



USERGUIDE

Software Version 3.4

Product Code: GACM-0100

C A S I A  G



Making flying safer by avoiding collisions.

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

Contents

| | |
|--------------------------------------|----|
| Features | 1 |
| Safety First | 2 |
| System Performance | 3 |
| Operational Limitations | 4 |
| Quality & Compliance | 4 |
| Operational Area | 5 |
| Included with Casia G | 6 |
| Casia G Module | 7 |
| Installation | 11 |
| Uploading Data | 28 |
| Standby Mode | 29 |
| Situational Awareness | 30 |
| Alert Behavior | 36 |
| Electro-Optical & ADS-B Correlation | 38 |
| Masking (Persistent False Positives) | 39 |
| Collision Avoidance Behavior | 40 |
| Simulation & Data Analysis | 40 |
| Pre-flight Checklist | 41 |
| Preventative Maintenance by uAvionix | 42 |
| Preventative Maintenance by Owner | 43 |
| WatchDog Behavior | 44 |
| Troubleshooting | 45 |
| Limitations & Disclaimers | 48 |



The world's most advanced, ground based, unlimited coverage, Detect and Alert system for cooperative and non-cooperative air traffic.

Features

Detect & Alert

Senses non-cooperative aircraft using a patented computer vision and AI system.

Integrated ADS-B

Integrated ADS-B for cooperative aircraft detection.

Electro-optical and ADS-B Detection Correlation

Electro-optical (non-cooperative aircraft) and ADS-B (cooperative aircraft) detections are correlated to provide a single intruder detection, and the most accurate data possible.

360 Degree Field of Regard

Our six camera Casia G systems provide a 360 degree field of regard around your drone operation.

Always On

Casia G is constantly focused on surveiling the airspace, allowing you to fly at a moments notice. It is ready and waiting and doesn't require breaks.

Unlimited Coverage

Each Casia G node is small and easy to install. If you want to cover a greater area, or give your operations more time to react to intruder aircraft, additional systems can be deployed that work together in a mesh network

Safety First

Casia G provides additional situational awareness and safety redundancy during UAS operations.

Follow the pre-flight checks to test all equipment and ensure operating conditions (e.g. visibility) are satisfactory before commencing any UAS mission.

Review the **Operating Limitations** section of this document.

It is your responsibility to maintain **operations in accordance with local aviation regulations**.

uAvionix does not take on liability for your UAS operations, regardless of whether uAvionix technology is leveraged.

Before commencing any UAV operations, read the Limitations and Disclaimers section of this document to understand the importance of correct maintenance, the operation of Casia, and the potential impacts of external factors on its performance.

System Performance

The following performance numbers were obtained by flying fixed wing and rotary GA aircraft at each of the 6 Casia G cameras at multiple altitudes, angles, and velocities. Declaration range varies based on the size of the intruder aircraft.



• Declaration range is the distance at which an aircraft is detected and classified. Once an intruder is detected, the time taken to react, the time taken for your UAS to move to a safe zone, and the speed of your UAS, and the typical speed of intruder traffic must be considered in determining your operational area.

Detection rate was determined based on real encounters of general aviation aircraft with Casia G. Detailed performance reports are available for regulatory approval purposes. Email sales@uavionix.com for more information.

Performance improves as new software is released. uAvionix reserves the right to alter the above without notice.

Performance will reduce below that specified when visibility decreases.

Casia G will classify intruders as one of the following.

| Detected Intruder Types | Small single engine aircraft, single disk rotorcraft, birds, multirotors |
|-------------------------|--|
|-------------------------|--|

Casia G has been trained and tuned to identify and classify small GA aircraft. The above results are specific to the detection of small GA aircraft.

Casia G will not perform to the above specified level when the intruders are small drones or birds. This is the case even when scale is considered, as there are many factors involved in Casia G detections.

Operational Limitations

Casia G must only be operated within the following limitations. In addition, pre-flight checks must be performed before flight, as specified in the Pre-flight Checklist section.

*Ambient Temperature **-10°C to 50°C**

*Ambient Humidity **85°C / 85% RH, 168 hours**

Times of Day **30 mins after sunrise,
30 mins before sunset**

Precipitation **Nil**

Cloud Coverage **Okta 0-8**

Visibility **Performance will vary based on visibility as follows:**

| | Small Plane | | Helicopter | |
|----------------------|---------------------------|----------------|---------------------------|----------------|
| Visibility | Average Declaration Range | Detection Rate | Average Declaration Range | Detection Rate |
| >= 10miles | 2089m | 98.6% | 1908m | 98.9% |
| 5 miles | 2030m | 98.6% | 1854m | 98.9% |
| 3 miles | 1978m | 98.6% | 1807m | 98.9% |
| 1 mile | 1693m | 98.6% | 1547m | 98.9% |

• *To operate in the specified ambient temperatures, sufficient airflow - as is provided by the standard Casia G mounts - should be provided over the underside of the Casia G. The heat sink on the underside of Casia G (black anodized metal area) conducts heat away from the device and is cooled by airflow.*

Quality & Compliance

Designed and hand assembled in the USA.

Tested by uAvionix for environmental and electrical ruggedness with over 1,150 hours with no operational issues.



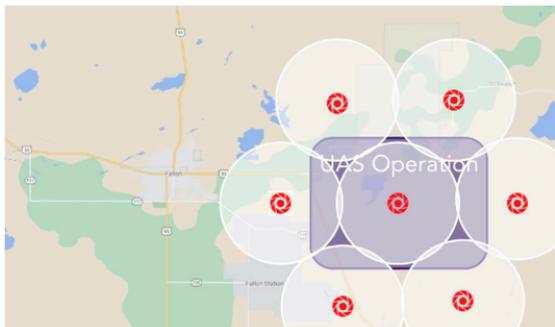
Operational Area

The surveillance area provided by Casia G provides time for you to maneuver to avoid intruding cooperative aircraft (detected via ADS-B receiver in Casia G) and non-cooperative aircraft (detected by Casia G cameras).

Each operation / location may have different surveillance area requirements due to variables such as:

- Air space class
- Desired area of operation
- Performance envelope of UAVs (turn rate, descent rate, cruise speed)
- Avoidance maneuvers to be performed, including whether they are initiated automatically or via directive or suggestive pilot interactions
- Typical speed and altitude of intruder aircraft

uAvionix can provide guidance on how best to conduct safe operations with Casia G. Contact support@uavionix.com



If your UAV operations cover a large area, you may require multiple Casia G systems.

