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**THORLABS**

## CM1003 - April 18, 2017

Item # CM1003 was discontinued on April 18, 2017. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

# CERNA™ MICROSCOPE WITH EPI-ILLUMINATION AND TRANS-ILLUMINATION MODULE

► Equipped with Single-Cube Epi-Illuminator and Trans-Illumination Module
► Ready to Accept Objectives, Cameras, Filters, and Illumination Sources

**Modular and Configurable**

**CM1003**
Cerna™ Microscope
(Optical Table Not Included)

Hide Overview

### OVERVIEW

**Features**

- Single-Cube Epi-Illuminator and Transmitted Illumination Module
    - Epi-Illuminator Compatible with Thorlabs' Mounted LEDs and Ø3 mm Liquid Light Guides
    - Transmitted Light Module Accepts LEDs for Visible and/or IR Light
- Accepts C-Mount Cameras from Thorlabs and Most Major Manufacturers
- Motorized Focus Control of Objective
- Trinoculars with 10X Eye Pieces

The CM1003 Cerna™ Microscope provides a preconfigured optical path that is ideal for experiments requiring either epi-fluorescence, reflected light, or brightfield imaging. The epi-illumination module accepts a variety of LEDs and lamps equipped with a Ø3 mm liquid light guide, while the brightfield illumination module includes Thorlabs' Visible Illumination Kit. A motorized objective holder on the microscope body provides 1" of vertical focusing adjustment for the objective.

Trinoculars with a 1X camera port support real-time viewing of the sample directly through the eyepieces. The C-mount-threaded camera port is compatible with most industry-standard cameras, which can be used to view the image on a computer screen in real time or to capture images to analyze later.

Unlike competing microscopes with similar capabilities, the Cerna platform's modularity lets the user quickly install and remove the microscope modules as needed for each experiment, providing a high degree of access and control. *In vitro* samples can be studied by positioning sample stages below the objective using fixed arms that can be attached directly to the microscope or rigid stands. To free room underneath the objective for large sample holding apparatuses, the brightfield module can be removed, providing a path for *in vivo* studies.

To address a wide range of experimental parameters, Thorlabs offers eight preconfigured Cerna microscopes, which are summarized in the table below. In addition, we can work with you to configure a microscope that meets your unique needs. To contact our team, please e-mail ImagingSales@thorlabs.com. We also offer Cerna™ components individually for customers interested in building their own microscope.

Click to Enlarge
Side View of CM1003 Cerna™ Microscope
(Optical Table Not Included)

Cerna Microscopy Platform
PDF

| Cerna™ Microscopes | CM1001 | CM1002 | CM1003 | CM2001 | CM2002 | CM3001 | CM3002 | CM3003(/M) |
|---|---|---|---|---|---|---|---|---|
| Objective Holder | Single | Single | Single | Dual | Dual | Dual | Dual | Dual |
| Epi-Illumination | 1 Cube | Up to 6 Cubes | 1 Cube | Up to 6 Cubes | Up to 6 Cubes | Up to 6 Cubes | Up to 6 Cubes | Up to 6 Cubes |
| Trans-Illumination | - | - | Brightfield (Visible) | Brightfield (Visible) | Dodt Contrast and Brightfield (Visible) | Dodt Contrast and Brightfield (Visible and NIR) | DIC Imaging and Brightfield (Visible and NIR) | DIC Imaging and Brightfield (Visible and NIR) |
| XY Motion | - | - | - | - | - | Microscope Translator | N/A | Translating Platform |

[Hide Microscope Design](#)

## MICROSCOPE DESIGN

### CM1003 Cerna™ Microscope

Entirely constructed from our line of modular components, this Cerna™ microscope includes several convenient features for imaging, which are highlighted below. We also offer a selection of microscope objectives, cameras, and illumination modules that can be used to complement your CM1003 Cerna microscope and customize it to your experiment. Details can be found on the *Accessories* tab. The *Shipping List* tab details the components used in this microscope, as well as a link to each component's webpage, where additional information (such as mechanical drawings) is available.

### Epi-Illumination

#### Features

- Single-Cube Epi-Illuminator Module (Filter Cubes and Sets Sold Separately)
- Accepts Thorlabs' Mounted LEDs or Lamps that Use Ø3 mm Liquid Light Guides

The epi-illumination module couples light emitted by the illumination source into the imaging path, through the objective, and onto the sample; it also allows epi-fluorescence generated by the sample to pass through the module to the eyepieces and camera. This epi-illuminator accepts one filter cube, making it suitable for several imaging modalities that require a single filter set. By installing a dichroic mirror and two emission filters, fluorescence imaging of a single fluorophore is possible. This filter set can be replaced with a 50:50 beamsplitter and two polarizers to create a reflected light imaging microscope. Alternatively, a multiband filter set combined with illumination from a multi-wavelength LED source allows the CM1003 Cerna Microscope to image samples with multiple fiducial markers.

