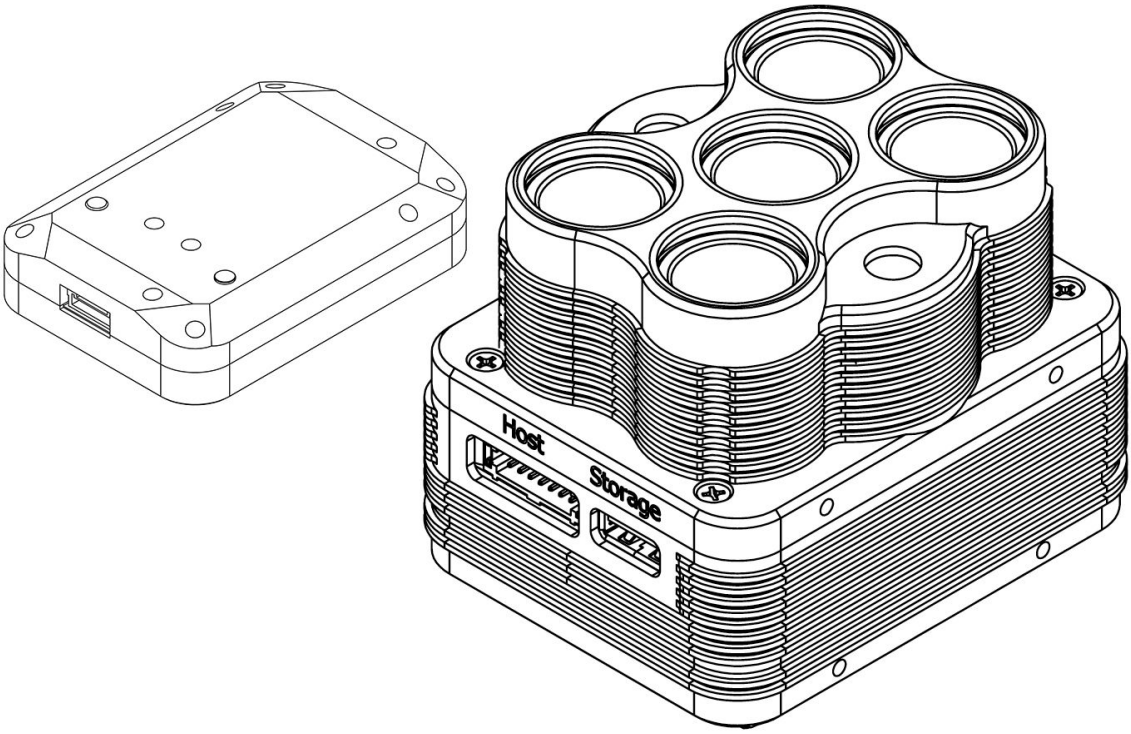
MicaSense Altum™ and DLS 2 Integration Guide



Revision 10

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MicaSense®

Seattle, WA

MSPN 900-00021-01

Table of Contents

Introduction

MicaSense Altum provides multiple options for integration - from stand-alone (where you only provide power to the sensor) to fully customized integrations. Advanced integrations take advantage of flexible interfaces including Ethernet, serial, and PWM/GPIO trigger, for seamless integration with any aircraft.

Firmware

It is important to have the latest version of firmware installed on your sensor. Please see the following page to get the latest version and learn how to update your firmware: https://www.micasense.com/firmware-updates

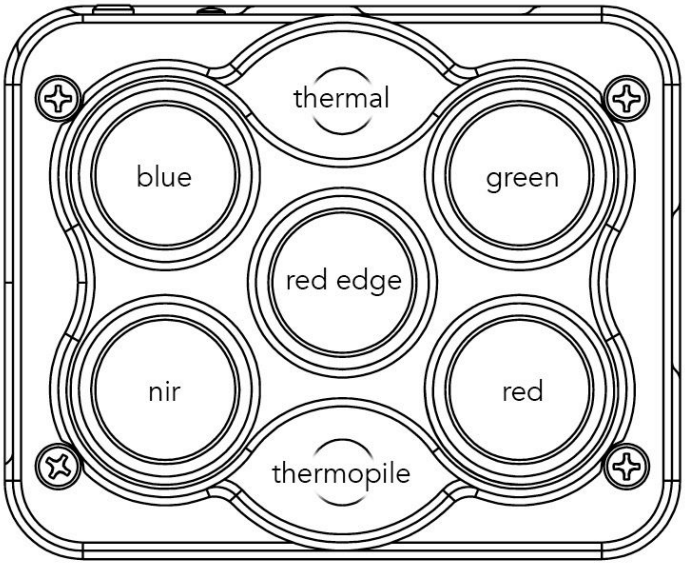
What's Included?

For the most up-to-date information on what's included with the Altum sensor kit, please see the Altum packing list.

