

# MicaSense RedEdge-M™ Multispectral Camera

## User Manual



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## 1. RedEdge-M Overview

The MicaSense RedEdge-M 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.

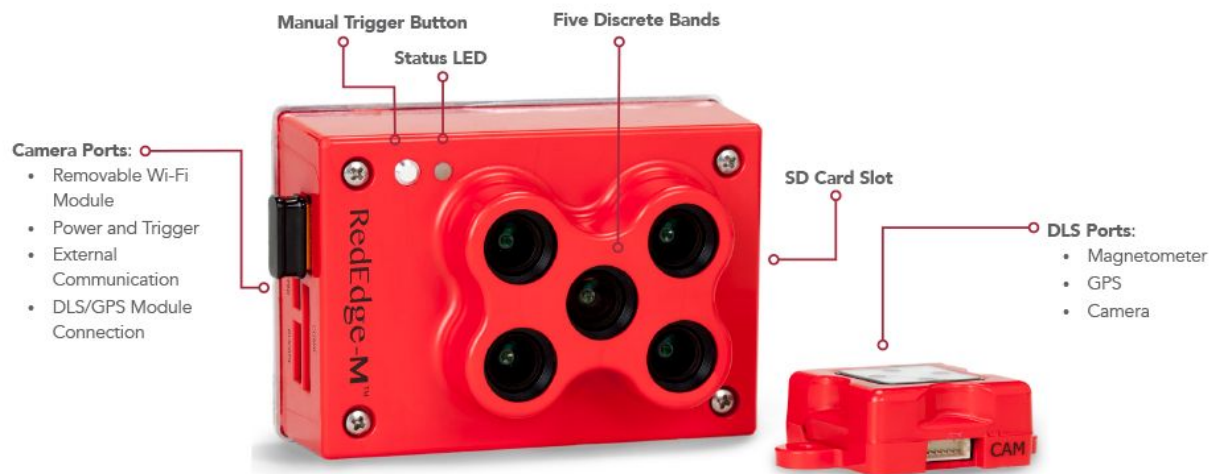
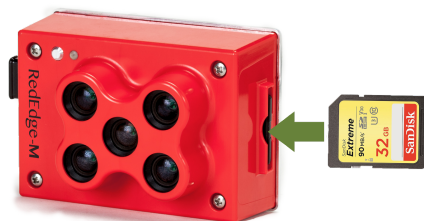


Figure 1: RedEdge-M Camera Features and Connections

## 2. Using The RedEdge-M Camera

### 2.1. Getting Started: Connections

#### Insert SD Card



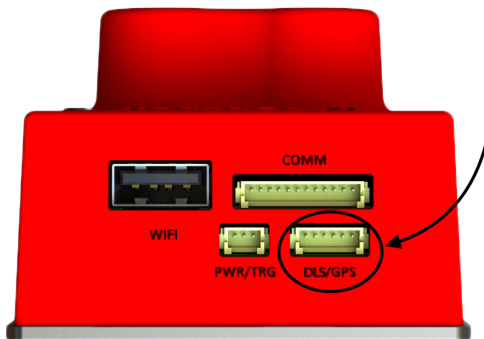
- Insert SD card, label side facing up, until it clicks into place.
- To remove SD card, press the edge of the card until the spring mechanism unlatches.

#### NOTE

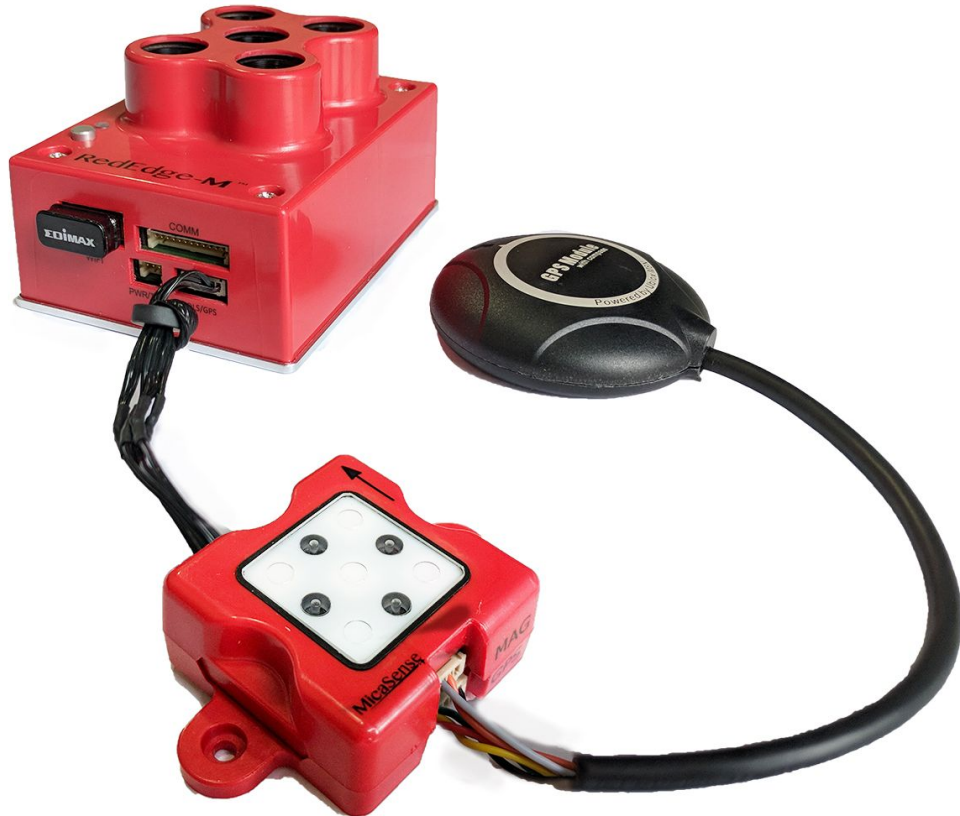
An SDHC Class 10 SD card with a write-speed capability of at least 45 MB/s is required (32 GB SanDisk Extreme recommended). SDXC SD cards are not compatible with the RedEdge-M camera.

## Connect DLS and GPS Module

The Downwelling Light Sensor (DLS) is a 5-band light sensor that connects directly to a MicaSense RedEdge-M camera. The DLS measures the ambient light during a flight for each of the five bands of the camera and records this information in the metadata of the images captured by the camera. When properly installed and calibrated, the information sensed by the DLS can be used to correct for lighting changes in the middle of a flight, such as those that can happen due to clouds that cover the sun during a flight.



- Connect DLS to the camera port labeled “DLS/GPS” using the 6-pin cable. The other end of the 6-pin cable is connected to the “CAM” port in the DLS.
- Connect the GPS module to the DLS using the two cables that are attached to the GPS module (4-pin and 6-pin).
- If stand-alone GPS module is used (without DLS):
  - Connect 6-pin cable that is attached to GPS module to camera connector labeled “DLS/GPS”. The 4-pin cable attached to the GPS module is left unconnected.
- For more advanced integrations where GPS data is provided by the autopilot or other GPS source, refer to RedEdge-M Integration Guide.
- To remove connectors, do not pull on wires; instead use a small flathead screwdriver to pry out the connector. See “External Connections”.

