robin
radar systems

10 Counter-Drone Technologies to Detect and Stop Drones Today.

Table of Contents

Counter the Drone Threat

This ebook provides an overview of Counter-Drone equipment you can buy today. You might also know it as Anti-Drone or Counter-UAS (C-UAS) technology.

We've focused on what's currently available in the market so if you need to implement (or are thinking about implementing) a counter-drone solution, then this is the ebook for you.

Read on for an (almost entirely) unbiased look at the anti-drone market, including helpful pros and cons on each technology.
And we've even provided links to vendors for you. How's that for helpful?

By the end of the ebook, you should have a good idea of what technology you need and what you don't.

We've split all the tech into two categories: Monitoring Equipment and Countermeasures.

Drone Monitoring Equipment

Drone monitoring equipment can be passive (simply looking or listening) or active (sending a signal out and analysing what comes back) and can perform several functions, including:

- Detection
- Classification or Identification
- Locating and Tracking
- Alerting

You should be aware that not all equipment performs all the above functionality at the same time.

Detection means the technology can detect drones. Detection alone usually isn't enough though. A radar that detects drones may also detect birds, for example.

That's why classification is useful. Technology that classifies drones will usually be able to separate drones from other types of objects - like planes, trains, and automobiles, for example.

One step further is identification. Some equipment can identify a particular model of drone, or even identify the drone's or controller's digital fingerprint, like a MAC address for example. This level of identification can be handy for prosecution purposes.

Being alerted that a drone is present somewhere in the vicinity is already useful. But your situational awareness, and ability to deploy countermeasures is greatly enhanced if you know the drone's (and/or the controller's) exact location. Some equipment will even allow you to track the drone location in real-time.

There are four main types of drone monitoring equipment:

- Radio Frequency (RF) Analysers
- Acoustic Sensors (Microphones)
- Optical Sensors (Cameras)
- Radar

OPTION 1

Radio Frequency (RF) Analysers

RF Analysers consist of one or more antennas to receive radio waves and a processor to analyse the RF spectrum. They're used to try to detect radio communication between a drone and its controller.

Some systems can identify the more common drone makes and models, and some can even identify the MAC addresses of the drone and controller (if the drone uses Wi-Fi for communication). This is especially useful for prosecution purposes – proving that a particular drone and controller were active.

Some high-end systems can also triangulate the drone and its controller when using multiple radio units spread far apart.

Pros:

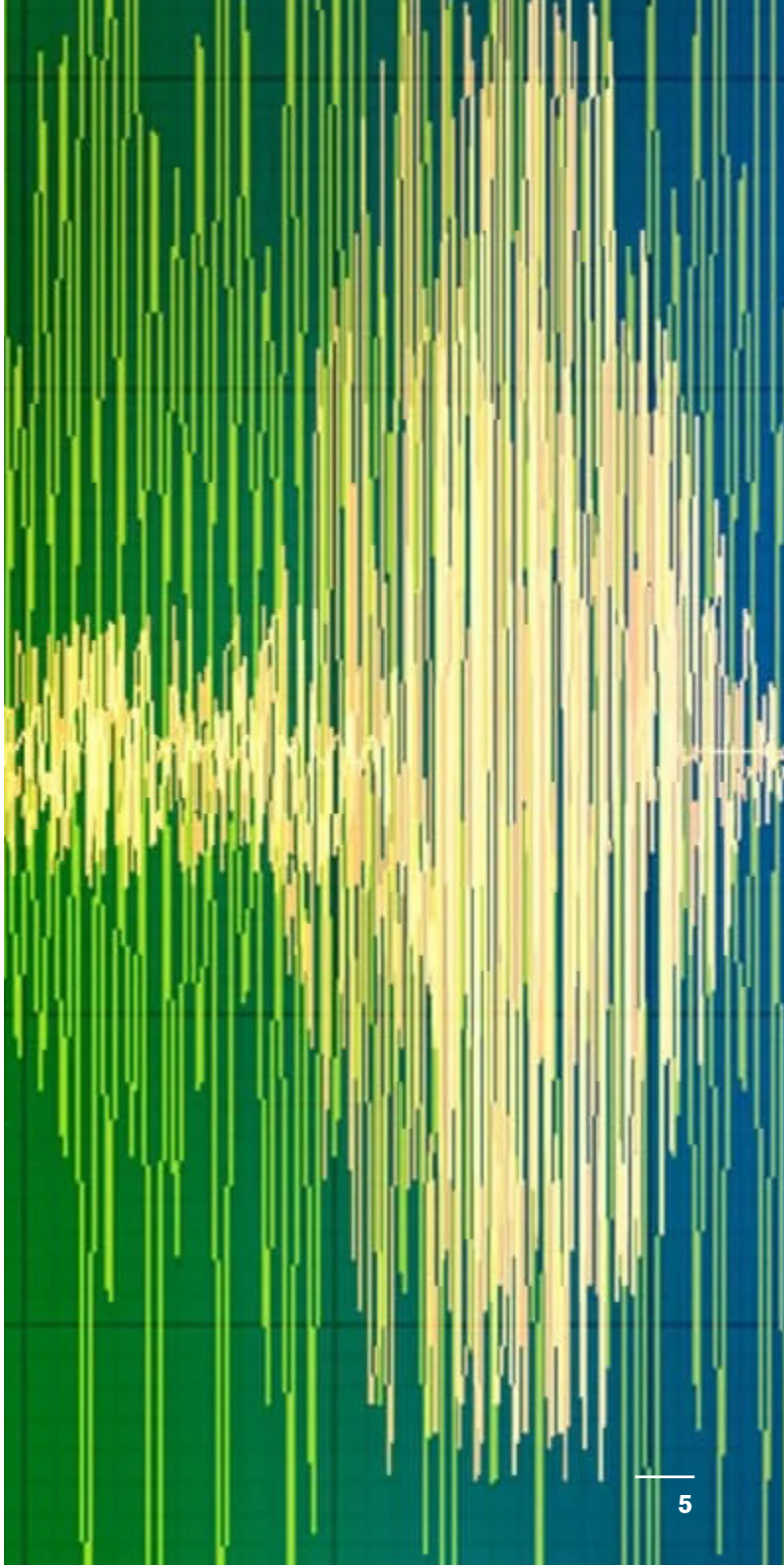
Can be low cost, detects (and sometimes identifies) multiple drones and controllers, passive so no licence required, some can triangulate drone and controller position.

Cons:

Doesn't always locate and track drones. Can't detect autonomous drones, less effective in crowded RF areas, typically short range. Difficult to detect drones controlled over 5G networks.
Successful RF identification also depends on libraries that require continuous reverse engineering and updating. Reverse engineering and updating take time, during which UAS with modified protocols go unseen. Subscriptions to library updates can be expensive.

Vendors:

Vendors of radio frequency analysers include: Rohde & Schwarz, Aaronia, Dedrone and CERBAIR.



OPTION 2

Optical Sensors (Cameras)

Optical sensors collect light at a range of wavelengths, including visible and infrared, as well as thermal radiation, to detect drones day and night.

Recent advances in optical sensor technology have improved resolution (and thereby range) and processing power, in the form of AI-powered detection, tracking, and classification.

Pros:

Provides visuals on the drone and it's (potential) payload, can record images as forensic evidence for use in eventual prosecution.

Cons:

Difficult to use for detection by itself, high false-alarm rates, mostly poor performance in dark, fog, etc.

Vendors:

Too many to mention...

OPTION 3

Acoustic Sensors (Microphones)

Usually, a microphone, or microphone array (lots of microphones), which detects the sound made by a drone and calculates a direction. More sets of microphone arrays can be used for rough triangulation.

Pros:

Detects all drones within the near-field, including those operating autonomously (without (RF-emissions). Detects drones in the ground clutter where other technologies can struggle. Great gap-filler in areas outside line-of-sight of other sensors. Highly mobile and quickly deployable. Completely passive.

Cons:

Doesn't work as well in noisy environments, very short range (max. 300-500m)

Vendors:

Vendors include Squarehead Technologies.

OPTION 4

Radar

A device using radio energy to detect an object. Drone detection radar sends out a signal and receives the reflection, measuring direction and distance (position).

Most radars send their radio signal as a burst, then listen for the ‘echo’. Almost all radars are designed to NOT pick up small targets. They are designed for large object tracking, like passenger aircraft.

DRONE COUNTERMEASURE EQUIPMENT

Countermeasures can be grouped as either:

- Physically destroying the drone
- Neutralising the drone
- Taking control of the drone

It’s important to note that, although the technology is available, current regulations in most countries forbid the use of any of the following technologies to be used for neutralising drones.

