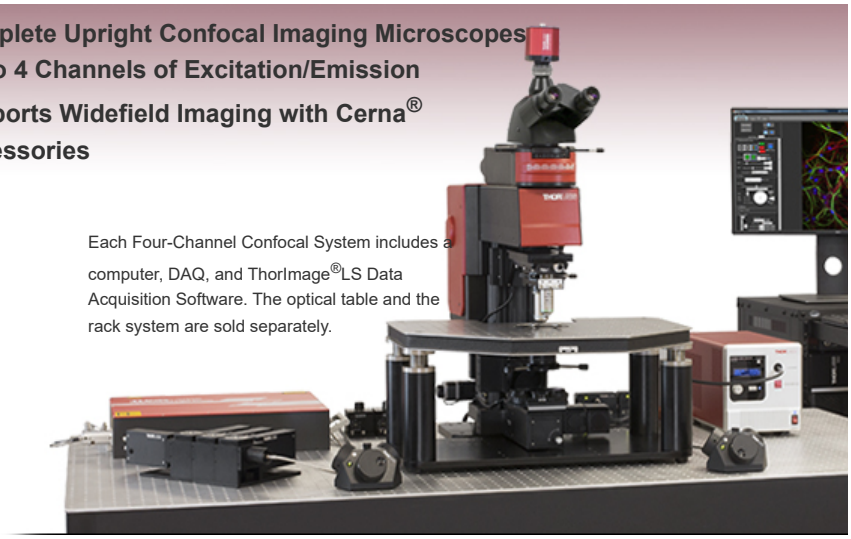
FOUR-CHANNEL, CERNA®-BASED CONFOCAL SYSTEMS

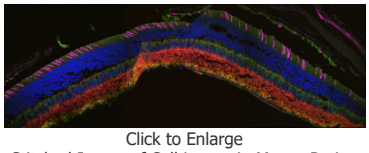
- Complete Upright Confocal Imaging Microscopes
- Up to 4 Channels of Excitation/Emission
- Supports Widefield Imaging with Cerna® Accessories



Each Four-Channel Confocal System includes a computer, DAQ, and ThorImage®LS Data Acquisition Software. The optical table and the rack system are sold separately.

OVERVIEW

Thorlabs' Confocal Microscopy System



Click to Enlarge
Stitched Image of Cell Layers in Mouse Retina
Sample Courtesy of Robert Fariss, Biological Imaging Core, NIH, Bethesda, Maryland

- Complete Upright Confocal Imaging Systems
- Up to 4 Channels of Excitation in a Monolithic, Fiber-Coupled Laser Source
- Up to 4 Channels of Detection with Multialkali or High-Sensitivity GaAsP PMTs
- Galvo-Galvo or Galvo-Resonant Scanners
- Full-Frame 4096 x 4096 Pixel Images
  - 2048 x 2048 Pixels (Bi-Directional)
  - 4096 x 4096 Pixels (Uni-Directional)
- Motorized Pinhole Wheel with 16 Sizes of Round Pinholes
- ThorImage®LS Data Acquisition Software with Lifetime Support
- Upright Microscope Body Based on Cerna® System to Support Future Expansion
  - Widefield Viewing Accessories
  - DIC or Dodt Contrast Imaging
  - XY Movement of Microscope and/or Sample
  - Other Modular Cerna Components

Thorlabs' Upright Confocal Microscopy Systems are complete, fully equipped microscopes available with galvo-galvo or galvo-resonant scan heads to support a variety of imaging applications. By eliminating signals that originate from outside the focal plane, confocal microscopy provides the ability to acquire high-resolution, optically sectioned images from within a thick sample or to reduce background fluorescence from thin cultures. Each system is tailored to meet individual imaging requirements; contact us using the link in the green box to the upper right for additional information and to receive a quote.