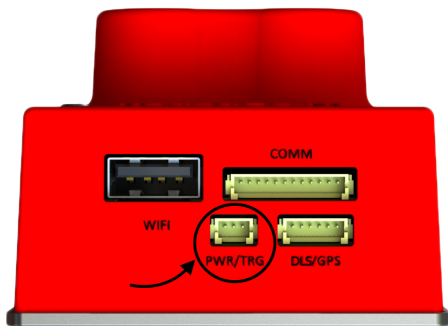


DLS and GPS connected

**CAUTION**

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

Connect Power Cable



- Refer to RedEdge-M Integration Guide for details on power requirements and connector pinout.
- Connect either the USB power cable, or another 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 "External Connections".

**CAUTION**

Power must not exceed 15.8V DC. Ensure correct pinout and polarity before connecting power. Failure to follow these instructions may result in permanent damage to the camera, the DLS, or the GPS module.



## 2.2.Using the RedEdge-M Camera

### Power ON the Camera



- The camera starts automatically when power is connected.
- Alternatively, press and release the Power Button.
- The Status LED will remain OFF while the camera is initializing (approx. 15 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 Power Button.

### To Power OFF the Camera:

- Press and hold the Power Button for at least 5 seconds.
- The Status LED will stop flashing once the camera has shut down.

## Camera LED Signals

One flash indicates normal behavior, that the camera is operating as expected. More than one flash indicates an issue as outlined in the following table:

Status LED Indicators		
Color	Type	Meaning
Green	1 Flash	Camera is ready for operation (it has a GPS fix and more than 2 GB available on SD card)
Blue	1 Flash	Capture completed
Yellow	2 Flashes	GPS unit detected, but does not have a fix
Red	3 Flashes	GPS timeout
Red	4 Flashes	No SD card installed
Red	5 Flashes	SD card is full (or almost full)

## DLS LED Signals

There are two green LED lights on the DLS, one on either side of the unit. The meaning of the LEDs is as shown in the table below. The LEDs are small and may not be easy to see without getting close to the unit. Refer to the following table for signal meanings:

DLS LED Signal Type	Meaning
4 simultaneous flashes on both LEDs	This occurs upon boot-up of the DLS
Sporadic flashing	Communications received. This is normal behavior
Alternating blinking between the two LEDs	Indicates a software/hardware problem. If the problem persists, contact MicaSense at <a href="mailto:support@micasense.com">support@micasense.com</a>
Both LEDs solid ON	

**CAUTION**

Power OFF the camera before removing the SD card. Failure to do so may corrupt some of the files in the SD card if they are still being written.

## Capturing Images (Manual Trigger)



- With the camera turned ON and SD card installed, press and release the Manual Trigger button.

**NOTE**

Captures created using the manual trigger are taken using a mode designed for panel pictures. Images taken this way may appear significantly darker than images taken using other trigger methods.

## 3. Camera Configuration and Live View

The RedEdge-M camera hosts a WiFi access point that is used in conjunction with any WiFi-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 smartphone) 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 "rededgeRMXX-XXXXXXXX-XX", where the Xs are the serial number of the camera. The serial number of the camera is printed on the rear 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

## DLS Verification

You can verify that the DLS is connected to the camera from the camera configuration home page. If connected, the DLS status should be green and display "Connected".

DLS Status  ✓ Connected

In the Camera Settings page, under "Advanced Configuration" in the "Multi-Camera Configuration" section, the DLS serial number and software version should be displayed.

### 3.3. Live View Page

Provides a live preview of images captured with the camera.