#### Add-Ons: Epi-Illumination

- Illumination Sources
  - Mounted LEDs
  - Lamps with Ø3 mm Liquid Light Guides
  - X-Cite DC Lamp
- Epi-Fluorescence Filter Cube
- Epi-Fluorescence Filter Sets


Click to Enlarge
The CM1003 Cerna™ microscope features a single-cube epi-illuminator.


Click to Enlarge
The front cover of the epi-illuminator is removed by unscrewing two M2 screws to install a filter cube (not included). Magnets on the cover and the housing ensure that the filter cube is positioned correctly when the door is replaced.


Click to Enlarge
The back of the epi-illuminator includes a removable, SM1-threaded adapter that accepts liquid light guides.


Click to Enlarge
Transmitted Illumination Module with White Light LED

### Trans-Illumination (Brightfield Imaging)

#### Features

- Supports Brightfield Illumination in the Visible and NIR
- Accepts Thorlabs' Illumination Kits (Visible Illumination Kit Included)
- Motorized Condenser Focusing Module with 1" Travel

This Cerna™ Microscope includes a module for brightfield imaging, designed to direct visible and/or IR illumination generated by one of our Illumination Kits into the optical path of the Cerna Microscope. Please see the full web presentation for additional information.

Bright illumination in the visible region of the spectrum is generated by the included illumination kit (Item # WFA1010), which uses one of Thorlabs' Mounted LEDs (Item # MWWHL3). The module features additional ports and a filter cube holder to allow for later expansion with IR or other wavelength LEDs. Please contact Technical Support with inquiries.
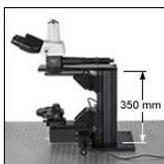

Click to Enlarge
The Cerna™ CM1003 microscope has a 350 mm tall microscope body.

### Microscope Body

#### Features

- Large Working Volume: Optical Path is 7.74" (196.6 mm) Away from Edge of Rail
- Linear Dovetail Surface Allows Modules to be Added and Removed
- 350 mm Body Height to Accommodate Sample Stages Mounted on Rigid Stands or Fixed Arms
- Motorized Objective Focusing Module with 1" Travel
- Mechanically Compatible with Thorlabs' 95 mm Rail Platforms

The backbone of the CM1003 Cerna™ Microscope is the 350 mm tall microscope body based on Thorlabs' 95 mm Optical Rails, providing stable long-term support and excellent vibrational damping. Its linear dovetail mounting surface allows modules to be removed when they are not needed, freeing additional workspace and opening the door to user customization. For alternate rail heights please see the full web presentation.


Click to Enlarge
This microscope includes trinoculars with a 1X camera port for widefield viewing.

### Widefield Viewing

#### Features

- Trinoculars for Viewing Visible Light from the Sample
- Fixed 1X Magnification Camera Port with C-Mount Accepts Most Industry-Standard Cameras
- Trinoculars with 10X Eyepiece Magnification and Adjustable Interpupil Distance

#### Add-On: Widefield Viewing

- Scientific Cameras

Widefield viewing on the CM1003 Cerna™ Microscope is provided by trinoculars and a 1X Camera Tube. The eyepieces feature an adjustable interpupil distance and rotate individually to allow the focus to be coarsely adjusted for each eye. The total system magnification for an image viewed through the eyepieces will be the objective magnification multiplied by 10.

The included camera tube contains all of the optics needed to image the light from the objective onto a camera sensor. The tube has 1X magnification, which means that the image will match the design field of view of the chosen widefield objective. External C-mount (1.000-32) threads on the top of the camera tube accept Thorlabs' scientific cameras, as well as cameras from most major manufacturers. For additional viewing port and camera tube options, please see the full web presentation.

### Objective Holders and Objectives

Click to Enlarge
The CM1003 Cerna™ Microscope has a single objective holder (objective not included).

#### Features

- Threaded for M32 x 0.75 Objectives
- Included Adapters:
  - M25 x 0.75-Threaded Objectives (Nikon)
  - RMS-Threaded Objectives (Olympus)

#### Add-On: Objectives

- Microscope Objectives

The Single-Objective Nosepiece connects to the motorized mounting arm on the microscope body via six M4 counterbores to provide 1" of motorized vertical translation of the objective. The nosepiece features an M32 x 0.75 threaded port for mounting objectives and includes two adapters to provide compatibility with other common objective threads: M25 x 0.75 (Nikon) and RMS (Olympus). Microscope objectives are available for purchase separately from Thorlabs, and we can also order other objectives from either Nikon or Olympus upon request. To mount multiple objectives, please see the full web presentation for additional mounting options.