For applications that require rapid imaging of live systems, our galvo-resonant scan head is capable of capturing up to 400 fps. Alternatively, microscopes with galvo-galvo scanners are ideal for experiments involving photo-uncaging. Select one of four pre-configured laser sources with up to four excitation wavelengths. A motorized pinhole wheel with 16 round pinholes provides true diffraction-limited imaging while allowing the user to optimize the pinhole size for their objective. Multi-spectral imaging is enabled by a two- or four-channel detection module with an included filter set that, together with the laser source, has been optimized for the excitation and emission wavelengths of popular fluorophores. Choose from standard multialkali photomultiplier tubes (PMTs) for samples with a large dynamic range or high-sensitivity GaAsP PMTs to image weakly fluorescent samples.

Each microscope includes a PC with DAQ card and the ThorImageLS data acquisition software. ThorImageLS was developed in conjunction with our laser scanning microscopy systems to provide a seamless, logical, intuitive program for acquiring and analyzing images. This open-source software package enables synchronization of external hardware and events, multi-dimensional data acquisition and display, region-of-interest scanning, and multi-user operation. All images are saved in the standard TIFF image format so that they can be viewed using software packages such as ImageJ/Fiji. See the *ThorImageLS* tab for additonal information on ThorImageLS features. Upon the purchase of a confocal system, Thorlabs provides lifetime support for the ThorImageLS package.

To explore the full range of possible system configurations, including laser source and emission filter options, see the *Confocal System* tab. For system specifications, please see the *Specs* tab.

Thorlabs' Confocal Microscopy System

Quick Links
Confocal Scanner
Laser Excitation
Image Detection

Thorlabs' Four-Channel Confocal Laser Scanning Microscopy Systems consist of a Cerna®-based microscope with a galvo-galvo or galvo-resonant scanner, monolithic laser source, multi-channel PMT detection module control electronics, pinhole wheel, and all fibers and cables needed to interconnect the system. All hardware components are directly controlled by ThorImage®LS software, including automated Z-step control for optical sectioning (via a piezo or stepper motor) and automatic calculation of Airy disk units based on the combination of the objective magnification and pinhole size; the intuitive interface allows novice and experienced users alike to obtain high-resolution microscope images quickly and easily.

Thorlabs' applications engineers install each confocal system and are available to address technical problems that may occur; for additional information, please see our Confocal Microscopy Contact Form.

Scanner

At the heart of our systems is a confocal scan head that can be configured with galvo-galvo or galvo-resonant scanners. Galvo-galvo scanners allow specific regions of interest to be targeted for experiments requiring photo-uncaging, while galvo-resonant scanners support high imaging speeds of up to 400 frames per second (at 512 x 32 pixel resolution). Both types of scanners can create full frame images with high spatial resolution of up to 4096 x 4096 pixels. At either extreme, or anywhere in-between, the control and acquisition system creates high-quality, jitter-free images.

The confocal scan path is integrated with a microscope body based on our Cerna Modular Microscopy System, allowing the system to be customized with widefield imaging accessories. A D1N dovetail on top of the scan path accepts single or double camera ports for scientific cameras, trinoculars, and epi-illuminators. A 95 mm dovetail along the length of the body accepts sample holders including a Z-axis piezo stage, condenser modules, or transmitted illumination modules for brightfield, Dodt contrast, or DIC imaging. In the most basic configuration, a mirror on a manual slider at the front of the scan path allows the user to switch between confocal and widefield imaging modalities. This optic can be upgraded to a dichroic or beamsplitter and the manual slider upgraded to a motorized one.

Our complete systems come standard with a primary dichroic that reflects four laser lines (405 nm, 488 nm, 532 nm, and 642 nm). Other primary dichroics for use with other wavelengths can be provided upon request.

Motorized Pinhole Wheel

A motorized pinhole wheel allows the pinhole size to be adjusted for a variety of imaging configurations and objective numerical apertures in order to simultaneously maximize the in-focus light that reaches the PMT detectors and minimize the transmission of signal from outside the focal plane. A rotating glass plate has 16 sizes of lithographic round pinholes deposited to exceedingly tight tolerances, ensuring that optimal alignment is maintained as each pinhole is rotated into the light path.

Click to Enlarge
Our A-coated motorized filter wheel shown disconnected from the confocal scan head with the SMA fiber connector removed for free-space output.