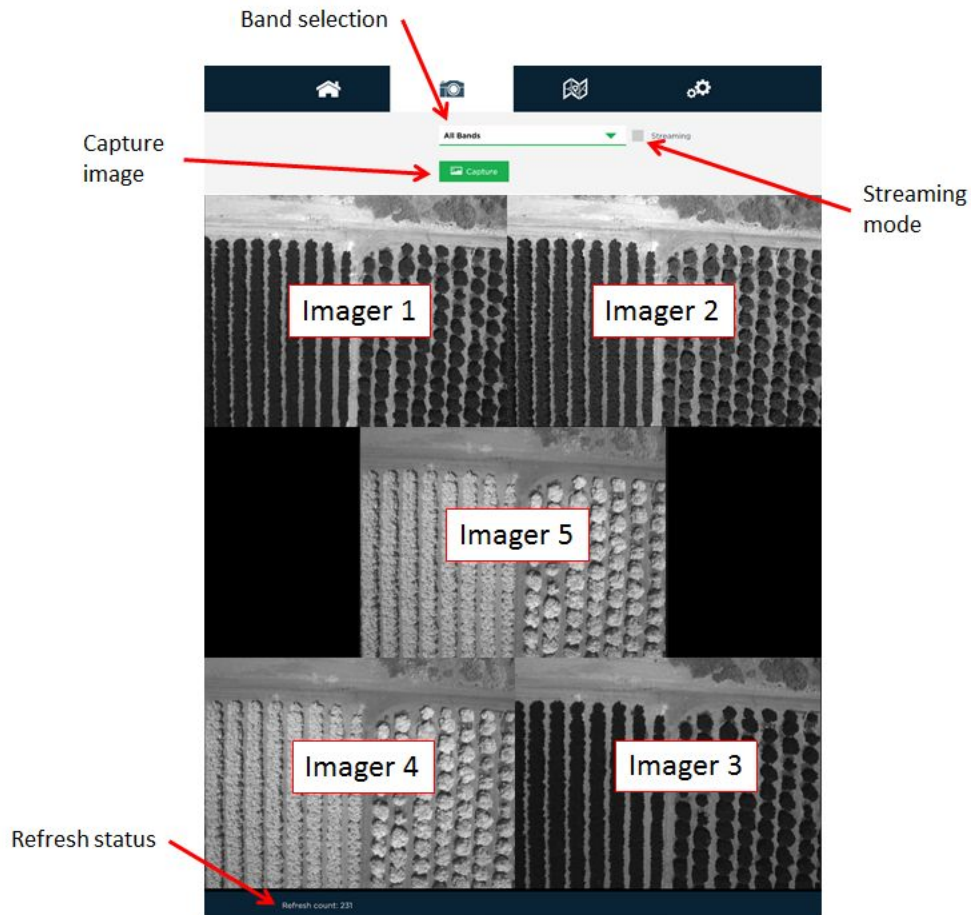


Figure 3: Live View Page



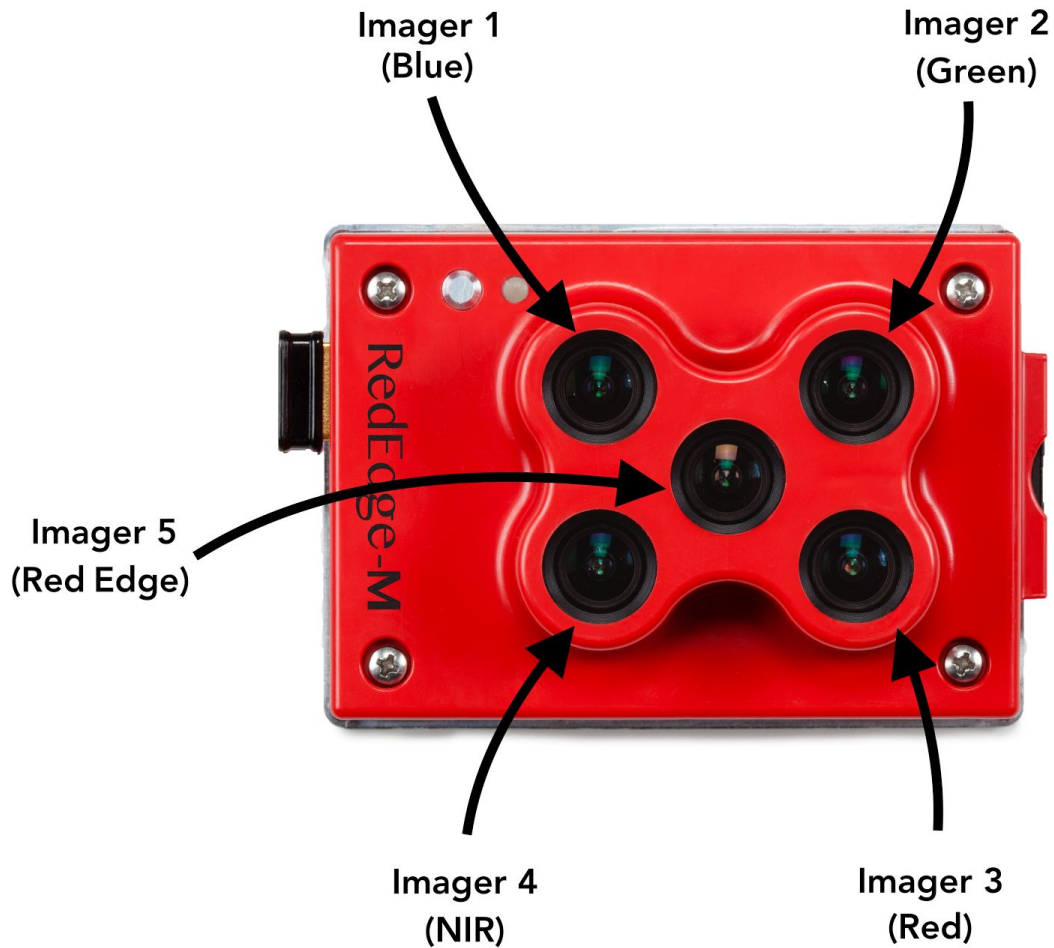


Figure 4: Imager Nomenclature

Whenever the camera captures images manually (using either the physical button or the web button), the selected 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 (approximately 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 or flying).

### 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. This page also provides a calculator for estimating parameters for mission planning.

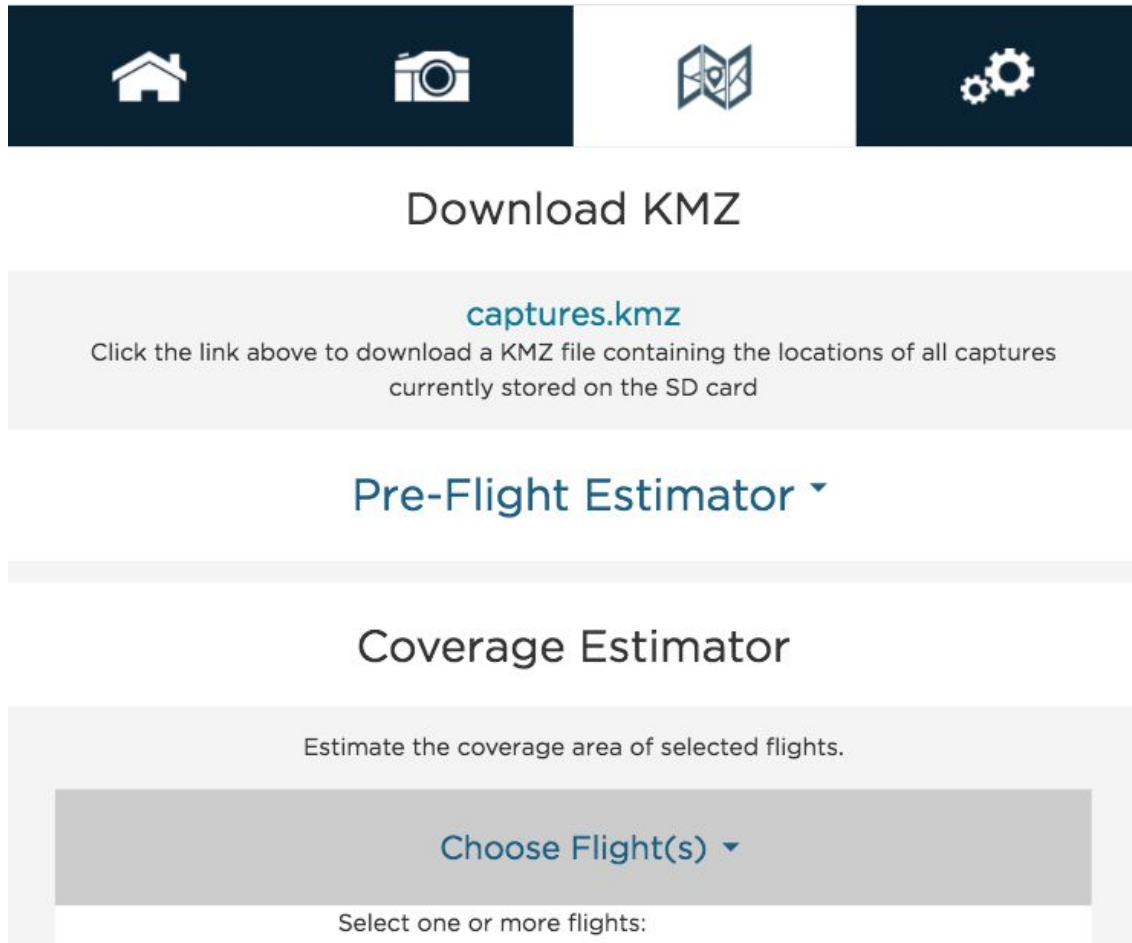


Figure 5: Coverage Page

#### Captures.kmz

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

### Pre-Flight Estimator

The Pre-flight Estimator is a calculator to estimate the results of a flight mission. Enter the mission parameters and press the "calculate" button to see the results below.

# Pre-Flight Estimator ^

Estimate the result of a flight mission.

## Mission Input

**Altitude AGL:**    **GSD:**






**Flight Speed:**    **Area of the Field:**

**Forward Overlap:**   **Cross Overlap:**

**Camera Orientation:**   **Image Output:**

**Aircraft Type:**

## Estimated Mission Result

<b>Footprint Width:</b>	104.73	m		<b>Footprint Height:</b>	78.55	m	
<b>Distance between Capture:</b>	19.64	m		<b>Distance between Track:</b>	26.18	m	
<b>Time between Capture:</b>	3.93	seconds		<b>Flight Time:</b>	0 hours 8 minutes		
<b>Number of Captures:</b>	88			<b>Number of Images:</b>	440		
<b>Area per Hour:</b>	85.47	acre/hr		<b>Storage Space Requirement:</b>	1.08	GB	

[Sample mission results](#)

## Coverage Estimator

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.

