



DRONEDEFENCE

SMART SECURED AIRSPACE

AEROSENTRY MARINE

FIXED DRONE DETECTION & MITIGATION

DRONEDEFENCE.CO.UK

**"AT DRONE DEFENCE WE USE OUR PROPITIATORY TECHNOLOGIES
TO DELIVER A SMART, SECURE AND ASSURED AIRSPACE."**

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PRIVACY IS PRICELESS

The commercial & hobby drone industry is accelerating at a phenomenal rate as more capable camera equipped drones are being sold in increasing numbers around the world.

But, like all new technologies, there is a risk that drone technology can be misused. Reckless drone users have spotted that drones can be used to fly drugs into prisons, invade privacy and disrupt events. Even worse, terrorist groups have weaponised commercial drone technology on the battlefield.

Yachts are a very attractive target for drone users, or those who use drones for more sinister purposes. Privacy is priceless and drones can pose a threat to yachts, their owners and guests in many different situations. Whether the yacht is on a coastal transit, in port or at anchor, drone users can easily pester the yacht and capture unwanted images of the owner or their guests.

This is where Drone Defence can help. We can provide equipment to detect, track, identify and defeat unwanted drones. We provide cost effective security products, which defeat the majority of commercial drones currently available using signal jamming. We aim to cause no harm to the boat, its systems or the offending drone and we help our clients develop legitimate & proportionate responses to drone threats, like;

- Invasion of Privacy
- Covert Listening Technology
- WiFi Sniffing
- GPS Spoofing
- Hostile Reconnaissance
- Kidnap & Ransom Threat
- Mid-Air Collision with Helicopter
- Delivery of Payload



DRONE DETECTION

When a drone is flown near to the vessel the RF sensors detects the drone's unique radio transmission.



IDENTIFICATION

Using advanced machine learning AeroSentry identifies what type of drone is close to the vessel. If close, the drone's operator may also be identified.



DEFEAT

AeroSentry is able to activate AeroDome to disrupt the drone's radio signal neutralizing the threat within 500m of the vessel. The drone simply returns to its owner.

WHY US?

DRONEDEFENCE

You can relax in the knowledge that Drone Defence has a proven track record in providing counter drone solutions for the super yacht industry.

In addition to the numerous yachts we already protect our systems offer:

- AeroSentry and AeroDome Marine is drone manufacturer agnostic. As a result we are able to detect 99% of COTS (Commercial Off The Shelf) drones.
- We are industry experts who are at the cutting edge of the conceptual development of not only the drone sector but we are setting the standard in counter drone applications.
- We sit at the top table of UK Governmental Strategy and Policy makers and have strong and established connections into the UK MOD, DSTL, CAST, NOMS, Met Police amongst others.
- We take part in all of the physical and conceptual simulated exercises for UK Government stakeholders meaning we remain market leaders.
- We have built up an extensive knowledge of drones, their capabilities and risks that they pose.
- We have award winning record-breaking security experts on staff who stand ready to support our customers.
- We provide full spectrum support for our products and our customers.
- Our systems are low power emitting - This means we remove and RF leakage and minimize impact on the boat's systems. Our systems are completely safe for the owner, guests and the crew.

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PROFILE OF THE PROBLEM DRONE USER

Over the last seven years Drone Defence has analysed thousands of illegal drone flights. We have also conducted extensive tests both internally and with the UK Home Office. This has enabled us to build a comprehensive understanding of problem drone operators.

The table below gives more details:

Who?	Registered or Unregistered Drone User
What (Intent)?	Inadvertent and deliberate invasion of privacy
Technical ability	Low – no modifications to drone
Evasion Ability	No awareness of drone defence technology, no defensive measures or actions taken.
Type of Drone	Commercial Off the Shelf (COTS)
Number of Drones	Single
Control Method Used	Real-time command and control
Frequencies Used	2.4 & 5.8 GHz
Launch distance from Target	Up to 500m
Altitudes flown	100 to 400ft
Flying Conditions	Fair weather only
Use of GPS	Yes
Likelihood	Very High
Impact	Varied (depending on imagery captured)



DEFINING THE CLAIM: 'DETECT 99% OF PROBLEM DRONES'

WHAT DOES THIS ACTUALLY MEAN?

Does it mean 99% of all drones on the market or 99% by volume sold?

There are thousands of 'ready-to-fly drones' on the commercial market. The vast majority of these drones are small toys which pose very little risk. Consequently, we propose a tighter definition of 'problem drones'.

We searched on Amazon (UK) for 'drones' there are thousands of entries therefore there is a need to understand which of these might pose a risk. We believe that for a drone to pose a risk it must have the following capabilities:



Have a HD Camera.



