



**SENSORS AND PARTS OF A DRONE**  
MULTIROTOR



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# BLACK BOX

The black box is responsible for storing a lot of flight data with geolocation information. They are usually stored in a micro-SD memory that is located inside the drone. If the equipment is healthy and in good condition, it can logically be accessed for reading only. If the drone had an accident, it must be accessed physically and with different software, analyze its content to carry out an expert report.

## WHEN CAN IT FAIL?

01

When the equipment was hit, an attempt was made to remove or access in an improper manner.

02

When a bad firmware update was performed.



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# OPTICAL ACOUSTIC SENSOR

It is a visual detection system, which operates with a processing core, integrated visual cameras, ultrasonic sensors and computer vision algorithms. It is basically composed of a microphone, a speaker and a video camera. This gives a new level of safety and confidence to the flight. In most teams it is found pointing downwards, the surface. Depending on the equipment, they work up to 15 m high AGL under normal conditions.

## WHEN CAN IT FAIL?

- 01 When the height is not as indicated according to the Manufacturer's Manual.
- 02 When objects or people move underneath it.
- 03 When to be used on acoustically reflective or absorbent surfaces.
- 04 When there is little lighting and the optical part does not work.



## OPTICAL SENSORS AND INFRARED

They are mini cameras that are located in different places on the drone (forward, backward, up, down) and that function by detecting light contrast change or image analysis. We also find infrared that already have the ability to illuminate in that spectrum and be able to detect obstacles or ambient light.

### WHEN IT CAN FAIL?

- 01 When the speed of the equipment is very high or it is in SPORT mode.
- 02 When objects reflect or are transparent.
- 03 When they are hit by a flare or ray of light.
- 0 When there is little lighting and the optical part does not work.



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# RADAR SYSTEMS

There are several types, mainly directional and omnidirectional. Directional pointing downwards (towards the Earth's surface), known as radio altimeters, give the drone an AGL height information.

Many teams can be fitted with millimeter wave radars (CSMs) with detection ranges from 1.5 m to 60 m as an option.

**Full-coverage radars (omnidirectional)**, they usually cover 360° horizontally; 60° vertical; 45° in the direction of vertical ascent and descent, and merge even when there is no ambient light.

## WHEN CAN IT FAIL?

- 01 When the manufacturer or operator places it on the drone having blind spots.
- 02 When you are below it, objects or people move.
- 03 When it is to be used on acoustically reflective or absorbent surfaces.



**DIRECTIONAL RADAR**



**OMNIDIRECTIONAL RADAR**

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# INERTIAL NAVIGATION SYSTEMS (INS)

Inertial navigation depends only on the input of sensors directly contained in the platform and that have no reference to an external artificial input (for example, GPS), so it is not susceptible to being manipulated or hacked.

The goal of inertial navigation, also known as "Dead Reckoning" is therefore to determine the position, speed and attitude of the platform by using onboard inertial sensors.

## WHEN CAN IT FAIL?

- 01 When the INS is bumped or has poor calibration
- 02 When a lot of time or a long distance has passed since the GPS signal was lost, the navigation error increases



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# LIDAR SYSTEMS

It is a remote sensing technology that uses laser beams to measure distances and precise movements in an environment, in real time. LiDAR is governed by the same principles as radar (radio detection and distance measurement, a location system used in maritime and air navigation) and sonar (sound navigation and location, a system normally used in submarines). All three technologies emit energy waves to detect and locate objects. The difference is that, while radar uses microwaves and sonar, sound waves, LiDAR uses reflected light, which can measure distance faster, with greater accuracy and resolution than radar or sonar. We can find, depending on their costs, **that they work up to heights of 500 m AGL.**

## WHEN CAN IT FAIL?

01

When the height is not as indicated according to the Manufacturer's Manual.

02

When they are not calibrated correctly.



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# ADS-B OR AIRSENSE SYSTEMS

AirSense is an alert system that uses ADS-B technology to give drone pilots greater situational awareness and help them make responsible decisions while flying. This feature collects flight data automatically sent from nearby aircraft with ADS-B transmitters, analyzing it to detect potential collision risks and alert users well in advance via the DJI mobile app. They operate with frequencies of 1090 Mhz, and generally in small teams they are only on mission (OUT).

## WHEN CAN IT FAIL?

- 01 When the operator does not deactivate, it will not report
- 02 When in areas with interference in the working frequency.
- 03 When you do not have georeferencing information.



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# PRECISION POSITIONING SYSTEMS

It is a high-precision navigation and positioning system specially designed for the flight controllers of many drones. Using dynamic differential technology, it provides ultra-precise 3D positioning at the centimeter level. This improved accuracy over typical barometer, compass, and GPS systems makes the D-RTK essential for commercial, industrial, and scientific applications where accuracy is imperative. The positioning accuracy is around 1 cm horizontally and vertically.

## WHEN CAN IT FAIL?

- 01 When the ground antenna is not linked to the drone and the remote control.
- 02 When the minimum number of receiving satellites on the base antenna was not reached.
- 03 When geopositioning was lost in the drone.



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# TRACKERS

These modules can be additionally added (optionally) to the equipment to be able to locate them if they are lost in case of contingencies, or to have real-time redundancy of its positioning and/or navigation.

There are different systems with different costs and paid or free services, such as the simplest ones such as putting an Airtag on it, to GPRS-based systems, Iridium satellite network based systems, and radio beacons that work with amateur radio frequencies.

## WHEN CAN IT FAIL?

- 01** When the tracker is not active or out of battery
- 02** When it is in areas where there is no coverage or with interference in the working frequency.
- 03** When you do not have georeferencing information.



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## CAMCORDER + STABILIZER (GIMBAL)

Most drones today have a built-in camera to take advantage of the flight and capture photos or videos from the air. If it is a navigation camera it is known as FPV (First Person Vision), and it is used only for forward vision. The camcorders can be fixed or held on the drone by electromechanical stabilizers, called in the jargon as GIMBAL (They are a set of motors that keep the camera aligned with a standard horizon). Depending on the size of the drone, the camera can be anything from a heavy professional camera to a lightweight mini GoPro action camera.

### WHEN CAN IT FAIL?

- 01 When the signal is lost and you can't see the live video.
- 02 When the spectrum is saturated with the video transmission frequency.
- 03 When the gimbal and camera are hit, or when dirt gets between the moving parts of the stabilizer.



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**QUESTION TIME!**