

MicaSense RedEdge™ 3 Multispectral Camera

User Manual



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1. RedEdge 3 Overview

The MicaSense RedEdge 3 is a professional multispectral camera capable of simultaneous capture of five discrete spectral bands to generate precise and quantitative information on the vigor and health of crops.

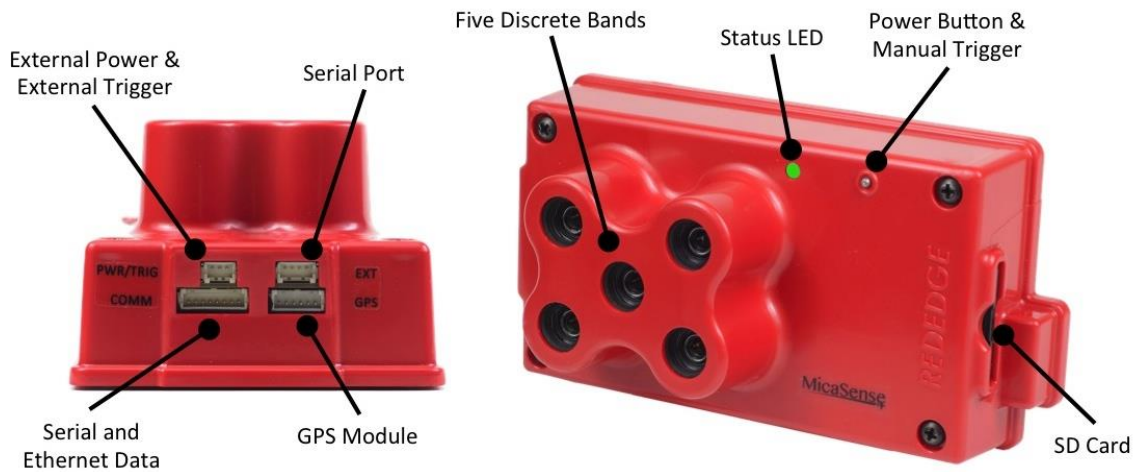


Figure 1: RedEdge Camera Features and Connections

2. Using The RedEdge Camera

2.1. Getting Started: Connections

Insert SD Card



- Insert SD card, label side facing up, until it clicks into place.
- To remove SD card, press the edge of the card until the spring mechanism unlatches.

NOTE

An SDHC Class 10 SD card with a write-speed capability of **at least 45 MB/s** is required (32 GB SanDisk Extreme recommended). SDXC SD cards are **not** compatible with the RedEdge camera.

Connect GPS Module



- If stand-alone GPS module is used:
 - Connect one end of 6-pin cable to camera connector labeled “GPS”.
 - Connect other end of 6-pin cable to GPS module connector labeled “GPS”.
- For more advanced integrations where GPS data is provided by the autopilot or other GPS source, refer to RedEdge Integration Guide.
- To remove connectors, do not pull on wires; instead use a small flathead screwdriver to pry out the connector. See Section 5.

CAUTION

Always connect the GPS module to the camera **before** turning on the camera. Failure to do so may damage the GPS module.

Connect Power Cable



- Refer to RedEdge Integration Guide for details on power requirements and connector pinout.
- Connect power cable to connector labeled “PWR/TRIG”.
- To remove connector, do not pull on wires; instead use a small flathead screwdriver to pry out the connector. See Section 5.

CAUTION

Power must **not** exceed **5.5 V DC**. Ensure correct pinout and polarity before connecting power. Failure to follow these instructions may result in permanent damage to the camera.

2.2. Using the RedEdge Camera

Power ON the Camera



- Press and release the ON/OFF button.
- **The Status LED will remain OFF while the camera is initializing (approx. 5 seconds).**
- After initialization has completed, Status LED will flash at approximately once every 1.5 seconds.

NOTE

The camera will automatically turn ON when power is first applied to the external power connector. If the camera is manually turned OFF, it can be re-powered ON by pressing the ON/OFF button.

Status LED Indicators

Color	Type	Meaning
Red	1 Flash	No SD card installed
Red	2 Flashes	SD card is full or close to full
Red	3 Flashes	GPS timeout
Red	4 Flashes	Low power source indication
Yellow	1 Flash	GPS unit detected, but does not have a fix
Green	1 Flash	Camera is ready for operation (GPS is good and SD card has > 2 GB space available)

To Power OFF the Camera:

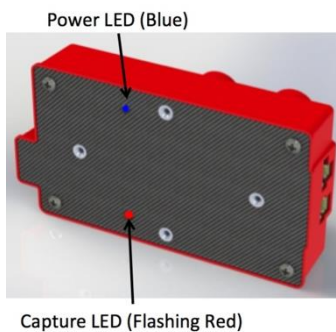
- Press and hold the ON/OFF button for at least 4 seconds.
- The Status LED will stop flashing once the camera has shut down.

CAUTION

Always power OFF the camera **before** removing the SD card. Failure to do so may corrupt some of the files in the SD card.

Capturing Images (Manual Trigger)

- With the camera turned ON and SD card installed, press and release the trigger button.
- The camera will command a capture and the red LED on the back cover will flash three times to indicate that a capture has been taken and the data is being written to the SD card.



3. Camera Configuration and Live View

The RedEdge camera hosts a Wi-Fi access point that is used in conjunction with any Wi-Fi-capable device for configuration of the camera and live preview of images acquired with the camera.





3.1. Establishing WiFi Connection

Any device (computer, tablet, or smart phone) can be used to establish a connection with the camera. To establish the WiFi connection:

1. Turn on the camera and wait for initialization process to complete
2. Use the device's WiFi configuration method to search for a WiFi access point called "rededgeXXXXXXX", where "XXXXXXX" is the 7-digit serial number of the camera.
3. The password for this WiFi access point is "micasense".

Once connected to the camera's WiFi, open any web browser and access the camera's web page by typing in "192.168.10.254" in the address bar of the browser.

There are 4 main "pages" for the camera:

	Home Page
	Live View Page
	Coverage Page
	Settings Page

3.2. Home Page

Provides status information for the camera and the GPS receiver that is connected to it.