Hide Accessories

## A C C E S S O R I E S

### Selected Accessories

In order to image with this microscope, it is necessary to add scientific cameras, an epi-illumination source, filter cubes and filter sets, objectives, and sample holders. It is often possible to improve the quality of your experimental data by carefully selecting accessories that complement your specific experiment. To that end, we have ensured that Cerna™ microscopes are compatible with a wide range of accessories. The information below compares the Cerna-compatible components that are manufactured or sold by Thorlabs. We have also indicated when it is possible to use equipment designed by other manufacturers.

#### Content

- Scientific Cameras for Widefield Viewing
- Illumination Sources for Epi-Illumination
- Filter Cubes and Filter Sets for Epi-Fluorescence
- Objectives
- Sample Holders

### Application-Optimized Cerna Microscopes

Contact Us

Developed in collaboration with our colleagues in the field, the Cerna™ microscopy platform is uniquely modular and flexible, making it adaptable to a wide range of demanding experimental requirements. If you would like to work with our application specialists, engineers, and sales team to design your own microscopes, please email ImagingSales@thorlabs.com.

### Scientific Cameras for Widefield Viewing

- Visualize the Field of View at a Computer
- Any C-Mount Camera is Compatible with a Cerna™ Microscope

Thorlabs offers scientific cameras optimized for a range of imaging needs. Cameras allow the field of view to be displayed on a computer screen and saved for later reference. Viewing your sample from a computer also enables remote sample positioning using our motion control accessories (see below), allowing samples to be moved in sensitive setups without introducing additional vibrations from your hands.

Click to Enlarge
The camera port provides fixed 1X magnification for visible light from the sample.

The CM1003 Cerna™ microscope includes a 1X camera tube, which provides a fixed magnification at the image plane that is equal to the objective magnification.

Any camera with C-Mount (1.000"-32) threading is compatible with this microscope. The most popular cameras used with Cerna systems are given in the table below. Higher resolution options can be found in our complete range of scientific cameras.

| Item # | DCU224M | 340M-USB | 1501M-USB |
|---|---|---|---|
| Product Photo (Click to Enlarge) | | | |
| Primary Feature | Lightweight | Fast Frame Rate | High Resolution and Dynamic Range |
| Sensor Type | Sony ICX205AL | On Semi / Truesense KAI-0340 Monochrome CCD | Sony ICX285AL Monochrome CCD (Grade 0) |
| Sensor Format | 1/2" (7.62 mm Diagonal) | 1/3" Format (5.92 mm Diagonal) | 2/3" Format (11 mm Diagonal) |
| Resolution | 1280 x 1024 Pixels | 640 x 480 Pixels | 1392 x 1040 Pixels |
| Pixel Size | 4.65 µm x 4.65 µm | 7.4 µm x 7.4 µm | 6.45 µm x 6.45 µm |
| Frame Rate (Max) | 15 fps | 200.7 fps | 23 fps |
| Host PC Interface | USB 2.0 (Cable Included) | USB 3.0 (Cable Included) | |
| Digital Output | 8 Bits | 14 Bits | 14 Bits |
| Mass | 96 g (0.21 lbs) | 750 g (1.65 lbs) | |

## Illumination Sources for Epi-Illumination

Illumination sources, filter cubes, and filter sets are available separately from the CM1003 Cerna™ microscope, allowing you to customize the illumination to the needs of your experiment. Compatible options are outlined below.

### Light Sources: LEDs

- Long Lifetimes (>10,000 Hours for LEDs Shown Here)
- Output can be Modulated with Suitable Driver
- Integrated EEPROM for Automated Driver Configuration



Click to Enlarge
A Thorlabs' Mounted LED can be threaded into the epi-illuminator and secured using the included locking ring.

