# DATASHEET

# C A S I A ®

**Ensuring no two aircraft collide mid-air.**

uAvionix reserves the right to alter this document at any time without notice.

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# CONTENTS

# C A S I A ®

The world's **smallest**, **lightest**, and **lowest power** long-range Detect and Alert (DAA) solution for small UAS.

# FEATURES

### DETECT & AVOID
Sense non-cooperative aircraft using a patented computer vision and AI system.

### INTEGRATED ADS-B
Integrated ADS-B for increased coverage with cooperative aircraft.

### COLLISION AVOIDANCE
Avoid collisions with automatically executed, safe, drone maneuvers.

### PILOT-IN-COMMAND
Report detected intruder aircraft to the ground-station and pilot-in-command in real time*.

### LOW SIZE, WEIGHT & POWER
Low SWaP (Size, Weight, and Power) for easy integration on small UAS platforms.

### AUTOPILOT COMPATIBLE
Turn-key integration with supported autopilot systems. Supports common commercially available autopilots.

*Requires support from the autopilot and ground-station software being used.

# Quality & Compliance

Designed, manufactured and hand assembled in the USA.

Tested for environmental and electrical ruggedness with over 500 hours of flight.

Compliant with FCC Part 15, Industry Canada, Conformité Européenne, RoHS, Lead

Free standards. Please recycle electronics.

# Performance Specifications

Casia detects and classifies small single engine aircraft and single disk rotorcraft.

| 98.9% | 4.7 | +/- 0.5 | +/- 0.5 | 7.9Hz |
|---|---|---|---|---|
| DETECTION RATE | HOURS | DEGREES | DEGREES | FRAME PROCESSING RATE |
| | AVERAGE BETWEEN FALSE POSITIVES | ELEVATION ACCURACY | BEARING ACCURACY | |

| | | Av. Declaration Range | Max Declaration Range |
|---|---|---|---|
| SMALL PLANE (E.g. Cessna-172) | | 1549 | 2656 |
| HELICOPTER (E.g. Bell 206) | 1080 | 1430 | |
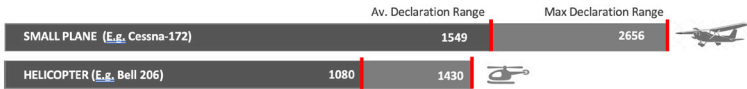
## Performance varies based on the detected intruder type:

### SMALL PLANE

| | |
|---|---|
| Maximum Declaration Range | **2656m** |
| Average Declaration Range | **1549m** |
| Range Estimation Accuracy | **+/- 12.8%** |
| Classification Precision | **99.82%** |
| Speed Estimation Error | **+/-34.9m/s** |
| Heading Estimation Error | **+/-88 degrees** |

### HELICOPTER

| | |
|---|---|
| Maximum Declaration Range | **1430m** |
| Average Declaration Range | **1080m** |
| Range Estimation Accuracy | **+/- 42.8%** |
| Classification Precision | **96.45%** |
| Speed Estimation Error | **+/-32.9m/s** |
| Heading Estimation Error | **+/-59 degrees** |

*Note: Declaration range is the distance at which Casia detects an intruder aircraft and classifies it, for example, as a small plane, helicopter, or multirotor.*

## IMPORTANT

Casia I has been trained and tuned to detect and classify small GA aircraft. The above detailed performance is specific to the detection of small GA aircraft (small planes and helicopters). Casia I will not perform to the above level when intruder aircraft are small drones. This is the case even when aircraft scale is considered, as there are many factors involved in etecting crewed aircraft.

The above performance specifications will not be achieved in all environments and conditions. See Limitations and Disclaimers for additional information. See the Casia I User Guide for performance evaluation criteria.

Performance improves as software releases are made and uAvionix reserves the right to alter the above performance data without notice.