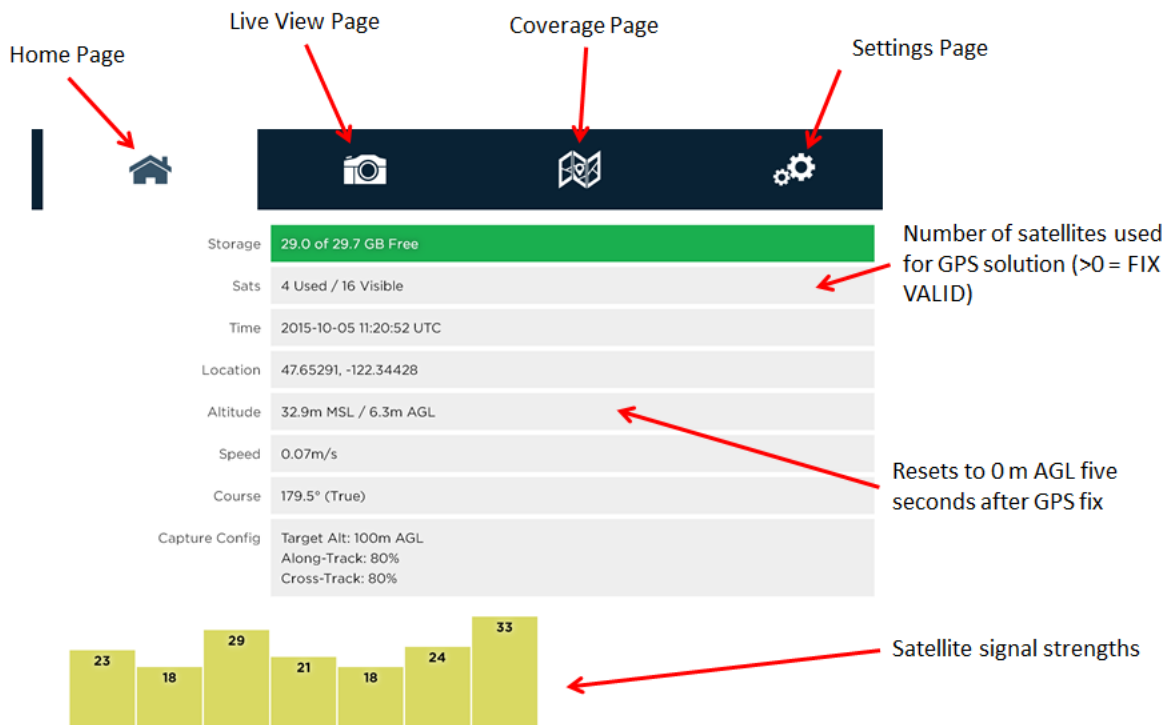


Figure 2: Home Page

3.3. Live View Page

Provides a live preview of images captured with the camera.

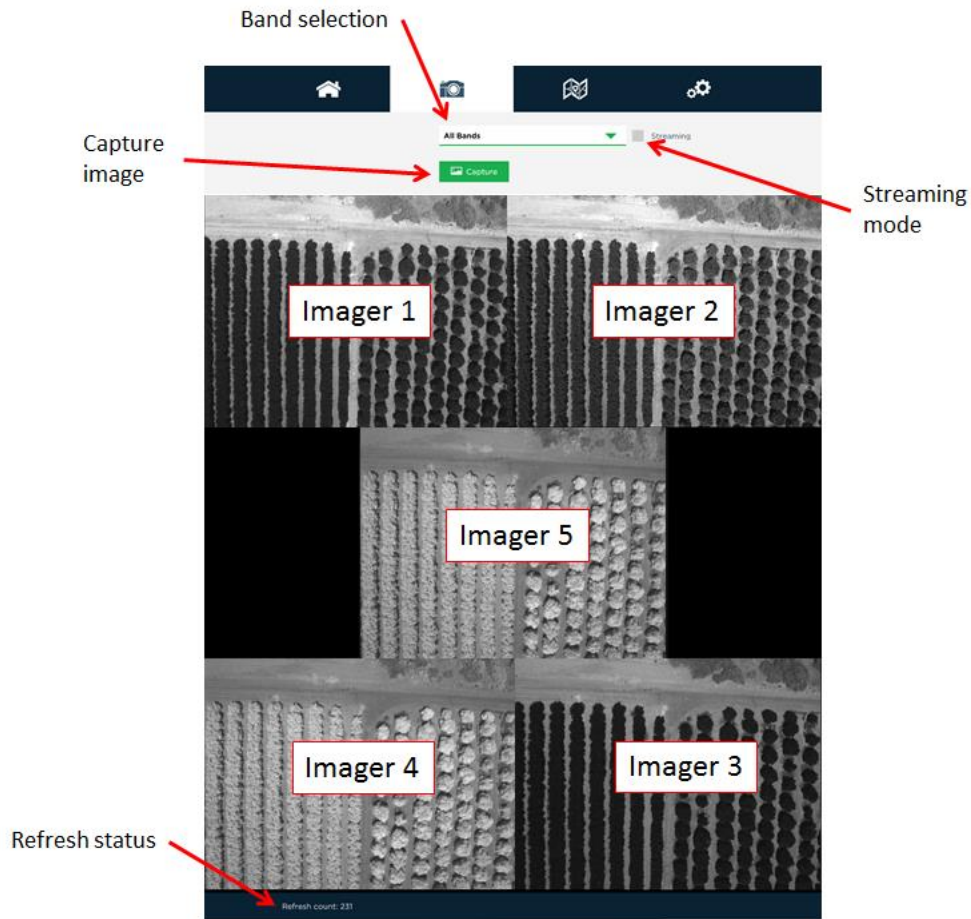


Figure 3: Live View Page

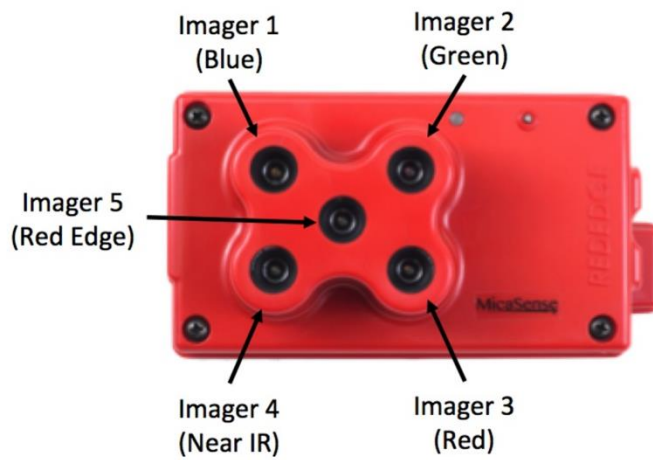


Figure 4: Imager Nomenclature

Whenever the camera captures images, the image(s) will be displayed in the Live View page based on the setting of the “Band” pull-down menu

Setting	Action
Multi	Shows all five single-band images at once in a matrix
Band 1	Shows imager #1 (Blue filter)
Band 2	Shows imager #2 (Green filter)
Band 3	Shows imager #3 (Red filter)
Band 4	Shows imager #4 (Near IR filter)
Band 5	Shows imager #5 (“Red Edge” filter)

Capture: The Capture button forces a capture for the camera, and is equivalent to pressing the manual trigger button on the camera.

Streaming: The Streaming checkbox is used for near-real-time preview images from the camera. When the Streaming mode is enabled, the images shown will update as quickly as the camera can support it (currently approx. twice a second). Note that Streaming mode does not save any images to the SD card. It just enables fast capture of the camera for preview purposes only.

