Spectral DEVICES INC.

Product Sheet

Custom Multispectral Cameras

MSC-CUS-1-A

[1]

MSC-CUS-1-A

Specifications subject to change

Revised April 12, 2021

Version 001

[1] Shown with example lens. Lens not included with camera.

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1. Description

The MSC-CUSXX-1-A multispectral camera incorporates a high performance 4MP CMOS sensor that is modified with Spectral Devices proprietary multispectral filter array technology. This multispectral snapshot camera can be ordered with a custom number of filter bands (4, 8, and 16), where each band is chosen by the customer. A wide selection of filter types is available. Since the filters are integrated on to the sensor, there is no need for additional filters, filter wheels, or tunable filters. The spectral images for all bands are captured simultaneously by the multispectral sensor. The camera is USB3 Vision-compliant with many pre-built software options such as 2ndlook graphical camera software. Programmers can build camera applications in Windows and Linux using a variety of SDKs. Power is supplied through the USB3 interface. The camera is compact, light, and designed for customer-specific imaging applications.

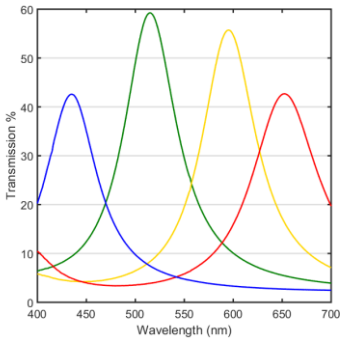
2. Key Features

Snapshot Operation (capture spectral images simultaneously)
Captures 4, 8, or 16 bands depending on customer requirements
Anti-X-Talk™ Technology (enhances contrast and spectral performance)
High Frame Rate (up to 94 FPS at full frame)
High Performance (4MP Global Shutter CMOS Sensor)
USB3 Vision & GenICam Compliant
Compact (56 mm x 50 mm x 52 mm)
Light (200 g)
Low Power Requirement (< 4.5W from USB cable)
Multiple M3, ¼-20, and 4-40 Mounting Points
SDK for Windows included
SDK for Linux (optional)

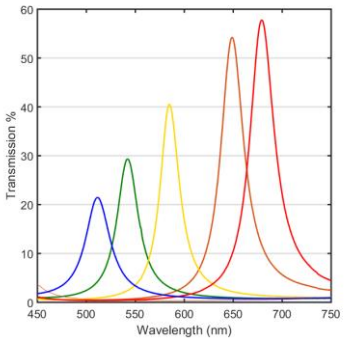
3. Spectral Characteristics

Custom filter response profiles

Customers can choose from the filter types listed in the figure below. The position of individual bands can be customized. Some filter types can be mixed and matched on the same sensor. Spectral Devices can advise on manufacturability of a custom camera only after band position and bandwidth are obtained from the customer.



F1



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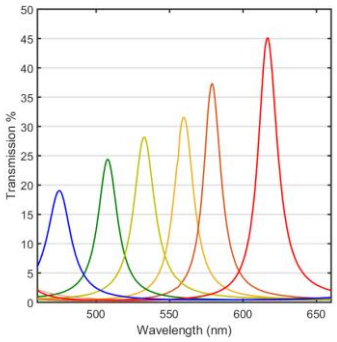

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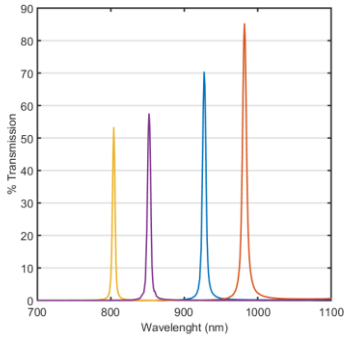

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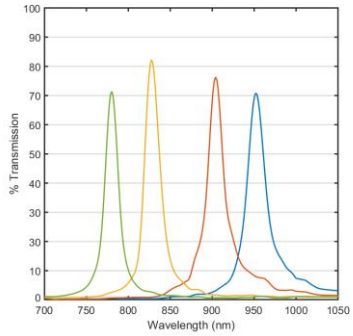