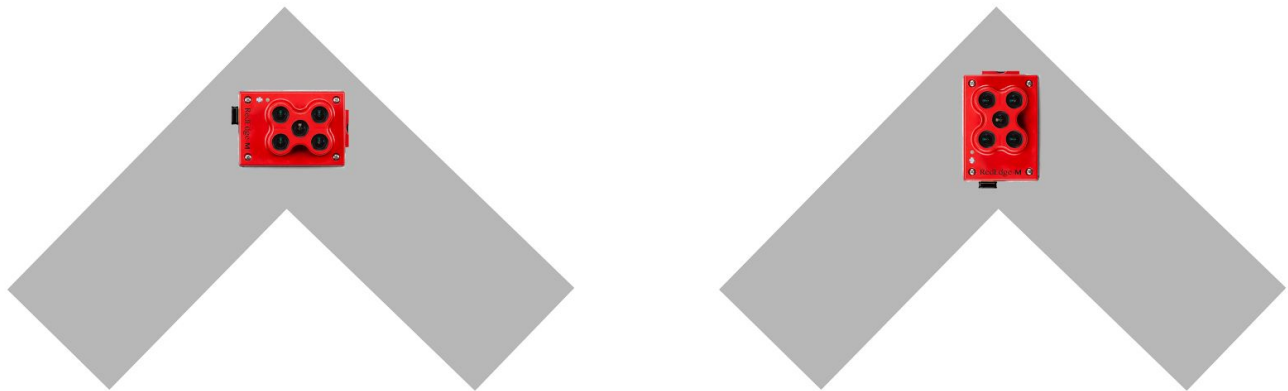


Figure 7: Landscape Orientation on Left, Portrait Orientation on Right

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.

The screenshot shows a mobile application interface for flight adjustment. At the top, there are two dropdown menus: "Choose Flight(s)" and "Flight Adjustment". Below these, the "Selected Flight" is identified as "0001SET". The "Flight Data" section displays "Estimated AGL: 80.06 meters" and "Horizontal GSD: 12.01 cm / pixel". The "Setting" section includes three adjustable parameters: "Camera Orientation" set to "Landscape", "Flight AGL" set to "80.06 meters", and "Estimate Resolution" set to "Low (faster)". A green "Draw Coverage" button is located at the bottom of the settings area.

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 smartphone.

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 Pix4D or another image processing platform. Areas that are yellow may work, but likely will not. Red areas will almost certainly not process correctly. 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.



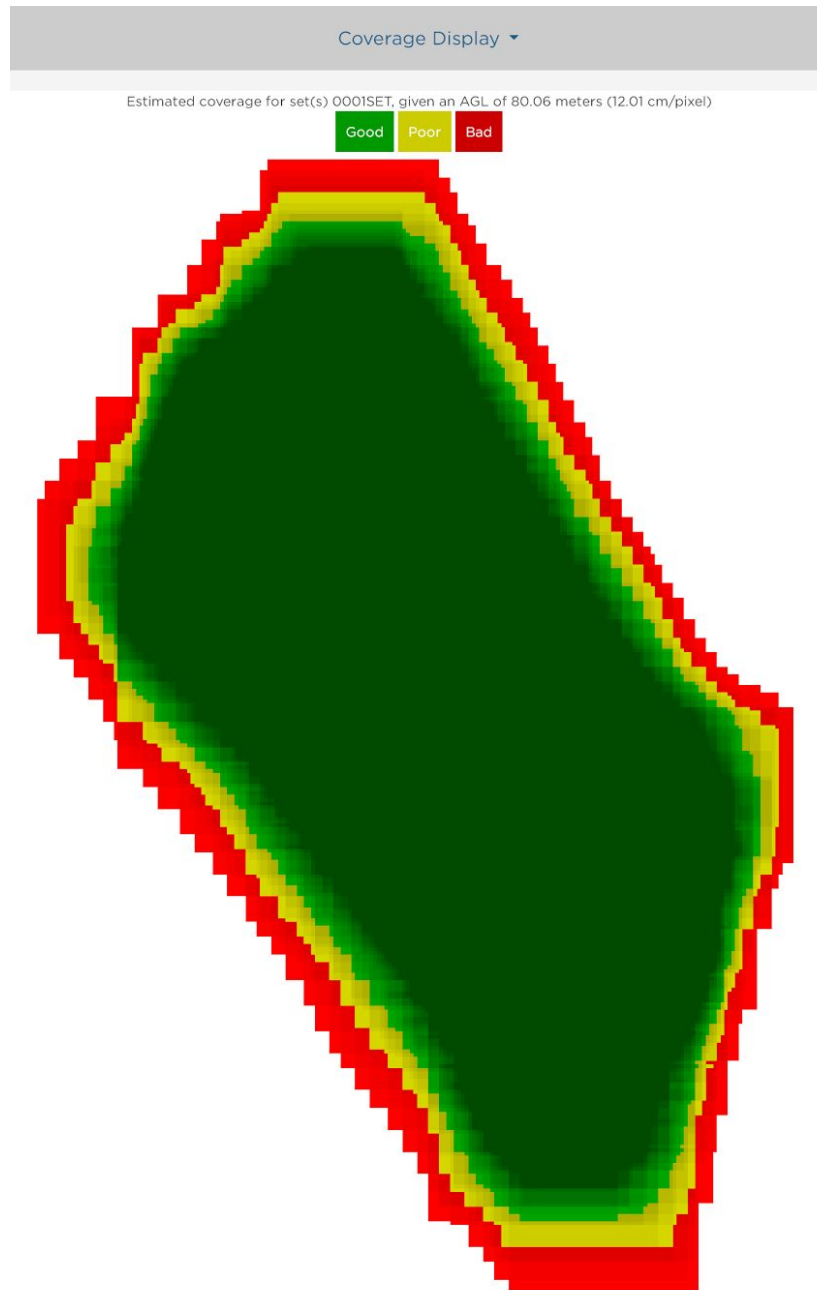


Figure 9: Example of Good Field Coverage

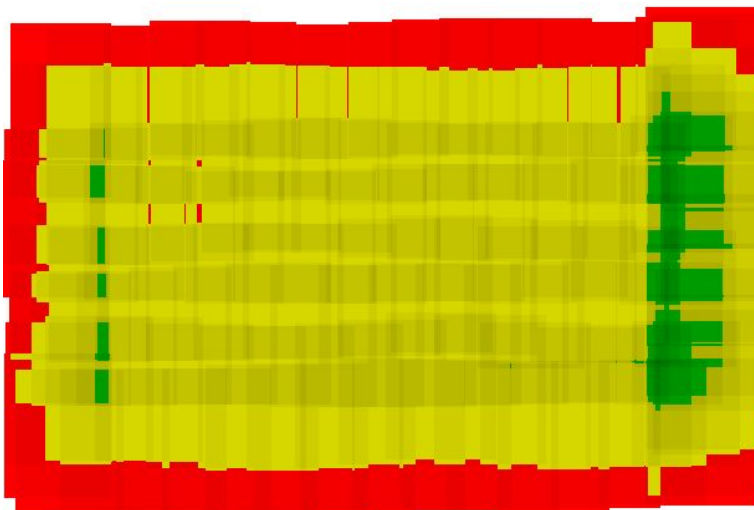


Figure 10: Example of Poor Field Coverage

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.

See the section labeled “Data Collection Recommendations” for more details on recommended data collection methods.