NOTE
Streaming mode is intended for live-preview. It is recommended that streaming mode be disabled before any other operations (particularly before enabling Auto-Capture mode).

3.4. Coverage Page

The coverage page provides information on the geographic location where images in the SD card were captured based on the GPS module information.

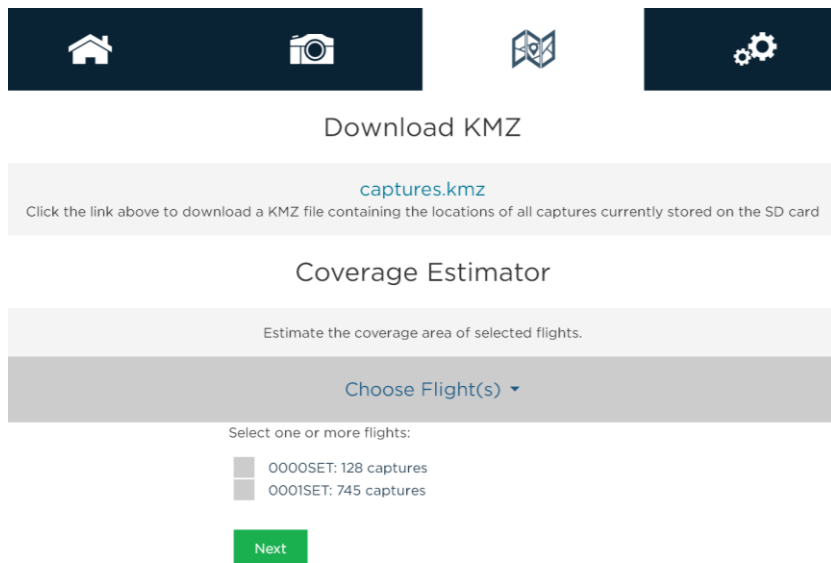


Figure 5: Coverage Page

Clicking the “captures.kmz” link will cause the camera to generate a KMZ file that will be downloaded by your browser. The KMZ file contains the lat/lon/alt of all captures in the SD card and can be used to verify coverage after a flight or series of flights. The KMZ file can be opened using Google Earth or a GIS application.



Figure 6: KMZ File Can Be Viewed In Applications Like Google Earth

The **Coverage Estimator** is a tool for quickly checking that a flight has sufficient overlap. From the initial Coverage Page, select one or more image sets to estimate and click “Next” (note: image sets must be geographically close together in order to work properly).

The Flight Adjustment tab should appear, and show a summary of its current estimation settings. Camera Orientation indicates the directionality of the camera with respect to the aircraft, as shown below.



Figure 7: Landscape Orientation on Left, Portrait Orientation on Right

The Flight AGL is estimated based on the GPS positions recorded for the images, with the assumption that calibration panel pictures were taken near ground level, but if the estimate is incorrect, you can manually enter the correct AGL.

The Estimate Resolution sets the quality of the output map. Low is sufficient for most applications.

Choose Flight(s) ▾

Flight Adjustment ▾

Selected Flight

0001SET

Flight Data

Estimated AGL:	80.06 meters
Horizontal GSD:	12.01 cm / pixel

Setting

Camera Orientation:	Landscape	▼
Flight AGL:	80.06	✎ meters
Estimate Resolution:	Low (faster)	▼

Draw Coverage

Figure 8: Confirm or Edit Coverage Estimate Settings

Clicking “Draw Coverage” will render the coverage estimate. The rendering time depends on your device’s CPU, the size of the field, number of images, flight AGL, and quality setting, but typically runs in under 30 seconds on a modern smart phone.

Finally, you will be presented with an estimate of your coverage. Any area that is dark green has a high probability of correctly being processed in ATLAS. Areas that are yellow may work, but likely will not. Red areas will almost certainly not process correctly.

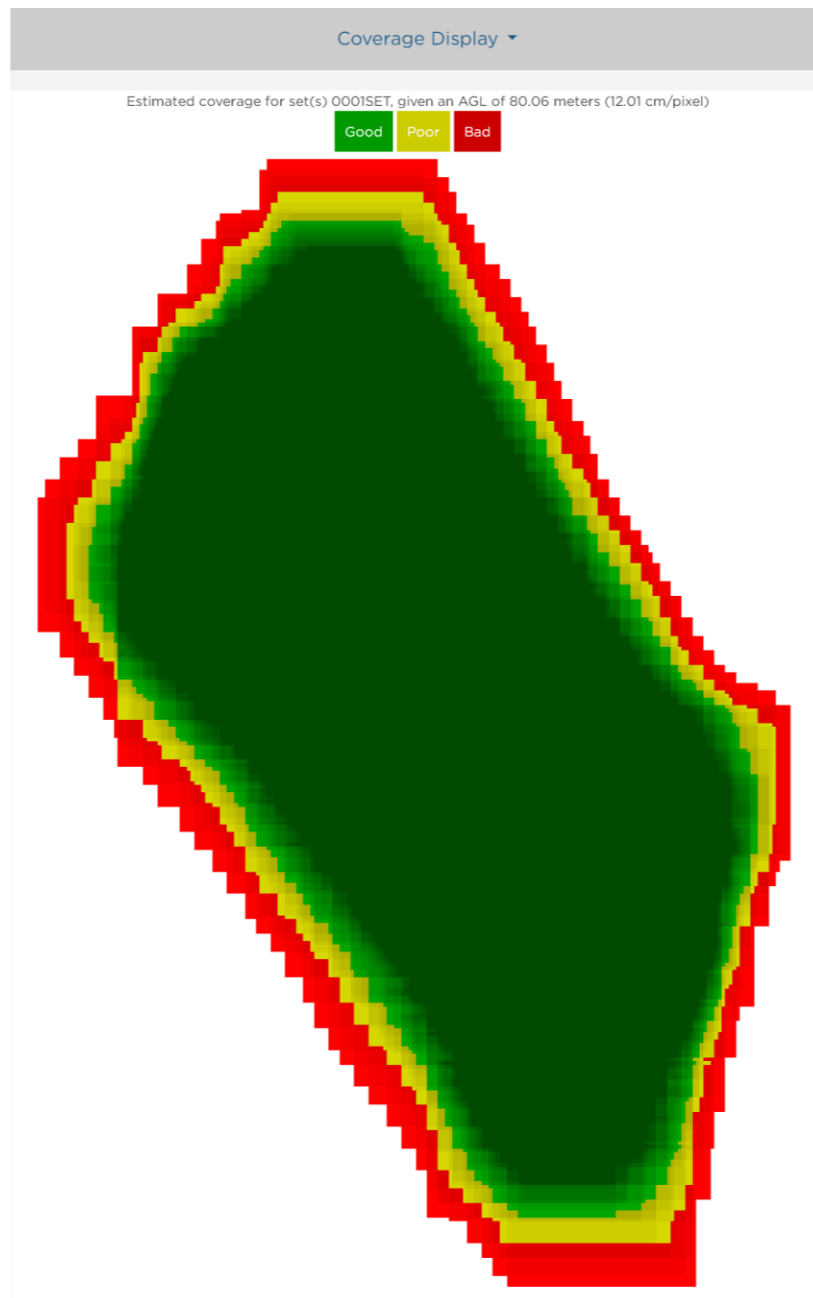


Figure 9: Example of Good Field Coverage

Edges around the field will typically show as red or yellow. This is okay as long as the data you are trying to collect is all contained within the dark green region.