Have a control range of 500m.



Be able to fly for a minimum of 20 minutes.



Have GPS Assisted Flight.

To get a more realistic number we refined our Amazon search for 'GPS+camera+drone' and applied a minimum price of £100. The results then narrowed to around 100 drones which came from the following manufacturers:

- DJI
- Parrot
- Yuneec
- Hubsan
- Autel Robotics
- Holy Stone
- Syma

It is widely reported 75% of commercial drones sold are from DJI, Yuneec & Parrott account for a further 20% meaning the rest comprise only 5% of the drones sold.

The most common illegal drone activity is likely to come from someone who deliberately wants to invade privacy. They will probably use commercially available drones like those listed above and they will fly the drone in real-time. Most of these drones use GPS and 2.4GHz for their command and control frequency, some also use 5.8GHz.

NB. A copy of our Radio Frequency (RF) Detection

Performance Statement can be found on page 15.



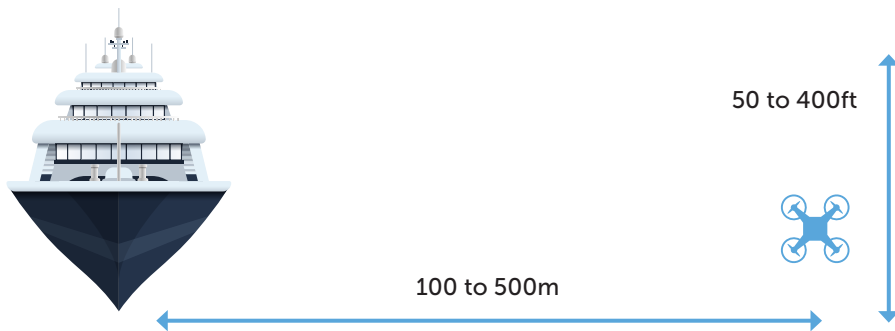
SHIP ACCEPTANCE TESTING (SAT)

EXPECTED PERFORMANCE

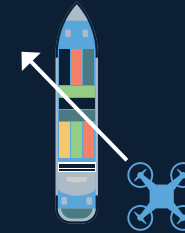
Drone Defence has established a comprehensive Ship Acceptance Test process to give end-users confidence in the performance of the detection and mitigation equipment.

These Acceptance Tests consist of the most likely and difficult drone flight profiles the vessel will face.

DRONE APPROACH FLIGHTS, RANGES & ALTITUDES

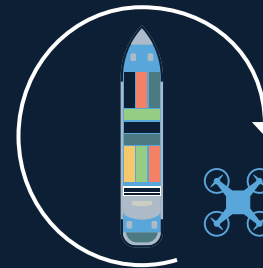


DRONE BEHAVIOUR



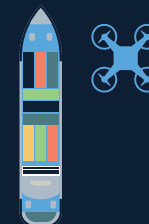
CROSSING

Drone crosses over vessel at low level (50ft) or high level (400ft).



ORBIT

Drone orbits vessel at low level (50ft) or high level (400ft).



HOVER AWAY

Drone hovers away from the vessel at low level (50ft) or high level (400ft).

AEROSENTRY MARINE ONE

DRONE DETECTION SOLUTION

Drone Defence's AeroSentry Marine One is the most advanced drone detection system available on the commercial market. It combines passive background scanning radio frequency technology with real-time signal analysis meaning that the system can identify and track (range and bearing).

Detects all operator controlled common drones using 2.4 and 5.8 GHz typically used by irresponsible drone users and paparazzi to invade privacy.

PHYSICAL FEATURES:

- Radome measuring 500mm (h) by 400mm (w).
- Integrated sun shields.
- Requires 110-240VAC power and Ethernet connection.
- Low power consumption under 100W.
- Easy to install.
- IP 65 rated.
- Operating temperature -20 to +50°C.

TECHNICAL CAPABILITIES:

- Detection range up to 3km (planning range 1km).
- Passively monitor multiple signals.
- 360 degree coverage.
- Mitigate mast shadow by using two detectors.
- Multi-layered detection methodology used to provide different type of indicators (either general alert (drone/no-drone), cardinal bearing indication or 3-D point position) dependant on detection methodology.
- Can be integrated into existing security system.
- Can use stand-alone command and control interface.
- Can be integrated with other detection systems like DJI's AeroScope, radars and cameras.
- Has Interface Control Document.



AEROSENTRY MARINE ONE

Privacy is Priceless – AeroSentry Marine One is a passive drone detection system which is able to detect drones operating close to and above the vessel.



KEY FEATURES



Detects majority of commercial drones up to Threat Level 1.