### 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.

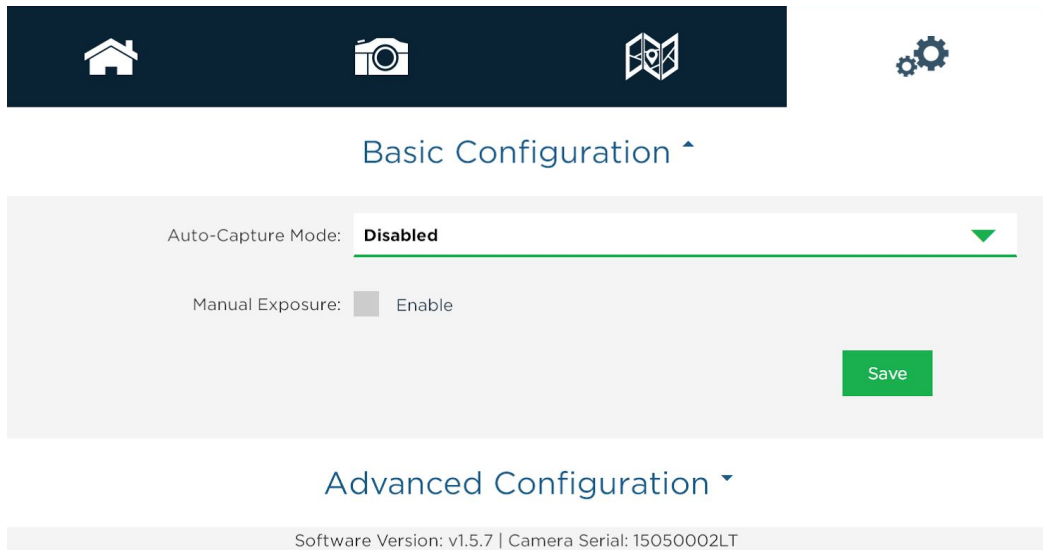
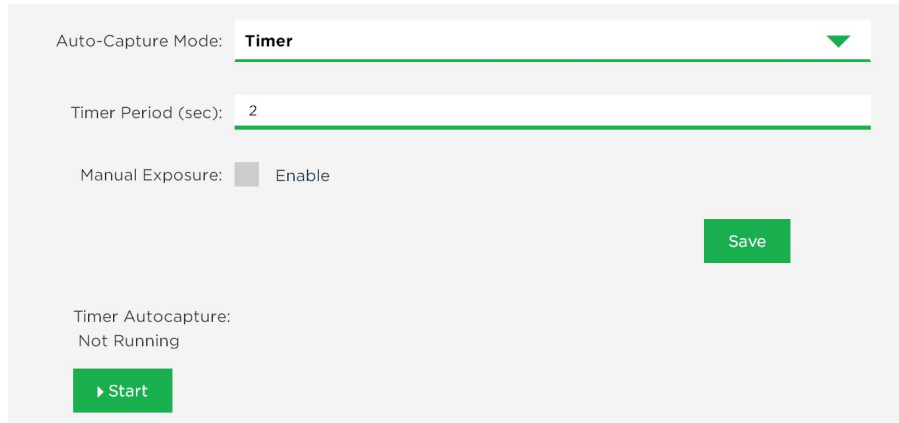


Figure 11: Settings Page

### 3.5.1. Timer Mode

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



The screenshot shows a configuration window for Timer Mode. At the top, 'Auto-Capture Mode:' is set to 'Timer' with a green dropdown arrow. Below it, 'Timer Period (sec):' is set to '2' in a text input field. Underneath, 'Manual Exposure:' has an unchecked checkbox and the text 'Enable'. A green 'Save' button is positioned to the right. At the bottom, 'Timer Autocapture:' is set to 'Not Running', and a green 'Start' button with a right-pointing arrow is located at the bottom left.

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 may not run at the specified interval, but 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

### 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-M 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 with 'Ext. Trigger' selected.
- Ext Trigger Mode:** A dropdown menu with 'Short PWM' selected.
- 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

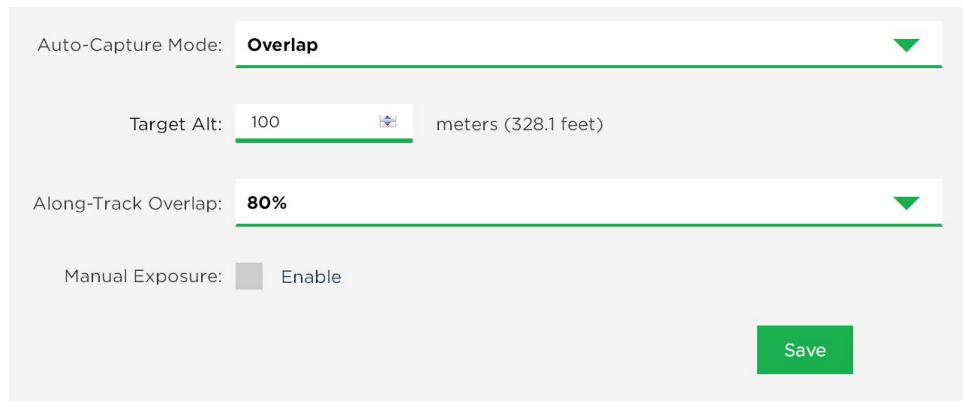
3. In the updated window, select the external trigger mode from the list. The settings are as follows:

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 (milli-seconds), 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.

### 3.5.3. Overlap Mode:

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



The screenshot shows a configuration window for 'Overlap Mode'. It contains the following elements:

- Auto-Capture Mode:** A dropdown menu with 'Overlap' selected.
- Target Alt:** A text input field containing '100' with a unit selector showing 'meters (328.1 feet)'.
- Along-Track Overlap:** A dropdown menu with '80%' selected.
- Manual Exposure:** A checkbox labeled 'Enable' which is currently unchecked.
- Save:** A green button at the bottom right.

Figure 14: Overlap Mode

2. In the updated window, select the Target Alt to be the altitude AGL (Above Ground Level) at which the aircraft will be operating during the mapping mission. Note that this is specified as AGL altitude.
3. Specify the Along-Track Overlap as a percentage (%) of image that is common between one image and the next 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 at the specified target altitude as specified in the % overlap setting.
6. When the measured altitude is lower than target altitude minus 50 meters, the camera stops taking captures.

### Advanced Configuration:

The Advanced Configuration menu provides controls for managing file storage for RedEdge-M, as well as Ethernet and Multi-Camera configurations. Make sure to click the “Save” button after making any changes, or the changes will be lost.

Home
Camera
Map
Settings

Basic Configuration ▾

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)** ▾

### PPS Pin Usage

Select the purpose of pin 4 on H3, called GPS PPS in the RedEdge 3 Integration Guide. The default usage of this pin is as a general purpose input pin. Top of Frame Output is for advanced integrations when external hardware, such as an RTK GPS receiver, needs to know the precise moment the RedEdge captures images.

**⚠ WARNING: Enabling Top of Frame output changes the PPS pin purpose from a digital input to a digital output. Damage to the camera may occur if another output pin, such as the PPS output on a GPS receiver, is connected when Top of Frame Output mode is enabled.**

Pin Purpose: **Input (default)** ▾

### 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	1634214	v2.1.3	

### Ethernet Configuration

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

The camera must be rebooted for an IP change to take effect

IP Address:

Save

[DLS Configuration ▲](#)

Calibrate DLS Mag

[Regulatory Notices ▾](#)

Software Version: v2.1.3 | Camera Serial: 1634214

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, but are not supported by some image software.

You can specify how you wish to use the PPS pin on the camera. See the RedEdge-M Integration Guide for details.

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-M 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.