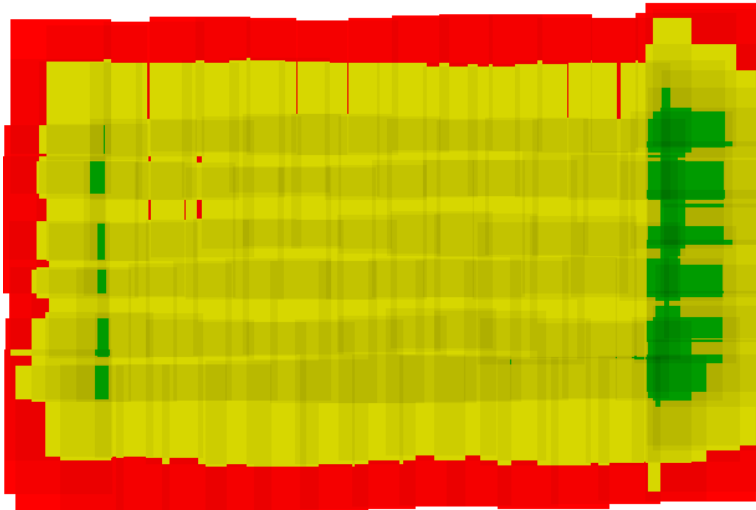


Figure 10: Example of Poor Field Coverage

If you discover your field coverage estimate is similar to the poor field coverage map shown above, double check to make sure the Flight AGL is set correctly. If the Flight AGL is incorrect, click back on the Flight Adjustment section, correct the Flight AGL, then click on “Draw Coverage” again. If the Flight AGL is correct, your overlap settings may have be wrong. You will need to capture more images of the field to ensure that post-processing will be successful.

3.5. Settings Page

The settings page is used primarily to configure the Auto-Capture options for the camera. The camera supports three methods of Auto-Capture: Timer mode, External Trigger mode, and Overlap mode.

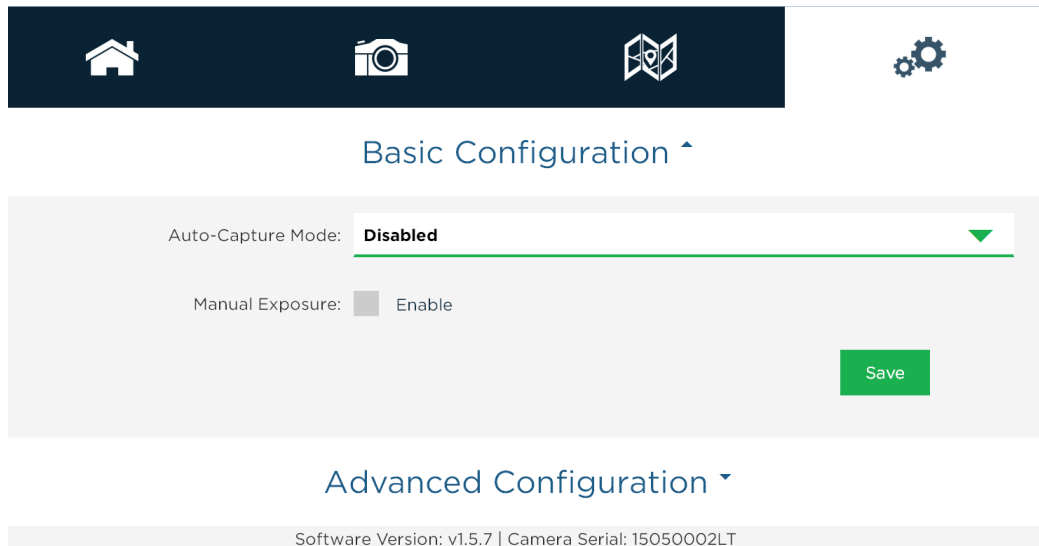
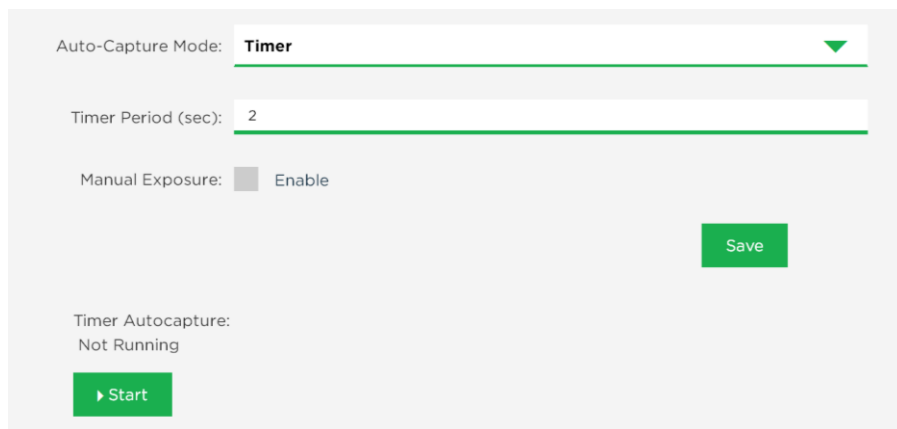


Figure 11: Settings Page

3.5.1. Timer Mode

1. Use the drop-down menu to select Auto-Capture Mode as “Timer”



Auto-Capture Mode: **Timer**

Timer Period (sec): 2

Manual Exposure: Enable

Save

Timer Autocapture:
Not Running

Start

Figure 12: Timer Mode

2. In the updated window, specify the interval between pictures to the desired setting. If the timer interval is set to less than 1.0 seconds, the camera will capture as quickly as it can (about once a second).
3. Press the “Save” button to save the Timer mode settings.
4. Press the Start button to begin capturing images at the desired interval rate.
5. Press the Stop button to stop capturing images
6. You can review and verify that images are being captured by selecting the Live View page. Use the “Multi” setting in that page to verify that all five imagers are functioning correctly and the images displayed are being updated at the interval rate selected.

3.5.2. External Trigger Mode

1. For external trigger mode, you will need to connect a triggering signal to the camera – refer to the RedEdge Integration Guide.
2. Use the drop-down menu to select Auto-Capture Mode as “Ext. Trigger”

The screenshot shows a configuration window for External Trigger Mode. It contains the following elements:

- Auto-Capture Mode:** A dropdown menu currently showing "Ext. Trigger".
- Ext Trigger Mode:** A dropdown menu currently showing "Short PWM".
- PWM Threshold (ms):** A text input field containing the value "1.5".
- Manual Exposure:** A checkbox labeled "Enable" which is currently checked.
- Save:** A green button located at the bottom right of the form.