Easy to install



No approvals needed (no ITAR)



Can be integrated into existing security system

SPECIFICATIONS

Range	Up to 3km in ideal conditions (1km planning range)
Device Type	Passive Radio Frequency Detection, Classification, Estimated Range and Bearing
Radio Frequency	2.4 & 5.8 GHz
Antenna Type	Multi-layered Sensing Array
L x W x H	455mm x 455mm x 505mm
Weight	10kg (21lbs)
Ingress Protection Rating	IP65 Certified
Operating Temperature	-20 to + 55 degrees Celsius (-4 to +131 degrees Fahrenheit)
Power Supply	100-240 V AC
Power Consumption	Peak 100W – Typical 25W
Communication	LAN
Connectivity	Local Area Network via Ethernet
Updates	Annual
Interface	Interface Control Document available

AERODOME MARINE ONE

DRONE MITIGATION SOLUTION

Drone Defence's AeroDome Marine One is the ideal companion for AeroSentry Marine. When a drone is detected by AeroSentry AeroDome can be automatically or manually activated. The user has the choice between activating an individual sector or all sectors together.

AeroDome is effective against all operator controlled common drones using 2.4 and 5.8 GHz typically used by irresponsible drone users and paparazzi to invade privacy. As an optional extra GPS mitigation can be specified, which would be effective against GPS programmed drones.

PHYSICAL FEATURES:

- Radome measuring 500mm (h) by 400mm (w).
- Integrated sun shields.
- Requires 110-240VAC power and Ethernet connection.
- Low power consumption under 10W on standby 500W in use.
- Easy to install.
- IP 65 rated.
- Operating temperature -20 to +50°C.
- Integrated overheat protection.

TECHNICAL CAPABILITIES:

- Mitigation range up to 1km (planning range 500m).
- 6 x 2.4 GHz – 10W and 5.8GHz – 2W modules.
- Optional GPS jamming module (subject to ITAR rules).
- Individually controlled six sector coverage.
- Mitigate mast shadow by using two jammers.
- Minimises impact on other ships' systems (WiFi etc.).
- Can be integrated into an existing security system.
- Manual or automated activation.
- Has Interface Control Document.



AERODOME MARINE ONE

AeroDome Marine One – 6 Section jamming system with optional GPS jamming.

KEY FEATURES



Defeats real-time controlled drones operating on 2.4 & 5.8 GHz



Matching radome to AeroSentry Marine One



No approvals needed (no ITAR) for 2.4 & 5.8 GHz



Can be integrated into an existing security system

SPECIFICATIONS

Range	Up to 1km in ideal conditions (500m planning range)
Device Type	Active Radio Frequency
Radio Frequency	2.4 & 5.8 GHz Option - GPS
Antenna Type	6 Sector Directional Antenna (2.4 & 5.8 GHz) Omnidirectional GPS jamming
Total Output Power	60W on 2.4GHz and 12W on 5.8GHz
Radiation Hazard	2 meters
L x W x H	455mm x 455mm x 505mm
Weight	10kg (21lbs)
Ingress Protection Rating	IP65 Rated
Operating Temperature	-20 to + 55 degrees Celsius (-4 to +131 degrees Fahrenheit)
Electrical Protection	Overheat Protection included
Power Supply	100-240 V AC
Power Consumption	Standby 10W – Operational 250W
Connectivity	Local Area Network via Ethernet
Updates	Not Required
Interface	Manual or interface controlled

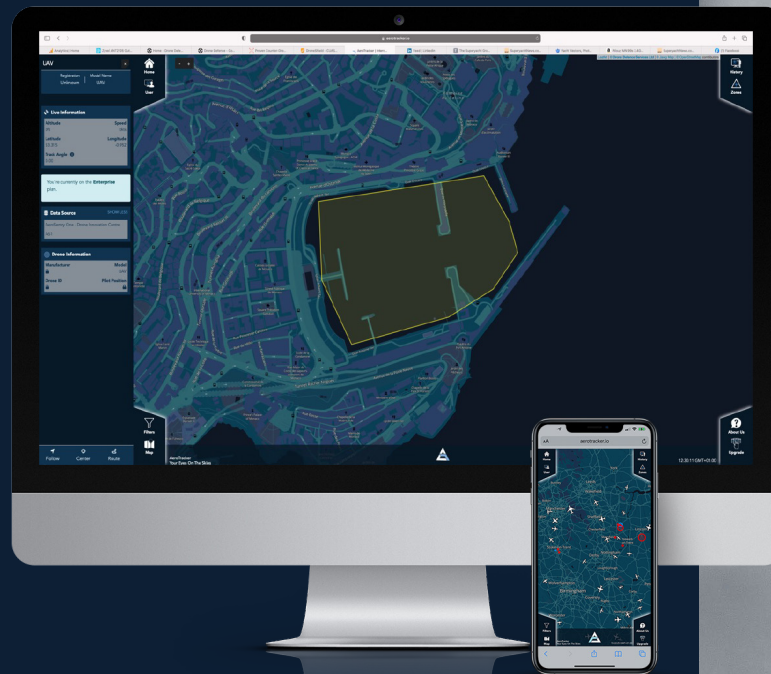
AEROTRACKER. COMMAND & CONTROL INTERFACE

