modules use the same motorized translation stage (Operated by MCM3001, Sold Separately).
- This is the orientation shown in the pictures below.

Part Number	Description	Price	Availability
ZFM2020	Motorized Module with 1" Travel for Edge-Mounted Arms	\$2,060.67	Today
ZFM2030	Motorized Module with 1" Travel for Middle-Mounted Arms	\$2,060.67	Today
CSA2100	Arm, Internal SM2 Threads, 60 mm Cage Compatible	\$157.68	Today
CSN100	Nosepiece for 1 Objective, M32 x 0.75 Threads, 60 mm Cage Compatible	\$112.00	Today
CSA1500	Arm, Blank with Alignment Mark	\$157.68	Today

Motion Controller for Cerna Components with 1" Travel Range

- ▶ Designed for Cerna Components with 1" Motorized Travel
- ▶ Knobs Provide Hand-Operated Control for up to Three Axes
- ▶ Each Axis can be Individually Disabled to Prevent Unintended Movements or to Retain a Position
- ▶ Adjust Translation Speed via Top-Located Knob

Compatible Stages	
Motorized Focusing Modules	
Translation Stages for Rigid Stands	

Controller Specifications	More [+]
----------------------------------	-----------------

Compatible Motor Specifications	More [+]
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Click to Enlarge
MCM3001 Being Used to Control Both Axes of the PLS-XY and a ZFM2020 Focusing Module

The MCM3001 3-Axis Controller consists of a hand-operated knob box and a separate controller, as shown in the photo to the right.

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, and is lit in green when the axis is enabled. Disabling the axis 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 Controller Specifications table for details).

Since each MCM3001 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.

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; see the Compatible Motor Specifications table for use with alternate motorized products. For components with a 2" travel range, such as our Translating Platforms, the MCM3002 controller should be used instead. If you would like a controller configured to drive more than one type of stage, please contact Tech Support.

SDK and LabVIEW examples are also available by contacting Tech Support.

Part Number	Description	Price	Availability
MCM3001	Three-Channel Controller and Knob Box for 1" Cerna Travel Stages	\$3,452.86	Lead Time

Mounting Platforms

- ▶ Provide Arrays of Mounting Holes for Creating DIY Microscope Modules
- ▶ Positioned by Sliding Along the Microscope Body Rail
- ▶ Drop-On Rail Carriages: Insert and Remove Anywhere Along the Vertical Rail
- ▶ XT95P12(M) Rail Plate: Insert at Rail End and Slide Along Rail



Click to Enlarge
XT95RC1 Drop-On Rail Carriage Attached to a 95 mm Optical Rail



Click to Enlarge
XT95P12 Rail Plate with T-Nuts Inserted in 95 mm Rail Channels

These mounting platforms can be used to mount home-built microscope modules to the 95 mm dovetail on a Cerna microscope body. Each platform includes a matrix of mounting holes for compatibility with our extensive selection of optomechanics.

The Drop-On Rail Carriages can clamp to the side of a 95 mm rail by tightening the side-located 1/4"-20 (M6) locking screws. When the locking screw is loosened, the assisted opening mechanism pushes the hinged clamping arm out and provides ample clearance for the dovetail of a 95 mm rail. This allows the carriage to be inserted and removed anywhere along an exposed rail side. Furthermore, while the carriage is clamped onto a rail, the locking screw can be loosened slightly, allowing the carriage to slide along the rail edge and be repositioned in another location.

In comparison, the XT95P12(M) Rail Plate includes a closely packed array of seventeen 1/4"-20 (M6) tapped holes and four 1/4" (M6) counterbores. Tightening the four included 1/4"-20 (M6) cap screws locks the rail plate in place. As shown in the image to the far right, these cap screws are attached to two T-Nuts that fit into the channels on the 95 mm dovetail. Because accessing these channels on a DIY Cerna microscope body requires the end of the rail to be available, the top plate of the body must be detached in order to install and remove this plate. We therefore only recommend this rail plate for microscope bodies without epi-illumination arms. It is difficult to reinstall and realign an epi-illumination arm that has an optical setup on it.

