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THORLABS

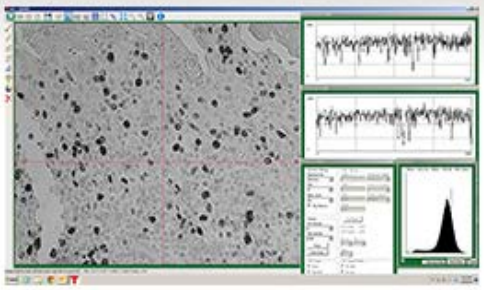
# DCU223M - April 21, 2021

Item # DCU223M was discontinued on April 21, 2021 For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

## HIGH-RESOLUTION USB CCD CAMERAS

- Pixel Resolution of 1024 x 768 or 1280 x 1024
- 30 fps or 15 fps Models Available
- USB 2.0 Interface

DCU223M



GUI and Software Package Included


## OVERVIEW

### Features

- 1024 x 768 Pixel B&W or 1280 x 1024 Pixel Color Versions Available
- 1/3" or 1/2" Image Sensor with Square Pixels
- Choose from 30 fps or 15 fps (Full Frame Mode)
- C-Mount Lens Mount for use with our Standard C-Mount Camera Lenses and High-Magnification Zoom Lenses
- Global Shutter
- Universal Trigger Input
- ThorCam™ Software for Windows® 7 and 10 Operating Systems
- SDK and Programming Interfaces Provide Support for:
  - C, C++, C#, and Visual Basic .NET APIs
  - LabVIEW, MATLAB, and µManager Third-Party Software

| Item # | DCU223M | DCU224C |
|---|---|---|
| Resolution | 1024 x 768 Pixels | 1280 x 1024 Pixels |
| Pixel Clock Range[a] | 5-30 MHz | |
| Binning | Vertical[b] | |
| AOI | Horizontal, Vertical[b] | |
| Frame Rate at 320 x 240 Pixel (Cif) | 78 fps | 38 fps |

- The max possible pixel clock depends on the computer used.
- Function increases the frame rate.

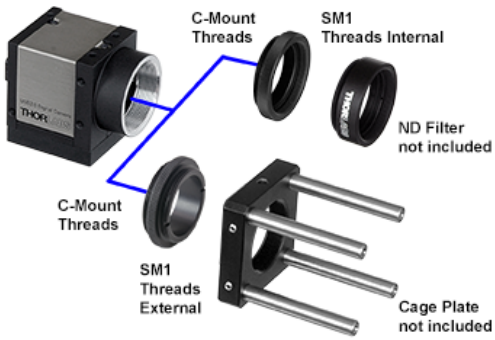
**Sensors and Functionality**

These ultra compact, lightweight CCD cameras feature USB connections, making them extremely versatile for a wide range of applications including industrial automation, quality control, medical imaging, microscopy, and security technology. The DCU223M model is equipped with a high-quality SONY 1/3" CCD sensor with XGA resolution (1024 x 768) and provides a full frame repetition rate of 30 fps. The DCU224C model has a 1/2" CCD sensor with SXGA resolution (1280 x 1024) and provide a full frame repetition rate of 15 fps.

For all models, higher frame rates can be achieved by using the Area of Interest (AOI) or Binning functions; the former increases the frame rate by only reading a

**SM1 Thread Compatibility**

selected area of the sensor, whereas the latter increases the frame rate by combining pixel readings before transferring them to the PC, but in this case, image resolution is sacrificed. The computer can communicate digitally with the camera through the USB 2.0 interface, thus enabling the user to transmit images and control camera settings seamlessly.



Compatibility of the CCD Camera with Thorlabs' SM1 Internal or External Threadings via the Included SM1 (1.035"-40) Adapters. Replacement adapters are shown below.

**Software**

Each CCD camera comes with ThorCam, our Windows-compatible software package on CD. In addition, the cameras are supported by an extensive software development kit. Standard drivers like Direct Show (WDM), Active X, and TWAIN are provided. In addition, over 20 demo programs (including source code) are supplied. A USB cable for connecting the camera to a PC is also included.

**Lenses**

The DCU223M CCD camera is fully compatible with our standard C-Mount Camera Lenses and High-Magnification Zoom Lenses, which are sold separately. Our standard lenses include fixed focal lengths of 3.5 mm - 75 mm with maximum apertures of up to f/0.95, as well as an 18 - 108 mm f/2.5 zoom lens. Our high-magnification zoom lenses are a modular system that features magnification from 0.07 - 28.