To discuss your needs, email sales@uavionix.com.

Included with Casia G

- 1x Quick Start guide
- 1x Casia G device
- 1x Casia G power supply in weather proof box
- Pole mount brackets for Casia G power supply box
- 1x RJ45 ethernet cable with bayonet connector (5 meters)
- 1x 24V power supply cable with 4 pin type A M12 (2 meters) - attached to power supply box
- 1x 110V power supply cable (3 meters) - attached to power supply box
- 1x microfibre cloth

Casia G mounting brackets are sold separately and include u-bolts and fasteners.



DO NOT OPEN OR ATTEMPT TO OPEN THE CASIA G BODY. DOING SO WILL VOID YOUR WARRANTY.

Casia G Module

The Casia G Module houses six cameras, a sensor package to automate configuration, and a graphical processing unit with uAvionix's proprietary software installed. The software is the brains of the Casia G ground based Detect and Alert system for detecting non cooperative air traffic.

The Casia G module also houses an ADS-B receiver to detect cooperative air traffic.

The anodized aluminium part of Casia G below the white molded plastic section housing the cameras contains the processing power.

A heatsink and fan are used to cool the processor. The airflow around the heatsink should not be impaired. Foreign bodies (e.g. screw drivers) should not be allowed to interfere with the fan's ability to spin.



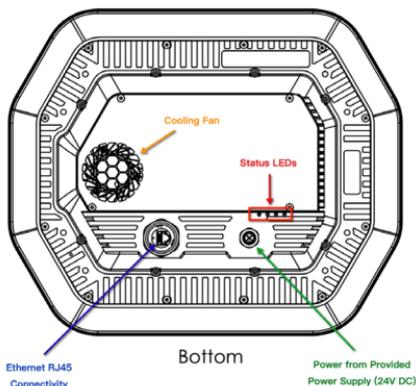
Casia G Module on tripod mount.

Power and Data Connections

As shown below, Casia G has two connections:

1. Ethernet RJ45 bayonet connection
2. Power from the provided 24VDC power supply - 4 pin type A M12

Casia G underside drawing



The ethernet connection is via a IP67 rated bayonet connector as shown below. The supplied CAT 6 cable is 5 meters long.

NOTES:

1. Electrical specifications:
 - Meets EIA/TIA-568-B.2 Cat 5e specification
 - Contact resistance: 20 mOhm max.
 - Insulation resistance: 500 MOhm min. @ 100 V DC
 - Current rating: 1.2 A max. at 25° C
 - Working voltage: 100 V DC
 - D. W. voltage: 1500 V DC/60 s contact to contact
 - 1500 V DC/60 s contact to metal shell
 - Temperature range: -40° C to +80° C
2. Material And Finish:
 - Coupler ring: Zinc die-cast, nickel plated
 - Plug housing: Zinc die-cast, nickel plated
 - Interfacial seal: Silicone, transparent
 - Cable gland: Brass, nickel plated
 - Cable gland rubber ring: NBR, black
 - RJ45 Plug metal shell: Copper alloy, nickel plated
 - RJ45 Plug plastic housing: PC UL 94 V-2, clear
 - RJ45 Plug contact: Phosphor bronze, finish min. 50µg gold over nickel
3. IP67, rated when covered or fully mated with the appropriate mating connector.
4. RJ45 Plug accepts both stranded and solid wire with outer diameter of 4.83mm to 6.73mm
5. Cable fitting accepts cable outer diameter range of 4.5mm to 6mm
6. RoHS compliant
7. Packaging Spec: 107-19763
8. Material And Finish:
 - Coupler ring: PBT UL 94 V-0, black
 - Plug housing: PBT UL 94 V-0, black
 - Interfacial seal: Silicone, transparent
 - Cable gland: PBT UL 94 V-0, black
 - Cable gland rubber ring: NBR, black
 - RJ45 Plug metal shell: Copper alloy, nickel plated
 - RJ45 Plug plastic housing: PC UL 94 V-2, clear
 - RJ45 Plug contact: Phosphor bronze, finish min. 50µg gold over nickel

REVISIONS

| REV | DESCRIPTION | DATE | BY | APP'D |
|-----|--|----------|----|-------|
| 1 | INITIAL RELEASE | 20080319 | SS | JR |
| A1 | CABLE GLAND MATERIAL CORRECTION NOTE 8 | 20080322 | SS | KSP |

Technical drawing of the RJ45 Plug Kit. It includes a side view showing the 'Bayonet coupler ring', 'Shielded Cat 5e RJ45 Plug', 'Cable Gland', and 'Plug Housing'. Dimensions include 11.00, 21, and 59.02. A top view shows the 'Interfacial seal' and 'Key protrusion (3x)'. A bottom view shows the 'RJ45' contact area with a diameter of 6.73 and a depth of 11.00. Labels include 'RJ45' and 'Key protrusion (3x)'.

| | | |
|--------|-----------|------|
| EB1956 | 2362760-2 | |
| EB1956 | 2362760-1 | |
| UL NO. | MATERIAL | TEPN |

THIS DRAWING IS A CONTROLLED DOCUMENT

| REV | DATE | BY | APP'D |
|-----|----------|----|-------|
| 1 | 20080319 | SS | JR |

REV: 1.0
 DATE: 20080319
 BY: SS
 APP'D: JR

STE TE Connectivity

RJ45 PLUG KIT
 SHIELDED CAT 5e RJ45 PLUG

DATE: 20080319
 TIME: 11:10:16Z
 FILE: A:\3\00719\007-2362760

Installation

#1 Installation Locations

Casia G needs a clear, 360 degree view of the sky, or its performance will be impacted. It cannot see through buildings, trees or other obstructions. As such, locate Casia G as far away as possible from any obstructions, or raise Casia G above obstructions.

Install Casia G away from buildings. Place on top of buildings when possible, or add additional systems to compensate when the sky is obscured.



Install Casia G away from trees, or mount above trees to ensure the field of view of the system is not obscured.