Lens and Imager Information

	Multispectral	Thermal
Pixel size	3.45 µm	12 µm
Resolution	2064 x 1544 px (3.2 MP x 5 imagers)	160 x 120 px (0.01 K)
Aspect ratio	4 : 3	4 : 3
Sensor size	7.12 x 5.33 mm (8.9 mm diagonal)	1.92 x 1.44 mm
Focal length	8 mm	1.77 mm
Field of view (h x v)	48° x 36.8°	57° x 44.3°
Thermal sensitivity	n/a	< 50 mK
Thermal accuracy	n/a	+/- 5 K
Output bit depth	12-bit	14-bit
GSD @ 120 m (~400 ft)	5.2 cm	81 cm
GSD @ 60 m (~200 ft)	2.1 cm	41 cm

Center wavelengths and bandwidth



Cameras with serial number AL05 or higher

Name	Center	Bandwidth
Blue	475 nm	32 nm
Green	560 nm	27 nm
Red	668 nm	16 nm
Red edge	717 nm	12 nm
Near infrared	842 nm	57 nm
Thermal	11 µm	6 µm

Cameras with serial number AL04 or lower

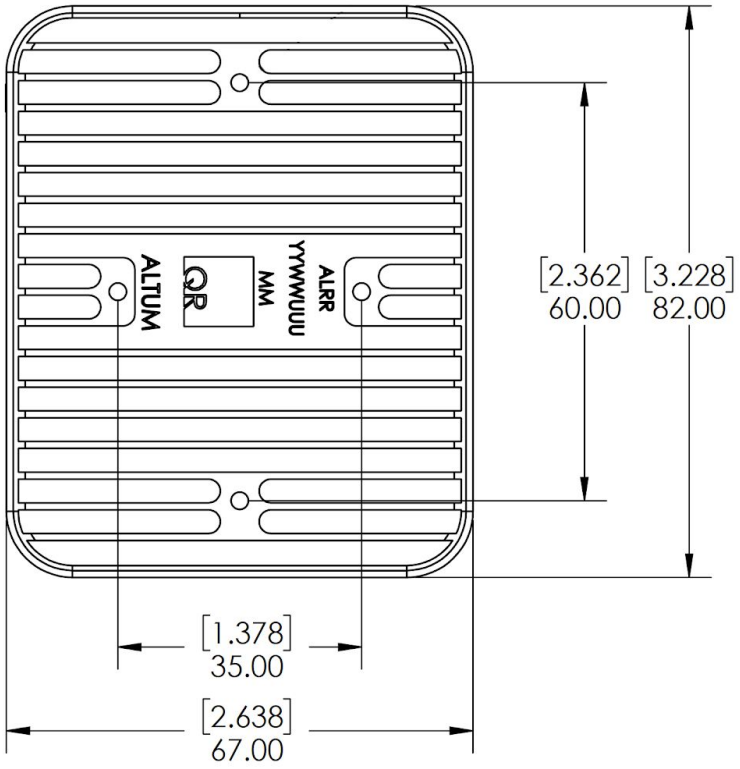
Name	Center	Bandwidth
Blue	475 nm	20 nm
Green	560 nm	20 nm
Red	668 nm	10 nm
Red edge	717 nm	10 nm
Near infrared	840 nm	40 nm
Thermal	11 µm	6 µm

Imager/band number and output

1	Blue
2	Green
3	Red
4	NIR
5	Red edge
6	Thermal

Measurements and Attachment Points

There are four M3 screw holes at 60 mm x 35 mm on-center. The sensor can be attached to the host aircraft using at least two of the four provided threaded mounting points and M3 x 0.5 screws. If using only two mounting points, it is important to choose two threaded points opposite of each other.



Length	82 mm
Width	67 mm
Height	64.5 mm
Weight	357 g

Recommendations for Installation

The Altum should be installed such that it has a clear view of the area directly below the aircraft. The "cone" of the lenses, especially thermal, which has the widest field of view (57° HFOV), should be considered in the process of deciding where to mount the sensor on the aircraft or payload bay.

Avoid putting windows or covers in front of the thermal sensor. Many materials that are transparent in visible bands are opaque in LWIR (thermal), so any coverings may prevent data collection. Even materials that are mostly transparent in LWIR will negatively affect the radiometric accuracy of the sensor output.

The multispectral sensors feature a global shutter and can withstand some vibration without degrading image quality; nevertheless, we recommend vibration isolation between the sensor mounting platform and the aircraft.

Make sure the sensor points straight down (with respect to the earth) at all times during flight. The best way to ensure this is to use a gimbal.

Airflow over all surfaces of the sensor is necessary for proper heat dissipation. Do not run Altum on the bench or in the field for extended periods of time without airflow. Do not completely cover or insulate the back surface of the sensor.

Normally, the sensor should be in landscape orientation. If you plan to mount the sensor in a portrait orientation, remember to swap the vertical and horizontal parameters in your mission planner.