#### 3.5.4. 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.



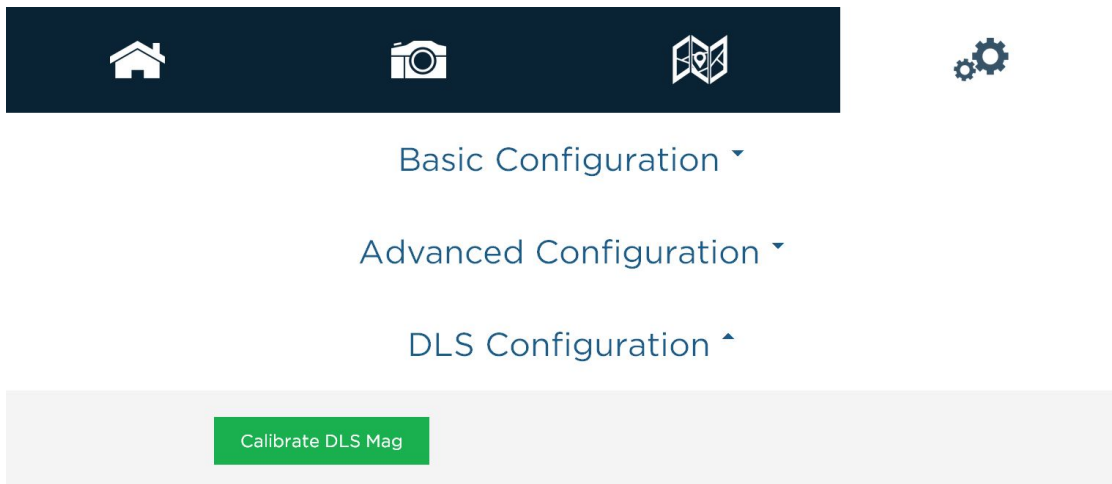
## 4. Magnetometer Calibration

This procedure is for the provided GPS only and is not required for configurations that provide GPS and attitude information via the serial or Ethernet connection. If the configuration for your RedEdge-M and DLS is one that uses the provided GPS module for GPS and magnetometer data, a calibration process for the magnetometer is needed.

### NOTE

You will need a compass to verify the calibration once completed.

From the Settings page, access the DLS Configuration section.



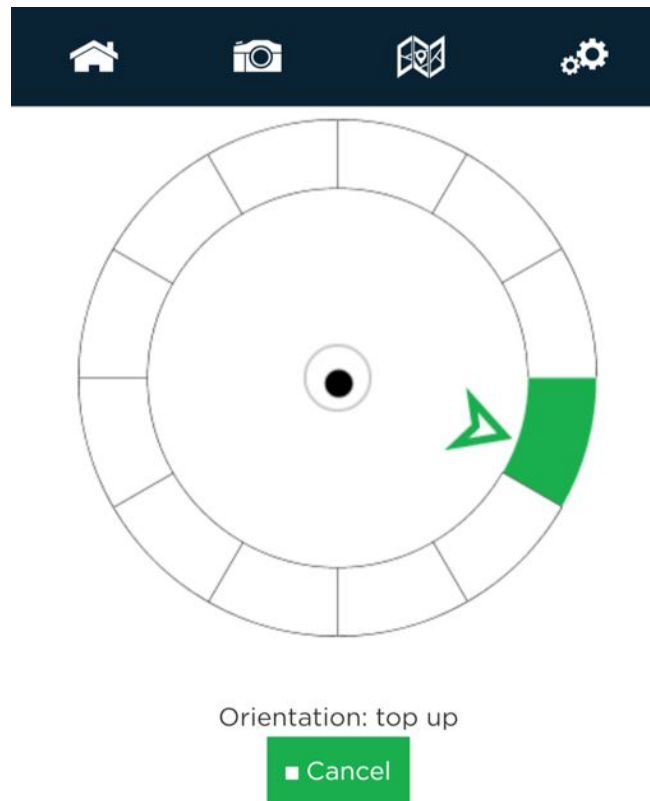
“Calibrate DLS Mag” is a clickable button that will start the calibration process. This calibration process is for the magnetometer sensor that is inside the 3DR GPS module.

Ensure that the DLS is connected to the GPS module with both the 4-pin and 6-pin connectors. Additionally, your DLS and GPS module should be rigidly mounted to your aircraft frame.

## NOTE

Before beginning the calibration routine, position yourself and the drone away from large metal objects such as cars and buildings. Also avoid paved areas, which may have metal rods inside the cement. An open field is preferred to avoid interaction with any sources of magnetic interference or objects that may perturb the Earth's natural magnetic field.

Once the startup sequence has finished, you will be shown a screen with instructions for which orientation your drone should be in for each of the calibration steps.



To calibrate the magnetometer, a 6-axis calibration routine needs to be performed. During the routine, the drone (specifically the GPS module) should remain in a fixed position while being rotated, i.e. the user performing the calibration should be moving around the magnetometer. The drone and GPS module should also be kept level to the plane they are on in each position. The on-screen rotation guide will show you when you have successfully completed one orientation and can move on to the next.

## NOTE

The black dot is a level (like a bubble level), indicating how level the unit is compared to the plane it is on. It does not indicate how far away from the center of rotation the unit is.



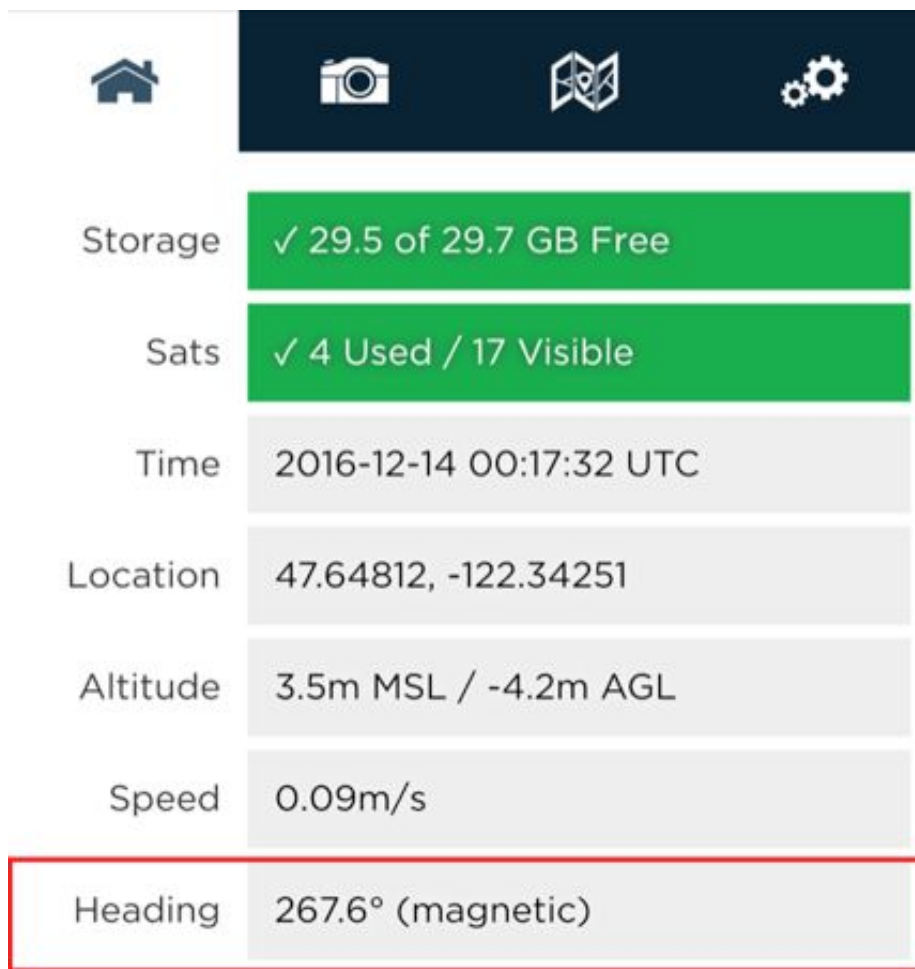
## NOTE





If you are using a MAVLINK or ethernet connection to supply GPS and attitude information to the RedEdge-M camera, you do not need to perform the magnetometer calibration described above.