# Hardware Specifications

| | |
|---|---|
| Input Voltage | **11V-40V DC** |
| Power | **10W Nominal, 15W Peak** |
| | |
| Mass | **Casia Module: 291g (with enclosure)** |
| | **Casia Module: 167g (without enclosure)** |
| | **Camera: 191g** |
| External Dimensions | **Module: 77mm (W) x 110mm (L) x 36mm (D)** |
| | **Camera:6 0mm (W) x 60mm (L) x 105mm (D)** |
| | |
| *Ambient Termperature | **-20℃ to 60℃** |
| *Ambient Humidity | **85℃ / 85% RH, 168 hours** |
| | |
| *Shock | **140G, 2ms** |
| *Vibration | **10Hz to 200Hz, 1G and 2G RMS** |
| | |
| Aviation Environment | **Visual Meteorological Conditions (VMC)** |
| Times of Day | **30 mins after sunrise,** |
| | **30 mins before sunset** |
| Precipitation | **Nil** |
| Cloud Coverage | **Okta 0-8** |
| | |
| *Over Water | **Casia may function over water but has been insufficiently tested.** |
| | **Contact support@uavionix.com for advice.** |
| *Over Sand | **Casia may work over sand but has been insufficiently tested.** |
| | **Contact support@uavionix.com for advice.** |
| *Over Snow | **Casia may work over snow but has been insufficiently tested.** |
| | **Contact support@uavionix.com for advice.** |
| | |
| Field of Regard | **Horizontal: 80 degrees** |
| | **Vertical: 50 degrees** |
| | |
| Interfaces | **TTL Serial UART (x1)** |
| | **CAN Bus (x2)** |
| | **USB 3.0 [Host] (x2)** |
| | **Ethernet (x1)** |
| | **Micro SD (x1)** |
| | **Micro USB [Device] (x1)** |

**\*** - *Indicates that testing is ongoing and that these are expected values. See the Casia User Guide for performance evaluation criteria.*

# Autopilot Support

The following table shows the levels of support and testing for different versions of the autopilot firmware that are supported by Casia.

|  | Collision Avoidance | Intruder Downlink | Alerts | ADS-B Passthrough |
|---|---|---|---|---|
| **ArduCopter** | 3.4.0+ (descend) | 3.4.0+ | 3.4.0+ | 3.4.0+ |
| **ArduPlane** | 3.4.0+ (right turn) | 3.4.0+ | 3.4.0+ | 3.4.0+ |
| **PX4** | 1.9.0+ (right turn) | 1.9.0+ | 1.11.2+ | 1.9.0+ |
| **Piccolo** | 2.2.4h (left & right turns) | 2.2.4h | 2.2.4h | 2.2.4h |
| **UAV Navigation** | Contact support@uavionix.com | | | |

*For additional autopilot support, contact sales@uavionix.com*

# Ground Control Station Compatability

The following features have varying support from the respective ground control station software packages available.

|  | Intruder Display | Intruder Alert | Avoidance Alert | Health Alert |
|---|---|---|---|---|
| **Mission Planner** | Yes | Yes | Yes | Yes |
| **QGround Control** | Yes | No | Yes | Yes |
| **Piccolo Command Center** | No | Yes | Yes | Yes |
| **Visionair** | Contact support@uavionix.com | | | |

# Electrical

## POWER INPUT
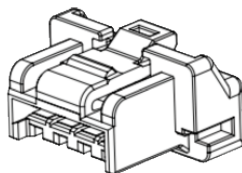
**EXTERNAL MARKINGS:** Power
**CONNECTOR SERIES:** Molex Clik-Mate
**MATING CONNECTOR:** 502439-0200
**CRIMP TERMINALS:** 502438-0100 (Loose),
                    502438-0000 (Reel)
**SUGGESTED WIRE GAUGE:** 22-26 AWG
**USAGE:** Power input supply to Casia systems

| Pin | Type | Signal | Voltage | Wire Color |
|-----|------|--------|---------|------------|
| 1 | Ground | GND | - | Black |
| 2 | Input | V+ | 11-40V DC | Red |

## SERIAL UART
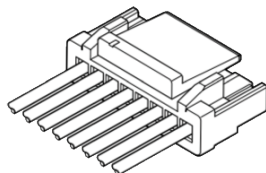
**EXTERNAL MARKINGS:** Serial 2
**CONNECTOR SERIES:** JST GH
**MATING CONNECTOR:** GHR-06V-S
**CRIMP TERMINALS:** SSHL-002T-P0.2 (Reel)
**SUGGESTED WIRE GAUGE:** 28-30 AWG
**USAGE:** Autopilot and ADS-B RX/TX connection

| Pin | Type | Signal | Voltage | Wire Color |
|-----|------|--------|---------|------------|
| 1 | Supply | 5V Output | 5.0 | - |
| 2 | Output | TX | 3.3V | Yellow |
| 3 | Input | RX | 3.3V | Orange |
| 4 | Output | CTS | 3.3V | Brown |
| 5 | Input | RTS | 3.3V | Green |
| 6 | Ground | GND | - | Black |