Ensure that the sensor is completely protected during landing. Note that we do not recommend using a lens cover during flight as it can filter the wavelengths that the sensor measures. Instead, protect the sensor with a recessed installation or by using landing gear.

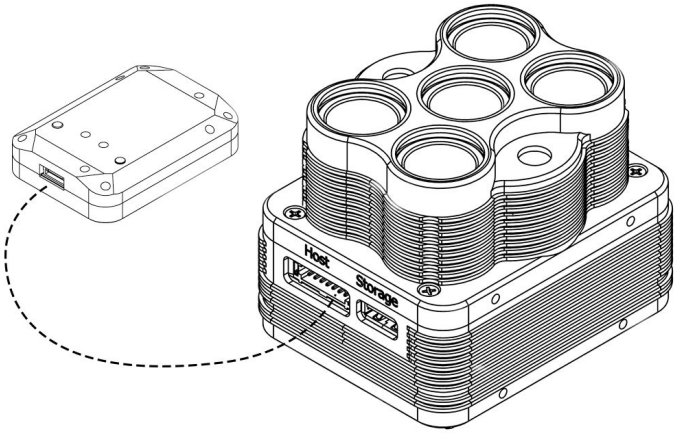
Use the provided lens cover when storing Altum, and do not set Altum lens-side-down as it will rest on and scratch the lenses.

More integration guidelines for the DLS 2 are in the DLS 2 section of this guide.

Configuration Options

There are many ways to configure Altum. The following summaries will help you choose the one that meets your needs. Many other options are possible. If you have any questions about your integration, please contact support@micasense.com

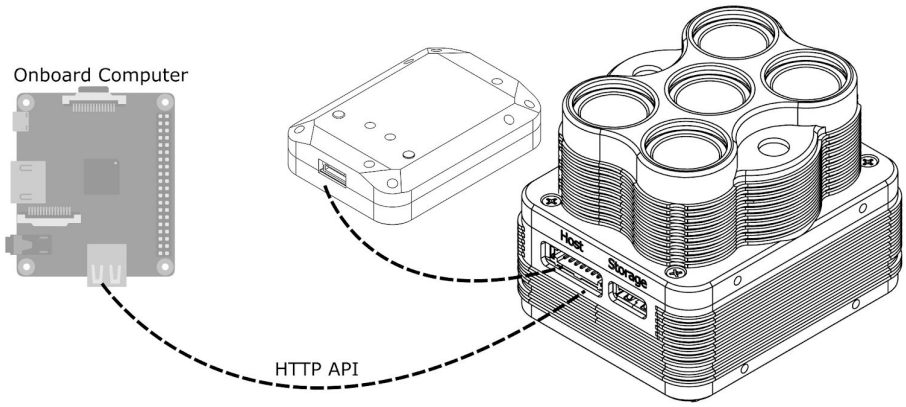
Default + Overlap mode



The default configuration uses the DLS 2's integrated GPS. Use the provided cable to connect the DLS 2 to the DLS 2 board on the HOST connector. Ensure the DLS 2's physical installation meets the requirements outlined later in the DLS 2 section of this guide. Connect a compatible power supply to pins 1 and 2 on the HOST connector. For more details about power, see the Input and Output section of this guide.

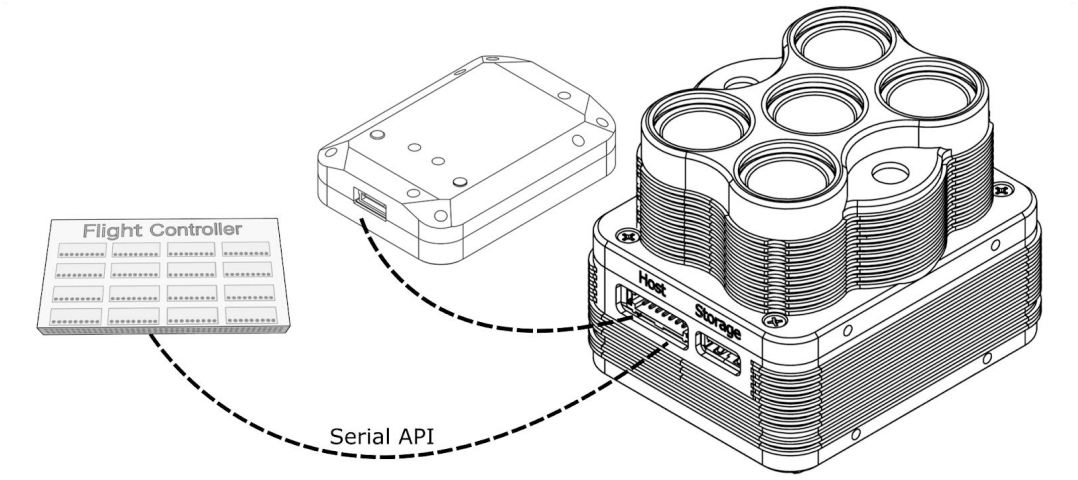
Once attached to the aircraft, use the Flight Calculator to determine the necessary overlap percentage for your desired Ground Sample Distance and Target Altitude, then input the parameters into the Overlap settings, outlined in the Triggering section in this guide. The sensor will begin capturing once it is within the Target Altitude Tolerance of your Target Altitude. It will capture often enough to maintain your overlap percentage at your desired altitude. This will ensure enough coverage to create a mosaic of your flight area with your preferred photogrammetry software.