## Magnetic Heading Check

Once the calibration routine has been completed, it is important to verify that the magnetometer information displayed in the Heading section of the RedEdge-M Home Page is accurate.

A handheld compass has been provided with your kit that will allow you to verify this in the field. Access the camera's Home Page and use the "Heading" field to check the four cardinal directions (North, East, South, West) and ensure a good match between the compass and the reading by the camera. You should see an error of less than +/- 5 degrees. If this error is exceeded, redo the magnetometer calibration.



	  
Storage	✓ 29.5 of 29.7 GB Free
Sats	✓ 4 Used / 17 Visible
Time	2016-12-14 00:17:32 UTC
Location	47.64812, -122.34251
Altitude	3.5m MSL / -4.2m AGL
Speed	0.09m/s
Heading	267.6° (magnetic)

Additionally, you will want to perform a magnetic interference test to verify that your drone will not affect the heading readings during flight.

## Magnetic Interference Check

A test procedure should be conducted any time electrical equipment is added or removed from the drone to ensure the magnetic field profile of the aircraft has not changed.

To test for any magnetic interference from the drone that is affecting the magnetometer, start by placing your drone facing North (you can use the magnetic heading from the Wi-Fi page to align yourself).

### WARNING

The next section involves spinning up the motors of your drone.

If you have a fixed wing aircraft this will require holding the plane in place while keeping clear of the propeller.

If using a multi-rotor, setup the aircraft as if it was ready for a normal take off, but you do not need to actually take off, just spin up of motors.

You DO NOT need to provide full power to the motor(s).

Throttle up the motor(s) on your drone and ensure that the heading reading has not changed, then throttle back down. Repeat this for each direction (North, East, South, West) to ensure there is no magnetic interference in any of the four cardinal directions.

### WARNING

FAILURE TO FOLLOW INSTRUCTIONS TO KEEP CLEAR OF SPINNING BLADES  
COULD RESULT IN INJURY OR DEATH.

### NOTE

Electromagnetic interference during the operation of your drone can cause errors in the magnetic heading readings. This can cause the irradiance data generated by the DLS to be not usable during processing.

## 5. Mapping Operations

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

Item	Value
Lens Focal Length	5.4 mm
Lens Field of View	46 deg. HFOV
Imager Size	4.8 mm x 3.6 mm
Imager Resolution	1280 x 960 pixels

## 6. External Connections

Refer to RedEdge-M 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.

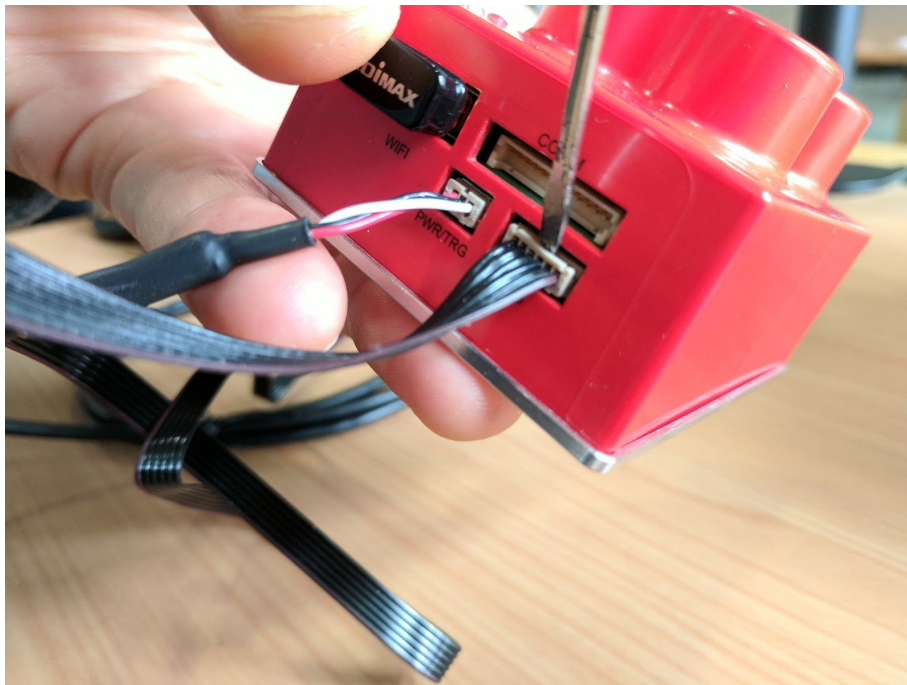


Figure 17: Removal of Connectors Using Small Flathead Screwdriver

## 7. File Storage

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

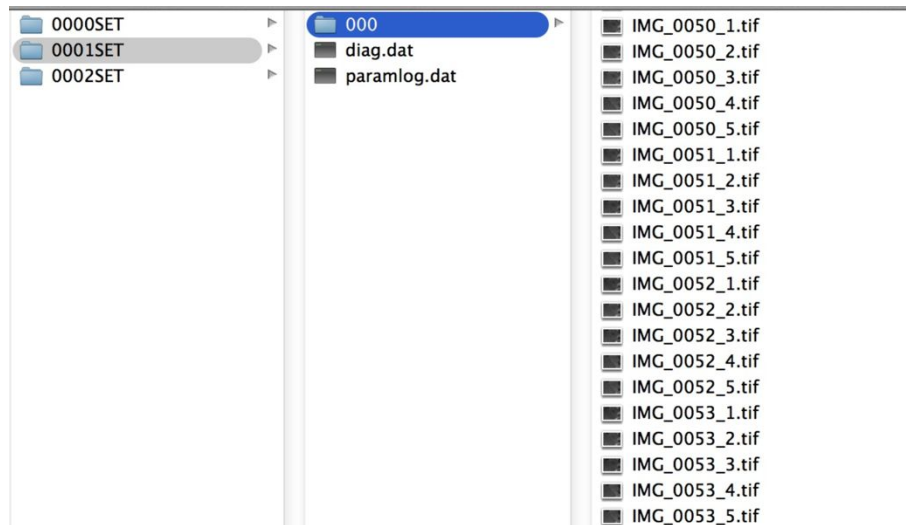


Figure 18: File Structure of SD Card

Within each folder, a subfolder with the images themselves is created. If more than 200 images are stored, a second image folder is created (“000” and “001” for instance). Two log files are also created for each camera power cycle.

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 EXIF format.

## 8. Data Collection Recommendations

In order to accurately process data captured with the MicaSense RedEdge-M 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 camera or DLS 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.

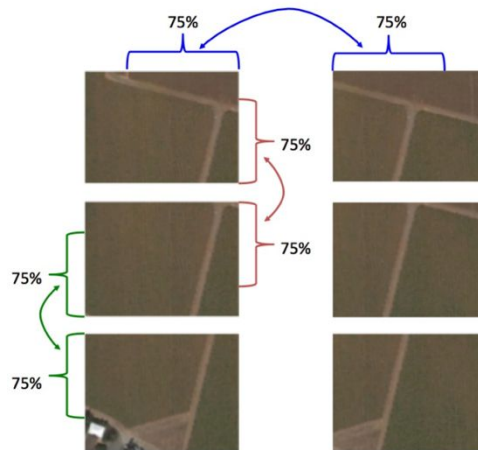


Figure 19: Overlap Recommendations

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)

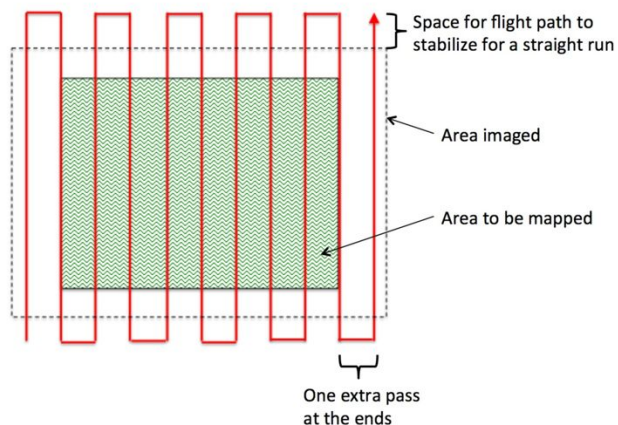


Figure 20: Coverage Area for Mapping a Field



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).