If using a rail carriage and rail plate in the same setup, please note that the distance between the mounting surface and the top of the rail will not be the same, as shown in this photo.

The Drop-On Rail Carriages can be attached anywhere along the 95 mm dovetail of the Cerna microscope body.

The XT95P12 Rail Plate is inserted through the rail channels, requiring the top plate of the microscope body to be removed. It is only recommended for microscope bodies without epi-illumination arms.

Item #	Length	Number of Mounting Holes	Mounting Hole Type	Locking Screw	Type
XT95RC1	1.00"	7	1/4"-20 Tapped	1/4"-20 (3/16" Hex)	Drop-On Rail Carriage
XT95RC2	2.00"	21			
XT95RC3	3.00"	35			
XT95RC4	4.00"	49			
XT95RC1/M	25.0 mm	7	M6 x 1.0 Tapped	M6 (5.0 mm Hex)	
XT95RC2/M	50.0 mm	21			
XT95RC3/M	75.0 mm	35			
XT95RC4/M	100.0 mm	49			
XT95P12	3.15"	17 Threaded, 4 Counterbore	1/4"-20 Tapped, 1/4" Counterbore	Four 1/4"-20 (3/16" Hex)	Rail Plate
XT95P12/M	81.3 mm		M6 x 1.0 Tapped, M6 Counterbore	Four M6 (5.0 mm Hex)	

Part Number	Description	Price	Availability
XT95RC1/M	Drop-On Rail Carriage for 95 mm Rails, 25.0 mm Long, M6 Tapped Holes	\$80.47	Today
XT95RC2/M	Drop-On Rail Carriage for 95 mm Rails, 50.0 mm Long, M6 Tapped Holes	\$94.61	Today
XT95RC3/M	Drop-On Rail Carriage for 95 mm Rails, 75.0 mm Long, M6 Tapped Holes	\$114.17	Today
XT95RC4/M	Drop-On Rail Carriage for 95 mm Rails, 100.0 mm Long, M6 Tapped Holes	\$133.75	Today
XT95P12/M	Rail Plate for 95 mm Rails, 81.3 mm Long, M6 Tapped Holes	\$50.19	Today
XT95RC1	Drop-On Rail Carriage for 95 mm Rails, 1.00" Long, 1/4"-20 Tapped Holes	\$80.47	Today
XT95RC2	Drop-On Rail Carriage for 95 mm Rails, 2.00" Long, 1/4"-20 Tapped Holes	\$94.61	Today
XT95RC3	Drop-On Rail Carriage for 95 mm Rails, 3.00" Long, 1/4"-20 Tapped Holes	\$114.17	Today
XT95RC4	Drop-On Rail Carriage for 95 mm Rails, 4.00" Long, 1/4"-20 Tapped Holes	\$133.75	Today
XT95P12	Rail Plate for 95 mm Rails, 3.15" Long, 1/4"-20 Tapped Holes	\$50.19	Today

Breadboard Tops for Microscope Bodies

- ▶ Male D1N Dovetail on Bottom for Attachment to DIY Cerna Microscope Bodies
- ▶ Available in Two Sizes in Imperial and Metric Versions:
 - ▶ Imperial: 14.00" x 11.00" or 18.00" x 4.60"
 - ▶ Metric: 350.0 mm x 275.0 mm or 450.0 mm x 116.8 mm
- ▶ 1/4"-20 or M6 x 1.0 Mounting Holes



Click to Enlarge
Each breadboard has a male D1N dovetail on the bottom.

These black-anodized aluminum breadboard tops support user-designed widefield viewing apparatuses, epi-illumination pathways, and laser scanning pathways on top of upright Cerna microscopes. Each contains a Ø1.5" (Ø38.1 mm) through hole that is centered on a male D1N dovetail. This dovetail allows the breadboard to be connected directly to the epi-illumination arm of the microscope body, and it can also be used to stack the breadboard on top of an epi-illumination module. Additional details on the dovetail are available in the *Microscope Dovetails* tab.



