Specification

RGB-NIR Multispectral Drone Camera

MSDC-RGBN-1-A

Table of Contents

Background Information

Trademarks

Spectral Devices Inc., MSC2,MS2-RGBN-1-A, MSDC-RGBN-1-A

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1. Description

The multispectral drone camera is a turnkey multispectral imaging solution for easy integration into drones with PixHawk flight controllers enabling capture of geotagged aerial images for further analysis in data mapping software.

Each MSDC-RGBN-1-A includes a snapshot multispectral camera (MSC2-RGBN-1-A), a lens, a vision computer, and a high-performance 3-axis gimbal (optional). System is compatible with common drone platforms. The system is energy-efficient, lightweight, and comes fully configured with camera control and image capture software. Images can be saved to SD card at up to 10 FPS. Start and stop buttons control image capture on demand. A live multispectral video feed is available for downlink.

The MSC2 RGB-NIR multispectral camera incorporates a high performance 4MP CMOS sensor that is modified with Spectral Devices proprietary multispectral filter array technology.

This miniature multispectral snapshot camera simultaneously captures images at 4 distinct bands (spaced between 400 nm and 800 nm) at 178 frames per second in full frame mode. There is no requirement for additional filters, filter wheels, or tunable filters.
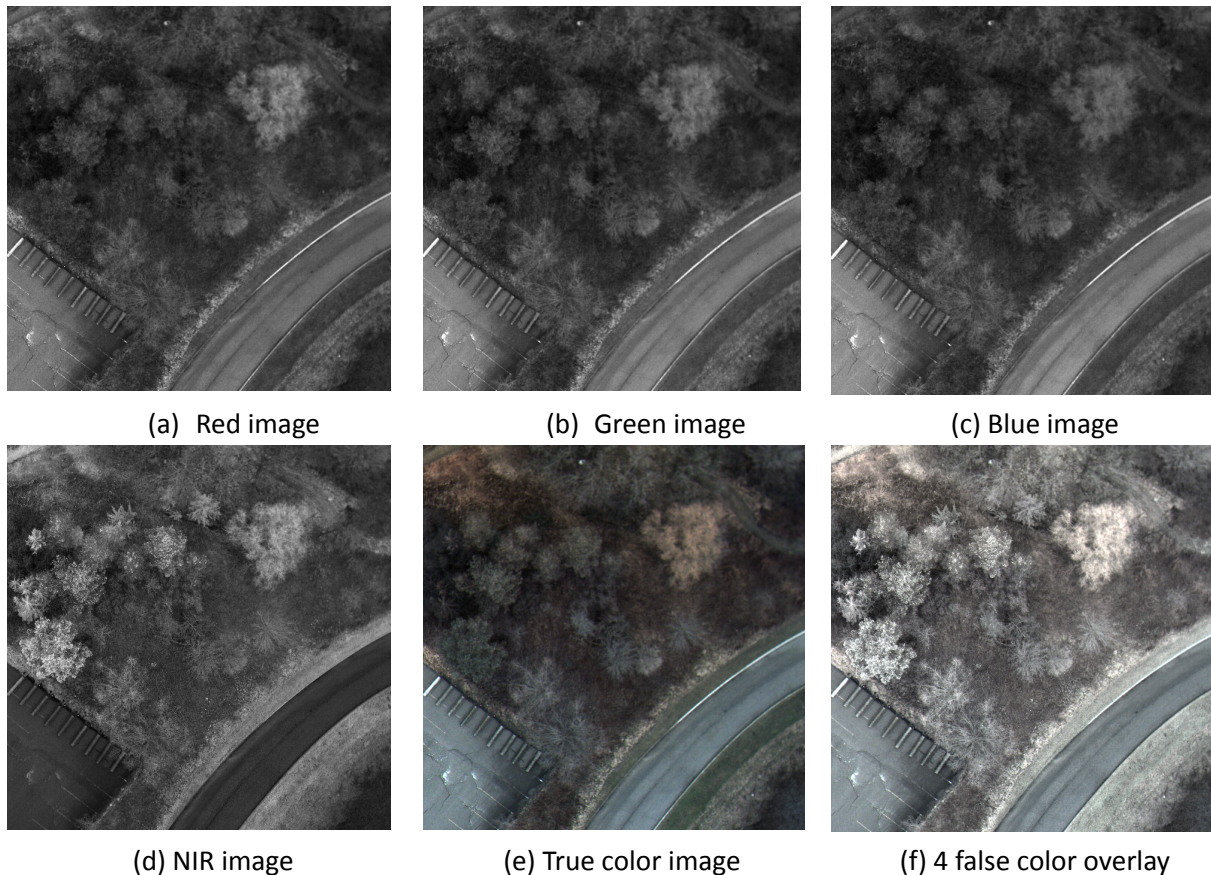
2. Key Features