*Pictures are for reference only and may not reflect exact connector
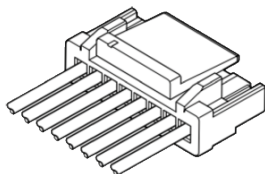
# CAN BUS INTERFACES

**EXTERNAL MARKINGS:** CAN 1, CAN 2
**CONNECTOR SERIES:** JST GH
**MATING CONNECTOR:** GHR-04V-S
**CRIMP TERMINALS:** SSHL-002T-P0.2 (Reel)
**SUGGESTED WIRE GAUGE:** 28-30 AWG
**USAGE:** Autopilot and ADS-B RX/TX connection

| Pin | Type | Signal | Voltage | Wire Color |
|-----|------|--------|---------|------------|
| 1 | Supply | 5V Output | 5.0 | Red |
| 2 | Input/Output | CAN H | $+/-12V_{CM}$ | Blue |
| 3 | Input/Output | CAN L | $+/-12V_{CM}$ | Green |
| 4 | Ground | GND | - | Black |

# USB 3.0

**EXTERNAL MARKINGS:** USB 3.0
**INTERFACE MODE:** Host
**CONNECTOR SERIES:** USB 3.0 Type A
                      Screw Locking
**MATING CONNECTOR:** USB 3.1/3.0/2.0
                       Type A Plug with Jack Screws
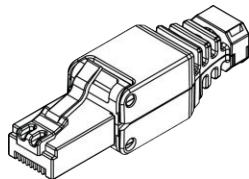**USAGE:** Casia camera interface

# ETHERNET

**EXTERNAL MARKINGS:** Ethernet
**CONNECTOR SERIES:** RJ45
**MATING CONNECTOR:** Standard RJ45
**USAGE:** Data transfer and software update

*Pictures are for reference only and may not reflect exact connector

## USB 2.0

**EXTERNAL MARKINGS:** Programming
**INTERFACE MODE:** Device
**CONNECTOR SERIES:** USB 2.0 Micro B
**MATING CONNECTOR:** USB 2.0 Micro B Jack
**USAGE:** uAvionix Engineering Debug