For thicker samples, the size of the pinhole should be optimized relative to the NA of the objective in order to maximize the signal to noise ratio. With this in mind, our engineers selected each pinhole size to complement a common objective NA. Conversely, for thinner samples that produce less light outside of the focal plane, a larger pinhole size can help improve throughput. Pinhole diameters up to 2 mm provide flexibility so that the system can be easily adapted to different experiments.

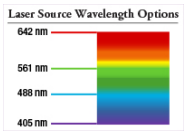
A round pinhole is the ideal shape for maximizing the transmission of light generated in the focal plane of your sample while also optimizing the rejection of signal generated above and below the layer that is being scanned.

The pinhole is conveniently powered and controlled via USB. Additionally, the motorized, encoded control of the pinhole ensures perfect alignment and vibration-free movement. The emitted light from the specimen is focused on the pinhole by an achromatic doublet and then collected by a large-core multimode fiber for transmission to the PMT detector system. To maximize transmission at the desired emission wavelengths, three AR coating options are available for the achromatic doublet.

Click to Enlarge
Four-Channel Laser Source

Excitation

The solid state multi-laser source minimizes maintenance with an all-fiber design. Each laser line is individually fiber-coupled using a permanent rigid system. The individual fiber-coupled lasers are then combined in an all-fiber coupler with an FC/PC connector. This design ensures the lasers never go out of alignment by keeping the full power of the lasers coupled to the scan head at all times.



Each confocal system also includes a filter set, chosen to complement the excitation wavelengths. Available pre-configured laser source wavelength combinations and the included filter sets are outlined in the table below.

The laser source is controlled by a controller box, which includes a safety interlock system and manual control of laser emission. The laser source can also be controlled remotely by way of an auxiliary input.

Laser Source Options							
Laser Source Identification #[a]	# of Lasers[b]	Excitation Wavelengths				Included Emission Filters	
		UV	Blue	Green	Red	Emission Filters (Center Wavelength/Bandwidth)	Longpass Dichroic Cutoff Wavelength(s)
CLS3	2	-	488 nm	561 nm	-	525 nm/45 nm and 600 nm/52 nm	573 nm
CLS5	3	405 nm	488 nm	561 nm	-	440 nm/40 nm, 525 nm/45 nm, and 600 nm/52 nm	495 nm and 573 nm
CLS4	3	-	488 nm	561 nm	642 nm	525 nm/45 nm, 600 nm/52 nm, and 647 nm/Longpass	561 nm and 635 nm
CLS6	4	405 nm	488 nm	561 nm	642 nm	440 nm/40 nm, 525 nm/45 nm, 600 nm/52 nm, and 647 nm/Longpass	495 nm, 573 nm, and 647 nm

- The laser source is not offered separately from the Confocal System, but we have provided a laser source identification # here for convenience when discussing a system configuration with one of our representatives.

- For sources with fewer than four lasers, slots will be filled from left to right.

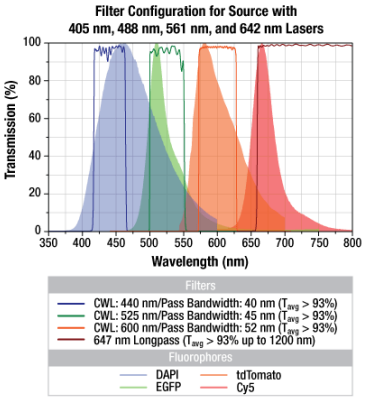
Click to Enlarge
Expandable PMT modules are designed for multi-channel laser scanning microscopy applications. The photo shows the four-channel module with standard sensitivity PMTs.

Detection

Detector: Future-proof your experiments with our remotely positioned detector module that can be readily expanded from two to four photomultiplier tubes (PMTs). Sitting in front of each PMT is a quickly exchangeable dichroic mirror and emission filter holder (for included filter sets, see the table above).