Default + trigger by HTTP API



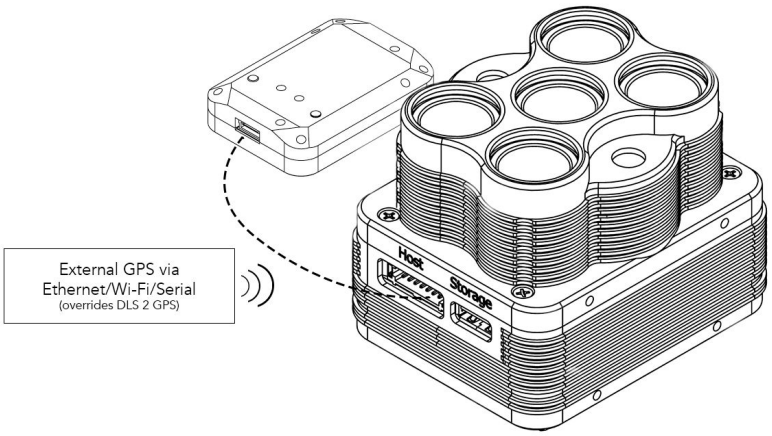
With this configuration, instead of automatically capturing with an automatic triggering mode, the HTTP API (see below) is used with an onboard computer to trigger the camera at intervals determined by your computer. See examples of the HTTP API here: [Integration examples for MicaSense sensors](#).

MAVLink with PixHawk or similar flight controller



The Altum can be triggered with a PixHawk flight control system using the serial API. MicaSense cameras currently use the MAVLink v1.0 messaging protocol for the serial API, which the camera uses to interact with PixHawk. You can read more detailed information here: [Guide for MicaSense Sensors and PixHawk](#).

DLS 2 with Aircraft GPS



For more control, advanced users can communicate with Altum by HTTP (Ethernet, Wi-Fi) or serial (MAVLink) using the MicaSense APIs (Application Programming Interfaces). The APIs can be used in lieu of the DLS 2 GPS to provide the sensor with a position and attitude data (from the aircraft GPS, for example). Anytime GPS data is sent to the sensor via the API commands, it will be written to the image metadata, overriding the DLS 2 internal GPS data for five seconds (or until another update is sent via the API).

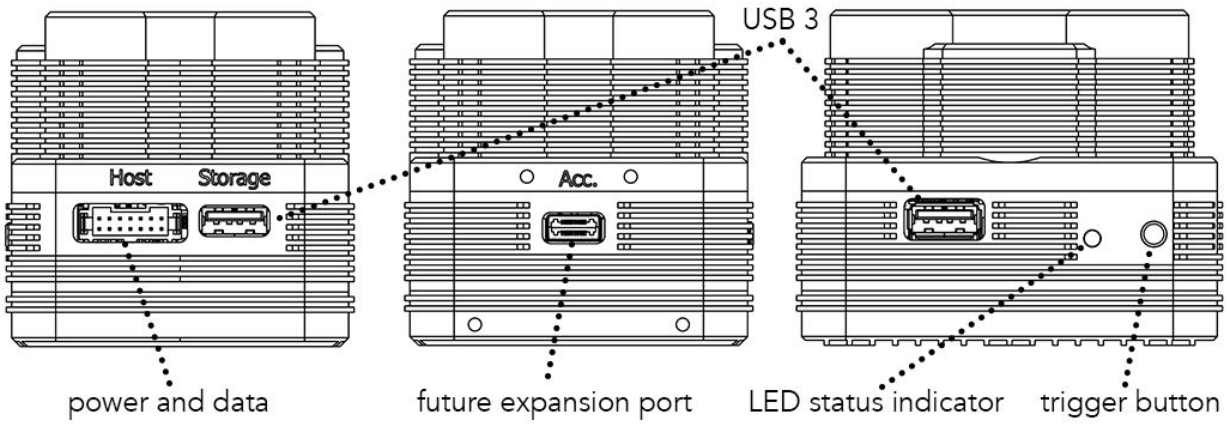
HTTP Connection

Attach a USB Ethernet adapter or USB Wi-Fi adapter to one of the USB 3 ports. See the User Guide for MicaSense Sensors for connection details and information. For HTTP API details, visit https://www.micasense.com/api