The epi-illuminator on the CM1003 Cerna microscope is compatible with Thorlabs' LEDs. Selected LEDs that emit at important visible and NIR wavelengths are outlined in the table below. We offer a much wider range of LEDs than the five presented here, at wavelengths from 280 nm to 1550 nm, all of which are compatible with the CM1003 Cerna microscope. For our full selection, please see their full web presentation. Please note that the drivers needed to power the LEDs are sold separately.
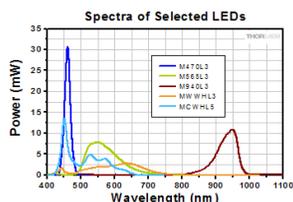


Click to Enlarge
The spectra of selected Thorlabs LEDs scaled for reference. The graph is intended to be used as a guideline to compare the spectra of different LEDs.

| Selected LEDs | | | |
|---|---|---|---|
| Item #[a] | Color[b,c] | Output Power (Typical)[b] | Compatible Drivers |
| M470L3 | Blue (470 nm) | 710 mW | LEDD1B DC2200 DC4100 DC4104 |
| M565L3 | Lime Green (565 nm) | 979 mW | |
| M940L3 | IR (940 nm) | 1000 mW | |
| MWWHL3 | Warm White (3000 K[d]) | 550 mW | |
| MCWHL5 | Cold White (6500 K[d]) | 840 mW | |
| Full Web Presentation for Mounted LEDs | | | |

a. We offer a much wider range of LEDs than the five presented here, at wavelengths from 280 nm to 1550 nm. For our full selection, please see their full web presentation.

b. Output power and nominal wavelength specs are only intended to be used as a guideline. The output power is specified before the light from the LED enters the optical path of the microscope.

c. For LEDs in the visible spectrum, the nominal wavelength indicates the wavelength at which the LED appears brightest to the human eye. For IR LEDs, the nominal value corresponds to the peak wavelength.

d. Correlated Color Temperature

### Light Sources: Liquid Light Guide Lamps

- White Light Sources Illuminate the Field of View Through the Objective
- Plasma Light Source with Output Spectrum from 400 - 700 nm
- X-CITE 200 Lamp with Output Spectrum from 340 - 800 nm



Click to Enlarge
The liquid light guide can be secured by tightening the thumbscrew on the included adapter.

Our selection of lamps incorporate flexible liquid light guides (or LLGs) to deliver broad spectrum visible light into the epi-illuminator. Their broadband emission makes them best suited for setups that require the flexibility to stimulate fluorophores that have absorption wavelengths that are spectrally separated. They are designed to be used in combination with filter cubes loaded into the epi-illuminator, which help condition the light from the lamp to target specific fluorophores. The epi-illuminator in the CM1003 Cerna microscope includes an adapter that directly accepts the LLG; simply insert the LLG and secure it using the included thumbscrew.



Click to Enlarge



Click to Enlarge

### HPLS343 Features

► Output Spectrum: 350 - 800 nm

### XCITE200DC Features

► Output Spectrum: 340 - 800 nm

- Intensity is Variable from 0.1% to 100% Using Knob
- External Control via USB 2.0 or BNC Inputs
- Lifetime: 10,000 Hours (Average)
- Includes Ø3 mm, 1.2 m (4') Long LLG
- Link to Full Web Presentation

- Intensity is Variable from 0% to 100% Using Knob
- External Control via BNC Input
- Lifetime: >2,000 Hour Minimum Lifetime; >2,500 Hours Lifetime
- Includes Ø3 mm, 5' (1.5 m) Long LLG and Nikon Bayonet Mount
- Link to Full Web Presentation

## Filter Cubes and Filter Sets

- Tune Epi-Illumination Source for the Excitation and Detection of Specific Fluorophores
- Easily Mount Filter Sets in the TLV-U-MF2
- Select Filter Sets Available Pre-Installed in Microscope Filter Cubes
- Each Thorlabs Set Consists of an Excitation Filter, an Emission Filter, and a Dichroic Mirror
- Cerna Microscopes are Compatible with Fluorescence Filters from All Major Manufacturers
- Other Filter Sets Available



Ø3 mm Core Liquid Light Guide Adapter, Internal SM1 Threads — Field Stop — Aperture Stop — Filter Cube (Sold Separately)

Click to Enlarge
Filter Cube in Single-Cube Epi-Illuminator

The epi-illumination module included with the CM1003 Cerna™ microscope accepts the TLV-U-MF2 Filter Cube. This filter cube is designed to hold one Ø25 mm emission filter (up to 5 mm thick), one Ø25 mm excitation filter (up to 3.5 mm thick), and one 25 mm x 36 mm dichroic mirror (up to 1.1 mm thick), as shown in the video below, allowing Cerna microscopes to be compatible with filters from all major manufacturers.

Several popular filter sets are listed with their target fluorophores in the table below. Each set includes an excitation filter, an emission filter, and a dichroic mirror. Thorlabs fluorescence filter sets can be pre-mounted in the TLV-U-MF2 filter cube free of charge if all items are purchased at the same time; contact Technical Support prior to ordering to take advantage of this option.