The detection module can be configured with our standard sensitivity multialkali PMTs or high sensitivity, ultra-low-noise GaAsP PMTs. The standard sensitivity multi-alkali PMTs provide a low-noise image with high dynamic range that is appropriate for most life-science and industrial applications. For weakly fluorescent or highly photosensitive samples, we also offer the option of high-sensitivity, TEC-cooled GaAsP PMTs. With either choice, the gain of the detector as well as the dynamic range of the digitizer is controlled within the ThorImageLS software.

Click to Enlarge
The filter sets are mounted in dichroic filter cubes for easy exchange. Here, an emission filter is being removed from a two-channel PMT module with high-sensitivity PMTs.



Click to Enlarge
The solid lines in the plot show the pass bands of the filters, and the shaded areas show the normalized emission spectra of the fluorophores.

Filters: Each confocal upgrade includes an appropriate set of emission filters that block laser light from entering the PMTs and provide pass bands at the fluorescence wavelengths of popular fluorophores. The exact configuration is determined by the laser wavelengths in your confocal system. Several common configurations and compatible fluorophores are outlined below. If you have questions concerning the filter set included with a specific laser configuration, please

Computer: Each confocal system includes a 64-bit computer with a 24" monitor. The included ThorImageLS software package provides an all-in-one solution for microscope control, automated data collection, and image review. See the *ThorImageLS* tab for more information.

SPECS

Specifications	
Excitation	
Laser Source	1 to 4 Channels (See Table Below for Pre-Configured Options)
Primary Dichroic Mirror	Quad-Band Dichroic Beamsplitter (Other Dichroics Available upon Request)
Scanning	
Scan Head	Galvo-Resonant Scan Head with 8 kHz Resonant Scanner (X) and Galvo Scan Mirror (Y)
Galvo-Resonant Scanning Speed	30 Frames per Second at 512 x 512 Pixels 400 Frames per Second at 512 x 32 Pixels 2 Frames per Second at 4096 x 4096 Pixels
Scan Zoom	Up to 2048 x 2048 Bi-Directional Acquisition; Up to 4096 x 4096 Uni-Directional Acquisition 1X - 16X (Continuous)
Digitization / Sampling Density	Up to 2048 x 2048 Bi-Directional Acquisition; Up to 4096 x 4096 Uni-Directional Acquisition
Diffraction-Limited Field of View (FOV)	FN25 = 442 µm x 442 µm FOV @ 40X; FN23 = 407 µm x 407 µm FOV @ 40X
Emission	
Photomultiplier Tubes (PMTs)	Standard Multialkali or High-Sensitivity GaAsP
Detection Channels	1 to 4 PMTs
Filters	Emission Filter Set and Longpass Dichroic to Complement Multi-Channel Laser Source (See Table Below for Pre-Configured Options)

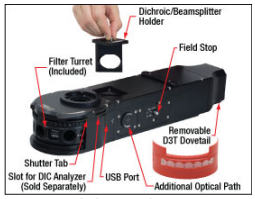
The laser wavelengths offered as part of the confocal system are available in one of the pre-configured integrated laser sources listed below. Each source is paired with a set of filters optimized for popular fluorophores that can be mounted in the PMT detection module. If you need help selecting a laser source for you

Laser Source Options							
Laser Source Identification #[a]	**# of Lasers[b]**	**Excitation Wavelengths**				**Included Emission Filters**	
		UV	**Blue**	**Green**	**Red**	**Emission Filters (Center Wavelength/Bandwidth)**	**Longpass Dichroic Cutoff Wavelength(s)**
CLS3	2	-	488 nm	561 nm	-	525 nm/45 nm and 600 nm/52 nm	573 nm
CLS5	3	405 nm	488 nm	561 nm	-	440 nm/40 nm, 525 nm/45 nm, and 600 nm/52 nm	495 nm and 573 nm
CLS4	3	-	488 nm	561 nm	642 nm	525 nm/45 nm, 600 nm/52 nm, and 647 nm/Longpass	561 nm and 635 nm
CLS6	4	405 nm	488 nm	561 nm	642 nm	440 nm/40 nm, 525 nm/45 nm, 600 nm/52 nm, and 647 nm/Longpass	495 nm, 573 nm, and 647 nm

ADD-ONS

Post-Installation Upgrades & Add-Ons

Each Four-Channel Confocal Microscope is designed so that imaging capabilities can be added or substituted after installation to accommodate new experimental needs as your research requirements grow. Some upgrades, such as adding Cerna® widefield imaging accessories, can be easily performed by the user. Others require replacing part of the hardware, in which case assistance will be provided by our technical staff; contact us using the link in the green box to the right for additional information.