Scan the QR code to watch the installation locations video.
See all installation videos at the Casia G getting Started page:
<https://flightdeck.irisonboard.com/casia-g/gettingstarted>

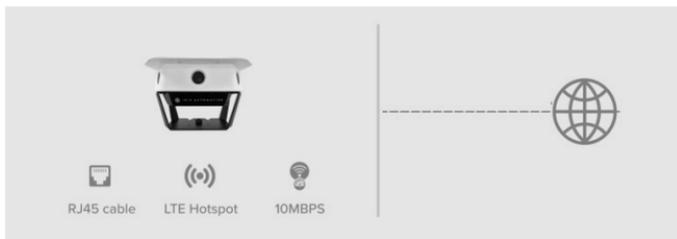


Casia G should be installed at least four feet above the ground (e.g. on a tripod), and performs well on top of very high buildings, up to 800 feet AGL. If you wish to install at altitudes above 800 feet, please email support@uavionix.com for guidance.

Casia G is powered via a 24V power supply, which in turn consumes peak power of 70W (65W nominal). The 24V power supply requires 110V AC. If the chosen location for Casia G does not have standard shore power, generators or solar panels can be leveraged. See the 'Powering Casia G' section of this document for more information.



Casia G needs to be connected to the internet to provide its output to your situational awareness tool. It can be connected to your internet router, or - if not available at your desired location - to an LTE device. See the 'Casia G Connectivity' section of this document for more information.



#2 Casia G Power Supply

Power Supply: 110V AC in / 24V DC out

The Casia G power supply is contained in a weathproof box. The power supply should be plugged into a standard 110V mains/shore power outlet. The power supply delivers 24V DC power to the Casia G module. The peak power consumption of Casia G is 70W, so at least this amount must be available. Casia G accepts a power input voltage of 11-36V. This power supply should be located within 100' of the Casia G.

If desired, Casia G can be powered from solar panels, however, consideration must be taken into whether power will available for all the the working hours of the system.

The EXTERNAL dimensions of the power supply box are 11.25 x 8.25 x 5.5 inches. The dimensions of the actual power supply inside the weatherized case are 3.75 x 7.5 x 1.5 inches.



Power Supply Box



Power Supply Pole Mount Option

The box containing the power supply has an LED light on the bottom which indicates if the power supply is producing power.



The power supply box can be screwed to a wall / post, or mounted to a mast/pole using optional hardware. When used with a tripod mount, the mounting bracket is not required, and it can be left under the tripod, or somewhere that it is not a tripping hazard.



Scan the QR codes for how to videos on installing brackets to the power supply box and mounting the power supply box to a mast. See all installation videos at: <https://flightdeck.irisonboard.com/casia-g/gettingstarted>



#3 Casia G Connectivity

Casia G needs to be connected to the internet to provide its output to your situational awareness tool. It can be connected to your internet router, or to an LTE device using the supplied RJ45 ethernet cable.

The upload speed should be at least 10Mbps for standard operations.

Standard operations would be sending detection data, heartbeat, and status messages to your situational awareness tool

Depending on the data collection parameters and the volume of air traffic in your location, each Casia G device can generate in excess of 1TB of video each day. Normally, video will just be overwritten if not uploaded. This is as designed, as generally, video of the sky is not that interesting to look at.

If you do want to upload video from the device, for example, for regulatory purposes, you will need a suitable internet connection. A 1 Gbps upload speed would be appropriate to facilitate this.

 **Some internet providers cap the volume of data that can be uploaded in a given time period.**

 **Casia G does not provide situational awareness while data is being uploaded.**

#4 Mounting (Mast, Tripod)

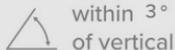
Casia G is typically mounted to a pole/mast (permanent locations) or to a tripod/telescopic pole (temporary locations). Other mounting configurations should be discussed with uAvionix. Please contact support@uavionix.com to discuss options.

Casia G Mounts can be sourced from uAvionix.

If mounting is to a pole/mast, the pole should be schedule 40 and 2-4”.

Casia G should be mounted at the top of the pole, otherwise the field of view will be partially obscured, reducing the effectiveness of the system.

The mast/pole should be within 3 degrees of vertical. This can be determined using a bubble level, the 'Measure' app on iOS, or the 'Bubble Level' app on Android. If the mounting pole is not vertical, it can impact the ability to install Casia G level, which can impact the accuracy of intruder altitude estimates. When mounting Casia G to the mast/pole, Casia mounts allow finer adjustment to easily get Casia within 1 degree of level.



Measure
(iOS)



Bubble Level
(Android)

If mounting Casia G to a telescopic mast on a trailer, the trailer should be leveled prior to extending the mast.



Scan the QR Code to watch instructional video the Casia G side mount and how to install Casia G perfectly level.

For all installation videos, go to:

<https://flightdeck.irisonboard.com/casia-g/gettingstarted>



Mast/Pole Side Mount Assembly

This mounting procedure is for a permanently mounted system where Casia is positioned at an elevated point on a riser pole. In this setup, hardware provided by uAvionix can be used to fix the Casia hardware and power supply to the pole with mounting brackets.

uAvionix will not provide the mast to be mounted on, but has some requirements for that mast to optimize performance of the system.

Equipment Provided by uAvionix

| Equipment | Quantity |
|----------------------------|----------|
| Mast Side Mounting Bracket | 1 |
| U-Bolt and nuts | 2 |

Equipment Provided by Customer

| Equipment | Quantity |
|---|----------|
| 2-4" Rigid Mast (schedule 40) | 1 |
| 110V AC Power Supply | 1 |
| Ethernet Access Point - Ideally gigabit | 1 |



Scan the QR Code for video on using the Casia G side mount to install Casia on a mast. Visit the Getting Started page for all instructional videos:

<https://flightdeck.irisonboard.com/casia-g/gettingstarted>



The mast being used to mount the Casia G must be rigidly fixed to ensure the best performance from the mounted system. Movement of the system while in operation will lead to decreased detection performance and accuracy of estimated intruder locations.

A shorter mast will ensure less movement of the system, but this must be counterbalanced with the need to provide a clear field of view for the system. Casia G should be mounted such that it has a clear field of view of the airspace to be monitored. Obstructions of the field of view by objects near the Casia G will prevent detections of aircraft in those areas. At an installation location with multiple other hardware systems in place, Casia G is ideally mounted at a higher elevation than all other systems.