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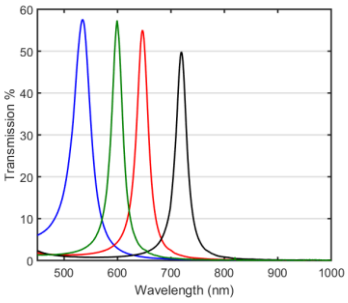
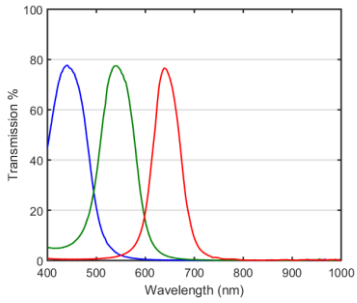
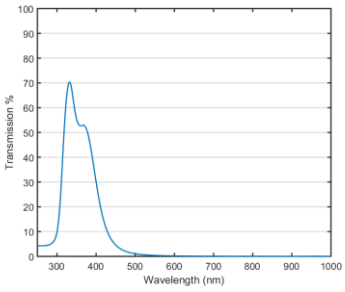


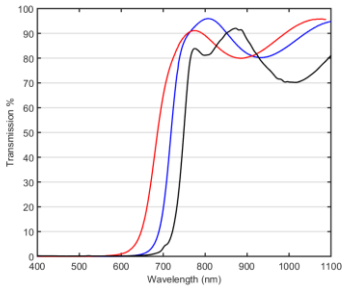
Visible



Wide Band



UV



NIR Long Pass

4. Anti-X-Talk™ Technology

Unique to Spectral Devices is an on-chip technology we refer to as Anti-X-Talk™ technology. Anti-X-Talk™ technology works at the filter level and prevents light leakage between individual filters. Without Anti-X-Talk™ technology, stray light between spectral channels is significant, often exceeding the light leakage due to spectral overlap between adjacent filters. Without Anti-X-Talk™ technology, images suffer from low contrast and spectral ambiguity. Spectral Devices invented Anti-X-Talk™ technology to overcome these problems. It works by blocking stray light between adjacent filters, so the pixel response is predictable and directly related to the actual spectral response of the overlying pixelated filter. The result is multispectral images with better

spectral discrimination and higher contrast. Furthermore, high quality image data from the camera can be used as is without the need for proprietary post-processing algorithms and the camera can be used with a wide range of lens types even at large apertures (e.g. f/2).

5. Specifications

Lens Mount	C-mount
Sensor Type	CMOS
Sensor Model	AMS CMV4000
Sensor Format	1-inch
Number of Spectral Channels	4, 8, or 16
Image Pixels Per Spectral Channel (4 band camera, MSC-CUS4-1-A)	512 x 512, 1024 x 1024 after debayering
Image Pixels Per Spectral Channel (8 band camera, MSC-CUS8-1-A)	256 x 256, 512 x 512 after debayering
Image Pixels Per Spectral Channel (16 band camera, MSC-CUS16-1-A)	256 x 256, 512 x 512 after debayering
Effective Pixel Size (H x V)	5.5 µm x 5.5 µm
Capture Method	Area
Spectral Channels	Customer selected
Spectral Bandwidth (FWHM)	Customer selected
On-chip Spectral Enhancement	Anti-X-Talk™ Technology
Shutter Type	Global
Sync System	External trigger (Hardware, Software) / Free run
Maximum Frame Rate (at Full Frame). Frame rate increases with smaller frame size	8 bit output 94 fps 10 bit output 75 fps 12 bit output 62 fps
A/D Converter	10 and or 12 bits in sensor
Video Data Output	8, 10 and 12-bit
Image Data Formats	Mono/Multispectral: 8 or 10 bit packed, 12 bit packed Color: Bayer 8 or 10 bit packed, RGB, YCC 422
Dynamic Range	60 dB
Exposure time	200 µs to 1.5 seconds (Default: 15,000 µs)
Digital Gain	Supported
Black Level	Supported
ROI	Up to 16 ROIs
Binning	Available in horizontal direction
Decimation	Not Available
HDR	Not Available
Image Flip	Not Available
Defective Pixel Correction	Turned off for multispectral readout
Auto Exposure	Not Supported
Auto Gain	Not Supported
GPIO	12-pin Hirose HR10A GPIO, opto isolated trigger, 2 opto isolated strobes

External Trigger Modes	Single Frame, Burst Mode, Bulb Mode
Synchronization	Via external trigger or software trigger
Image Buffer	256 MB Buffer
Dimensions (W x H x D)	56 mm x 50 mm x 52 mm
Mass	200 g
Power Consumption	5V via USB3.0 interface, maximum <4.5W
Compliance	CE, FCC, RoHS
Operating System	Windows, Linux
Warranty	One Year

6. Physical Properties

Appearance

The MSC series camera has a CNC precision machined aluminum case for strength that is anodized black for durability (Figure 7.1). The C-mount lens holder is centered with respect to the front of the case for easy alignment. The case offers three sets of deeply threaded holes enabling a wide variety of mounting options.