Click to Enlarge
Epi-Illuminator Module Add-On

Widefield Imaging Add-Ons

- Widefield Epi-Illumination with a Six-Filter Removable Turret or Using a Single Filter Cube
- Eyepieces, Trinoculars, and Scientific Cameras for Sample Viewing
- Transmitted Illumination Including Brightfield, Dodt Contrast, and DIC Imaging Modules
- Modules for Mounting Objective Changers, Condensers, and Sample Holders
- Microscope Mover with 2" of Translation in X and Y

Confocal Capability Upgrades

- Update Excitation Wavelengths
- Switch Multialkali or GaAsP PMT Detection
- Update the Primary Mirror to a Dichroic to Utilize Multiple Optical Paths
- Piezo Objective Stage or Z-Axis Piezo Sample Stage for Fast Z-Stacks
- Fast Motorized XY Stage for Large Area Tiling

IMAGES

Images Obtained with Thorlabs' Confocal Systems

ThorImage®LS Software

ThorImageLS is an open-source image acquisition program that controls Thorlabs' microscopes, as well as supplementary external hardware. From prepared-slice multiphoton Z-stacks to simultaneous *in vivo* photoactivation and imaging, ThorImageLS provides an integrated, modular workspace tailored to the individual needs of the scientist. Its workflow-oriented interface supports single image, Z-stacks, time series, and image streaming acquisition, visualization, and analysis. See the video to the lower right for a real-time view of data acquisition and analysis with ThorImageLS.

ThorImageLS is included with a Thorlabs microscope purchase and open source, allowing full customization of software features and performance. ThorImageLS also includes Thorlabs' customer support and regular software updates to continually meet the imaging demands of the scientific community.

For additional details, see the full web presentation.

Advanced Software Functionality

- Multi-Column Customizable Workspace
- Image Acquisition Synced with Hardware Inputs and Timing Events
- Live Image Correction and ROI Analysis
- Independent Galvo-Galvo and Galvo-Resonant Scan Areas and Geometries
- Tiling for High-Resolution Large-Area Imaging
- Independent Primary and Secondary Z-Axis Control for Fast Deep-Tissue Scans
- Automated Image Capture with Scripts
  - Compatible with ImageJ Macros
- Multi-User Settings Saved for Shared Workstations
- Individual Colors for Detection Channels Enable Simple Visual Analysis

Seamless Integration with Experiments

- Simultaneous Multi-Point Photoactivation and Imaging with Spatial Light Modulator
- Fast Z Volume Acquisition with PFM450E or Third-Party Objective Scanners
- Electrophysiology Signaling
- Wavelength Switching with Tiberius® Laser or Coherent Chameleon Lasers
- Pockels Cell ROI Masking
- Power Ramped with Depth to Minimize Damage and Maximize Signal-to-Noise

New Functionality: Version 4.0 (Click to Expand for More Details)

3.x, 2.x and 1.x versions, it may not be compatible with older microscopes. We continue to support older software versions for customers with older hardware. See the full web presentation for functionality of previous versions.

New Hardware Support

- Added Support for Windows® 10 OS
- Added Support for CS895MU and CS505MU Monochrome Cameras (Requires ThorCAM 3.2)
  - Allows for Hot Pixel Correction
- Added Support for CSN210 Motorized Dual-Objective Nosepiece
  - Allows for Improved Objective Setup and Control
- Added Support for Secondary Three Channel Controller
- Added Support for Second LED of the DC2200 LED Driver
- Added Support for New Version of Thorlabs' Tiberius® Femtosecond Ti:Sapphire Laser (Up to 1060 nm)
- Added Support for Second Channel for GGNI (Allows for Sequential Imaging with 2 Channels)
- Added Support for Controlling Up to 6 Digital Shutters (ThorShutterDig)
- Added Support for Resonant-Galvo-Galvo Scan-Head (Galvo-Resonant or Gavlo-Galvo Scan Modes Only)
- Added Support for Coherent® Discovery with AOM Support (Requires Coherent® Discovery GUI Version 1.8.3 and 3rd Party Virtual Serial Port Software)