Installation of a Filter Set and Filter Cube into
the Single-Cube Epi-Illuminator (OEM Filter Cube Shown)

| Item # | Accepted Filter Sizes |
|--------|----------------------|
| TLV-U-MF2 | Emission Ø25 mm, ≤5 mm Thickness<br>Excitation: Ø25 mm, ≤3.5 mm Thickness<br>Dichroic Mirror: 25.2 mm x 36.0 mm, ≤1.1 mm Thickness |

| Selected Compatible Fluorescence Filter Sets[a] | | |
|-------------------------|-------------------------------|------------------------------------------|
| Item # | Target Fluorophore | Transmission Graph (Click for Plot) |
| MDF-BFP | BFP (Blue Fluorescent Protein) | |
| MDF-GFP2 | Alexa Fluor® 488, GFP | |
| MDF-MCHA[b] | mCherry | |
| MDF-MCHC[c] | mCherry | |
| MDF-TOM | tdTomato | |

a. Please see the full web presentation for a complete listing of fluorescence filter sets offered.
b. This filter set's excitation range is centered around 578 nm, making it well matched to typical LEDs.
c. This filter set's excitation range is centered around 562 nm, making it well matched to typical lamps.

## Objectives

- Cerna™ CM1003 Microscope Directly Accepts Objectives with M32 x 0.75 Threads
- Includes Thread Adapters for Compatibility with Objectives from Major Manufacturers
  - M25 x 0.75-Threaded Objectives (Nikon)
  - RMS-Threaded Objectives (Olympus)

The nosepiece of this microscope has one M32 x 0.75-threaded bore for mounting objectives. The M32 x 0.75 thread standard is used by newer widefield microscope objectives and offers larger back apertures than previous standards. M25 x 0.75- and RMS-threaded adapters are included for compatibility with most objectives from Olympus and Nikon. Shown below are selected widefield Nikon objectives that are commonly used with the CM1003 Cerna Microscope. They can be mounted in the microscope's CSA1100 single-objective holder using the included M32 x 0.75 to M25 x 0.75 adapter. We offer other objectives and can order other objectives from either Nikon or Olympus upon request.

| Item # | N4X-PF | N10X-PF | N20X-PF | N40X-PF | N60X-PF |
|--------|--------|---------|---------|---------|---------|
| Photo (Click to Enlarge) | | | | | |
| Magnification | 4X | 10X | 20X | 40X | 60X |
| Numerical Aperture (NA) | 0.13 | 0.3 | 0.50 | 0.75 | 0.85 |
| Working Distance (WD) | 17.2 mm | 16 mm | 2.1 mm | 0.66 mm | 0.31 - 0.4 mm |
| Threading | M25 x 0.75 | | | | |

## Sample Stages and Holders

- Rigid Stands to Hold Samples Underneath and Around the Objectives
  - Designed for Slides, Petri Dishes, Well Plates, Recording Chambers, Micromanipulators, and Custom Inserts
  - Translation Stages with 1" of X and Y Travel Available
- Fixed Arms Allow Fast XY Stage, Lens Tubes, and/or Cage Systems to be Placed Directly Into the Optical Path
  - CSA1000: For Our MLS203-1 Fast XY Scanning Stage
  - CSA1001: For Ø1" Lens Tubes and 30 mm Cage Systems
  - CSA1002: For Ø2" Lens Tubes and 60 mm Cage Systems



Click to Enlarge
MP100-MLSH Rigid Stand with MLS203P2 Slide/Petri Dish Holder



Click to Enlarge
MLS203-1 Stage with MLS203P2 Slide Holder on CSA1000 Fixed Arm (All Sold Separately)



Click for Details
MP100-RCH2 Slide Holder in a Cerna Microscope

Thorlabs offers highly configurable solutions for mounting your sample beneath the objective of the Cerna™ Microscope. Rigid stands are available with multiple platform styles that can accept slides, petri dishes, recording chambers, micromanipulators, and custom inserts. The included collar makes them lockable at a height and angle chosen by the user. We also manufacture translation stages for these rigid stands that provide motorized horizontal translation of the sample.

Our fixed arms enable the sample stage to be attached directly to the microscope body via a dovetail that extends the full height of the microscope body, allowing the arms to be positioned anywhere along the body height. For a pre-configured sample holder solution, use the CSA1000 fixed arm with the MLS203-1 Fast XY Scanning Stage. This stage is compatible with our MZS500-E Piezo-Driven Insert, which adds high-resolution Z-axis adjustments. Alternatively, the CSA1001 and CSA1002 rigid arms are compatible with Thorlabs' wide selection of optomechanical components, allowing custom sample holder configurations and additional optics to be easily integrated the CM1003 Cerna microscope.