A 2-4" diameter mast is required to accommodate the mounting bracket provided with the Casia G system. For most applications, it is recommended that a galvanized steel pipe be used to ensure rigidity and corrosion resistance. The mast must be securely anchored at its base and as far up the length of that mast as possible. The longer the length of unsupported mast, the more rigid the mast must be in order to prevent deflection at the top of that mast. Rigidity of the mast can be increased by either increasing the diameter of the mast or the thickness of the mast walls. For an unsupported length of 1-4', a 2" diameter SCH 40 pipe is sufficient.

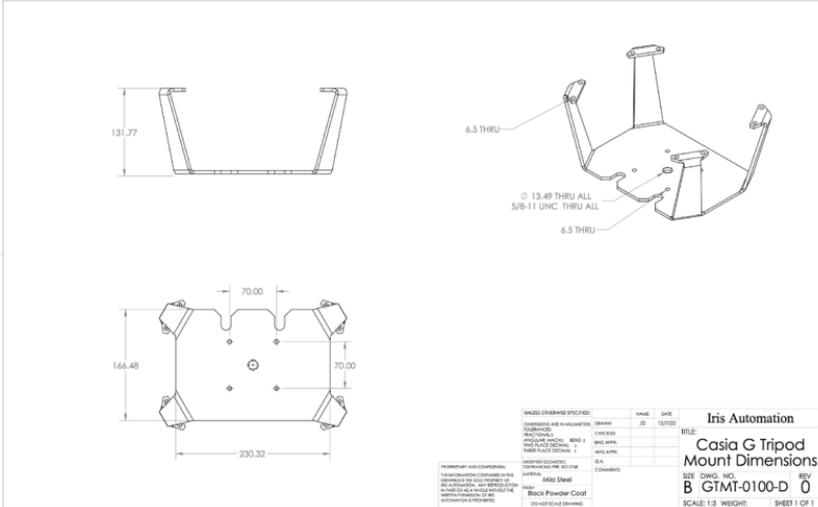
The mast must be positioned as vertical as possible to provide a level mounting point for the Casia G system. The cameras internal to Casia G are rigidly affixed to the enclosure which is in turn rigidly affixed to the mast, so a vertical mast is required to ensure a proper field of view of Casia G. The mast must be within 5 deg of vertical at a minimum and is ideally within 1 deg for best performance. It is recommended that the anchoring point for the mast be adjustable so that fine tuning of the position of the mast can be performed.

Vibration of the Casia G will decrease the performance of the system. The mast must be rigid enough to ensure that it does not experience low frequency or high frequency oscillations when subjected to outside forces such as wind. Rigidity can be improved by increasing the thickness or diameter of the mast or by using guy wires to decrease the amount of unsupported mast. Guy wires can also be used as a means of fine adjustment of the position of the mast to ensure a level platform for Casia G.

Tripod Mount Assembly

The mount shown below is for temporary installations. The mount fastens onto the bottom of the Casia G using M6x8 Button Head bolts.

The mount then screws onto a 5/8"-11 bolt of a tripod or telescopic mount.



Casia G Tripod Mount.

Equipment Provided by uAvionix

| Equipment | Quantity |
|-------------------------|----------|
| Tripod Mounting Bracket | 1 |

Equipment Provided by Customer

| Equipment | Quantity |
|---|----------|
| Tripod | 1 |
| 110V AC Power Supply | 1 |
| Ethernet Access Point - Ideally gigabit | 1 |



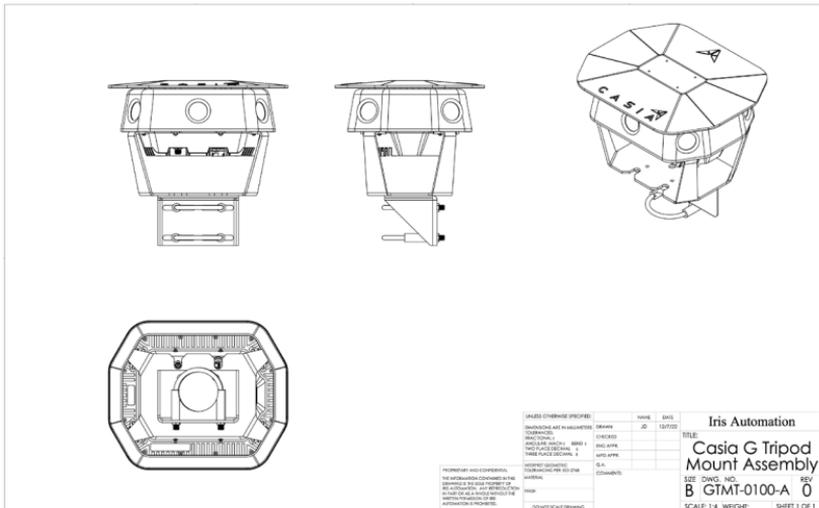
Scan the QR Code video on how to install Casia G on a tripod mount. For all installation videos, got to the Casia G Getting Started page: <https://flightdeck.irisonboard.com/casia-g/gettingstarted>



Mast Top Mount Assembly

This mount is for permanently mounting Casia on top of a riser pole. It leverages the tripod mount with an additional bracket. In this setup, hardware provided by uAvionix can be used to fix the Casia hardware and power supply to the pole with premade mounting brackets.

A 2-4" diameter mast is required to accommodate the mounting bracket. For most applications, it is recommended that a galvanized schedule 40 steel pipe be used to ensure rigidity and corrosion resistance. The mast should be securely anchored at its base and as far up the length of that mast as possible.



When assembled, the Casia G and mounting hardware weighs approximately 7 kg. The mounting bracket has a central thread that can accept a 5/8x11 thread, a common thread for construction or survey tripods. The mount also has a 4x M6 bolt pattern that can be used for a more custom solution.

The area directly below the Casia G body must be kept clear in order to allow for cable clearance and proper airflow to the heatsink. When installed, cables should be routed down the mast and then secured so that they are not free hanging.



Scan the QR code for video on installing Casia G on a mast top mount. Visit the Casia G getting Started page for all installation videos: <https://flightdeck.irisonboard.com/casia-g/gettingstarted>



#5 Check Casia G is Working

Now that Casia G is mounted, lets check everything is working properly.