As well as being operated by third party command and control interfaces, AeroSentry and AeroDome can be seamlessly hosted on Drone Defence's command and control system, AeroTracker.

AeroTracker is able to fuse data from cameras, radars and RF sensors to give a complete airspace picture. Hosted locally or through a low bandwidth cloud connection AeroTracker can provide situational awareness in a simple, intuitive manner. With the ability to have multiple sites and for use on the move, AeroTracker can be connected to other locations like private residences.

SYSTEM FEATURES:

- NMEA Mapping available.
- Autonomous or manual operation.
- Graphically shows drone and controller.
- Gives detailed drone capabilities.
- Create zones and alert areas.
- Cloud or local hosting.
- Smart Phone App (Android & iOS).
- Absorbs AIS and ADS-B data.
- Historical reporting.
- Exportable reports.
- Weather overlays.
- Drone behaviour analysis.



SUGGESTED PACKAGES

A number of factors should be considered when deciding which is the most suitable system for each vessel. As AeroSentry and AeroDome are RF based systems performance may be effected by large superstructures and masts. End users should also consider their appetite for RF jamming technology.



BRONZE

Vessel Size below 70m

Single AeroSentry Marine

No AeroDome Marine



SILVER

Vessel Size 70 to 90m

Single AeroSentry Marine

Single AeroDome Marine



GOLD

Vessel Size 90 to 120m

Dual AeroSentry Marine

Single AeroDome Marine



PLATINUM

Vessel Size above 120m

Dual AeroSentry Marine

Dual AeroDome Marine

RETAIL PRICE LIST

Category	Description	Code	RRP (GBP)
RF Detection Hardware	Single AeroSentry Marine One Includes first year software license	S-ASM1	£75,000
RF Detection Hardware	Dual AeroSentry Marine One Includes first year software license	D-ASM1	£125,000
Software	Software updates for AeroSentry Marine System per annum	SW-ASM-1YR	£6,000
Warranty	Extended warranty for AeroSentry Marine System per annum (dual and single)	EW-ASM-1YR	£6,000
RF Mitigation Hardware	Single AeroDome Marine Controllable Six-Sector jamming system Control Frequencies - 2.4 & 5.8 GHz	S-ADM	£60,000
RF Mitigation Hardware	Dual AeroDome Marine Controllable Six-Sector jamming system Control Frequencies - 2.4 & 5.8 GHz	D-ADM	£100,000
Warranty	Extended warranty for AeroDome Marine System per annum (dual and single)	EW-ADM-1YR	£6,000
RF Mitigation Hardware	GPS Jamming Module (only available with AeroDome Marine)	GPS-ADM	£5,000
Export Control	Export Control Application and End Users' Certificate	EX-GPS	£3,000
Hardware	Local Server (required if AeroTracker interface is specified)	SER-ASM	£5,000
Hardware	Touch Screen Interface	SCR-ASM	£1,500
Consultancy	Design or Consultancy work relating to a specific project	CON-DD	N/
Commissioning	2 x Engineers to test system on installation	COM-ASM	£7,500
Training	Any training requirements.	TRG-DD	N/
Misc	Bespoke paint for Radomes (per radome)	PAI-ASM	£3,000

NOTES

- From placing order please allow for 16 weeks for hardware delivery.
- All figures are subject to change.
- All figures quoted are subject to applicable rates of VAT.
- Drone Defence Standard Terms apply.
- Standard payment terms are 40% on order, 40% prior to delivery, 20% on delivery.
- The quote is for the supply of hardware and software only. Any design or installation costs will need to be considered in addition.
- Export control End Users' Certificates required for GPS jammer.
- All goods are delivered EXW.
- Volume pricing available on request.