User Interface (UI) Improvements

- Renamed "Bleaching" to "Stimulation"
- Added Scale Bar in Image
- Added Help Menu Features
  - Allows User to Check for Updates
  - Allows User to View Log File for Trouble-Shooting
- Added Shortcuts to Hardware Settings and Application Settings in Hardware Connections

New Features

- Added Ability to Save Experiment Data in Multi-Page TIFF Format (OME TIFF)
- Added Rapid Image Update for Galvo-Galvo Scanner
  - Updates Image Every 16 Scan Lines During Acquisition
- Added Galvo-Galvo External Trigger Sync (Minimum 1 MHz) (GGNI Not Supported)
- Added Improved Galvo-Galvo and Galvo-Resonant Triggering Times
- Added Ability to Read Resonant Frequency Probe
- Added Configurable Trigger Output (Signal Generator) Based on Time or Other Digital Events
- Added Auto Update for Histograms
- Added Dedicated Bleach Shutter Control for Galvo-Galvo and GGNI
- Added Stimulation Epoch Control
- Added Additional Stimulation Features (Pre Idle, Post Idle) and Control Lines (Active, Cycle Output, Epoch)
- Added SLM Multiple Epoch Control (Random Epoch)
- Added Ability to Invert Z Control's Plus and Minus Buttons (Supports Both Primary and Secondary Z Controllers)
- Added Ability to Display X and Y Positions in Microns or Millimeters
- Added BCM-PA Slider Step Size
  - Allows for Setting Slide Step Size When Using Slider Plus and Minus Buttons for Power Adjustment.
- Added Auto Saving of Changed Fine Alignment Values
- Added Ability to Save Image Location and Zoom Level When Switching Image Modalities
- Added ThorSync Changes
  - Stack Panel Option

Introduction to Microscope Dovetails

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.

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.

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.

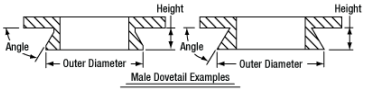
To learn which dovetail type(s) are on a particular component, consult its mechanical drawing, available by clicking on the red Docs icon ( ) below. For adapters with a female dovetail, the drawing also indicates the size of the hex key needed for the locking setscrew(s). It is important to note that 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.

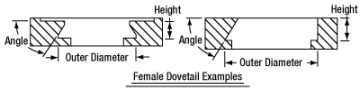
Thorlabs Dovetail Reference [a]			
Type	**Shape**	**Outer Dimension**	**Angle**
95 mm	Linear	95 mm	45°
D1N	Circular	Ø2.018"	60°
D2N[b]	Circular	Ø1.50"	90°
D2NB[b]	Circular	Ø1.50"	90°
D3N	Circular	Ø45 mm	70°
D5N	Circular	Ø1.58"	90°
D6N	Circular	Ø1.90"	90°
D7N	Circular	Ø2.05"	90°
D1T	Circular	Ø1.50"	60°
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).

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.

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.