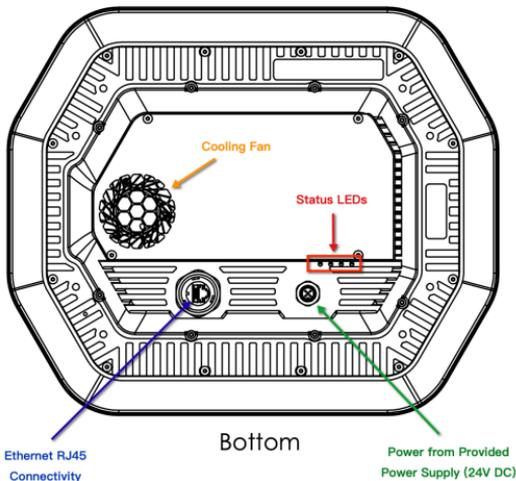
Is Power Supply Receiving Power?

First of all, Plug it in and check that the red LED on the bottom of the power supply box is illuminated.



System Status LEDs Nominal?

Next, check the status of the LEDs on the underside of the Casia G unit. The software watchdog, hardware watchdog, and power LEDs should all be solid red.



As shown in the Casia G underside diagram above, Casia has four status LEDs which help establish whether Casia G is functional. These LEDs are explained below.

| | Status | |
|----------------------------------|--|---|
| Reserved ■□□□ | N/A | N/A |
| Software Watchdog ■□□□ | Solid On <ul style="list-style-type: none"> Ready for Flight Receiving heartbeats from all software components | Slow Blink <ul style="list-style-type: none"> Booting Up/Initialization wait time Fast blink <ul style="list-style-type: none"> Error, lost heartbeats from Software Watchdog Will reset software after timeout finished |
| Hardware Watchdog □□■□ | Solid red <ul style="list-style-type: none"> Ready Receiving heartbeats from linux system to Hardware Watchdog | Slow Blink <ul style="list-style-type: none"> Booting Up/Initialization wait time Fast blink <ul style="list-style-type: none"> Error, lost heartbeats from the Linux system service Will reboot the hardware/device |
| Power □□□■ | Solid red = ready | Not illuminated indicates device not powered. Check power connection. |

#6 Alignment & Configuration

Automated Configuration

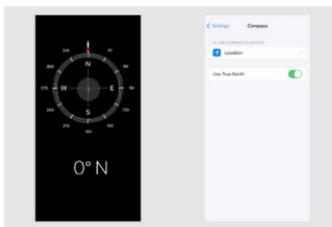
Most Casia G parameters such as position, altitude, roll angle and pitch angle are automatically determined by the internal sensors or are assumed to be a specific value (e.g. alignment). See the Manual Configuration section if for some reason, you cannot use any of the automatically determined values.

Alignment with True North

Once Casia G has been installed on the mast or tripod, it has to be aligned correctly. The simplest way to do this is to ensure that the arrow on the top is pointing to True North. In order for the azimuth of intruder aircraft to be precisely determined by Casia G, alignment must be accurate to within **one degree**. To achieve this, rotate the Casia G on its mount until the arrow on top points to True North.



To determine True North, you may use the Compass app on your smart phone, but ensure to **adjust the app settings to use True North as opposed to magnetic North**.



Scan QR code for instructional video on alignment of Casia G, or visit the Getting Started page for all installation videos:

<https://flightdeck.irisonboard.com/casia-g/gettingstarted>



Manual Configuration

It may not always be possible to use the automated configuration parameters determined by Casia. For example, if Casia cannot accurately determine its GPS location due to nearby buildings or other interference.

In this case, the following parameters must be entered into the uAvionix web application, FlightDeck. This will need to be done if you are installing your device for the first time, or if you have moved your device to a new location.

First, power on your Casia G device and connect it to the internet. Find your device in FlightDeck (flighdeck.irisonboard.com) by selecting the 'Devices' menu option on the left.

Select your device by clicking on it and scroll down to the 'Configuration' section. Click the pencil icon to edit device configuration.

Expand the **Autopilot** section. For automated configuration using Casia Gs built in sensors, the `autopilot__type` should be set to '**GSPA-0100**'. To set your own configuration values, select '**Ground**'. Contact support@uavionix.com if you need assistance.

| Parameter | | Default Value | Value | Rule |
|------------------------------|---|---------------|--|----------|
| <code>autopilot__type</code> |  | GSPA-0100 | <input type="text" value="GSPA-0100"/> | Required |

Now expand the **Static Deployment** section. The question mark icons will give you details on the affect of each parameter.



Enter appropriate values for:

- heading (enter value in radians. This value should be zero (0) if system is pointing to True North)
- latitude (specify to 5 decimal places)
- longitude (specify to 5 decimal places)
- altitude in meters in the AMSL reference frame

| Parameter | | Default Value | Value | Rule |
|--|---|---------------|--|----------|
| <code>autopilot__ground_heading</code> |  | 0 | <input type="text" value="0"/> | Required |
| <code>autopilot__ground_latitude</code> |  | 0 | <input type="text" value="32.83274"/> | Required |
| <code>autopilot__ground_longitude</code> |  | 0 | <input type="text" value="-97.31655"/> | Required |
| <code>autopilot__ground_altitude</code> |  | 0 | <input type="text" value="174"/> | Required |

Be sure to click **Save & Push** to make your configuration affective.

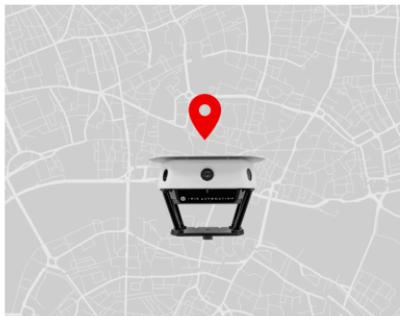
Email support@uavionix.com for assistance.

Save & Push

Configuration Check

Whether the system was configured automatically or manually, you must confirm that the system is properly configured. The easiest way to do this is to check the position of your Casia G in your situational awareness tool.

Ensure your Casia G can be found in the expected location on the map in your tool.



If you experience issues, repeat the configuration steps or email support@uavionix.com.

Advanced Configuration Parameters

Data Collection Parameters

If you require recorded video data for any of the following reasons, you can configure the parameters of your system to collect some / all data:

- Evaluate the performance of Casia G
- Gain regulatory approvals
- Understand traffic in your airspace (airspace categorization)

To do this, find your device in FlightDeck (<http://flighdeck@irisonboard.com>). Go to the 'Configuration' section. Click the pencil icon to edit device configuration. Expand the Data Capture Parameter section. The question mark icon will give you details on the effect of each parameter.



