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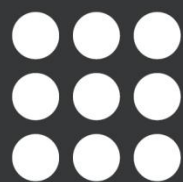
# MAIA S2

*The multispectral camera*

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Datasheet

Rev. 0.2 - 02/2018



**MAIA**

the multispectral camera

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**MAIA S2 is a product by**



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## 1 DATASHEET

### 1.1 OVERVIEW

MAIA S2 is a multispectral camera designed to be employed on board UAV systems, entirely made in Italy and jointly developed by SAL Engineering - Modena and by EOPTIS - Trento. MAIA S2 is based on an array of 9 sensors with 1.2 Mpixel (9 monochrome with relative band-pass filters) for the analysis of the VIS-NIR spectrum at the same wavelength intervals of the ESA's Sentinel-2™ satellite, from 433 nm to 899.5 nm.

### 1.2 OPTICS

CMOS sensors settled in MAIA S2 has 1280x960 pixels and the dimension of each pixel is 3.75 μm x 3.75 μm. Sensors present excellent characteristics in terms of sensitivity. Each sensor is global shutter and shoot simultaneously: it follows that it is not necessary to stabilize acquisition with gimbal, which is indispensable with rolling shutter sensors to avoid distortions, crawling and blurring pixels in the images. The high quality and the radiometric validity of data obtained with MAIA S2 are then guaranteed even during high speed flights.

Each optics of every produced MAIA S2 is calibrated in laboratory and for each camera the Calibration Certificate is available, with the following parameters:

- calibrated Focal Length;
- position of Principal Point;
- distortion lens parameters.

Calibration and certificate is carried out by 3DOM group - 3D Optical Metrology of FBK - Fondazione Bruno Kessler based in Trento (IT), in their laboratories.

### 1.3 CONNECTIONS AND DEVICES

The user can interact with the camera to configure operating parameters and to manage the images both through the GigaEthernet port and through integrated Wi-Fi. Many parameters can also be configured through the dedicated keypad using the On-Screen Display on the output port of the composite video. Thanks to a web panel, MAIA S2 permits a fine regulation of all parameters concerning the acquisition activities, from exposure time of each sensor to shot frequency. Automatic configurations are available for standard operations.

MAIA S2 can communicate and can be interconnected with various devices including:

- GNSS: GPS L1 or L1 / L2; GLONASS, Galileo, Beidou, for an accurate log of synchronized shutter positions (available in PPP, PPK, RTK);
- VIDEO TX for real-time transmission of images of the selected sensor, also remotely;
- RDX for remote control of the camera (frame rate, video source selection, wi-fi activation);
- GIMBAL for attitude and balance control (an integrated IMU with 3 accelerometers and 3 gyroscopes provides orientation parameters).

## 1.4 MULTISPECTRAL IMAGES

Images are stored in an internal hard disk (120 Gb SSD) that provides high speed and the possibility to save about 10,000 images in the maximum format allowed (12-bit raw).

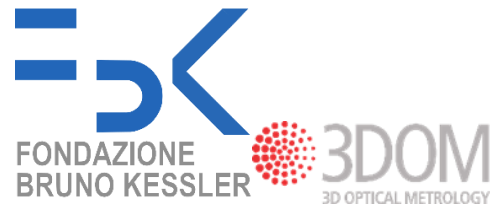
MultiCam Stitcher Pro is the images pre-processing software integrated with MAIA S2, that allows the correction of geometrical distortion, radial distortion of the raw images, and allows to stitch the images of each single band on one multispectral image with the pixel-pixel convergence. It also allows you to calculate, for each image, NDVI, SAVI index and any type of customized band calculations and combination of bands.

MultiCam Stitcher Pro allows the radiometric calibration of images in different ways:

- reference image on white target, of which you know the reflectance coefficients;
- empirical parameters based quantum efficiency of the sensor, bandwidth, transmittance of the filters and exposure times;
- through parameters data obtained by Incident light sensor – ILS that analyzes the radiance of the light source for each acquisition.

The multispectral images can be exported in formats recognized by multispectral analysis softwares (eg. ERDAS™, ENVI™, PCI Geomatics™, etc.) and photogrammetric processing softwares, in order to generate 3D models and orthophotos of single-band images or indexes.