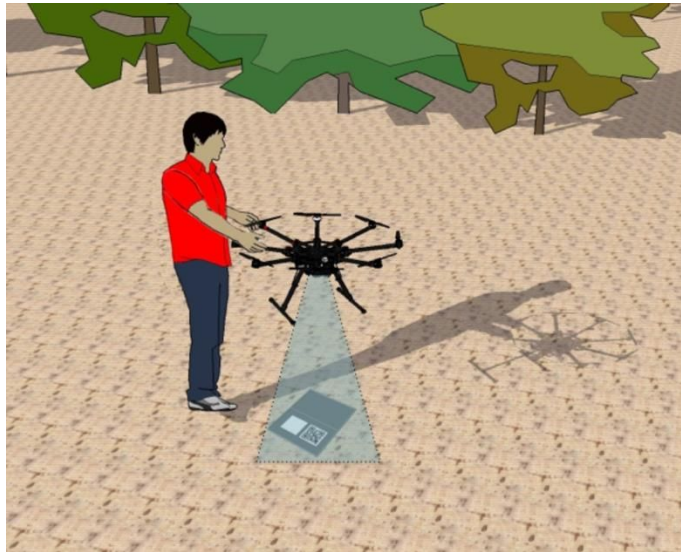


Figure 21: Capturing Reflectance Panel Image

#### 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.

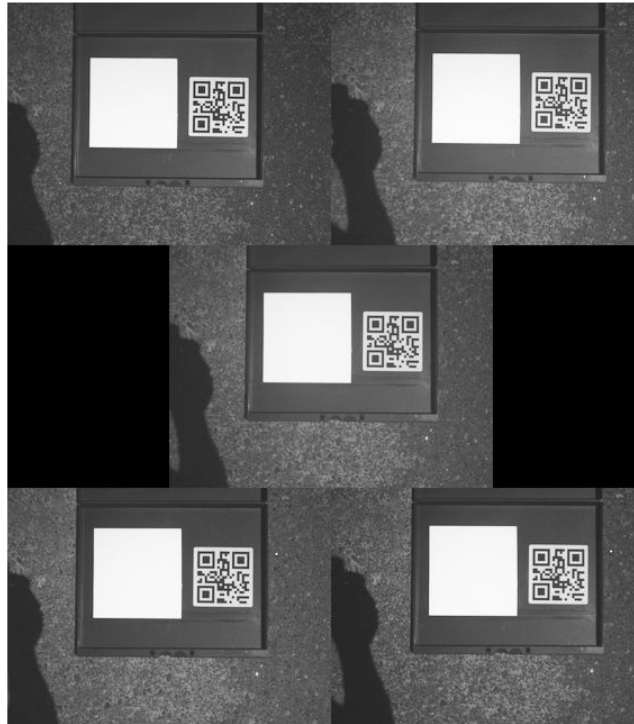


Figure 22: Example of Panel Capture

6. Gather data during weather that provides consistent illumination, such as uniformly overcast days, or clear, sunny days (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:

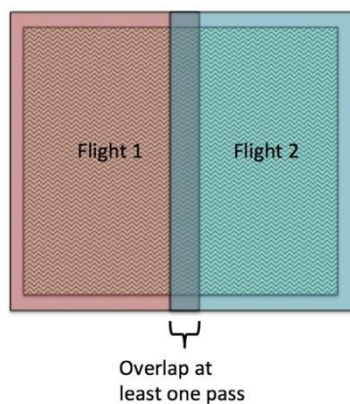


Figure 23: Multiple Flights for the Same Field Should Overlap

## 9. Checklist for Operation

### 1. Before Power-Up

SD card installed
Power cable connected
GPS and DLS 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 "rededgeRXXX-XXXXXXX-XX" WiFi network (password: "micasense")
Open web browser and point to 192.168.10.254
Select Home Page
Verify free space on SD card sufficient for mission
Verify GPS date and time are correct
Verify DLS is reported as connected
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
	If using External Trigger mode:
	Force a manual trigger capture using aircraft's controller

#### 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 KMZ 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)

## 10. Firmware Update

It is essential to keep the camera firmware updated at all times. It is available for download via [atlas.micasense.com](http://atlas.micasense.com). The firmware in the RedEdge-M camera can be easily updated following these steps:

1. Copy the *rededgem.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 to the camera and power camera ON if it doesn't power on automatically.
4. Wait approximately 30-60 seconds
5. The camera should then boot up normally, and the status light in the front will flash at approximately a once every 1.5 seconds.
6. 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.



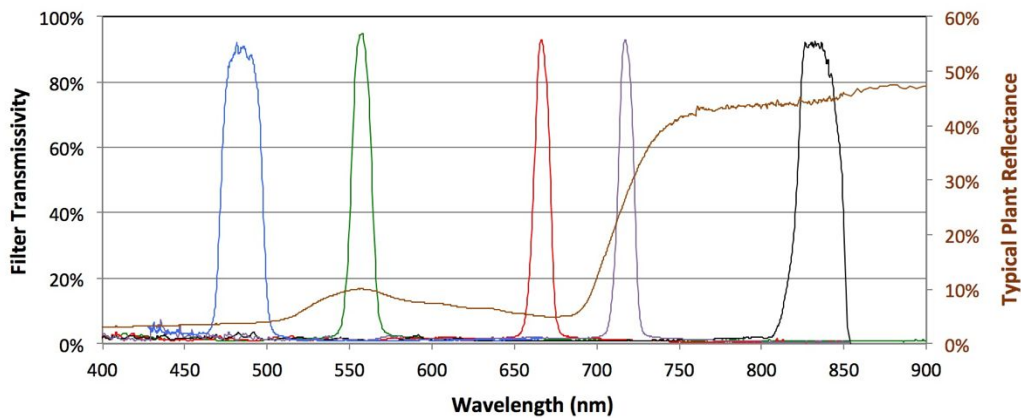
7. Power down the camera, remove the SD card and delete the bin file (otherwise each time you power up the camera, it will re-install the firmware).

## 11. Specifications

### Basic Specifications

Weight	170 g (Including DLS)
Dimensions	9.4 cm x 6.3 cm x 4.6 cm (3.7" x 2.5" x 1.8")
Power	4.2V-15.8V, 4 W nominal, 8W peak
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
Maximum 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

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MicaSense RedEdge-M™ Multispectral Camera  
User Manual  
Rev 01 – October 2017

MicaSense, Inc.  
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## RedEdge-M™

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

1. Reorient or relocate the receiving antenna.
2. Increase the separation between the equipment and receiver.
3. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
4. Consult the dealer or an experienced radio/ TV technician for help.

### FCC Caution

This device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Any changes or modifications not expressly approved by the party responsible for compliance could void the authority to operate equipment.