	Microscope Dovetails										Optical Component Threads[a]		Cage Systems[b]
Item #	95 mm	D1N	D2N	D2NB	D3N	D5N	D1T	D3T	D1Y	D5Y	Internal	External	
2CM1	-	-	-	-	-	-	-	-	-	-	SM1[c] (1.035"-40) and SM2[d] (2.035"-40)	SM1[c] (1.035"-40)	60 mm[d]
2CM2	-	-	-	-	-	-	-	-	-	-	SM1[c] (1.035"-40) and SM2[d] (2.035"-40)	SM1[c] (1.035"-40)	30 mm[c]
BSA2000[e]	-	-	-	-	Female	-	-	-	-	-	-	-	-
CEA1350	Male	Female	-	-	-	-	-	-	-	-	-	-	60 mm[d]
CEA1400	Male	Female	-	-	-	-	-	-	-	-	-	-	60 mm[d]
CEA1500	Male	Female	-	-	-	-	-	-	-	-	-	-	60 mm[d]
CEA1600	Male	Female	-	-	-	-	-	-	-	-	-	-	60 mm[d]
CFB1500	Male	-	-	-	-	-	-	-	-	-	-	-	-
CSA1000	Female	-	-	-	-	-	-	-	-	-	-	-	-
CSA1001	Female	-	-	-	-	-	-	-	-	-	SM1[c] (1.035"-40)	-	30 mm[c]
CSA1002	Female	-	-	-	-	-	-	-	-	-	SM2[d] (2.035"-40)	-	60 mm[d]
CSA1003	-	Female	-	-	-	-	-	-	-	-	-	-	60 mm[d]
CSA1051	Female	-	-	-	-	-	-	-	Male	-	-	-	-
CSA1200[e,f]	-	-	-	-	-	-	-	-	-	-	-	-	60 mm[d]
CSA1400[e]	-	-	-	-	-	-	Female	-	-	-	-	-	60 mm[d]
CSA1500[e,g]	-	-	-	-	-	-	-	-	-	-	-	-	-
CSA2000[e]	-	-	-	-	Female	-	-	-	-	-	SM2[d] (2.035"-40)	-	60 mm[d]
CSA2001	-	-	-	-	Female	-	-	-	-	-	-	SM2[d] (2.035"-40)	-
CSA2100[e]	-	-	-	-	-	-	-	-	-	-	SM2[d] (2.035"-40)	-	60 mm[d]
CSA3000(/M)	-	Male	-	-	-	-	-	-	-	-	-	-	-
CSA3010(/M)	-	Male	-	-	-	-	-	-	-	-	-	-	30 mm[c] and 60 mm[d]
Item #	**95 mm**	**D1N**	**D2N**	**D2NB**	**D3N**	**D5N**	**D1T**	**D3T**	**D1Y**	**D5Y**	**Internal**	**External**	**Cage Systems**
CSC1001	-	-	-	-	Male	-	-	-	-	-	-	-	-
CSC1002	-	-	-	-	Male	-	-	-	-	-	-	-	-
CSC2001	-	-	-	-	Male	-	-	-	-	-	-	-	-
CSD1001	-	Male & Female	-	Female	-	-	-	-	-	-	-	-	-
CSD1002	-	Male & Female	-	-	-	-	-	-	-	-	-	C-Mount[h]	-
CSE2000	-	Male & Female	-	-	-	-	-	-	-	-	-	-	60 mm[d]
CSE2100	-	Male & Female	-	-	-	-	-	Female	-	-	SM1[c] (1.035"-40)	-	30 mm[c] and 60 mm[d]
CSE2200	-	Male & Female	-	-	-	-	-	Female	-	-	SM1[c] (1.035"-40)	-	30 mm[c] and 60 mm[d]
CSN100[e]	-	-	-	-	-	-	-	-	-	-	M32 x 0.75	-	60 mm[d]
CSNK10	-	-	-	-	-	-	-	-	-	-	M32 x 0.75	-	60 mm[d]
CSNK100[e]	-	-	-	-	-	-	-	-	-	-	M32 x 0.75	-	60 mm[d]
CSN200	-	-	-	-	-	-	Male	-	-	-	M32 x 0.75	-	-