Serial Connection

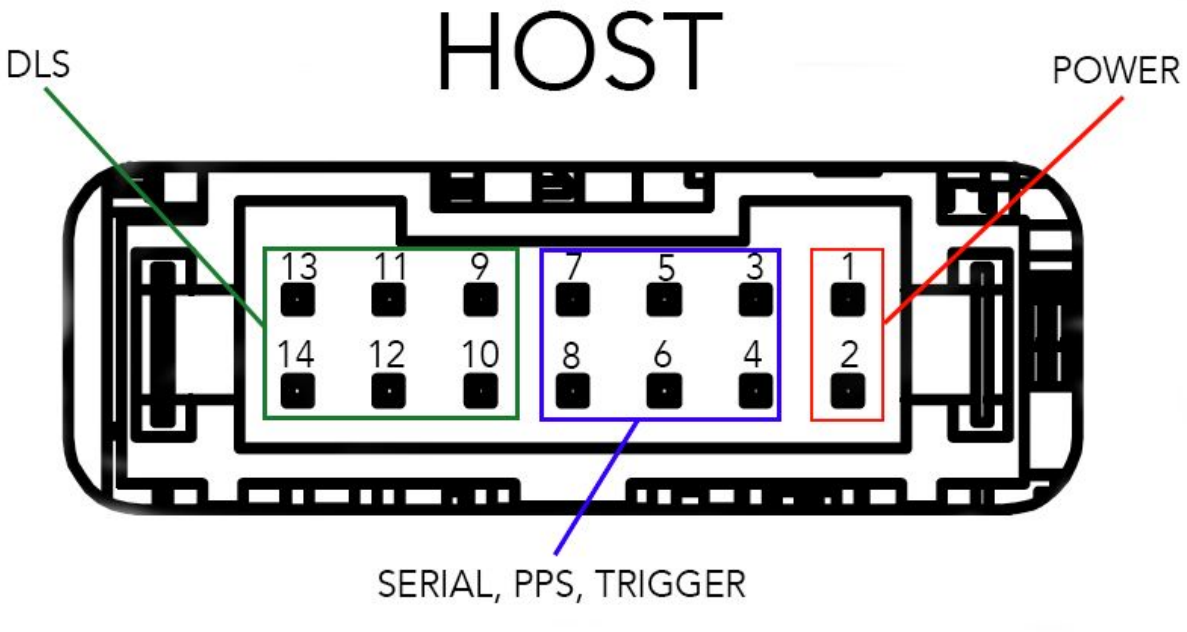
Use the provided pigtail from the host connector cable to connect to your serial device. See the Input and Output section of this document for pin layout and details. Visit https://www.micasense.com/api to learn more about communicating with the MAVLink API.

Input and Output



The Altum & DLS 2 sensor kit includes all necessary cables for integration. If extending the cables, ensure that the voltage at the camera is at acceptable levels as outlined in the "Powering" section of this guide.

Host Interface Connector (Power and Data I/O)



Connector type/part number: (provided as pigtail assembly with every Altum integration kit from MicaSense)
Samtec - 14pin, 2.00mm Tiger Eye™: PN# T2M-107-01-S-D-RA-WT

13 DLS RX CAM TXF	11 DLS AUX OUT CAM INF	9 DLS POWER	7 CAM HOST PPS IN	5 CAM RX HOST TX	3 CAM PPS OUT	1 POWER
14 DLS TX CAM RXF	12 DLS PPS OUT CAM PPS IN	10 DLS GND	8 ISO GND	6 TRIG IN	4 CAM TX HOST RX	2 GND

Power supply specifications

Voltage	5.2 V - 25.2 V
Standby	5.5 W
Average	7 W
Peak	10 W

Altum requires 5.2 V DC for operation, with a maximum operating voltage of 25.2 V. The supply must be able to provide 10 W peak. Power can be provided to the sensor in two main ways:

- shared power from aircraft's main battery pack
- a rechargeable Lithium-Ion battery pack (a two-cell LiPo will provide optimal efficiency).

Ensure the power source conforms to the specifications listed above and can supply the required voltage at the power port of the camera, accounting for any losses in the wiring.

Input and Output

Nominal IO Voltage*	3.3 V DC
IO Voltage Range*	0.0 V DC to 5.5 V DC
Absolute Maximum IO Voltage*	5.6 V DC
PWM Trigger Expected Range	1.0 ms to 2.0 ms
VIH High-level input voltage*	2.0 V to 5.5 V
VIL Low-level input voltage*	0.0 V to 0.8 V

*All 3.3V HOST IO lines are referenced to ISO GND (Pin 8). To ensure proper operation of Trigger, Serial, and PPS lines, make sure ISO GND is connected to your host system's IO ground. This ground is isolated from the Altum power supply ground and must be connected for the IO to function properly.

USB Storage and Ethernet

Altum features two high-speed USB 3 ports which support USB 3 compatible devices. Tested, compatible devices include:

- Samsung MUF-64BA 128 GB flash drive
- Edimax Wi-Fi adapters:
    - EW-7811Un
    - EW-7611ULB (requires Altum firmware version 2.0.0 or higher)
- AmazonBasics USB 3.0 to 10/100/1000 Gigabit Ethernet Internet Adapter
- Cable Matters USB to Ethernet Adapter (USB 3.0 to Ethernet)

Most USB external flash storage devices (thumb drives, hard drives, and others) should work, but you should perform a thorough bench test before flight.