Click for Details
CSA3010 Used to Mount a Custom Epi-Illuminator and Widefield Viewing Apparatus with a sCMOS Camera



Click for Details
CSA3000 Used to Mount a Custom Epi-Illuminator and Widefield Viewing Apparatus with a Previous-Generation CCD Camera

The breadboards are available in two sizes. The larger version [Item # CSA3000(M)] provides additional work surface, but protrudes past the sides of the epi-illumination arm, which may restrict approach angles around the objective for micromanipulators. The smaller version [Item # CSA3010(M)] does not restrict approach angles and also has eight 4-40 taps around the Ø1.5" through hole for 30 mm and 60 mm cage systems.

In configurations where the breadboard is mounted directly on top of the epi-illumination arm, four M4 counterbores can be used to provide additional mounting stability.

Item #	CSA3000	CSA3000/M	CSA3010	CSA3010/M
Dimensions (L x W)	14.00" x 11.00"	350.0 mm x 275.0 mm	18.00" x 4.60"	450.0 mm x 116.8 mm
Breadboard Thickness	1/2"	12.7 mm	1/2"	12.7 mm
Hole Size and Spacing	1/4"-20 Tapped Holes on 1" Centers	M6 x 1.0 Tapped Holes on 25 mm Centers	1/4"-20 Tapped Holes on 1" Centers	M6 x 1.0 Tapped Holes on 25 mm Centers
Number of Tapped Holes	154	154	87	89
Cage System Compatibility	-		Four 4-40 Taps for 30 mm Cage Systems Four 4-40 Taps for 60 mm Cage Systems	
Click for Mechanical Drawing	i	i	i	i
Dovetail	Male D1N			
Material	Matte Black Anodized Aluminum			

Part Number	Description	Price	Availability
CSA3000/M	Breadboard Top, 350.0 mm x 275.0 mm, M6 x 1.0 Taps, Male D1N Dovetail	\$755.76	Lead Time
CSA3010/M	Breadboard Top, 450.0 mm x 116.8 mm, M6 x 1.0 Taps, Male D1N Dovetail	\$918.87	Lead Time
CSA3000	Breadboard Top, 14.00" x 11.00", 1/4"-20 Taps, Male D1N Dovetail	\$755.76	Lead Time
CSA3010	Breadboard Top, 18.00" x 4.60", 1/4"-20 Taps, Male D1N Dovetail	\$918.87	7-10 Days

Breadboard Top with Two-Position Slider

- ▶ Two-Position Slider to Combine or Switch Between DIY Optical Paths
- ▶ Slider has Internal SM2 Threads and Holds One 35 mm x 52 mm x 3 mm Optic
- ▶ Back Port has Internal SM2 Threads and Four 4-40 Taps for Our 60 mm Cage System
- ▶ Imperial and Metric Versions
 - ▶ OPX2400: 10.16" x 3.94" Breadboard with Double-Density 1/4"-20 Tapped Holes
 - ▶ OPX2400/M: 258 mm x 100 mm Breadboard with Double-Density M6 x 1.0 Tapped Holes
- ▶ Stackable Design with Female and Male D1N Dovetails on Top and Bottom, Respectively



Click to Enlarge
[APPLIST]
[APPLIST]

Here, a white-light illumination path has been connected to the OPX2400 using our 60 mm cage system, and a GFP fluorescence path has been mounted on top of the OPX2400 via our WFA2002 epi-illuminator module.



Click to Enlarge
Slider Located Above Objective



Click to Enlarge
Slider Not in Optical Path with Objective

The lid of the slider housing is opened by removing four cap screws with a 3 mm balldriver. The slider and the slider housing are internally SM2-threaded. Two stainless steel tracks and detents provide repeatable positioning.

The OPX2400(/M) Breadboard

Top with Two-Position Slider adds a manually operated optic slider to the epi-illumination arm of a Cerna microscope body. By mounting a dichroic, beamsplitter, or mirror into the slider, users may combine or switch between widefield viewing, epi-illumination, and/or laser scanning pathways.

The optic slider has a clear aperture of Ø1.65" (Ø41.9 mm) and uses a leaf spring to retain a rectangular optic (minimum size: 34.9 mm x 51.9 mm x 2.8 mm; maximum size: 35.0 mm x 52.0 mm x 3.2 mm); the large aperture and optic size allow the entire aperture of the scan lenses above to be utilized. It has internal SM2 (2.035"-40) threads that face the back of the stationary housing, allowing a tube lens to be installed at a fixed distance from the dichroic. The back of the housing also has internal SM2 threads, as well as four 4-40 taps spaced for our 60 mm cage system.