**Included Mounting Adapters**

Each CCD camera includes two thread adapters: one external C-Mount to internal SM1 (1.035"-40) and one external C-Mount to external SM1. The C-Mount threading of the CCD camera can be easily connected to components with Thorlabs' standard SM1 thread via one of the two included SM1 adapters, as shown in the photo to the right. Additional or replacement adapters may be purchased below. A mounting adapter plate is also provided with the CCD camera; by using the included M4 x 10 mm or 8-32 x 3/4" cap screw, the camera can be threaded onto Thorlabs' TR series Ø1/2" posts. Every unit also ships with four M3 x 6 mm screws for mounting the adapter plate to the camera.

**Trigger Option**

The optional CAB-DCU-T1 and CAB-DCU-T2 cables can replace the standard USB connection while also enabling the use of the additional trigger input and output ports of these cameras. The exposure and readout/transfer events of the camera can be initiated via the input trigger; external events like strobe lights can be triggered by the camera through the output trigger. The trigger configuration, i.e. the source of the input trigger and the timing for the output trigger, can be set through the provided software or the LabVIEW drivers. Please click here for more details about the cables and the ordering information.

## SPECS

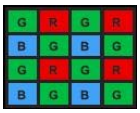
| Item # | DCU223M | DCU224C |
|---|---|---|
| **Sensor** | | |
| **Sensor Type** | CCD | |
| **Exposure Mode** | Electronic Global Shutter | |
| **Read Out Mode** | Progressive Scan | |
| **Resolution** | 1024 x 768 Pixels | 1280 x 1024 Pixels |
| **Optical Sensor Class** | 1/3" | 1/2" |
| **Exact Sensitive Area** | 4.76 mm x 3.57 mm | 5.95 mm x 4.76 mm |
| **Exact Optical Sensor Dimension (Diagonal)** | 6.0 mm (0.24") | 7.6 mm (0.30") |
| **Pixel Size** | 4.65 µm x 4.65 µm | |
| **Sensor Name** | Sony ICX204AL | Sony ICX205AK |
| **A/D Converter Resolution** | 8 Bit | |
| **S/N Ratio** | ≥38 dB | |
| **Frame Rates** | | |
| **Pixel Clock Range[a] (Allowed/Recommended)** | 5 - 30 MHz/10 - 20 MHz | |
| **Frame Rate, Freerun Mode[b]** | 30 fps | 15 fps |
| **Frame Rate, Trigger Mode,** | 28.7 fps | 17 fps |

| | | |
|---|---|---|
| **1 ms Exposure Time**[b] | | |
| **Exposure Time in Freerun Mode** | 30 µs[b] - 773 ms[c] | 66 µs[b] - 1360 ms[c] |
| **Exposure Time in Trigger Mode** | 30 µs[b]- 10 min[c] | 66 µs[b] - 10 min[c] |
| **Binning** | Vertical[d] | |
| **Method** | V: Monochrome Binning, Additive | |
| **Factor, Maximum Resolution, Frame Rate** | 2x, 1024 x 384 Pixel, 53 fps | 2x, 1280 x 512 Pixel, 23 fps |
| **Factor, Maximum Resolution, Frame Rate** | 4x, 1024 x 192 Pixel, 85 fps | 4x, 1280 x 256 Pixel, 31 fps |
| **Subsampling** | - | |
| **AOI** | Horizontal, Vertical [d] | |
| **Frame Rate at 320 x 240 Pixel (Cif)** | 78 fps | 38 fps |
| **Absolute Image Width, Step Width** | 16 - 1024 Pixel, 4 | 16 - 1280 Pixel, 4 |
| **Absolute Image Height, Step Width** | 120 - 768 Pixels, 1 | 120 - 1024 Pixels, 2 |
| **Position Raster Horizontal** | 1 | 2 |
| **Position Raster Vertical** | 1 | 2 |
| **Gain** | | |
| **Monochrome Model** | 10.47X (Master) | 8.9X/4.0X (Master/RGB) |
| **Offset Control, Mode** | Auto, Manual, Additive | |
| **Gain Boost** | 2x | n/a |
| **Trigger** | | |
| **Hardware Trigger** | Asynchronous | |
| **Trigger Delay With Rising Edge, Jitter** | 39.5 µs ± 2.6 µs | 39.9 µs ± 2.5 µs |
| **Trigger Delay With Falling Edge, Jitter** | 57.9 µs ± 2.6 µs | 57.7 µs ± 2.5 µs |
| **Additive Trigger Delay To the Sensor** | 15 µs - 4 s | |
| **Sensor Delay To the Exposure Start** | <100 µs[b] | |
| **Trigger Low Level**[e] | 0 V Min, 2 V Max | |
| **Trigger High Level**[e] | 5 V Min, 24 V Max | |
| **Power Consumption** | 1.0 - 1.7 W | 1.1 - 2.1 W |
| **Housing** | | |
| **Protective Window, Removable** | Uncoated Glass (D263) | IR Filter D263 with HQ coating |
| **Interface** | USB 2.0 | |
| **Power Supply** | 1.7 W, via USB | 1.1 to 2.1 W |
| **Operating Temperature** | 32 to 122 °F (0 to 50 °C) | |
| **Security Labels** | CE, FCC, Class A | |
| **Dimention (H x W x D)** | 1.59" x 1.26" x 1.35" (40.35 mm x 32 mm x 34.4 mm) | |
| **Weight** | 0.21 lbs (96 g) | |
| **Lens Connector** | C-Mount | |
| **Included Adapters** | External C-Mount to External SM1 (Replacement Item # SM1A39) and External C-Mount to Internal SM1 (Replacement Item # SM1A9 or SM1A9TS) | |