For details on how the sensor writes files to the storage device, see the File Storage section of the Sensor User Guide.

Capture Rate

Altum's capture rate is heavily dependent on the storage device. The Altum kit includes a 128 GB flash drive which has a maximum capture rate of about 1.5 seconds per capture. Using a USB 3 drive with a fast write rate, such as a 2242 M.2 SATA USB 3 drive, will ensure the fastest capture rate possible (about one capture per second). When setting up a mission or flight plan, adjust the desired overlap, flight altitude, and speed so that the capture interval does not exceed the maximum capture rate.

Accessory Port (ACC)

The accessory port can be used with the Altum SD Card Adapter. When other uses of this port are available, we will update this guide.

Automatic Capture/Triggering

Altum supports three methods for capturing images: Overlap, Timer, and External Trigger. To learn more about how to configure these settings, please see the User Guide for MicaSense Sensors.

Overlap (recommended)

In Overlap mode, when the aircraft climbs to within your chosen Target Altitude Tolerance below your Target Altitude, Altum will start capturing and only take a capture if it has traveled forward enough distance to ensure the overlap percentage you have specified. Prior to Altum firmware release 2.0.0, the Target Altitude Tolerance was fixed at 50 meters, but this can now be specified by the user. When the sensor's altitude is below the Target Altitude Tolerance from the Target Altitude, the sensor stops capturing. Overlap mode only calculates the forward overlap, and cannot account for the side overlap, which must be calculated in a flight planner, using the sensor's field of view to create an appropriate row spacing.

We recommend this mode because it helps ensure proper overlap (75% or higher), which is essential in order to produce high-quality output when processing the data in standard photogrammetry software.

Timer

When in timer mode, Altum will capture according to the timer period, which is every two seconds by default. If the timer period is set to capture faster than the storage device can write the captures, inconsistent capture intervals may result. The capture rate is heavily dependent on the write speed of the attached storage device, and is prone to unreliable physical capture spacing if the aircraft does not travel at a constant ground speed. See the USB Storage and Ethernet and Capture Rate headings in this guide for more details.

External Triggering

For more control, you can enable external trigger mode to talk to Altum by PWM or edge triggering. See the Host Interface Connector section of this document for detailed pin information.

External Trigger

The sensor can be set to trigger by the rising-edge of a pulse, the falling-edge of a pulse, or a PWM signal (such as is typically used with standard servos). When using a PWM signal as the trigger, the sensor detects a transition from a "long" PWM to a "short" PWM (or vice-versa). When using PWM, rising-edge, or falling-edge, ensure that the input signal's ground is connected to the isolated ground pin 8 on the Altum.

HTTP API (Ethernet and Wi-Fi)

The HTTP API is the most powerful way to interface with the Altum. You can use this API using either the Ethernet connector or the camera's Wi-Fi access point.

The API is accessed via HTTP connection to port 80 at the sensor IP address. Most data is exchanged in the JSON format.

The actual value of the IP address depends on the configuration. When accessing the sensor via its Wi-Fi access point, the sensor IP address will be 192.168.10.254. When the sensor is connected to an Ethernet network, the sensor IP address will be 192.168.1.83 by default.

The sensor can be commanded to take a capture by either a GET or POST request to the /capture URL.

For more information, please see https://www.micasense.com/api
For examples, please see these articles:

- Integration examples for MicaSense sensors

- Inputs and outputs for MicaSense sensors

Serial API

The Serial API provides a MAVLink interface to the Altum. You can use this API by connecting your MAVLink-capable system to the host serial port on the sensor.

The API is accessed via serial messages in the MAVLink format. MAVLink provides an open data format for interaction as well as a suite of tools to assist the programmer in developing and testing the interface. Altum uses MAVLink v1.0 messages and communicates with the host at 57600 baud.