In addition, a breadboard with sixty-eight 1/4"-20 (M6 x 1.0) through-tapped holes in a double-density hole pattern is included to support a home-built optical path. More 1/4"-20 (M6 x 1.0) tapped holes (sixteen on the imperial version and eighteen on the metric version) are located on the sides of the breadboard. Measured from the top of the breadboard, the beam height is 50.0 mm. Thorlabs manufactures Ø12 mm pedestal posts that center many of our 30 mm and 60 mm cage plates at this beam height, as illustrated in this photo, which provide structural support for large or heavy setups.

Thorlabs offers a 750 nm shortpass dichroic (Item # DMSP750B) and a protected silver mirror (Item # PFR14-P02) as stocked items. Beamsplitters and dichroics at additional cutoff wavelengths are available by contacting Tech Support. Once the optic is mounted, a 5/64" (2 mm) hex balldriver can be used to fine tune the optic slider's pitch and yaw adjusters. The slider may be locked in either position by tightening the included locking screw with a 3/32" balldriver. In the photo to the upper right, the locking screw is installed in the forward position.

In laser scanning Cerna systems, we recommend attaching the tube lens using the internal SM2 threads on the slider, since this will maximize the distance available along the throat depth to mount the objective and, if desired, non-descanned detectors.

Part Number	Description	Price	Availability
OPX2400/M	Breadboard Top with Slider, M6 x 1.0 Taps, Male & Female D1N Dovetails	\$4,777.20	Today
DMSP750B	35 mm x 52 mm Shortpass Dichroic Mirror, 750 nm Cutoff	\$1,471.41	Today
PFR14-P02	35 mm x 52 mm Protected Silver Mirror	\$543.71	Today
OPX2400	Breadboard Top with Slider, 1/4"-20 Taps, Male & Female D1N Dovetails	\$4,777.20	Today

Epi-Illuminator Module for One Filter Cube

- ▶ Internal SM1 (1.035"-40) Threads, Four 4-40 Taps for 30 mm Cage Systems, and Female and Male D1N Dovetails
- ▶ Magnetic Door Cover Holds Filter Cube in Optical Path

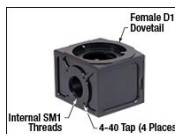
This animation shows the installation of a loaded MDFM-MF2 filter cube into the WFA2002 Epi-Illuminator Module.

cube in the epi-illumination pathway of a DIY Cerna system. With a female D1N dovetail on top and a male D1N dovetail on the bottom, it is designed to mate with the epi-illumination arm of a Cerna microscope body, as well as with other epi-illumination modules. Additional details on dovetails are available in the *Microscope Dovetails* tab.

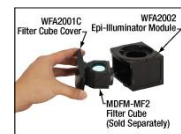
As shown in the image to the right, its optical input port has internal SM1 (1.035"-40) threads and four 4-40 taps for our 30 mm cage system. These mechanical interfaces enable Thorlabs' extensive selection of SM1 and 30 mm cage components to be used to build custom epi-illumination paths.

The module includes a magnetically secured cover that can be connected to an MDFM-MF2 Filter Cube, manufactured by Olympus. The animation to the left shows the filter cube installation procedure. Extra covers, which the user can attach to the filter cubes to speed up filter cube exchange, are sold as Item # WFA2001C. These filter cubes can be used to hold fluorescence filter sets, beamsplitters with crossed polarizers, or mirrors.

We also offer the WFA2001 Epi-Illuminator Module, which ships ready to accept an uncollimated light source with a Ø3 mm core liquid light guide or an SM1-coupled output.



Click to Enlarge
The back of the WFA2002 module has internal SM1 threads and four 4-40 taps for our 30 mm cage system.



Click to Enlarge
The front of the module has a magnetic door cover that holds an MDFM-MF2 filter cube.