- Snapshot Operation (capture spectral images simultaneously)
- Captures 4 Bands (450, 550, 650, 800 nm)
- Anti-X-Talk™ Technology (enhances contrast and spectral performance)
- High Frame Rate (up to 178 FPS)
- High Performance (4MP Global Shutter 1-inch CMOS Sensor)
- Lens Mount C-mount
- Interface USB3.0
- Camera weight 55 g, computer weight 140 g, gimbal weight 465 g
- Real-time HDMI output of multispectral images
- Power: 5V/4A input
- Input Voltage UBEX 14 – 52 V
- Input Voltage Gimbal 12V / 5A
- Connection USB, CAN, UART, HDMI
- Pan Range +/- 330 degrees
- Tilt Range -45 degree / +135 degree
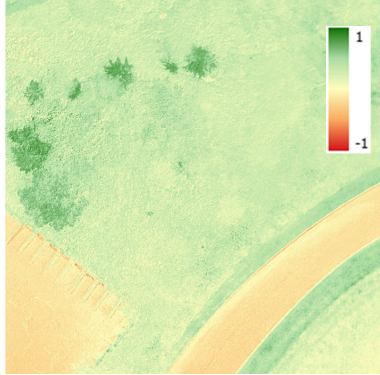- Roll Range -90 degree / +45 degree

3. Applications

The camera is suitable for applications such as remote sensing for agriculture and geological surveys, and industrial color inspection. Combined with Spectral Devices SBC-1

miniature vision computer, the MSC2-RGBN-1-A offers an easy-to-use lightweight and modular imaging solution for UAV users.

Figure 3.1 shows example images obtained with MSC2-RGBN-1-A. The camera produces 4 greyscale co-registered images corresponding to green, red, blue and NIR bands shown in Fig. 3.1 (a-d), respectively. Overlay of red, green and blue bands produces a true color image (Fig.3.1e). Addition of the NIR band to the image allows for visualization of more features (Fig.3.1f) compared to the true color image. Healthy vegetation is known to reflect more NIR light compared to other spectral bands. Lastly, numerous metrics can be used for further image analysis. For example, the Normalized Difference Vegetation Index (NDVI) (Fig.3.1g) can be used to assess plant health. Higher NDVI indicates greater plant health (between values of 0-1), reflected by the higher chlorophyll content in the vegetation. Low NDVI values (0 - -1) indicate presence of water, rocks or man made objects.


| (a) Red image | (b) Green image | (c) Blue image |

| (d) NIR image | (e) True color image | (f) 4 false color overlay |

(g) NDVI

Figure 3.1. Example of images obtained with MSC2-RGBN-1-A camera. (a) Red band image, (b) Green band image, (c) blue band image, (d) NIR band image, (e) Images in (a-c) overlay, (f) Images in (a-d) overlay, (g) Normalized Difference Vegetation Index (NDVI) calculated as NDVI = (NIR - Red) / (NIR + Red).