Several common options are outlined below, while our full selection of sample holders can be explored in the Cerna Components presentation.

Rigid Stands

Click to Enlarge

Click to Enlarge

Click to Enlarge

Click to Enlarge

### MP100-RCH2 Slide Holder

- Designed for Standard 3" x 1" (76.2 mm x 25.4 mm) Microscope Slides
- Height Range: 148.1 - 208.5 mm
- Other Heights Available

### MP100-MLSH Insert Holder

- Designed for Multiple Slides, Petri Dishes, Calibration Targets, Breadboards, Our MZS500-E Z-Axis Piezo Stage, and User-Designed Inserts
- Height Range: 148.1 - 208.5 mm
- Other Heights Available

### MP100-RCH1 Recording Chamber Holder

- Circular Hole Designed for Recording Chambers
- Height Range: 148.1 - 208.5 mm
- Other Heights Available

### MP100 Rigid Stand with Platform

- 24 M6 x 1.0 Tapped Holes for Holding Micromanipulators or Other Equipment
- Height Range: 148.1 - 208.5 mm
- Other Heights Available

Fixed Arms

Click to Enlarge

Click to Enlarge

Click to Enlarge

### CSA1000 Fixed Arm

- Accepts MLS203-1 Fast XY Scanning Stage

### CSA1001 Fixed Arm

- Compatible with Ø1" Lens Tubes and 30 mm Cage Systems

### CSA1002 Fixed Arm

- Compatible with Ø2" Lens Tubes and 60 mm Cage Systems

Hide Shipping List

## SHIPPING LIST

The microscope on this webpage is entirely constructed from our selection of modular Cerna™ components. This tab lists all of the components that the microscope contains.

| Item # | Qty. | Description | Photo (Click to Enlarge) |
|--------|------|-------------|---------------------------|
| **Microscope Body** | | | |
| CEA1350 | 1 | Cerna™ Microscope Body with Epi-Illumination Arm, 350 mm Tall | |
| **Widefield Viewing** | | | |
| WFA4000 | 1 | Trinoculars with Eyepieces | |

| | | | |
|---|---|---|---|
| WFA4105 | 1 | Camera Tube with C-Mount | |
| **Epi-Illumination** | | | |
| WFA2001 | 1 | Single-Cube Epi-Illuminator Module (Filter Cube Not Included) | |
| **Condenser** | | | |
| CSC1001 | 1 | Nikon FN-C LWD Condenser, 0.78 NA | |
| **Objective & Condenser Mount** | | | |
| CSA1100 | 1 | Single-Objective Nosepiece | |
| CSA2000 | 1 | Condenser Mounting Arm with ±2 mm Travel in X and Y | |
| ZFM2020 | 2 | Motorized Focusing Module with 1" Travel | |
| MCM3001 | 1 | 3-Axis Controller for Focus Control | |
| **Trans-Illumination** | | | |
| WFA1000 | 1 | Brightfield Illumination / DIC Imaging Module | |
| WFA0150 | 1 | Transmitted Light Module Dovetail Clamp | |
| **Illumination Kit** | | | |
| WFA1010 | 1 | Visible Illumination Kit | |
| LEDD1B | 1 | T-Cube LED Driver, 1200 mA Max Drive Current (Power Supply Not Included) | |
| KPS101 | 1 | 15 V Power Supply Unit for a Single K-Cube or T-Cube | |

[Hide Hyperspectral Imaging](#)

## HYPERSPECTRAL IMAGING

### Application Idea: Hyperspectral Imaging

In hyperspectral imaging, a stack of spectrally separated, two-dimensional images is acquired. This technique is frequently used in microscopy, biomedical imaging, and machine vision, as it allows quick sample identification and analysis.

Hyperspectral imaging obtains images with significantly better spectral resolution than that provided by standalone color cameras. Color cameras represent the entire spectral range of an image by using three relatively wide spectral channels—red, green, and blue. In contrast, hyperspectral imaging systems incorporate optical elements such as liquid crystal tunable bandpass filters or diffraction gratings, which create spectral channels with significantly narrower bandwidths.
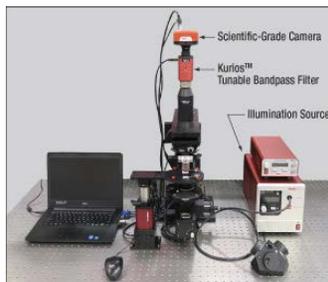
Click to Enlarge
A hyperspectral imaging system built using Thorlabs' Cerna™ Microscopy Platform, KURIOS-VB1 Tunable Bandpass Filter, and 1501M-GE Monochrome Scientific Camera. Several components shown here were modified from their stock configuration.
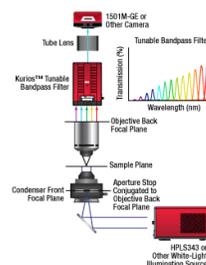
Click to Enlarge
Schematic of Hyperspectral Imaging