Select appropriate values for each parameter. Email support@uavionix.com for assistance.

Automated Daily Reboot Time

Casia should be rebooted every day. This is automatically enabled for your device to happen at 07:00 UTC.

Change Automated Reboot Time

To change to another time, find your device in FlightDeck (<http://flighdeck@irisonboard.com>). Go to the 'Configuration' section. Click the pencil icon to edit device configuration. Expand the Setting section. Change 'setting_reboot_time' to the desired time in UTC.

setting_reboot_time  07:00

Disable Automated Restart

The automated restart can interrupt data uploads which can occasionally be inconvenient. To eliminate this inconvenience, automated restarts can be disabled. To disable the automated restart, contact support@uavionix.com.

setting_auto_reboot_enabled  Enabled Enabled Disabled

 **IMPORTANT: After changing this parameter, Casia must be restarted for the update to take affect.**

 **Disabling the daily restart should only be done for data upload purposes as it can impair the performance of Casia.**

Uploading Data

See the previous section on Data Collection Parameters to ensure your device is collecting the data appropriate for your needs prior to gathering and uploading data.

Casias G Onboard Data

Casias G is able to store approximately 1TB of data (video and log files). This is generally enough for around 8 hours of continuous data capture. Depending on the volume of intruder traffic and your data collection parameters, this could be enough for 8 hours or many days if there is little traffic in your area and the data capture settings are very minimal.

Once the onboard data storage is full, the device will simply start to overwrite old data with new data. Casias will continue to function without impairment. However, should you want/ need some data, you should upload it as soon as possible, as once overwritten, it cannot be recovered.

How to Upload Data

To upload data from your Casias device, click on your device in <http://flightdeck@irisonboard.com>. From the Devices page, select to 'Manage Device Data' and click 'Go'. Then select the data you want to upload based on time recorded, number of intruder aircraft detected, etc.



Uploading data can take a long time, so use the fastest internet connection you have available.



Casias does not detect aircraft while data is being uploaded,

How to Delete Data

There is usually no reason to delete data other than if a file has been corrupted for some reason. However, if you would like to remove data from your Casias device, you can do so by selecting the 'Manage Device Data' option from the Device page.



Scan the QR Code for video on managing Casias G device data.

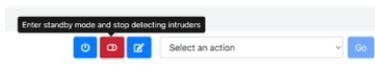
Visit the Getting Started page for all instructional videos:

<https://flightdeck.irisonboard.com/casias-g/gettingstarted>.



Standby Mode

With Casia powered up, you may want to pause its operation for a time - for example - to stop alerts to your situational awareness tool, or to break the recorded data into chunks around specific planned events or tests for easier upload management. This can be achieved by placing Casia in standby mode. To do this, click on your device in <http://flighdeck@irisonboard.com>. In the Devices page select the option to enter standby mode as shown below.



✘ While in standby mode, Casia will NOT detect intruder aircraft.

To exit standby mode and resume detecting intruder aircraft, click the option as shown below.



Situational Awareness

Casia G provides intruder aircraft location, altitude, velocity, classification and other data to situational awareness tools. These tools will process the data and display it to the RPIC, providing awareness to intruder aircraft. This allows decisions to be made on whether and how to keep the UAS operation safe.

Situational awareness can be provided via:

- Applications built by 3rd party organizations
- uAvionix Ground Station tool (provided only for demonstration, initial testing and onboarding)

3rd Party Situational Awareness Tools

There are many situational awareness tools available on the market. See the <https://www.irisonboard.com/casia-g/> web page for uAvionix partners.

These tools commonly provide map interfaces on which intruder aircraft - and often UAS - can be displayed for situational awareness. In many cases, they are also able to provide directive or suggestive avoidance instruction to the RPIC.

uAvionix offers a standard communications protocol for integration with 3rd party tools.

- Full documentation can be found [here](#).
- An emulator of Casia G output can be used to build an integration without a live Casia G device. The emulator can be downloaded [here](#).

Contact sales@uavionix.com to better understand integration possibilities and paths.

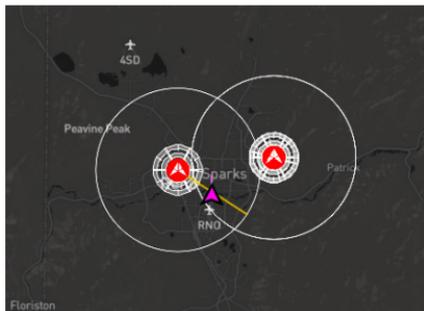
uAvionix Ground Station

uAvionix's Ground Station tool provides situational awareness to intruder aircraft detected by the Casia G electro optical computer vision system, and the integrated ADS-B receiver. This includes audible and visual alerts to the RPIC, and intruder images.

For further reference, review the **Casia G Groundstation Guide** at www.uavionix.com/support

Electro-Optical & ADS-B Correlation

ADS-B Correlation combines ADS-B reports with vision detections in real time to provide enhanced identification capabilities in real time. The algorithm works by using computer vision algorithms to predict a virtual image from ADS-B reports, and computing a similarity metric based upon the real image points and the virtual image points. These correlations enhance the quality of the vision information by allowing it to perform in in challenging conditions such as rain, fog, and cloud cover.



The above shows a correlated EO/ADS-B track, which, in the uAvionix Ground Station application is represented by a purple icon.

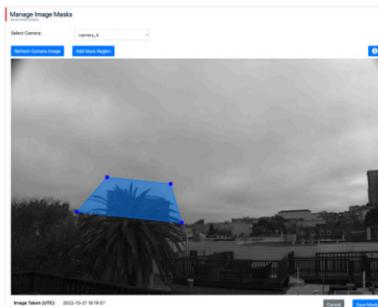
Masking (Persistent False Positives)

A false positive can occur when Casia G falsely detects a non-aircraft object as an aircraft which may be due to some similarity in shape or other factors. For example, a tree branch moving in the wind could - under some conditions - look like a plane. Such false positives could trigger frequently and hamper UAS operations.

uAvionix provides masking capabilities to stop the system triggering on persistent false positives. These capabilities are available via the FlightDeck web application at <https://flightdeck.irisonboard.com/>.

Log on, navigate to your device and select the 'Manage Device Masking' option from the drop down list in the top right corner.