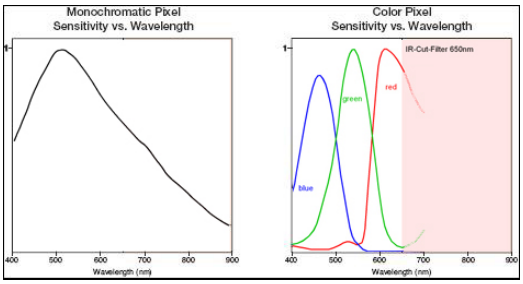
- The max. possible pixel clock depends on the used computer.
- Values are only achieved with maximum pixel clock.
- Values are only achieved with minimum pixel clock.
- Function increases the frame rate.
- Trigger High and Low voltages are for the current USB board revision. A previously purchased camera contains the current USB board revision if it is compatible with our most recent driver (Version 3.82).

## PIXEL SENSITIVITY

### Pixel Sensitivity of the CCD Camera




Pixel sensitivity versus wavelength plots are shown at the right for the monochromatic and color versions of these CCD cameras. The color model incorporates a removable IR filter that blocks the spectral region marked by the pink background. For this model, the popular Bayer color filter array is used to acquire digital color images. The filter is based on the repeating 2 x 2 pattern shown to the left; half of the total number of pixels are green (G), and the remaining pixels are equally divided between red (R) and blue (B).




Due to this arrangement, each pixel is only sensitive to one color, and as a result, the overall sensitivity of the color image is three times lower than that achievable with a monochromatic sensor. Thus, B&W CCD cameras are preferred in low-light situations. Even though only one third of the color information is obtained at each pixel, a full-color image can be achieved through the use of various demosaicing algorithms that interpolate a set of red, green, and blue B G B G values at each point.

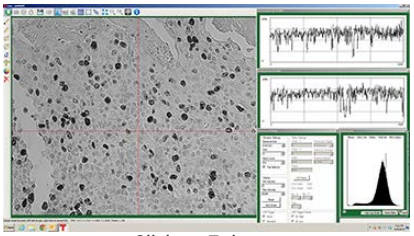
## SOFTWARE

### ThorCam™

### Software

**Version 3.5.1**

Click the button below to visit the ThorCam software page.



Click to Enlarge
ThorCam Graphical User Interface (GUI)

Software

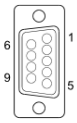
ThorCam is a powerful image acquisition software package that is designed for use with our cameras on 32- and 64-bit Windows® 7 or 10 systems. This intuitive, easy-to-use graphical interface provides camera control as well as the ability to acquire and play back images. Single image capture and image sequences are supported. Application programming interfaces (APIs) and a software development kit (SDK) are included for the development of custom applications by OEMs and developers. The SDK provides easy integration with a wide variety of programming languages, such as C, C++, C#, and Visual Basic .NET. Support for third-party software packages, such as LabVIEW, MATLAB, and µManager* is available.

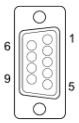
*µManager control of Zelux and 1.3 MP Kiralux cameras is not currently supported. When controlling the Kiralux Polarization-Sensitive Camera using µManager, only intensity images can be taken; the ThorCam software is required to produce images with polarization information.