4. Sensor and its Spectral Characteristics

The MSC2-RGBN-1-A camera has 4 distinct bands centered at 450, 550, 650, 800 nm (FWHM ~70 nm). The sensor of the camera is covered with a multispectral filter array providing each sensor element (pixel) its own spectral response (Fig.4.1a). Spectral response of the MSC2-RGBN-1-A camera sensor is displayed in Fig.4.1b.
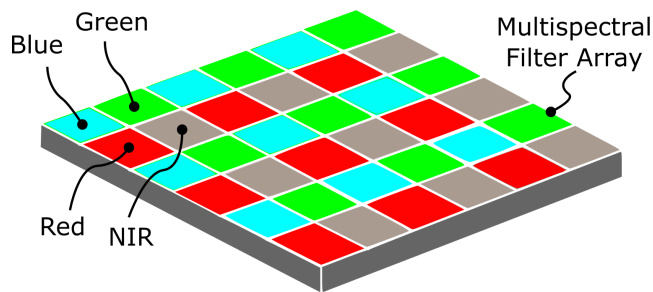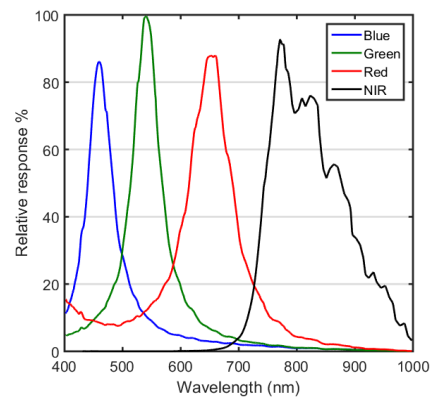
(a)   (b)

Figure 4.1. (a) Example of MSC2-RGBN-1-A multispectral filter array structure (note: band arrangement can vary between cameras) (b) Spectral response of the MSC2-RGBN-1-A camera.

5. Anti-X-Talk™ Technology

Anti-X-Talk™ technology is an unique Spectral Devices Inc. on-chip technology working at the filter level and preventing 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. As a result 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, making the pixel response more 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 MSC2-RGBN-1-A 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).

6. Specifications

Lens Mount	C-mount
Sensor Type	CMOS
Sensor Model	AMS CMV4000
Sensor Format	1-inch
Number of Spectral Channels	4
Image Pixels Per Spectral Channel	512 x 512 (1024 x 1024 after debayering)
Effective Pixel Size (H x V)	5.5 µm x 5.5 µm
Capture Method	Area
Spectral Channels	450, 550, 650, 800 nm
Spectral Bandwidth (FWHM)	~70 nm
On-chip Spectral Enhancement	Anti-X-Talk™ Technology
Shutter Type	Global
Exposure time	22 µs to 16.77 seconds (Default: 11,116.0 µs)
Auto Exposure	Supported
Interface	USB3.0
Weight	Camera 55g, computer 140g, gimbal 465g, total 660g
Power	5V/4A input
Input Voltage	UBEX 14 – 52 V, Gimbal 12V / 5A
Connection	USB, CAN, UART, HDMI
Pan Range	+/- 330 degrees
Tilt Range	-45 degree / +135 degree
Roll Range	-90 degree / +45 degree