For each camera, mask at least the area below the skyline, and mask other regions as appropriate. If the camera image is outdated, you may want to refresh it by clicking the 'Refresh Camera Image' button. If required, please request assistance by emailing support@uavionix.com.



Scan the QR code for instructional video on masking to prevent false positives. Visit the Getting Started for all instructional videos:
<https://flightdeck.irisonboard.com/casia-g/gettingstarted>



Collision Avoidance Behavior

Physical Avoidance Maneuver

Casia G detects and alerts the operator to intruder aircraft. Suitable safety procedures must be developed to specify how to handle such alerts, including specifying the avoidance maneuver.

 For assistance developing CONOPS and safety cases, please contact support@uavionix.com

Simulation & Data Analysis

Simulation Services

It can be time consuming to gather data across a variety of lighting conditions, visibilities (fog, haze, etc.), cloud cover, and intruder aircraft.

uAvionix can provide simulation of your environment to gather additional robust data to assist in regulatory approvals including demonstrating compliance with ASTM Risk Ratios.

Email sales@uavionix.com for additional information.

Data Analysis Services

uAvionix can share collected data with you, and can perform analysis of collected and simulated data to aid in regulatory approvals, airspace categorization, and evaluation of risk ratios of your operation.

Email sales@uavionix.com for additional information.

Pre-flight Checklist

The following checks must be performed before flight each day to ensure that Casia G is functioning correctly, and that operating conditions are suitable for Casia G to perform adequately. If any of these checks fail, the issue(s) must be corrected and the checklist started again, and/or flight delayed until operating conditions improve sufficiently.

Lenses / Glass

- Inspect Casia G glass windows/ field of view for dust, particulates, liquids, fingerprints, or other blemishes. This can be done by physically inspecting the glass, by looking at images taken by the system (see section on Masking for how to refresh to see updated images from each camera).
- If glass is dirty, it should be cleaned using a microfibre cloth and a glass cleaning fluid such as windex.

Casia Status

- Situational awareness tool is receiving heartbeats from Casia G indicating it is functional.
- Ensure system is installed level and with the correct orientation as per the installation section of this document. If the system is permanently installed, daily checks will not be necessary.

Environment / Operating Conditions

- Ensure Casia G is within operating limits, including visibility and temperature. See the Operational Limitations and Limitations & Disclaimers sections of this User Guide.

Preventative Maintenance by uAvionix

Casia G systems are easy to maintain and we recommend you perform preventative maintenance yourself. However, If you contract uAvionix to provide preventative maintenance, uAvionix will perform regular maintenance on your Casia G systems. This includes cleaning and software upgrades. Should you incur issues between scheduled maintenance, contact support@uavionix.com.

Certain maintenance activities may necessitate your hardware be returned to uAvionix for tests or for maintenance to be performed.

 If subjected to a heavy impact, Casia may incur damage that is not detectable via visual inspection. Casia devices that may have received impacts beyond standard operating conditions should no longer be used. Contact support@uavionix.com for further advice.

uAvionix's FlightDeck web application enables management of Casia devices including:

- Software updates
- System configuration changes
- Data collection parameters

Preventative Maintenance by Owner

If you are performing preventative maintaining on your Casia G system (as opposed to via contract with uAvionix), preventative maintenance should be performed as described below to ensure reliable performance.

 If subjected to a heavy impact, Casia may incur damage that is not detectable via visual inspection. Casia devices that may have received impacts beyond standard operating conditions should no longer be used. Contact support@uavionix.com for further advice.

uAvionix has a portal (<http://flightdeck.irisonboard.com>) which enables fleet-wide management of Casia devices as well as a host of other features such as:

- Software updates
- System configuration changes
- Data collection parameters

Inspection and Maintenance

Until the optimal cadence can be established for your environment (level of rain, dust, etc.), your system should be visually inspected and checked for obvious issues every month. If necessary, the glass should be cleaned with a class cleaning solution (e.g. Windex) and a microfibre cloth.

Casia Software Updates

uAvionix is constantly improving the performance of the software, fixing issues and bugs, improving reliability, and adding important features and integrations.

Flight Core software is usually updated on a 12 week cadence. You will receive a notification when new software is available. Also, if you log into FlightDeck (<http://flightdeck.irisonboard.com>), you will be able to see if a software upgrade is available for any of your Casia G devices.

Follow the instructions in FlightDeck to upgrade the software on your device.

WatchDog Behavior

Casia includes a Watchdog System that allows it to detect and recover from errors while in operation. There are multiple layers of watchdogs built into Casia in order to capture and recover from all potential internal failures of the system.

Software (SW) Watchdog

All elements of the Casia software report constantly to the Software Watchdog that they are still functional. If one of these elements stops reporting, the Software Watchdog will assume a failure and reset the entire software system allowing it to start from scratch and recover from the error.

Hardware (HW) Watchdog

It is possible that an error encountered was outside the Casia software itself, and is a result of an underlying operating system or hardware problem. Casia also has a Hardware Watchdog which will reboot the entire device when issues are detected enabling it to start fresh and recover from any problems.

Resetting the entire device can take upto a couple of minutes.

Troubleshooting

If you encounter an issue with your device, follow these steps to diagnose and fix the problem. If you cannot resolve the issue, email support@uavionix.com for assistance.