Figure 13: External Trigger Mode

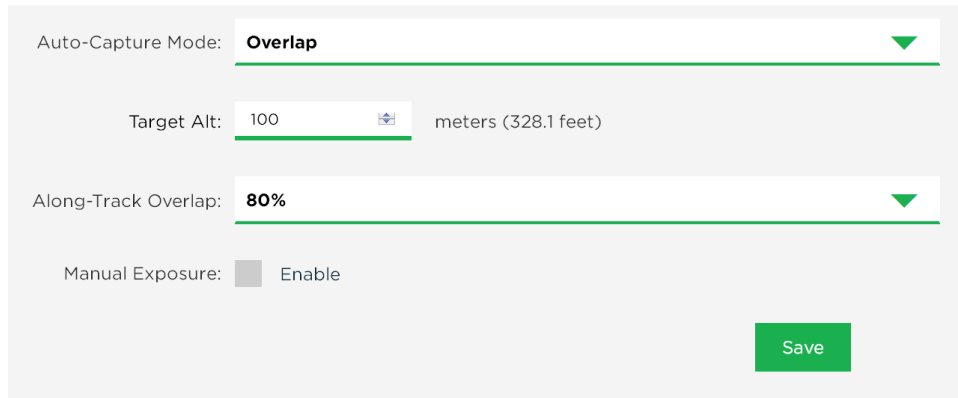
3. In the updated window, select the external trigger mode from the list. The settings are as follows:

Setting	Meaning
Rising Edge	Camera will trigger on the rising edge of a pulse
Falling Edge	Camera will trigger on the falling edge of a pulse
Short PWM	Camera will trigger if PWM transitions from longer than Threshold to shorter than Threshold
Long PWM	Camera will trigger if PWM transitions from shorter than Threshold to longer than Threshold

4. For PWM mode, enter the threshold PWM – note that this value is in ms (milliseconds), so the value is typically between 1.0 and 2.0.
5. Press the “Save” button to save the External Trigger mode settings.
6. Verify that the triggering is functioning by commanding a camera capture through the host device and viewing the updated image in the Live View page.

3.5.3. Overlap Mode:

1. Use the drop-down menu to select Auto-Capture Mode as “Overlap”



Auto-Capture Mode: **Overlap** ▼

Target Alt: 100 meters (328.1 feet)

Along-Track Overlap: **80%** ▼

Manual Exposure: Enable

Save

Figure 14: Overlap Mode

2. In the updated window, select the Target Alt to be the altitude AGL at which the aircraft will be operating during the mapping mission. Note that this is specified as **AGL (Above Ground Level)** altitude.
3. Specify the Along-Track Overlap in % of image that is common between one image and the adjacent one.
4. Press the “Save” button to confirm the settings.
5. When the aircraft reaches the target altitude minus 50 meters, it will initiate taking captures and will take a capture if the distance traveled is detected to be greater than the required distance as specified in the % overlap setting.
6. When the measured altitude is lower than target altitude minus 50 meters, the camera stops taking captures.

3.5.4. Advanced Configuration:

The Advanced Configuration menu provides controls for managing file storage for RedEdge, as well as Ethernet and Multi-Camera configurations.

Advanced Configuration ^

Format for RAW files

DNG: **Smaller files, not compatible with all software**

TIFF: **Larger files, most compatible file format**

RAW format: **TIFF (16-bit)**

Enabled SD Output files

Select type of file(s) to be saved to SD card for each band

Camera	Raw
1	<input checked="" type="checkbox"/>
2	<input checked="" type="checkbox"/>
3	<input checked="" type="checkbox"/>
4	<input checked="" type="checkbox"/>
5	<input checked="" type="checkbox"/>

Multi-Camera Configuration

Network Mode: **Master**

Multi-camera setups must have exactly one master

The camera must be rebooted for a mode change to take effect

Type	Mode	Serial	Software	GPS
camera	master	15050002LT	v1.5.7	direct

Ethernet Configuration

Select a static IP address that is not already used on your network

IP Address: **192.168.1.83**

Save

Software Version: v1.5.7 | Camera Serial: 15050002LT

Figure 15: Advanced Configuration

You can specify the RAW Format to be either 12-bit DNG or 16-bit TIFF. The 12-bit DNG format will produce files that are 25% smaller in size than 16-bit TIFF files.

The menu also enables the user to specify which bands to capture to SD card. The default of capturing all 5 bands is the recommended setting. However, if only a subset of the bands are desired, the other bands can be de-selected. Click “Save” button to commit any changes.

The Network Mode is only relevant if you have more than one RedEdge camera. The table below the setting indicates the settings of all other networked cameras. In addition to configuring a single master, all of the camera software versions should match. After changing the camera's network mode, you must click "Save", and then reboot the camera in order of the new setting to take effect.

Ethernet Configuration allows you to assign a different IP address to the camera. Note that this will NOT configure the WiFi address, which will always be 192.168.10.254.

3.5.5. Manual Exposure:

Manual exposure checkbox enables manual control of the exposure and gain of the camera, with settings available in the Live View Page. This is an advanced operation option and should normally NOT be enabled.

4. Mapping Operations

For proper overlap settings during mission planning, the following information may be required:

Item	Value
Lens Focal Length	5.5 mm
Lens Field of View	47.2 deg. HFOV
Imager Size	4.8 mm x 3.6 mm
Imager Resolution	1280 x 960 pixels

Figure 16 shows parameters for mission planning and file storage planning.