Exceptions are sometimes made for military or law enforcement agencies.

Pros:

Long range, constant tracking, highly accurate localisation, can handle hundreds of targets simultaneously, can track all drones regardless of autonomous flight, independent of visual conditions (day, night, fog, etc.)

Cons:

Detection range dependant on drone size, most do not distinguish birds from drones, requires transmission license and frequency check to prevent interference.

Vendors:

Well, that’d be us then! But... ...we should probably point out here that our own Drone Detection Radar, IRIS®, isn’t like standard radars.

For starters, we built IRIS® specifically to track drones. Featuring 360-degree azimuth and 60-degree elevation coverage, IRIS® provides early warning of approaching drones from any direction, in full 3D.

Micro-doppler radar detects speed differences within moving objects. For example, a drone’s rotor. This enables IRIS® to distinguish between drones and other small, fast-moving objects, like birds, reducing false alarms. It can even detect autonomous and hovering drones and track multiple targets simultaneously.

Lightweight and easy to deploy, IRIS® can integrate seamlessly with your existing drone detection systems.

Drone Countermeasure Equipment

Countermeasures can be grouped as either:

- Physically destroying the drone
- Neutralising the drone
- Taking control of the drone

It's important to note that, although the technology is available, current regulations in most countries forbid the use of any of the following technologies to be used for neutralising drones.

Exceptions are sometimes made for military or law enforcement agencies.

OPTION 5

Radio Frequency Jammers

An RF Jammer is a static, mobile, or handheld device which transmits a large amount of RF energy towards the drone, masking the controller signal. This results in one of four scenarios, depending on the drone:

1. Drone makes a controlled landing in its current position
2. Drone returns to user-set home location (which could be set to a target position instead of home)
3. Drone falls uncontrolled to the ground
4. Drone flies off in a random uncontrolled direction

Pros:

Medium cost, non-kinetic neutralisation.

Cons:

Short range, can affect (and jam) other radio communications, can result in unpredictable drone behaviour, could unintentionally send the drone to its target.

Vendors:

TRD and HP Wust provide jamming systems.

OPTION 6

GPS Spoofers

GPS spoofers send a new signal to the target drone that replaces the communication signal it uses to navigate. In this way, it spoofs the drone into thinking it's somewhere else.

By dynamically altering the GPS coordinates in real time, the spoofer can control the drone's position. Once the spoofer gains control, they can direct the drone to a 'safe zone', for example.

However, GPS spoofers can inadvertently disrupt other systems beyond the target drone. Because of the risks, GPS spoofers are primarily used on the battlefield and aren't as common for civilian operations.

Pros:

Medium cost, non-kinetic neutralisation.

Cons:

Short range, can affect (and jam) other radio communications.

Vendors:

Regulus manufactures GPS spoofers specifically for drone defence.

OPTION 7

High Power Microwave (HPM) Devices

High Power Microwave (HPM) devices generate an Electromagnetic Pulse (EMP) capable of disrupting electronic devices.

The EMP interferes with radio links and disrupts or even destroys the electronic circuitry in drones (plus any other electronic device within range) due to the damaging voltage and currents it creates.

HPM devices may include an antenna to focus the EMP in a certain direction, reducing potential collateral damage.

Pros:

Within range, the drone can be stopped effectively, non-kinetic.

Cons:

High cost, risk of unintentionally disrupting communications or destroying other electronic devices in the area, drone effectively switches off instantly falling uncontrolled to the ground..

Vendors:

Diehl Defence provides a HPEM solution.

OPTION 8

Nets and Net Guns

Firing a net at a drone, or otherwise bringing a net into contact with a drone stops the drone by prohibiting the rotor blades. There are three main types:

- Net Cannon fired from the ground: can be hand-held, shoulder-launched, or turret-mounted. Anywhere from 20m to 300m effectiveness. Can be used with or without a parachute for controlled descent of the captured drone.
- Net cannon fired from another drone: overcomes the limited range of a net cannon on the ground. Can be difficult to capture another moving drone. Normally used with a parachute for controlled descent of the captured drone.
- Hanging net deployed from a 'net drone'. The drone is captured by manoeuvring the friendly net carrying drone towards the rogue drone. The 'net drone' will normally be capable of either carrying the rogue drone to a safe zone, or if it is too heavy, can release the captured drone with or without a parachute for controlled descent.