| Issue | Cause | Resolution | Resolution Details |
|---|--|--|---|
| Casias G Main Unit | | | |
| Not detecting intruder aircraft as expected | Device glass is dirty | Clean the glass | Fingerprints, dirt, ice, snow, etc. may impact the performance of Casias. Review the maintenance section of this document to understand how to check the glass for clarity and how to clean it. |
| | Insufficient visibility | Ensure environmental conditions / visibility is adequate | The performance of Casias is impacted by weather (rain, snow, etc.) and visibility (smoke, fog, etc.). See the performance specification of this user guide. Check visibility is appropriate for your operations. |
| | Airspace obstructed | Move obstruction or relocate Casias | Casias cannot see through buildings, trees, poles or other objects that may prevent a clear view of the sky. Either remove any such obstructions, or relocate Casias. |
| | Insufficient light | Use during the day only. | See operating limitations of Casias G in the user guide. Casias can only be used between 30 minutes after sunrise and 30 minutes before sunset. |
| | System not active | Ensure system is active | Check the system is shown as active by your situational awareness tool. If not, ensure it has power and is connected to the internet. |
| Power LED not illuminated (Underside of Casias G) | Not receiving power | check power supply box is receiving power | If the LED is not illuminated, the system may not be receiving power from the power supply. Check the power supply box LED is illuminated and that it is receiving at least 70W. |
| | | Check power cables | Check that the cable from the power supply box to Casias G is plugged in, is undamaged, and is securely fastened. |
| HW LED Fast Flashing (Underside of Casias G) | Persistent error detected by the Casias hardware watchdog. | Wait for 15 minutes | Casias G may be able to resolve the issue itself. Give it some time. |
| | | Ensure cables connected properly | Check that all cables are plugged in, undamaged, and securely fastened. |
| | | Check external devices | Ensure external devices are powered on by checking their respective status indication LEDs. |
| | | Reboot Casias | Power cycle the Casias device by disconnecting and reconnecting power. |
| SW LED Fast Flashing (Underside of Casias G) | Persistent error detected by the Casias software watchdog | Wait for 15 minutes | Casias G may be able to resolve the issue itself. Give it some time. |
| | | Ensure cables connected properly | Check that all cables are plugged in, undamaged, and securely fastened. |
| | | Reboot | Power cycle the Casias device by disconnecting and reconnecting power. |
| | | Check cables | Check that all cables are plugged in, undamaged, and securely fastened. |
| Data uploads slow | Internet speed | Obtain faster internet | Consider getting internet connectivity with a faster upload speed. Gbit upload speed would be ideal. |
| | Data volume | Record less data | See the Data Collection Parameters section of this document for further information. |

| Issue | Cause | Resolution | Resolution Details |
|--|--|--|---|
| Casia G Main Unit (Continued) | | | |
| Data uploads slow (continued) | Data volume (continued) | Upload less data | See the Data Collection Parameters section of this document for further information. |
| Data uploads interrupted Daily | System daily reboot setting | Change configuration setting | Before uploading, disable the daily restart from the device Configurations page in FlightDeck. After upload, this must be re-enabled. |
| Casia G reboots at the same time every day and disrupts operations | System daily reboot setting | Change configuration setting time | Change the daily restart from the device Configurations page in FlightDeck to a time that will not interrupt operations. |
| Power Supply Box | | | |
| LED not illuminated on bottom of power supply box | No power to power supply box. | Check power cables connected | Ensure the power supply is connect to 110 V AC supply and that the cables are securely fastened and not damaged. |
| Situational Awareness Tool | | | |
| Incorrect location shown for Casia G | Casia unable to obtain correct GPS location. There are several p | Manually enter GPS location in FlightDeck or relocate away from interference | Review the Configuration section of the user guide for instructions on manually entering GPS coordinates. |
| Device Disconnected Message | No power to power supply box. LED on power supply box NOT illuminated. | Check power cables connected | Ensure the power supply is connect to 110 V AC supply and that the cables are not damaged. |
| | No power to Casia G. Power LED on Casia G NOT illuminated. | Check power to device | Ensure that the power supply box is firmly connected to the Casia G unit and that the cables are not damaged. |
| | Insufficient power | Ensure supplied power is adequate | The available power must be in excess of 70W. Contact a qualified electrician for assistance. |
| | No internet Connection | Check cable connections | Ensure ethernet cable connections are firm and cables are not damaged. |
| | | Check internet speed | Use speed test app to ensure upload speed is in excess of 10Mbps. |
| Frequent False Positives Disrupting Operation | Persistent detections on infrastructure, trees, etc. | Leverage masking tool in Flightdeck | Use the masking tool in FlightDeck to stop detections on those static objects. See the Persistent false Positives section of this document for further information. |
| Intruder aircraft appear in the wrong location | Poor alignment of Casia G | Repeat Alignment process | Casia G may not have been aligned correctly. Repeat the alignment process as outlined in this User Guide. |
| | | Secure Casia to pole / mast and repeat alignment | Casia G may have rotated on its bracket if not sufficiently secured. |

| Issue | Cause | Resolution | Resolution Details |
|--|---------------------------------------|---|---|
| Situational Awareness Tool (Continued) | | | |
| Intruder aircraft appear in the wrong location (continued) | Poor alignment of Casia G (continued) | Incorrect setting in FlightDeck | The default settings for Casia assume it is pointing to True North. As such, the default value for alignment is zero (0) radians. This should be checked to ensure it is in agreement with the device. |
| | Poor leveling of Casia G | Repeat leveling process | Casia G may not have been installed sufficiently level. Check and whether it is level and if not, repeat the leveling portion of the installation. |
| Detecting birds | Expected functionality | Filter out these detections | Casia G has been trained to detect and classify birds. If you do not want bird detections, they may be filtered by your situational awareness too. At times, Casia may think a bird is a plane as they can look very similar. |
| Intruders disappear when they are very close to Casia | Casia does not look up. | Expected functionality. | Casia looks out to see aircraft coming from far away. Higher flying aircraft will not be detected as they fly over Casia G. |
| Cannot hear audible alerts | Volume too low / muted | Increase / un-mute volume | |
| | No intruder detected | Wait for intruder aircraft in field of view | No alert will be heard if no intruder was detected, Ensure intruder aircraft are present and retry. |
| No intruder detections | No intruders present | Wait for intruder aircraft in field of view | No adetections will be made if no intruders are present, Ensure intruder aircraft are present and retry. |
| | Casia not connected | Connect casia to power and internet | Connect casia to power and internet as described in the installation section of this document. |

Limitations & Disclaimers

Setup and maintenance of Casia must be performed as per the Casia G User Guide to ensure that Casia performs optimally. Contact support@uavionix.com for assistance.

Incorrect installation can affect Casia performance:

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

Pre-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 the environment. Casia has been trained to identify small piloted aircraft and helicopters. 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 the frequency of false positives - may vary from that specified.
- 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, 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 stated time between false detections excludes birds as the number of birds varies dramatically from environment to environment. If you are operating in an area with an extremely high population of birds, you may see higher false positive rates.

Casia G has been trained and tuned to identify and classify small GA aircraft. The specified results are specific to the detection of small GA aircraft (small planes and helicopters). Casia 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 G detecting crewed aircraft.

Reliability / average uptime of the Casia System is under evaluation.

Following a heavy impact, your Casia system should be replaced or 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 support@uavionix.com.



Ensuring no two aircraft collide mid-air.

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

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