RF DETECTION PERFORMANCE STATEMENT

The maximum detection distance we are able to achieve with our RF detection is 5,000 meters from point of transmission to RF Receiver. However, as with all RF based systems, performance is dependant on a number of factors including;

- Complexity of the environment
- Terrain
- Transmission Power of Drone
- Sensitivity of Receiver
- RF Noise Floor
- Altitude of Drone
- Altitude of Sensor
- Magnetic Fields
- Time of Day
- Weather Conditions
- Humidity
- Atmospheric Pressure

Given there are so many variables it is impossible to determine with 100% certainty how any RF system will perform in any specific environment and results may vary.

We employ a number of different RF analysis techniques to detect drones, these include;

- Packet Decryption
- Packet Analysis
- Power Difference on Arrival Direction Finding
- WiFi Protocol Analysis
- Pattern Matching

There are also a wide range of communication protocols used by drones with varying transmission powers. Due to the nature of these protocols some are easier to detect than others and offer more information which we can analyse.

The result of these factors mean that we offer various detection results depending on technologies used. These detection results vary in fidelity from 3D position to proximity alert, detection ranges up to 5km and frequency of detection up to 45 seconds.

HIGHEST TO LOWEST FIDELITY

- 3D Position and Classification of Drone & Controller up to 5km updated every 1 - 5 seconds Decryption
- 3D Position and Classification of Drone up to 1km updated every 10 - 20 seconds
- 90 Degree direction of Drone up to 1km updated every 1 - 5 seconds
- Proximity alert of Drone up to 1km updated every 10-20 seconds



LEGAL CONSIDERATIONS

When deploying Drone Defence technology there are some legal and operational factors to consider. While we are not lawyers, we can also provide more confidential, in-depth advice if required.

Drones are essentially remote-controlled cameras which allow their operators to take images from distances and heights that were, only a few years ago, impossible to achieve. Modern drones have 4K cameras, can fly for 30 mins and can be flown at distances of 8km from their controller. They work on a remote-control radio signal which operates in the 2.4 or 5.8 GHz range of the spectrum (same as Bluetooth or home WiFi). The vast majority of drones are flown with their operator controlling them in real-time and the drone transmitting images back to a screen or mobile phone. This means that the control and video signal can be detected and disrupted. Drones also use GPS to navigate, by disrupting GPS signals for a short period a drone will not be able to navigate onto a target when it is flown autonomously.

The first aspect that a boat should consider is the legal position when using drone defence technology. This is not as simple as it seems as a boat will transit through many jurisdictions during the season. The laws concerning the disruption of signals vary from country to country with some countries allowing drone jamming and others prohibiting it. It should also be acknowledged that legislation often doesn't keep up with emerging threats and we believe that this is particularly apparent with drones. However, in most developed countries people are permitted to use proportional force to prevent crime.

Given that a drone is likely to be flown illegally when threatening a boat then it could be argued that use of a jammer by trained crew member who had an honestly

held belief that a drone was a threat could be considered as legitimate proportionate. Having a crew member make the decision to activate the drone defences is an essential part of the process.

Next a boat should consider the operational implications of using a drone jammer. As with all new markets, like a gold rush, there are many companies appearing and selling drone jamming technology. Much of this is cheap, overpowered, low-quality far-east sourced electronics. The use of low-quality components could have an impact on not only the boats systems but also have an adverse health effect on the crew if they were subjected to RF exposure. Many of the cheap Chinese products on the market leak RF energy into other parts of the spectrum, to overcome this, manufacturers increase transmission power to ensure they can jam the drone in the correct band. The impact of increased power (40W and above) mean that the boat's other electronics could be overwhelmed and burnt out by excessive exposure to RF energy. There are also negative health impacts on the crew to excessive RF exposure.

Our philosophy is to use high quality components which are fully tested meaning we can have the same effect on the drone at much lower power levels (typically 5-10W). This means we remove RF leakage and minimize impact on the boat's systems. Our systems are completely safe for the owner, guests and the crew.

Finally, we help our clients deploy their drone defence technology in the most effective manner and we assist with developing standard operating procedures and responses to drone threats.

Legal Disclaimer:

Our drone jamming technology has not been authorized as required by the United States Federal Communications Commission ("FCC"). Consequently, these devices are not, and may not be, offered for sale or lease, or sold or leased, in the United States, other than to the United States government, its agencies, and its properly delegated representatives, until such authorization is obtained. The use of our jamming technology in the United States by other persons or entities, including, in certain circumstances, state or local government agencies, is prohibited by federal law. Laws limiting the availability of our jamming technology to certain types of users may apply in other jurisdictions. Drone Defence does not accept liability for use.

Our jamming technology affects 2.4Ghz, 5.8Ghz and GPS/ Glonass/L1. Emergency broadcasts, handheld radios, baby monitors, mobile phone communications and other dedicated channels remain unaffected.

End users of Drone Defence technology should seek independent legal advice if required.

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