Click to Enlarge
The photo above shows a home-built epi-illumination path mounted on the WFA2002 via a 30 mm cage system.

Part Number	Description	Price	Availability
WFA2002	Epi-Illuminator Module for 1 Cube, Male & Female D1N Dovetails	\$429.54	Today
WFA2001C	Extra Filter Cube Cover for WFA2001 and WFA2002 Epi-Illuminator Modules	\$192.99	Today
MDFM-MF2	OEM Microscopy Cube Assembly for Olympus AX, BX2, IX2, and Thorlabs Cerna Microscopes with WFA2001 or WFA2002 Epi-Illuminator Module	\$536.83	Today

Trinocular Eyepiece Adapter

- ▶ Replace Trinocular Eyepiece for DIY Construction
- ▶ Compatible with SM1, SM2, and 30 mm Cage Construction Systems



Click to Enlarge
Two SM2N2 adapters attached to the trinocular eyepieces.

The SM2N2 Eyepiece Adapter allows custom-built optical detection systems to attach to either eyepiece on the trinoculars of a Cerna Microscope. This adapter replaces the lens element on the eyepiece that sets the image plane at the the back of the eyes (see image to the right). Five alignment slots ensure the adapter fits snugly inside the eyepiece without rotation; because of the drop-in nature of this adapter, take care the attached system does not overbalance the 40 g eyepiece adapter when it is inside the trinoculars.

This adapter features internal SM1 (1.035"-40) threading for Ø1" lens tubes; two SM1RR retaining rings are included to secure an optic inside the adapter. The adapter also has external SM2 (2.035"-40) threading for Ø2" lens tubes. The face with the item # engraving has 4-40 tapped holes for 30 mm cage systems.

Item #	SM2N2
Microscope Connection	Ø1.18" Eyepiece Tube (Alignment Slot, 5 Places)
SM Threading	Internal SM1 (1.035"-40) External SM2 (2.035"-40)
Cage Compatibility	30 mm Cage System (4-40 Tap, One Side, 4 Places)
Clear Aperture	Ø0.90" (22.9 mm)
Adapter Profile (Click for Drawing)	

Part Number	Description	Price	Availability
SM2N2	Nikon Eclipse or Cerna Microscope Eyepiece Adapter, Internal SM1 and External SM2 Threads, 30 mm Cage Compatibility	\$146.80	Today

Dovetail Adapters

- ▶ Extend Versatility of Our Lens Tube and Cage Construction Systems to DIY Cerna Systems
- ▶ Compatible with DIY Cerna Modules that Have D1N, D2N, D2NB, D3N, or D3T Dovetails

The items shown here represent our complete selection of dovetail adapters for Thorlabs' Cerna microscopy platform. They integrate the Cerna platform with our SM1 (1.035"-40) lens tube, SM30 (M30.5 x 0.5) lens tube, SM2 (2.035"-40) lens tube, 30 mm cage, and 60 mm cage construction systems, making them ideal for creating custom widefield viewing, epi-illumination, trans-illumination, and condenser mounting apparatuses. Additionally, we offer the LCPN3 trinocular port adapter, designed to allow Olympus trinoculars that have a male D5Y dovetail to be used with DIY Cerna systems. See the images and table below for application ideas and the adapters' mechanical features.

The D1N, D2N, and D2NB dovetails are primarily used by our widefield viewing and epi-illumination accessories, while the D3N is Thorlabs' designation for the dovetail used by the majority of Nikon condensers for upright microscopes. The D3T dovetail is compatible with our CSE2100 epi-illuminator module. Lastly, the D5Y is Thorlabs' designation for the dovetail used by the majority of Olympus widefield viewing modules.

Application Ideas



Click to Enlarge
Here, our WFA4111 D1N Adapter is being used to support an SM2 lens tube that contains user-selected optics for forming an image on a Scientific Camera.



Click for Details
In this photo, the CSA1003 D1N Adapter is connecting a 60 mm cage system to a WFA2002 Epi-Illuminator Module.



Click to Enlarge
In this setup, the SM2A56 D2N Adapter is connecting a Solis® high-powered LED to the back of a CSE2100 epi-illuminator module.