Thorlabs' Cerna™ microscopy platform, Kurios® tunable filters, and scientific-grade cameras are easily adapted to hyperspectral imaging. The Cerna platform is a modular microscopy system that integrates with Thorlabs' SM lens tube construction systems and supports transmitted light illumination. Kurios tunable filters have SM-threaded interfaces for connections to the Cerna platform and our cameras. In addition, Kurios filters include software and a benchtop controller with external triggers, which enable fast, automated, synchronized wavelength switching and image capture.

### Example Image Stack

The data in the images and video below demonstrate the hyperspectral imaging technique. Figure 1 depicts two images of a mature *capsella bursa-pastoris* embryo (also known as shepherd's-purse) taken with a Kurios filter set to center wavelengths of 500 nm and 650 nm. These two images show that an entire

field of view is acquired at each spectral channel. Figure 2 is a video containing 31 images of the same sample, taken at center wavelengths from 420 nm to 730 nm in 10 nm steps. (10 nm is not the spectral resolution; the spectral resolution is set by the FWHM bandwidth at each wavelength.) In Figure 3, images from each spectral channel are used to determine the color of each pixel and assemble a color image. Figure 3 also demonstrates that a broadband spectrum is acquired at each pixel, permitting spectroscopic identification of different sample features within the field of view.

Kurios tunable filters offer a number of advantages for hyperspectral imaging. Unlike approaches that rely upon angle-tunable filters or manual filter swapping, Kurios filters use no moving parts, enabling vibrationless wavelength switching on millisecond timescales. Because the filter is not moved or exchanged during the measurement, the data is not subject to "pixel shift" image registration issues. Our filters also include software and a benchtop controller with external triggers, making them easy to integrate with data acquisition and analysis programs.
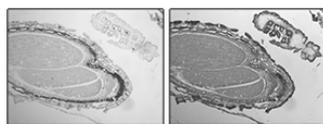
500 nm          650 nm

Click to Enlarge

**Figure 1:** Two images of a mature *capsella bursa-pastoris* embryo taken at different center wavelengths. The entire field of view is acquired for each spectral channel.
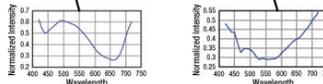
Click to Enlarge

**Figure 3:** A color image of the mature *capsella bursa-pastoris* embryo, assembled using the entire field of view acquired in each spectral channel, as shown in Figure 1. By acquiring across multiple channels, a spectrum for each pixel in the image is obtained.

Hide Microscope Guide

## MICROSCOPE GUIDE

### Elements of a Microscope

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

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

### Terminology

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

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

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

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

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

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

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

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

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

**Optical Path:** The path light follows through the microscope.

**Click on the different parts of the microscope to explore their functions.**
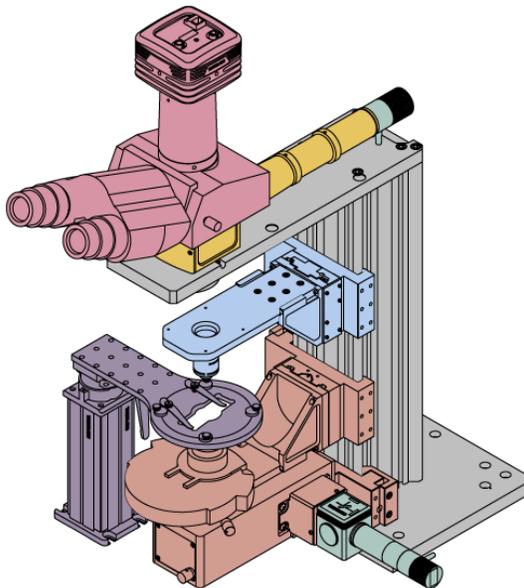
**Rail Height:** The height of the support rail of the microscope body.