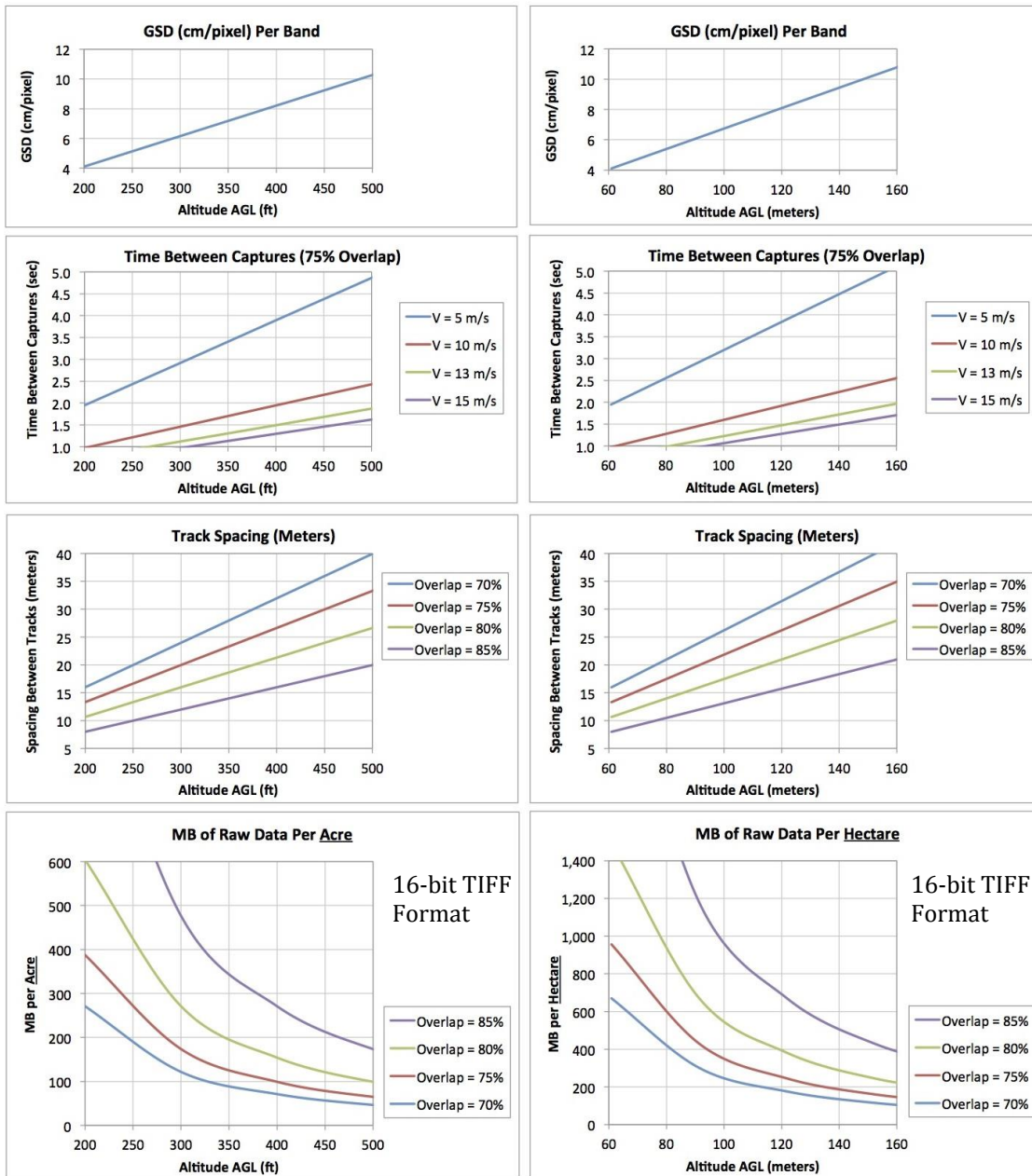


Figure 16: Mission Planning Information

5. External Connections

Refer to RedEdge Integration Guide for details on connectors, pin-outs, and voltage specifications. When removing the cables that plug into these connectors, use a small flathead screwdriver to pry off the connector at the plastic interface. Do not pull on the wires to unplug these connectors.



Figure 17: Removal of Connectors Using Small Flathead Screwdriver

6. File Storage

The RedEdge camera stores files in the SD card in a folder structure. A new folder is created for each time the camera is powered up.

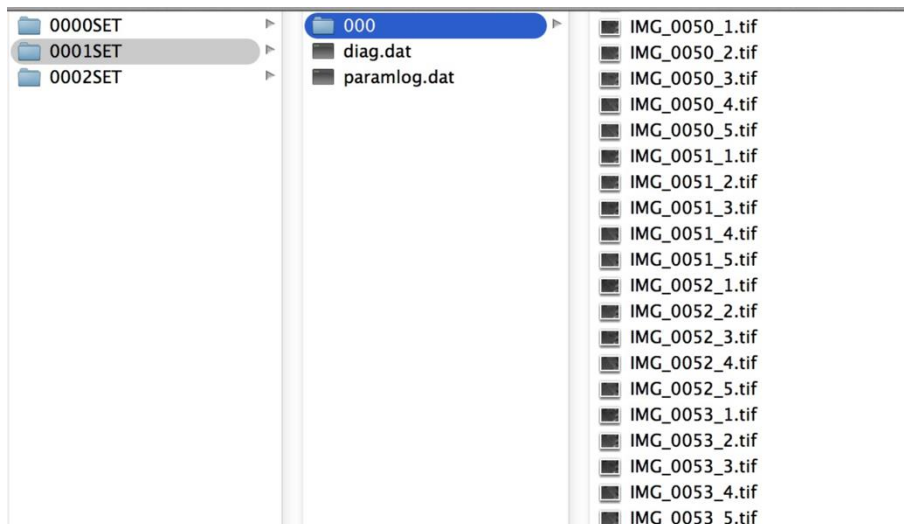


Figure 18: File Structure of SD Card

Within each folder, a subfolder with the images themselves is created. If more than 999 images are stored, a second image folder is created (“000” and “001” for instance). Two log files are also created.

Within each subfolder, a group of 5 files is created for each image capture (5 TIFF files). The suffix at the end of each file indicates the imager number (see Figure 4), from 1 through 5.

Format	Average File Size
12-Bit DNG	1.8 MB per file (5 files per capture)
16-Bit TIFF	2.5 MB per file (5 files per capture)

The TIFF files are 12-bit resolution stored in either 12-bit DNG RAW format or 16-bit TIFF RAW format depending on the setting (see Section 3.5.4). The resolution is 1280x960 pixels. Metadata tags are embedded for each file in standard format.

7. Data Collection Recommendations

In order to accurately process data captured with MicaSense's RedEdge camera, the following recommended guidelines should be observed during collection of the data:

1. A GPS receiver module or other source of GPS information should be connected to the RedEdge camera and a valid GPS fix should be verified prior to flight.
2. A minimum cross-track and along-track overlap of at least 75% is recommended.