7. Camera Mechanical Drawings
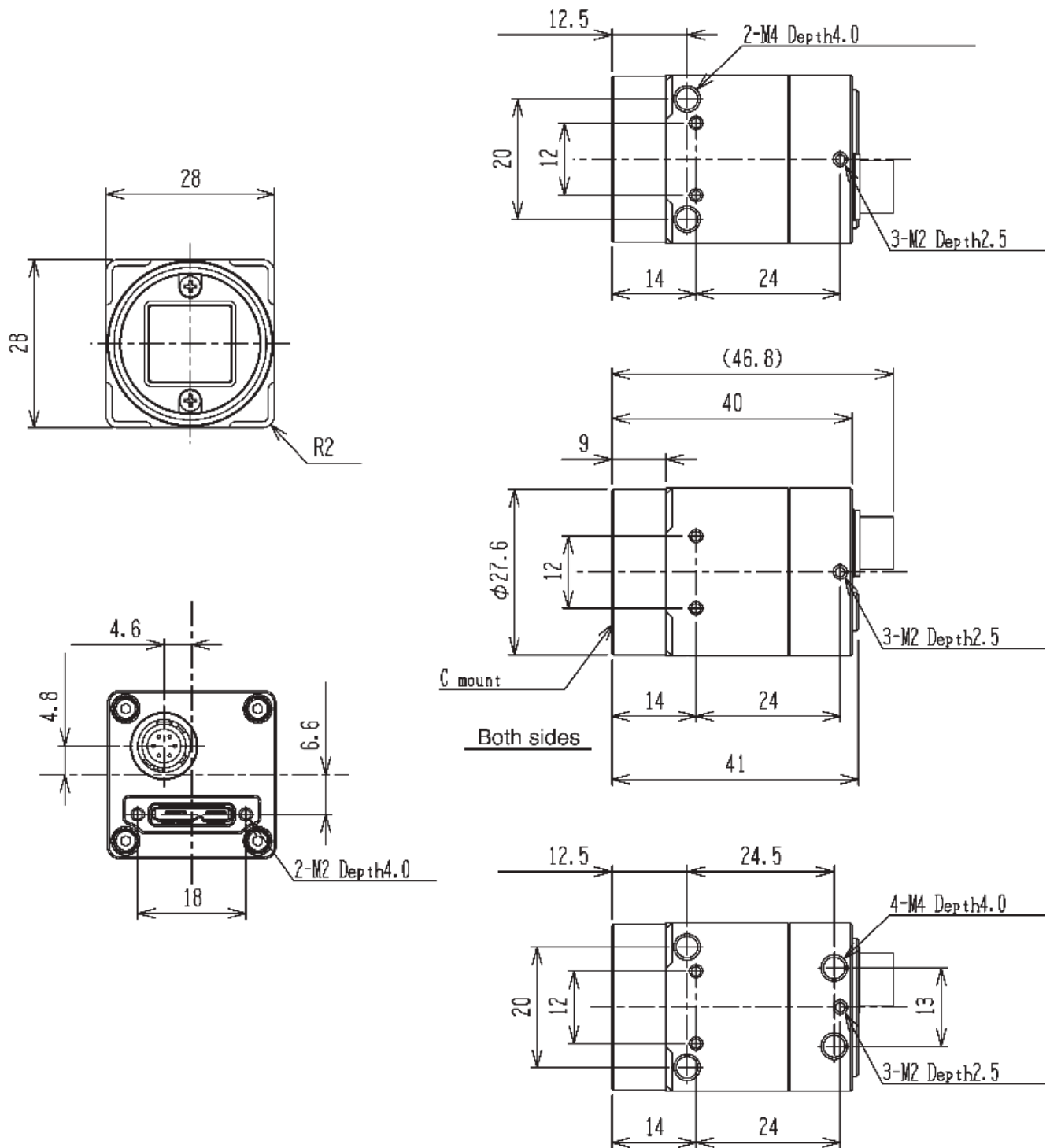
8. Package Contents

The MSDC is shipped with several items including a multispectral camera integrated with a vision computer, lockable ruggedized lens, 128 GB microSD card with microSD adaptor, a Pixy U Gremsy Gimbal (optional), Camera and Vision Computer Cables to the camera gimbal end, Camera Trigger IN/OUT from the QR gimbal end to Pixhawk, gimbal other accessories, power adaptor, a country specific power cord, and a USB Wi-Fi dongle. All accessories come in a waterproof case.
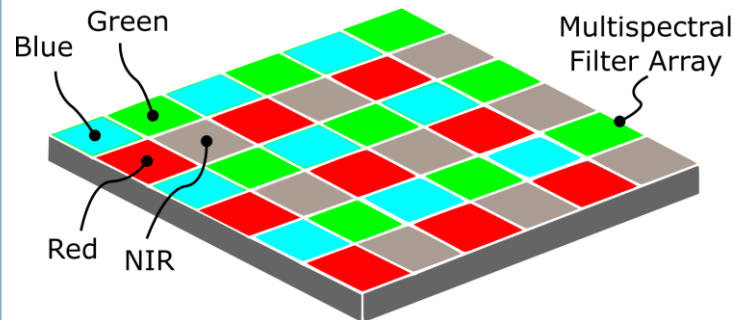
Spectral DEVICES INC.

MSDC-RGBN-1-A

The MSDC is a multispectral drone camera for easy integration to drones with PixHawk flight controllers enabling capture of geotagged aerial images for further analysis in data mapping software.

FEATURES

- Captures co-registered spectral images simultaneously

- 4 bands – 450, 550, 650, 800 nm

- Anti-X-Talk™ Technology - enhances contrast and spectral performance

- Frame rates @ 89 FPS

- 4MP Global Shutter CMOS sensor

- Accommodates c-mount lenses

- Weight: camera 55g, computer 140g, gimbal 465g, total 660g

SENSOR

Blue
Green
Red
NIR
Multispectral Filter Array

SPECTRAL RESPONSE

Blue
Green
Red
NIR

Relative response %

Wavelength (nm)