For more information and examples, please see https://www.micasense.com/api

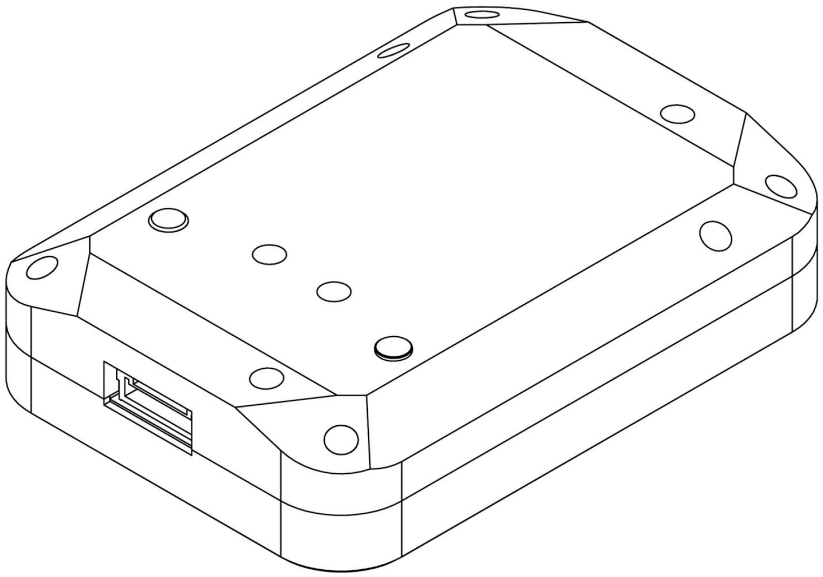
Disabled

"Disabled" should be set when triggering via Skyport (PSDK), HTTP API, or the serial (MAVLink) API. This mode disables the camera's automatic triggering functions, and will require trigger commands directly from the drone via PSDK, HTTP, or MAVLink, depending on the integration.

Thermal Non-Uniform Calibration (NUC)

Performing Non-Uniform Calibrations on (NUCing) thermal images helps reduce image noise, resulting in better thermal image quality. The auto-NUCing feature is enabled on boot, and ensures that the calibration is up to date with NUCs occuring every five minutes or when the temperature of the camera changes by 2 Kelvin. Altum firmware version 2.0.0 and newer has a manual NUCing feature available through the HTTP API and through the serial API, which allows the user or autopilot to request a NUC, instead of depending on the auto-NUCing feature. Once a manual NUC is commanded, auto-NUCing will remain disabled until the camera is turned off and then back on again. Manual NUCing can ensure that NUCs don't occur at inopportune times during data collection, but may lead to poor data quality if NUCs aren't performed as often as needed.

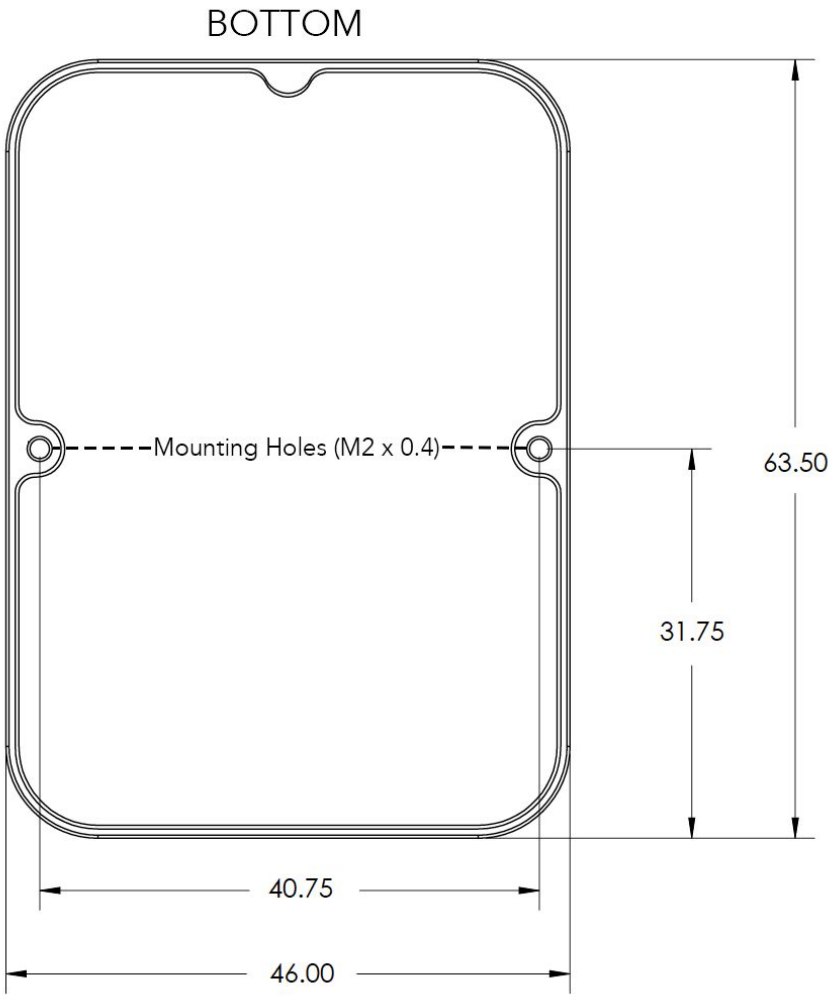
Downwelling Light Sensor 2 (DLS 2)



The Downwelling Light Sensor (DLS 2) is an advanced incident light sensor that connects directly to Altum. During a mission, the DLS 2 measures the ambient light and sun angle and records this information in the metadata of the TIFF images captured by the camera. This information can then be used by specialized processing tools (like Pix4Dmapper) to correct for global lighting changes in the middle of a flight, such as those that can happen due to clouds covering the sun.