Front Perspective

Side

Front

Back

Photos of the MSC-series camera.

Exterior features

1. Lens holder

   C-mount lens ready.

2. Glass or filter

   Some models of cameras are fitted with a protective glass, an IR Cut filter, or a specialized filter, which is mounted at the back of the Lens Holder. The glass or filter is held in place with a retaining ring. Although the glass and filter are removable, doing so will void the warranty since the sensor will be unprotected and easily damaged.

3. M3x0.5 mounting holes

   Twelve locations on camera case for multiple mounting options.

4. ¼-20 mounting holes

   Twelve locations on camera case for multiple mounting options.

5. 4-40 mounting holes

   Four locations on front of camera case for mounting 30 mm cage components from Thorlabs and Newport.

6. General purpose I/O connector

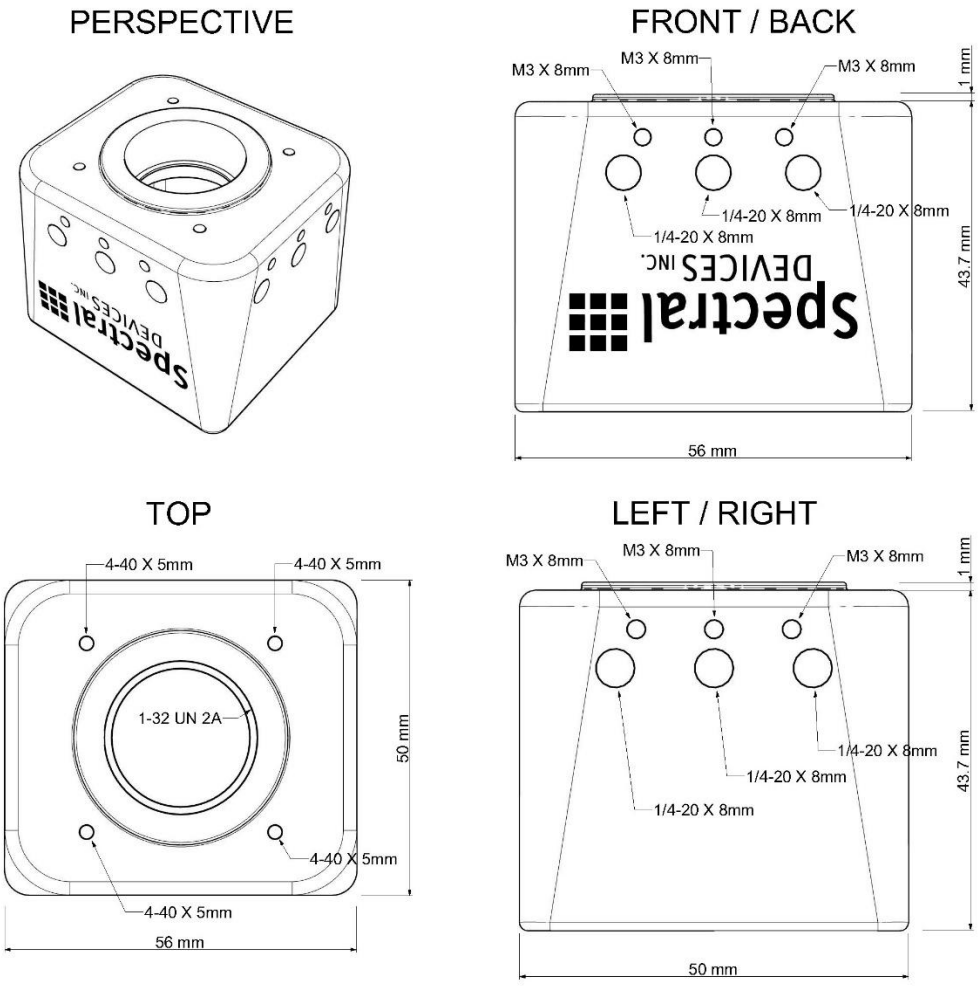
   A 12 pin Trigger/Strobe connector.

7. Status LED

   Indicates the current state of the camera operation.

8. USB3 connector

Mechanical Drawings



Dimensional drawings of MSC-CUS-1-A. All measurements in mm.

7. Software

The MSC series of cameras can be controlled using various software packages, including:

1. IO Industries 2ndLook
2. National Instruments LabVIEW with Vision
3. MATLAB
4. Pleora eBUS SDK
5. JADAK Medley SDK

USB3 Vision is a communication interface for vision applications based on the USB 3.0 technology. All cameras supporting USB3 Vision interact the same way with software also supporting USB3 Vision. All MSC cameras are USB3 Vision compliant.