## MICRO SD

**EXTERNAL MARKINGS:** Micro SD
**CONNECTOR SERIES:** Standard Micro SD
**USAGE:** Currently unused

*Pictures are for reference only and may not reflect exact connector

# Mechanical

*Footprint and mounting hole pattern for Casia module.*



FRONT

USB 3.0   USB 3.0   GMSL   A B C   CAN TERM.   CAN 1   CAN 2   SERIAL 1   SERIAL 2   POWER STAT.   POWER + 11-40VDC

40mm

BACK

CASIA   MICRO SD   PWR   RKV   RST   ETHERNET   MICRO USB

32mm

TOP

54mm

120mm

128mm

# Optical

*Footprint and mount points for FLIR Backfly S family of cameras*

## CAMERA BODY: FLIR Blackfly S
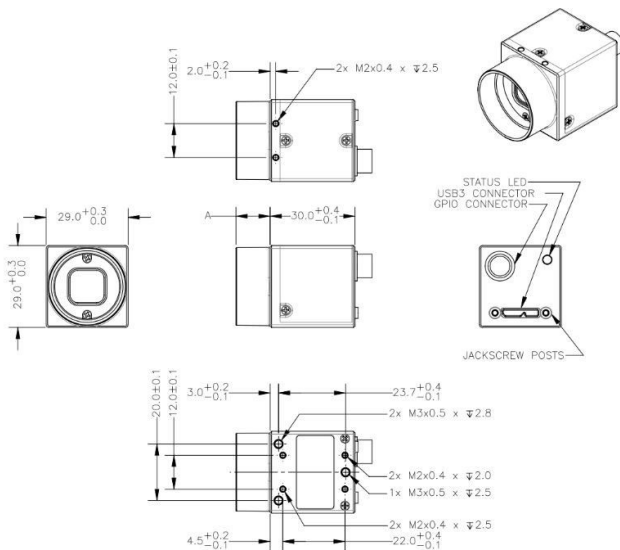


## CAMERA LENS:

Dimensions of Computar 8mm Low Distortion C-Mount Lens
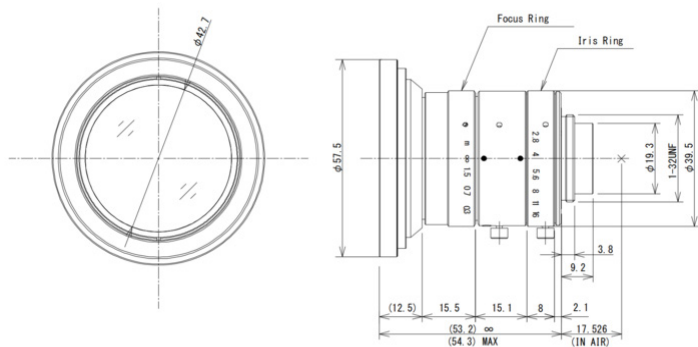
# Limitations and Disclaimers

Setup and maintenance of Casia must be performed as per the Casia User Guide to ensure that Casia performs optimally. Setup of the Casia System must be verified by an uAvionix Engineer. Contact support@uavionix.com for assistance.

Incorrect camera focus or installation can affect Casia performance:

• If the camera is not focussed correctly, Casia will not detect as specified.

• If the field of view of the camera is partially obscured - for example - by a propeller, wing, or other part of the UAS, or any other object including bugs and water droplets, Casia will not detect as specified.

• Elevation and bearing accuracy of Casia will vary based on the precision of integration of Casia cameras.

Pre and post-flight checks must always be performed as specified in the Casia User Guide.

uAvionix leverages artificial intelligence and machine learning to ensure Casia 'learns' to correctly interpret its environment. Casia has been trained to identify small piloted aircraft and helicopters, and is designed for use in low risk airspace, some distance away from airports. The performance and limitations of the Casia system should be understood by the pilot in command before using Casia as part of a layered air risk mitigation approach.

• If Casia has not been 'trained' in an environment similar to yours, performance - including detection rates and the frequency of false positives - may vary from that specified. Casia has been 'trained', tested and performance verified in the following operational environments: Agricultural, forested, desert (with visible features), sparsely populated urban areas, and above canyons. Evaluation of Casia in other environments is ongoing. For such environments, Casia's performance should be assumed to be extremely low / zero until testing is performed. Please contact support@uavionix.com for guidance.

• Casia has been optimized for low risk airspace, away from airports. If Casia 'sees' larger aircraft (e.g. Boeing 747) several miles away, it may report a smaller aircraft at a closer range.

• Casia was not trained to detect powered parachutes, paraplanes, hot air balloons, large planes/jets, other aircraft or other objects. This should be considered by the operator when evaluating air risk.

- Casia may not detect every aircraft in all environments under all circumstances, and may not detect all intruders early enough for an avoidance maneuver to be successfully performed. This must be considered during air risk assessment.

- The time taken for Casia to detect uncooperative piloted aircraft can vary due to environmental conditions, distance, aircraft size, clutter, smoke, and other factors.

- Depending on the performance (turn radius, cruising speed, ascent/descent rates, acceleration/deceleration rate) of your UAS, the time taken to avoid a detected intruder aircraft will vary. This must be considered during air risk assessment.

- The specified range estimation accuracy assumes automated avoidance maneuvers are enabled. This configuration ensures intruder aircraft do not get as close to the ownship. If automatic avoidance is disabled and intruder aircraft are allowed to get closer to the ownship, it should be assumed that range estimation accuracy decreases.

- Casia does not detect static objects.

The specified Casia performance - particularly the detection rate - was based on actual encounters with piloted aircraft intruding from above the skyline. Performance below the skyline is still being assessed and should therefore be presumed to be significantly lower.

Reliability / average uptime of the Casia System is under evaluation. Casia should be rebooted between flights to maximize performance.

EMI from Casia may interfere with range and performance of C2 systems. This should be fully evaluated by the operator and, if necessary, advice sought from support@uavionix.com.

Casia I has been trained and tuned to identify and classify small GA aircraft. The above results are specific to the detection of small GA aircraft (small planes and helicopters). Casia I will not perform to the above level when the intruder aircraft are small drones. This is the case even when aircraft scale is considered, as there are many factors involved in Casia I detecting crewed aircraft.

Your Casia system should be replaced following a crash or heavy impact, or should be returned to uAvionix for evaluation and repair.

If you believe Casia may not be performing correctly, it should NOT be used and support@uavionix.com should be contacted for guidance.

For regulatory guidance, please contact sales@uavionixcom.

# Ensuring no two aircraft collide mid-air.