**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.
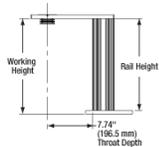
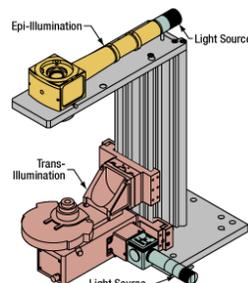Click to Enlarge
Body Details
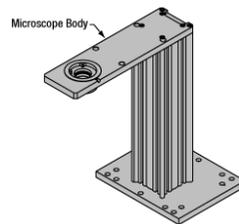
Click to Enlarge
Cerna Microscope Body

| Microscope Bodies | Microscope Translator |
|---|---|

## Illumination

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

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).
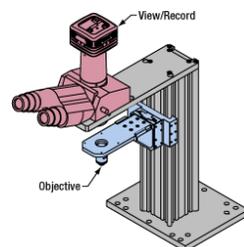
Click to Enlarge

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).

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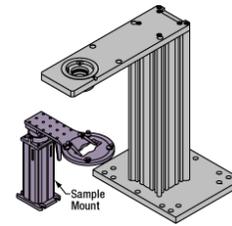
Click to Enlarge
The rigid stand (purple) pictured is one of various sample mounting options available.
Close

| | | | | |
|---|---|---|---|---|
| Translating Platforms | Rigid Stands | Translation Stages for Rigid Stands | Motorized XY Stages | Manual XY Stage |

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

Product Families & Web Presentations

| | | | |
|---|---|---|---|
| Sample Viewing | Breadboards & Body Attachments | Cameras | PMTs |

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

| | | | | |
|---|---|---|---|---|
| Objectives | Objective Thread Adapters | Parfocal Length Extender | Piezo Objective Scanner | Objective Mounting |

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

| | | | |
|---|---|---|---|
| Translating | Translation Stages | Motorized XY | |

Platforms    Rigid Stands    for Rigid Stands    Stages    Manual XY Stage

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

Hide Preconfigured Cerna™ Microscope

### Preconfigured Cerna™ Microscope

The CM1003 Cerna™ Microscope includes all components shown in the *Shipping List* tab.

| Part Number | Description | Price | Availability |
|---|---|---|---|
| CM1003 | Cerna Microscope with Single-Cube Epi- and Trans-Illumination | $20,004.27 | Lead Time |

Hide Cerna™ Microscope Components for Customized Configurations

### Cerna™ Microscope Components for Customized Configurations

To tailor the CM1003 Cerna microscope to your imaging needs, its components can be added all at once to the shopping cart using the "Add Kit" button at the bottom of the ordering area, or individually using the shopping cart icon next to each item. Items may be removed from the default item list by changing the value in

the "Qty" box to 0 before clicking the "Add Kit" button. This allows our modular microscope components to be used to adapt the microscope to the needs of the particular experiment. A discount is offered when a sufficient number of components are purchased, as reflected in the price of the CM1003. Please see the *Shipping List* tab for additional information about each component in the CM1003 microscope.

| Part Number | Description | Price | Availability |
|---|---|---|---|
| CEA1350 | Cerna Microscope Body with Epi-Illumination Arm, 350 mm Rail | $828.00 | Today |
| WFA4000 | Trinoculars with 10X Eyepieces, Inverted Image, IR Filter | $2,915.00 | Today |
| WFA4105 | 1X Camera Tube with C-Mount, Male D2N Dovetail | $395.00 | Today |
| WFA2001 | Epi-Illuminator Module for 1 Cube, Conditioning Optics, Male & Female D1N Dovetails | $1,699.00 | Today |
| CSC1001 | Nikon FN-C LWD Condenser, 0.78 NA, Male D3N Dovetail | $1,987.00 | Today |
| CSA1100 | Nosepiece for 1 Objective, M32 x 0.75 Threads, 60 mm Cage Compatible | $174.00 | Today |
| CSA2000 | Condenser Arm, ±2 mm Travel in X & Y, Female D3N Dovetail, 60 mm Cage Compatible | $692.00 | Today |
| ZFM2020 | Motorized Module with 1" Travel for Edge-Mounted Arms | $1,726.00 | Lead Time |
| MCM3001 | Three-Channel Controller and Knob Box for 1" Cerna Travel Stages | $3,113.00 | 3-5 Days |
| WFA1000 | Transmitted Light Illumination / DIC Imaging Module, 30 mm Cage Compatible | $4,150.00 | Today |
| WFA0150 | 95 mm Dovetail Clamp for WFA1000 and WFA1100 Modules | $265.00 | Today |
| WFA1010 | Warm White Illumination Kit | $789.00 | Today |
| LEDD1B | T-Cube LED Driver, 1200 mA Max Drive Current (Power Supply Not Included) | $299.00 | Today |
| KPS101 | 15 V, 2.4 A Power Supply Unit for One K-Cube or T-Cube | $26.25 | Today |

Visit the *Cerna™ Microscope with Epi-Illumination and Trans-Illumination Module* page for pricing and availability information:
https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=8876