The USB3 Vision standard defines required elements for camera identification, control, and output. It uses GenICam, a programming interface for camera attribute control. GenICam allows camera vendors to define features and attributes in an XML file stored inside the camera. The file is parsed by the host application when the camera is initially discovered. One of the key benefits of GenICam is the ability for camera vendors to introduce new camera-specific features without needing to update the host application.

Each camera attribute, such as exposure time, is controlled by a specific GenICam feature. The camera includes an XML device description file for interfacing with third-party GenICam-compliant APIs. A full listing of features that are included in the XML file is provided in the user manual.

For more information on the USB3 Vision standard, visit visiononline.org.

For more information on GenICam, visit http://www.emva.org/standards-technology/genicam/

IO Industries 2ndLook

2ndLook is a complete image acquisition software package that enables users to connect and acquire images from one or more cameras on a single PC. The software offers real-time synchronized video recording from GenICam-compliant USB3 Vision, GigE Vision, and DirectShow cameras. Easily record directly to popular file formats such as AVI and TIFF. Even record from multiple cameras to different file formats concurrently. For example, record from a USB3 Vision camera to QuickTime and from a GigE Vision camera to TIFF at the same time. 2ndLook offers an easy-to-use interface with interactive help and user guides. 2ndLook must be purchased separately. See Section 9 for a detailed example.

National Instruments LabVIEW

National Instruments LabVIEW can be used for MSC control and image acquisition if the LabVIEW Vision component is installed.

MATLAB

Users can acquire images and video from MSC cameras using MATLAB. MATLAB provides a high-level programming language to manipulate data in matrix format. Users can modify the graphical interface using MATLAB's GUIDE and program new features into the example code to solve a specific imaging task. MATLAB must be purchased separately, but an example application with source code is provided with every MSC camera.

Pleora eBUS SDK

The Pleora eBUS SDK is the industry standard for USB3 Vision cameras that allows customers to create custom applications to control MSC cameras in Windows and Linux. Included in the SDK are a number of source code examples to help programmers get started. For end users, a full-featured USB3 vision camera viewer application is provided. The Pleora eBUS SDK must be purchased directly or through a Pleora channel partner. Please visit www.pleora.com for more information.

JADAK Medley SDK

Similar to the Pleora eBUS SDK, the JADAK Medley SDK enables users to program MSC using a variety of languages on Windows platforms. The Medley SDK is provided with every MSC camera free of charge. Our MATLAB code requires that the Medley SDK be installed. The Medley SDK is available at https://www.jadaktech.com/products/machine-vision/medley-software-development-kit/.

8. Windows Software (optional)

2ndLook is a complete image acquisition software package that enables users to connect and acquire images from one or more multispectral cameras on a single PC. Offers real-time synchronized video recording from GenICam-compliant USB3 Vision, GigE Vision, and DirectShow cameras (Figure 8.1). Easily record directly to popular file formats such as AVI and TIFF. Record from multiple cameras to different file formats concurrently. Multispectral imaging conversion filters for Spectral Devices cameras are built in (Figure 8.2). View montage of spectral images in real-time (Figure 8.3). Easy to use interface with interactive help and user guides. Demo version provides all features, except save to disk function.

Figure 8.1. Real-time display of raw multispectral images.

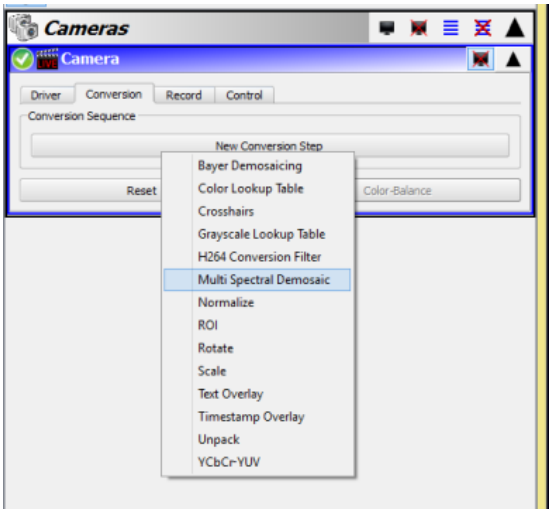


Figure 8.2. Multispectral conversion filters

Figure 8.3. Real-time display of multispectral images in montage format. Example here collected with 4-band multispectral camera for agriculture.