CSN210	-	-	-	-	-	-	Male	-	-	-	M32 x 0.75	-	-
CSN1201[f]	-	-	-	-	-	-	-	-	-	-	M32 x 0.75	-	-
CSN1202[f]	-	-	-	-	-	-	-	-	-	-	M25 x 0.75	-	-
CSS2001	-	-	-	-	-	-	-	-	Female	-	-	-	-
LAURE1	-	Male	Female	-	-	-	-	-	-	-	-	-	-
LAURE2	-	Male	Female	-	-	-	-	-	-	-	-	-	-
LCPN1	-	-	-	-	Male	-	-	-	-	-	SM30 (M30.5 x 0.5)	-	30 mm[c] and 60 mm[d]
LCPN2	-	Male	-	-	-	-	-	-	-	-	SM30 (M30.5 x 0.5)	-	30 mm[c] and 60 mm[d]
LCPN3	-	Male	-	-	-	-	-	-	-	Female	SM30 (M30.5 x 0.5)	-	60 mm[d]
Item #	**95 mm**	**D1N**	**D2N**	**D2NB**	**D3N**	**D5N**	**D1T**	**D3T**	**D1Y**	**D5Y**	**Internal**	**External**	**Cage Systems**
OPX2400(/M)	-	Male & Female	-	-	-	-	-	-	-	-	SM2[d] (2.035"-40)	-	60 mm[d]
SM1A70	-	-	-	-	-	-	-	-	-	-	SM30 (M30.5 x 0.5)	SM1[c] (1.035"-40)	-
SM1A58	-	-	Male	Male	-	-	-	-	-	-	SM1[c] (1.035"-40)	SM2[d] (2.035"-40)	30 mm[c]
SM2A56	-	-	-	-	-	-	-	Male	-	-	-	SM2[d] (2.035"-40)	-
TC1X	-	-	Male	-	-	-	-	-	-	-	-	-	-
WFA0150	Female	-	-	-	-	-	-	-	-	-	-	-	-
WFA1000	-	-	-	-	-	-	-	-	-	-	-	-	30 mm[c]
WFA1010	-	-	-	-	-	-	-	-	-	-	SM1[c] (1.035"-40)	-	30 mm[c]
WFA1020	-	-	-	-	-	-	-	-	-	-	SM1[c] (1.035"-40)	-	30 mm[c]
WFA1051	-	-	-	-	-	-	-	-	-	-	SM1[c] (1.035"-40)	-	30 mm[c]
WFA1100	-	-	-	-	-	-	-	-	-	-	-	-	30 mm[c]
WFA2001	-	Male & Female	-	-	-	-	-	-	-	-	SM1[c] (1.035"-40)	SM1[c] (1.035"-40)	-
WFA2002	-	Male & Female	-	-	-	-	-	-	-	-	SM1[c] (1.035"-40)	-	30 mm[c]
WFA4100	-	Male	-	-	-	-	-	-	-	-	SM1[c] (1.035"-40)	C-Mount[h]	-
WFA4101	-	Male	-	-	-	-	-	-	-	-	SM1[c] (1.035"-40)	C-Mount[h]	-
WFA4102	-	Male	-	-	-	-	-	-	-	-	SM1[c] (1.035"-40)	C-Mount[h]	-
WFA4111	-	Male	-	-	-	-	-	-	-	-	-	SM2[d] (2.035"-40)	-
WFA4112	-	-	-	Male	-	-	-	-	-	-	-	C-Mount[h]	-
Item #	**95 mm**	**D1N**	**D2N**	**D2NB**	**D3N**	**D5N**	**D1T**	**D3T**	**D1Y**	**D5Y**	**Internal**	**External**	**Cage Systems**
XT95RC1(/M)	Female	-	-	-	-	-	-	-	-	-	-	-	-
XT95RC2(/M)	Female	-	-	-	-	-	-	-	-	-	-	-	-
XT95RC3(/M)	Female	-	-	-	-	-	-	-	-	-	-	-	-
XT95RC4(/M)	Female	-	-	-	-	-	-	-	-	-	-	-	-
XT95P12(/M)	Female	-	-	-	-	-	-	-	-	-	-	-	-
ZFM1020	Female	-	-	-	-	-	-	-	-	-	-	-	-
ZFM1030	Female	-	-	-	-	-	-	-	-	-	-	-	-
ZFM2020	Female	-	-	-	-	-	-	-	-	-	-	-	-
ZFM2030	Female	-	-	-	-	-	-	-	-	-	-	-	-

- This blank arm is designed for custom DIY machining for non-standard components, threads, and bores.
- 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.