In addition, the DLS 2 provides GPS data to Altum unless GPS data is provided from an external source as outlined earlier in this guide. If using an alternative GPS source, the GPS receiver will remain on at low power.

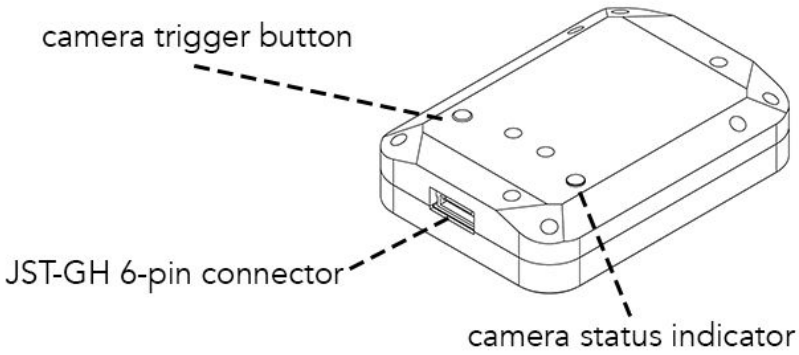
Measurements and Attachment Points



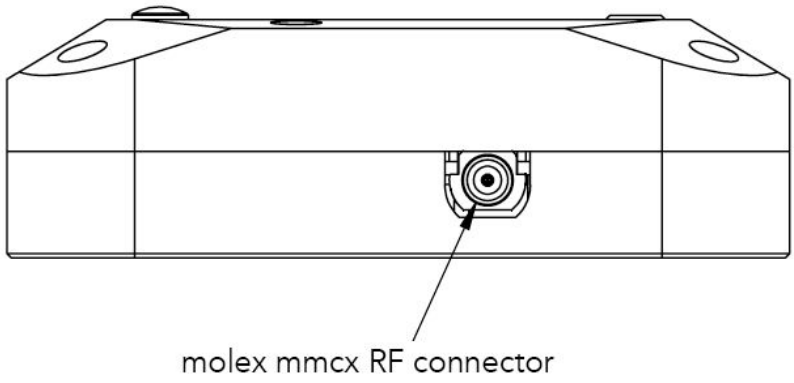
Height	14.03 mm
Width	46.00 mm
Length	63.50 mm
Weight	49 g

DLS 2 Connectors and Buttons

The sensor kit includes all required interface cables to connect to the DLS 2.



The LED camera status indicator mimics the LED signals on Altum. The signal types are outlined in the User Guide for MicaSense Sensors. The camera trigger button will command a capture on the Altum. This is useful for capturing a preflight image of the calibration panel, but care should be taken not to cover or shade any of the light sensors when pressing the button.



Older DLS 2 have an RF connector. This connector is not used by the DLS 2 or camera.

DLS 2 Installation Guidelines

The DLS 2 should always be the highest object on the aircraft in order to avoid shadows or reflections. It contains an integral GPS sensor that may be utilized for geotagging of the Altum imagery if system GPS signals are not provided to the sensor by other means. Install the module where it will have a clear view of the sky, far away from any devices that could interfere with GPS signals (like a data link or video transmitters).

When the DLS 2 starts up, it attempts to calibrate, which requires it to be still and motionless. Ensure that there is no vibration or movement until the DLS 2 has completed this procedure, indicated by normal LED status lights (shown in the User Guide for MicaSense Sensors).

NOTE

The 6-pin connector on the DLS 2 should be facing forward, in the flight direction. Mounting it in the opposite direction will cause the magnetometer calibration *process* to be backwards, but will otherwise still work.

Fixed-wing

Always install the DLS 2 at the high-point of the fuselage (if possible) to avoid any shadowing or reflections from the aircraft fuselage, tail, or propellers.

Do not recess or embed the DLS 2 sensor body below the metallic base.

Local reflections could impact light sensor measurements. Avoid bright or metallic paint near the DLS 2 light sensor as this may interfere with incoming light values.

Multirotor

Install the DLS 2 on a rigid post such that it is the highest object on the aircraft.

Ensure that there are no obstructions in the DLS 2's field of view to the sky, including propellers and other items on the aircraft.

Keep the DLS 2 away from the aircraft GPS. Installing the DLS 2 near the aircraft GPS may impact the aircraft's GPS reception.

Example Integration

Altum and DLS 2 on a Matrice 200. The sensor draws power directly from the Matrice via the Skyport. The DLS 2 is the highest object on the aircraft.

MicaSense Altum and DLS 2 Integration Guide

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MicaSense, Inc.
Seattle WA 98103

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Revision History

Revision	Description	Date
08	Initial Release	26 Apr 2019
09	Added inputs and outputs	18 Jun 2019
10	Updated band wavelengths, added NUC info, updated "What's included?"clarified USB Ethernet options, noted the need to be on latest firmware version	02 June 2020