Pros:

Physically captures drone – good for forensics and prosecution, ground-launched net cannons are semi-automatic with high accuracy, drone deployed nets have long range, low risk of collateral damage.

Cons:

As a kinetic solution, it can result in debris (depending on parachute options). Drone-deployed nets can be imprecise and have long reload times, ground-launched nets have a short range. Drone-mounted netguns often struggle to intercept and neutralize hostile drones that fly aggressively or evasively, due to inertia.

Vendors:

Fortem Technologies' DroneHunter 700 supports three netgun attachments that enable it to stop drones of almost any size. Additionally, OpenWorks Engineering offers both shoulder-mounted and turret-mounted net cannons.

OPTION 9

High-energy lasers

A high-powered optical device which produces an extremely focused beam of light, or laser beam. The laser defeats the drone by destroying the structure and/or the electronics.

Pros:

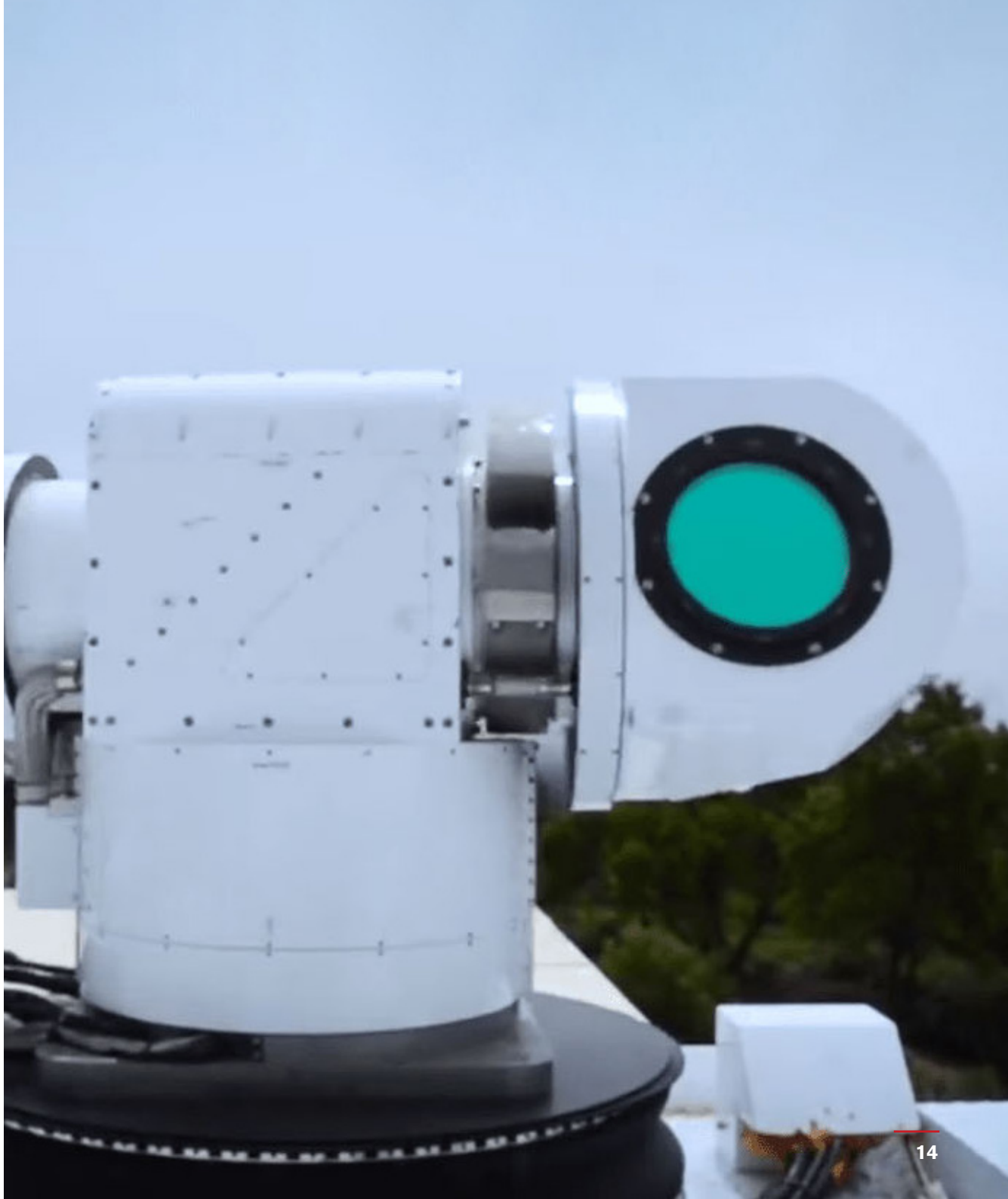
Long-range, low-cost-per-kill solution. Physically stops and destroys target drones to neutralise threats quickly. Doesn't require physical ammunition, like nets.