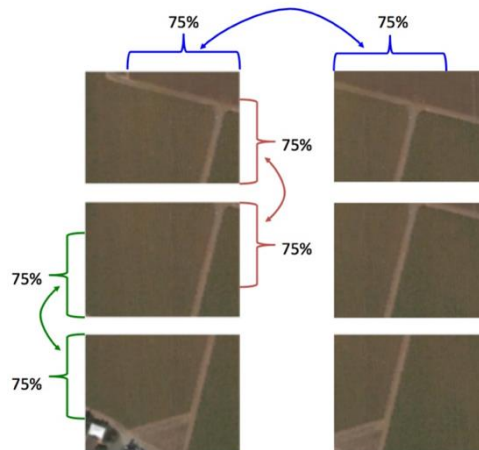


Figure 19: Overlap Recommendations

3. At least one track of the flight area should be outside all edges of the field to be mapped (to ensure that there is data going all the way to the edges of the field)

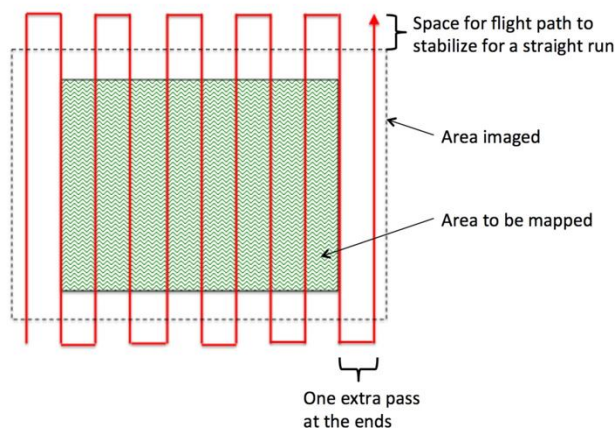


Figure 20: Coverage Area for Mapping a Field

4. View of camera should be within 10 degrees of Nadir (within 10 degrees of straight down with respect to the Earth) during the mapping portions of the flight. Use of a nadir-pointing gimbal for the camera is highly recommended.

5. For accurate reflectance data, pictures of a calibrated reflectance panel (Spectralon or similar) should be captured from directly overhead the panel **immediately** before **and immediately** after each flight.

When imaging the reflectance panel, place the panel flat on the ground and ensure that it is not shadowed by anything, that it is receiving direct light from the sun or sky, and that the angle of view from the camera to the panel is as perpendicular as possible (without shadowing). Avoid having the sun reflect off any surface and hit the panel. It's best to place your shadow just to the left or right of the panel (see below for recommended position).

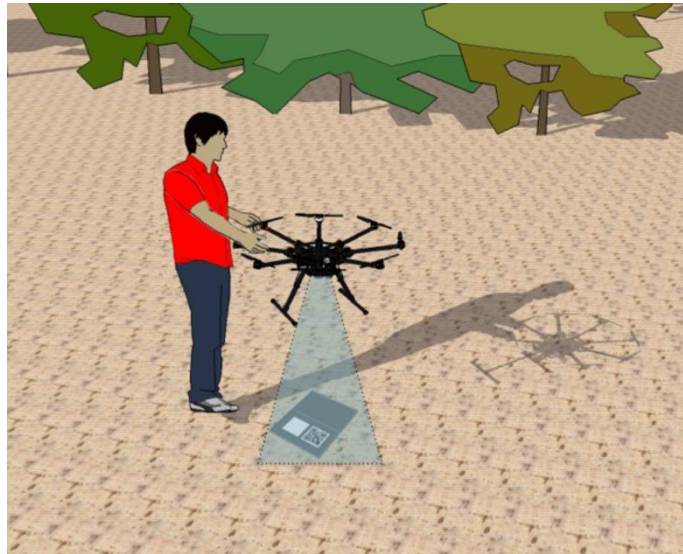


Figure 21: Capturing Reflectance Panel Image

NOTE

The camera applies a different gain/exposure optimization method for panel captures versus captures taken in flight. You should capture images of the panel using the **Capture** button on the Wi-Fi interface **or** by pressing the physical capture button on the camera.

Do not use Timer, Overlap, or External Trigger modes for panel captures.

The panel should take approximately half of the view of the camera. If using a MicaSense panel, ensure that the QR code is visible in the image.

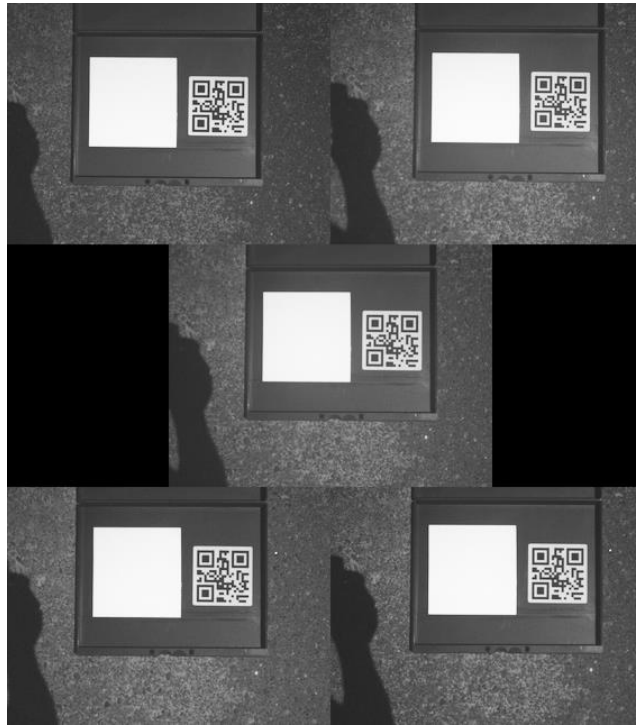


Figure 22: Example of Panel Capture

6. It is recommended to gather data during weather that provides consistent illumination (avoid days with clouds that move in and out and cast changing shadows on the ground).
7. For best results, data collection should be done within 2.5 hours of local solar noon.
8. For vineyards and plants with significant height above the ground, optimal results are obtained when the flight path is perpendicular to the rows if possible.
9. If a field needs to be flown in more than one flight, the coverage regions for each flight should overlap:

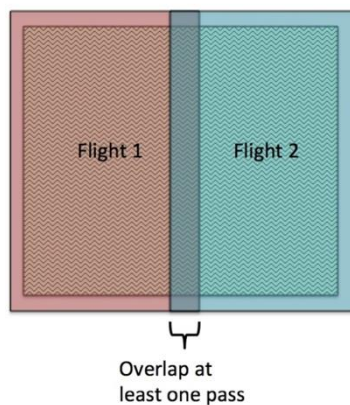


Figure 23: Multiple Flights for the Same Field Should Overlap

8. Checklist for Operation

1. Before Power-Up

	SD card installed
	Power cable connected
	GPS for camera connected and connectors secured
	Lenses are clean, not scratched, clear of obstructions
	If using external trigger: trigger cable connected to triggering source
	If using gimbal: gimbal is functional and operating properly

2. Camera Power-On and Configuration

	Apply power or manually turn ON camera - verify boot-up complete (blinking Status LED)
	Connect to camera using WiFi-capable device
	Connect to "rededgeXXXXXX" WiFi network (password = "micasense")
	Open web browser and point to 192.168.10.254
	Select Home Page
	Verify voltage is good (green background, 4.0 to 5.5 V DC)
	Verify free space on SD card sufficient for mission
	Verify GPS date and time are correct
	Wait for GPS fix
	Confirm GPS fix (> 3 Satellites Used)
	Confirm green blinking Status LED
	Configure auto-capture mode - press "Save" after all changes

3. Before-Flight Reflectance Panel Images

	Select Live View Page
	Point camera at reflectance panel (make sure camera has GPS fix)
	Panel placed on ground, far from any obstructions
	Panel fills about half the camera's field of view
	Camera pointed as perpendicular to panel as possible
	No shadows on panel
	Direct sunlight illumination on panel (no reflected lighting)
	Press "Capture" button on Live View Page and verify image captured correctly
	Take at least two captures
	Panel captures should ONLY be commanded from the Live View Page interface or by pressing the physical trigger button. Do not use Timer, Overlap, or External Trigger mode for capturing panel images.