MultiCam Stitcher Pro software is jointly developed by SAL Engineering Srl and 3DOM - 3D Optical Metrology - Fondazione Bruno Kessler (FBK), based in Trento (IT).

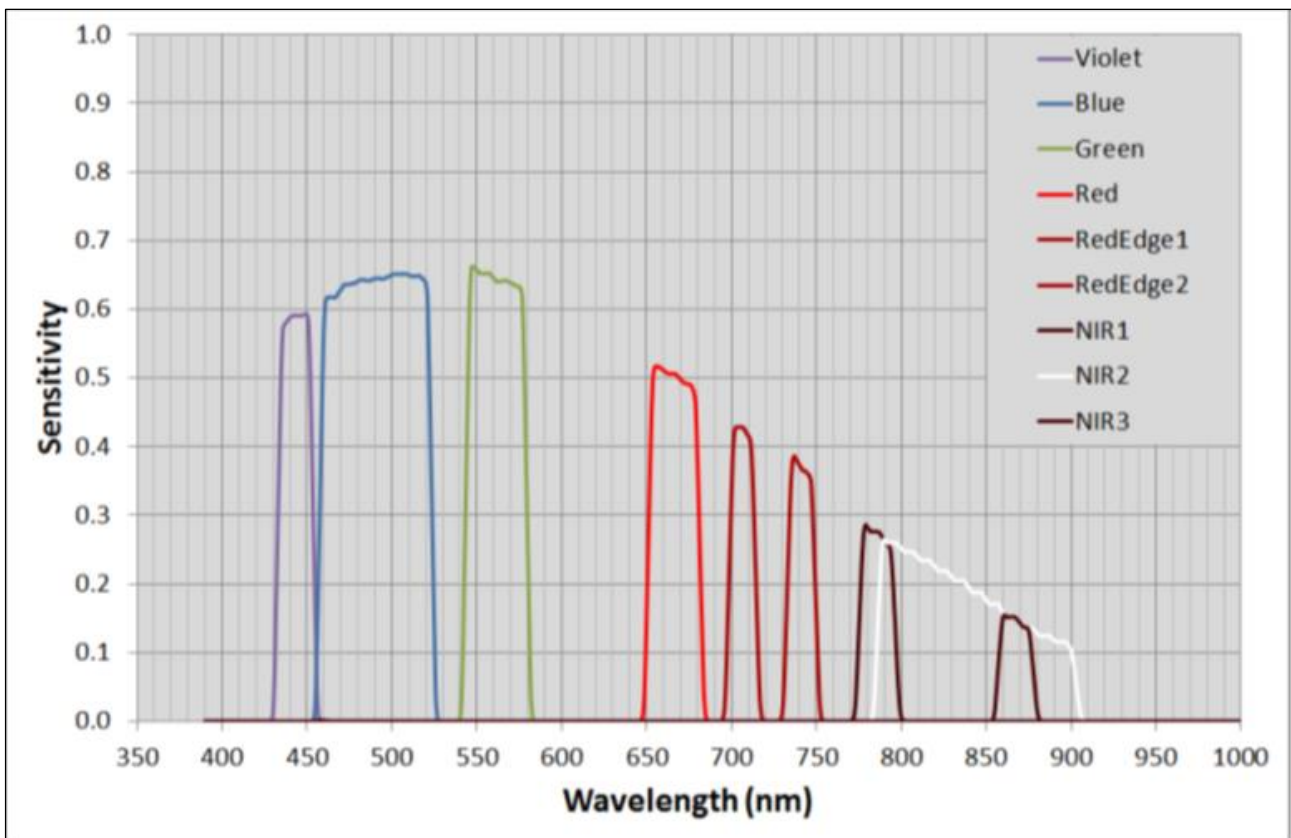


## 1.5 WAVELENGTH INTERVALS

Mono-chromatic sensors are matched with bandpass filter-set based on the wavelengths intervals as follows:

FILTER ID	COLOR	START wl (nm)	STOP wl (nm)	Cwl (nm)	fwhm (nm)
BP1	VIOLET	433	453	443	20
BP2	BLUE	457.5	522.5	490	65
BP3	GREEN	525	575	560	35
BP4	RED	650	680	665	30
BP5	RED EDGE 1	697.5	712.5	705	15
BP6	RED EDGE 2	732.5	747.5	740	15
BP7	NIR 1	773	793	783	20
BP8	NIR 2	784.5	899.5	842	115
BP9	NIR 3	855	875	865	20

**Table 1** Table of wavelength intervals of the filter-set settled in MAIA S2 multispectral camera.



**Table 2** Diagram of wavelength intervals of the filter-set settled in MAIA S2 multispectral camera.

### 1.6 TECHNICAL FEATURES

<b>Sensors</b>	Number Array Resolution Type Image format Pixel size	9 Mono-Chromatic sensors + Bandpass filters Array 3x3 – Centre to centre: 25mm 1.2 Mpixel (1280x960) each Global Shutter 4:3 3.75 $\mu\text{m}$ x 3.75 $\mu\text{m}$
<b>Optics</b>	Lens Focal length Open FOV	Fixed focus 7.5 mm f/#2.8 35° HFOV; 26° VFOV; 43° DFOV
<b>Exposure</b>	Type Start Exposure time	Manual Automatic Automatic based on Max Time Exposure Simultaneous for each sensor 0.1 ms - 50 ms – Typical: 1 ms
<b>Acquisition</b>	Type Max frame rate	Single shot Continuous with external trigger Continuous at fixed-time interval 3 frames/sec with RAW 10 bit and RAW 12 bit; 6 frames/s with RAW 8 bit
<b>File format</b>	File format	RAW 8 bit RAW 10 bit RAW 12 bit
<b>Memory</b>	Type Capacity Image size	Internal SSD 120GB (standard); 250GB; 500GB (on demand) 21.2 MByte in RAW10 e RAW12 11.8 MByte in formato RAW8
<b>Embedded data</b>	Exposure time for each sensor. Timestamp at the shot time. Time, position, speed, fix GNSS.	

<b>Interfaces</b>	Gigabit Ethernet. WiFi in Hot Spot by DHCP server. Serial for GNSS (level RS-232, 3.3V TTL) Synchro input – Trigger (3.3V TTL) Synchro output – Strobe (3.3V TTL) Composite Video output 2 channels PWM input from radiolink (3V3 TTL) IMU/GYRO connection 3 leds for events and status Keyboard with 8 function buttons. All 3.3V input can tolerate 5V.
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<b>Configuration</b>	Web interface from Ethernet or Wifi Video input with on-screen text + keyboard Radiolink input										
<b>RAW images processing software</b>	Professional software for elaborating multispectral images: <ul style="list-style-type: none"> <li>- tiff multi-layer extraction;</li> <li>- geometrical correction (undistortion);</li> <li>- pixel-pixel stitching;</li> <li>- radiometric correction (manual, auto, white);</li> <li>- radiometric radial correction;</li> <li>- index images creation (NDVI, GNDVI);</li> <li>- band math (raster calculator);</li> <li>- false-color images creation;</li> <li>- multichannel images creation;</li> <li>- mono-chromatic images creation;</li> <li>- preview of raw dataset.</li> </ul>										
<b>Physical Characteristics</b>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">Width</td> <td>99 mm</td> </tr> <tr> <td>Height</td> <td>129 mm</td> </tr> <tr> <td>Depth</td> <td>47 mm</td> </tr> <tr> <td>Fixing</td> <td>4 fixing holes M3x0.5-6H</td> </tr> <tr> <td>Weight</td> <td>420 g</td> </tr> </table>	Width	99 mm	Height	129 mm	Depth	47 mm	Fixing	4 fixing holes M3x0.5-6H	Weight	420 g
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## 2 REVISIONS

<i>Version</i>	<i>Date</i>	<i>Notes</i>
Rev. 0.0	08/2016	Preliminary
Rev. 0.1	09/2017	First internal software update
Rev. 0.2	02/2018	Update of texts, contents, layout for MAIA S2