## High-Resolution USB CCD Cameras

| Part Number | Description | Price | Availability |
|---|---|---|---|
| DCU223M | CCD Camera, 1024 x 768 Resolution, B&W, USB 2.0 | $1,715.58 | Lead Time |

## USB and Trigger Cables

| Item # | CAB-DCU-T1 | | | Pin | Assignment |
|---|---|---|---|---|---|
|  Click to Enlarge | **Connector Device Side** | Micro Sub-D, 90° Angled |  | 2 | Trigger Input + |
| | **Connector PC Side** | USB 2.0 A Male | | 3 | Shield |
| | **USB Standard** | Hi-Speed USB2.0 | | 4 | USB +5 V |
| | **Trigger In (Bare Wire)** | x | | 5 | USB GND |
| | **Flash & Digital Out (Bare Wire)** | x | | 6 | Flash Strobe Output + |
| | **Wire Gauge USB** | 24AWG/2C and 28AWG/1PR | | 7 | Trigger Input - |
| | **Shielding** | Double Shielded 80 °C 30 V | | 8 | USB D+ |
| | **Length** | 3 m | | 9 | USB D- |

| Item # | CAB-DCU-T2 | | | Pin | Assignment |
|---|---|---|---|---|---|
|  Click to Enlarge | **Connector Device Side** | Micro Sub-D, Straight |  | 2 | Trigger Input + |
| | **Connector PC Side** | USB 2.0 A Male | | 3 | Shield |
| | **USB Standard** | Hi-Speed USB2.0 | | 4 | USB +5 V |
| | **Trigger In (Bare Wire)** | x | | 5 | USB GND |
| | **Flash & Digital Out (Bare Wire)** | - | | 6 | Not Connected |
| | **Wire Gauge USB** | 24AWG/2C and 28AWG/1PR | | 7 | Trigger Input - |
| | **Shielding** | Double Shielded 80 °C 30 V | | 8 | USB D+ |
| | **Length** | 3 m | | 9 | USB D- |

| Item # | CAB-DCU-T3 | | | Pin | Assignment |
|---|---|---|---|---|---|
|  Click to Enlarge | **Connector Device Side** | Hirose HR25-7TP-8S |  | 2 | Flash Output[a] |
| | **End Opposite Connectors** | Tinned End of Wires | | 3 | GPIO 1, 3.3 V LVCMOS |
| | **Function** | GPIO | | 4 | Trigger Input[a] - |
| | **Trigger In (Bare Wire)** | yes | | 5 | Flash Output[a] + |
| | **Flash & Digital Out (Bare Wire)** | yes | | 6 | GPIO 2, 3.3 V LVCMOS |
| | **Cable Type** | Shielded High-Flexible Control Cable 8 x 0.1 mm, Ø4.9 mm | | 7 | Trigger Input[a] + |
| | **Shielding** | Single Shielded | | 8 | Output Supply Voltage, 5 V (100 mA) |
| | **Length** | 2 m | | 9 | N/A |

- These pins are opto-decoupled inside the camera to protect against high or incorrect voltages.

| Part Number | Description | Price | Availability |
|---|---|---|---|
| CAB-DCU-T1 | Customer Inspired!&nbspUSB and Trigger Cable (In/Out) for DCU Series and DCC1240 Cameras, 3 m | $145.33 | Today |
| CAB-DCU-T2 | Customer Inspired!&nbspUSB and Trigger Cable (In Only) for DCU Series and DCC1240 Cameras, 3 m | $85.23 | Today |
| CAB-DCU-T3 | Trigger and I/O Cable, Hirose 25, for DCC3240, DCC3260, WFS30 and WFS40, 2 m | $103.81 | Today |

## C-Mount to SM1 Adapters for Cameras

Each CCD camera includes two thread adapters: one external C-Mount to internal SM1 (1.035"-40) and one external C-Mount to external SM1. Replacement adapters are sold below.

| Item # | SM1A9 | SM1A9TS[a] | SM1A39 |
|---|---|---|---|
| Image (Click To Enlarge) |  |  |  |
| **Thread 1** | External C-Mount (1.00"-32) | | |
| **Thread 2** | Internal SM1 (1.035"-40) | | External SM1 (1.035"-40) |
| **Material** | Anodized Aluminum | Black Delrin®[b] | Anodized Aluminum |
| **Typical Application** | Mount a C-Mount Camera to an Externally Threaded SM1 Lens Tube | Mount a C-Mount Camera to an Externally Threaded SM1 Lens Tube | Mount a C-Mount Camera to an Internally Threaded SM1 Lens Tube |

- Thermally Insulating Adapter
- Delrin® is a registered trademark of DuPont Polymers, Inc.

| Part Number | Description | Price | Availability |
|---|---|---|---|
| SM1A9 | Adapter with External C-Mount Threads and Internal SM1 Threads, 4.4 mm Spacer | $19.96 | Today |
| SM1A9TS | Customer Inspired!&nbspThermally Insulating Adapter with External C-Mount Threads and Internal SM1 Threads, 6.5 mm Spacer | $23.61 | Today |
| SM1A39 | Customer Inspired!&nbspAdapter with External C-Mount Threads and External SM1 Threads, 3.2 mm Spacer | $21.21 | Today |

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