4. Immediately Before Flight

	Confirm green Status LED in front of camera
	Verify auto-capture settings
	If using Timer mode:
	When ready to launch, press "Start" in Settings Page
	Go to Live View page and verify capture at desired interval
	If using Overlap mode:
	When ready to launch, press "Start" in Settings Page
	If using External Trigger mode:
	Force a manual trigger capture using aircraft's controller
	In Live View Page, verify image captured

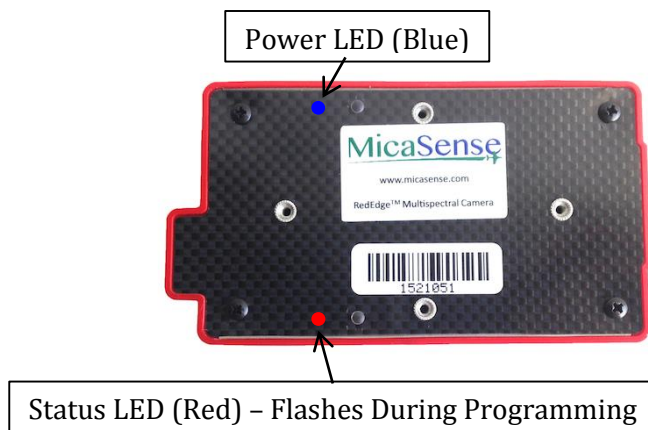
5. After Flight

	Connect to camera using WiFi capable device
	In Home Page, verify SD card free space:
	If SD card is full it is likely some pictures were not captured
	If desired, download KML file from Coverage Page and view in Google Earth or GIS application
	If using Timer auto-capture mode:
	In Settings Page, click "Stop" button
	Obtain after-flight reflectance panel images
	Same process as before-flight reflectance panel images
	Power camera OFF (hold power button for at least 4 seconds)

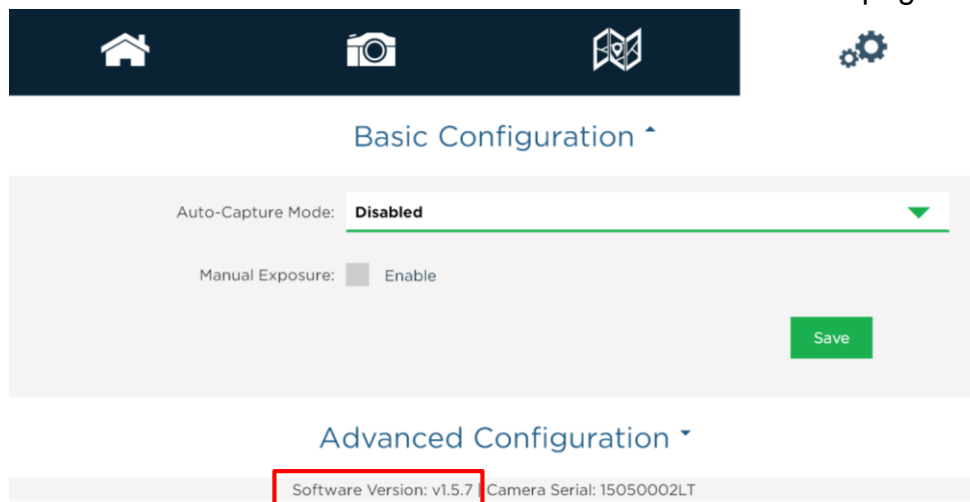
9. Firmware Update

The firmware in the RedEdge camera can be easily updated following these steps:

1. Copy the *rededge.bin* file to the **root** folder of any SD card (the SD card that came with the camera is recommended).
2. With camera powered **OFF**, insert SD card into camera.
3. Provide a source of power (5.0 Volts DC at 5 Watts) to the camera and power camera ON if it doesn't power on automatically. The red light on the back of the camera will immediately start to rapidly flash, indicating that the camera is installing the firmware. When the red light stops flashing, the installation process is complete (should be less than 30 seconds).



4. The camera should then boot up normally, and the light in the front will flash at approximately a once per second interval.
5. Verify the software was updated by checking the “Settings” page on the camera’s web page. The firmware version number is shown at the bottom of the page.



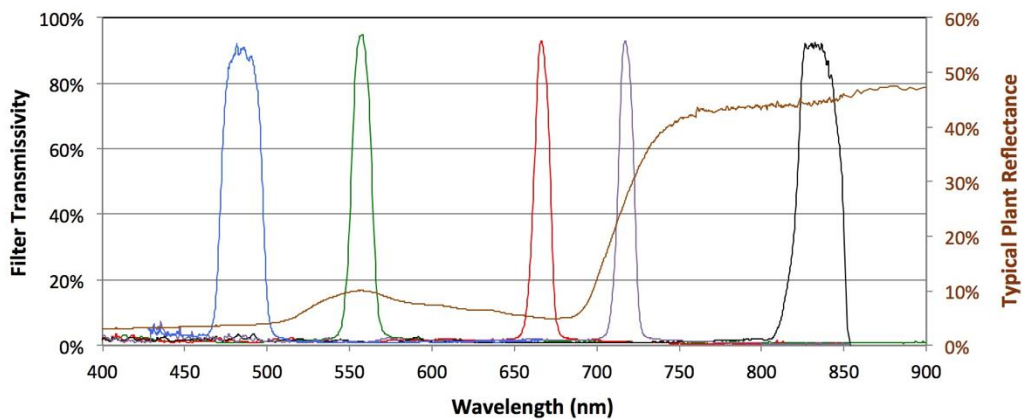
6. Remove the SD card and delete the bin file (otherwise each time you power up the camera, it will install the firmware).

10. Specifications

Basic Specifications

Weight	150 g
Dimensions	12.1 cm x 6.6 cm x 4.6 cm (4.8" x 2.6" x 1.8")
Power	5.0 V DC, 4 W nominal
Spectral Bands	Narrowband: Blue, Green, Red, Red Edge, Near IR
Ground Sample Distance	8.2 cm/pixel (per band) at 120 m (400 ft.) AGL
Capture Speed	1 capture per second (all bands), 12-bit RAW

Spectral Bands



Band Number	Band Name	Center Wavelength (nm)	Bandwidth FWHM (nm)
1	Blue	475	20
2	Green	560	20
3	Red	668	10
4	Near IR	840	40
5	Red Edge	717	10

MicaSense RedEdge™ 3 Multispectral Camera
User Manual
Rev 06 – October 2015

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