Cons:

Large system. Mostly experimental. Risk of collateral damage to other airborne targets and people at ground level, especially to eyes.

Vendors:

Lockheed Martin and Raytheon.



OPTION 10

Cyber Takeover Systems

Cyber takeover, or cyber takedown, systems are a relatively new counter-drone technology. They passively detect radio frequency transmissions emitted by drones to identify the drone's serial number and locate the pilot's position using AI.

If the operator recognises the drone as a threat, they can send a signal to hack the drone, assume control, and direct it to a safe location.

Pros:

Precise, with a low risk of collateral damage. Lightweight, and can be configured for both static and mobile applications. Automatically captures incident data vital for forensic investigation. Effective against both piloted and autonomous drones.

Cons:

New and largely untested technology. Relies on an up-to-date library of commercial drones, making it less effective against homemade or state-developed drones.

Vendors:

D-Fend Solutions' Enforce Air System is one of the market leaders for counter-drone takeover technology.

Integrating it all Together

It's more than likely that the best drone detection solution for you is going to be a mix of the above technologies. Which mix exactly? Well, that's going to be dependent on your specific use case.

We work with several integrators all over the world who integrate our radars into modular counter-drone systems, so you don't have to. This solves the headache of dealing with multiple vendors and means you don't need to integrate different hardware and software solutions.

Talking about software; Command & Control (C2) software can make or break your counter-drone system. All the data from those different sensors and technologies need to be collected, processed and displayed in a user-friendly way that makes sense and is actionable.

So, it pays to make sure you're getting a scalable, sensor-agnostic, and user-friendly C2 solution with your system.

Good examples of counter-drone C2 systems are ESG's ELYSION, Dedrone's DedroneTracker, and Operational Solutions' FACE.

C2-systems vary significantly in terms of capability and cost. The complexity of the connected sensors and effectors, the type of threat, and your budget influence whether you require all the bells and whistles or a more basic system. However, drone defence companies are developing industry standards for C-UAS integration, with SAPIENT's out-of-the-box data integration capabilities at the forefront.

This isn't the whole story, of course. And while data interoperability is a pre-requisite, don't underestimate the importance of other C2-system functions like data fusion, workflow management, and decision support.

Here's a small selection of companies offering complete and modular counter-drone systems worldwide.

- ESG (DE)
- Operational Solutions (UK)
- TRD (SG)
- CS Group (FR)

About Robin Radar

Our mission is to provide actionable information that increases safety and security for both humans and birds. We do that by combining purpose-built radars with unique software algorithms.

Our bird radars are installed at numerous civil and military airports around Europe, including Amsterdam, Frankfurt, Berlin, and Copenhagen. There we monitor birds all around the airport to prevent bird strikes on approaching and departing aircraft.

We also protect the birds themselves and help to reduce the environmental impact of wind turbines with our avian radars at wind farms.

Our counter-drone radars have regularly been used to protect infrastructure, events and VIPS from rogue drones, sine 2016.

ROBIN originally started in the eighties as a project within the well-respected Dutch Research Institute for Applied Science (TNO). The project name was an acronym for Radar Observation of Bird INtensity.

In 2010 high-tech entrepreneur Siete Hamminga spun out the technology from TNO to make it commercially available.

Listed in the top three most innovative Dutch companies, we've received FD Gazelle, and Deloitte Fast 50, fast growing business awards, and we've been listed as an official Great Place To Work. All the while we continue to research, develop, manufacture, and above all, innovate.

To learn more about the best solutions for preventing drone disruption, read our guide to countering drones.

READ OUR GUIDE

If you need help with finding the right drone detection system to protect your airspace, please get in touch.

GET IN TOUCH

www.robinradar.com