Click to Enlarge
Our CSA2001 D3N Adapter is used by our CSA2000 Condenser Arm to hold a condenser to our CXY2 Translation Mount. This mount provides orthogonal XY adjusters for the condenser.

Item #	Dovetail ^a	Threading	Cage Compatibility	Clear Aperture	Built-In Tube Lens	Adapter Profile (Click for Drawing)
WFA4111 ^b	Male D1N	Internal M38 x 0.5 ^c External SM2	None ^d	Ø1.47" (37.0 mm)	-	i
WFA4110 ^b	Male D1N	External SM2	None ^d	-	TTL200	i
LCPN2	Male D1N	Internal SM30 ^e	30 mm Cage System (4-40 Tap ^f , 4 Places) 60 mm Cage System (Ø6 mm Bore, 4 Places)	Ø1.10" (27.9 mm)	-	i
LCPN3	Male D1N Female D5Y	Internal SM30 ^e	60 mm Cage System (Ø6 mm Bore, 4 Places)	Ø1.10" (27.9 mm)	-	i
CSA1003	Female D1N	None ^d	60 mm Cage System (Ø6 mm Bore, 4 Places)	Ø1.50" (38.1 mm)	-	i
SM1A58	Male D2N Male D2NB	Internal SM1 ^g External SM2	30 mm Cage System (4-40 Tap, 4 Places)	Ø1.008" (25.6 mm)	-	i
LCPN1	Male D3N	Internal SM30 ^e	30 mm Cage System (4-40 Tap, 4 Places) 60 mm Cage System (Ø6 mm Bore, 4 Places)	Ø1.10" (27.9 mm)	-	i
CSA2001	Female D3N	External SM2	None ^d	Ø1.58" (40.0 mm)	-	i
SM2A56	Male D3T	External SM2	None ^d	Ø1.40" (35.6 mm)	-	i

- Additional information on dovetails is available in the *Microscope Dovetails* tab.
- Item #'s WFA4111 and WFA4110 have identical mechanical profiles, but Item # WFA4110 has a permanently installed TTL200 Tube Lens, which can be used to construct a custom camera tube.
- This internal M38 x 0.5 threading is compatible with our SM38RR retaining rings.
- An SM2-threaded cage plate can be used to convert between SM2 lens tubes and 60 mm cage systems.
- This internal SM30 threading is compatible with our SM30RR retaining rings. Two SM30RR retaining rings are included.
- These tapped holes are on the side opposite the dovetail only.
- This internal SM1 threading is not deep enough for mounting optics.

Part Number	Description	Price	Availability
WFA4111	Adapter with Male D1N Dovetail, External SM2 Threads, and Internal M38 x 0.5 Threads	\$100.00	Today
WFA4110	Adapter with Male D1N Dovetail, External SM2 Threads, and TTL200 Tube Lens	\$634.44	Lead Time
LCPN2	Nikon Eclipse or Cerna Microscope Trinocular Adapter, Male D1N Dovetail, Internal SM30 Threads, 30 and 60 mm Cage Compatibility	\$114.17	7-10 Days
LCPN3	Customer Inspired! Nikon Eclipse or Cerna Microscope Trinocular Adapter, Male D1N Dovetail, Female D5Y Dovetail, Internal SM30 Threads, 60 mm Cage Compatibility	\$107.54	Today
CSA1003	Adapter with Female D1N Dovetail and Bores for 60 mm Cage System	\$270.64	7-10 Days

SM1A58	Upright Nikon Eclipse and Thorlabs Cerna Microscope Camera Port Adapter, Internal SM1 Threads, External SM2 Threads, 30 mm Cage Compatible	\$83.74	Today
LCPN1	Nikon Eclipse or Cerna Microscope Condenser Adapter, Male D3N Dovetail, Internal SM30 Threads, 30 and 60 mm Cage Compatibility	\$108.74	Today
CSA2001	Adapter with Female D3N Dovetail and External SM2 Threads	\$150.00	Today
SM2A56	Adapter with Male D3T Dovetail and External SM2 Threads	\$108.74	Today

Visit the *Body Attachments and Extensions for DIY Cerna® Systems* page for pricing and availability information:
https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=10093

