



# DSIAC TECHNICAL INQUIRY (TI) RESPONSE REPORT

## Counter-Unmanned Aerial System (C-UAS) Technologies Using Nonkinetic Electromagnetics

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A chief service of the DoD IACs is free technical inquiry (TI) research, limited to 4 research hours per inquiry. This TI response report summarizes the research findings of one such inquiry jointly conducted by DSIAC.

## ABSTRACT

The Defense System Information Analysis Center (DSIAC) was asked to search for existing counter-unmanned aerial system technologies that can defeat drone swarms with nonkinetic electromagnetics. One known system is the Tactical High-Power Operational Responder (THOR) by the U.S. Air Force Research Laboratory. The inquirer was interested in systems with similar capabilities to test alongside the THOR system. DSIAC searched for similar technologies and summarized their capabilities and features in this report. Similar technologies include the Liteye Anti-Unmanned Aerial Vehicle Defense System, Northrop Grumman's Epirus, Inc. Electromagnetic Pulse counter-unmanned aerial system (c-UAS) and Mobile Application for UAS Identification, Drone Guard systems, the DroneDefender, the Department 13 MESMER Counter Drone System, the Silent Archer c-UAS, and CACI's Corian system.

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## 1.0 TI Request

### 1.1 INQUIRY

What Counter-Unmanned Aerial System (C-UAS) technologies exist or are being developed with the capability to defeat drone swarms with nonkinetic electromagnetics?

### 1.2 DESCRIPTION

The known system examined with nonkinetic electromagnetic capabilities is the Tactical High Power Operational Responder (THOR) by the U.S. Air Force Research Laboratory. The inquirer is interested in any other technologies similar to THOR's capabilities.

## 2.0 TI Response

To compare technologies similar to THOR's capabilities, an overview of THOR is provided. THOR is a counter-swarm electromagnetic weapon which provides non-kinetic defeat of multiple targets [1]. THOR is operated from a wall plug and uses high power microwaves to cause a counter electronic effect. It can be stored in a 20 ft transport container and can be set up within three hours. The user interface is designed to require minimal training for users.

### 2.1 LITEYE ANTI-UNMANNED AERIAL VEHICLE (UAV) DEFENSE SYSTEM (AUDS)

AUDS is designed to disrupt and neutralize UASs engaged in hostile airborne surveillance and potentially malicious activity [2]. The AUDS combines electronic scanning, micro-Doppler radar target detection; electro-optical (EO) tracking; classification; and directional radio frequency (RF) inhibition capability. The AUDS is a smart-sensor and effector package capable of remotely detecting small UASs. It then tracks and classifies them before providing the option to disrupt their activity. The system may be used in remote or urban areas to prevent UASs from being used for terrorist attacks, espionage, or other malicious activities.

The system can be operated from fixed locations or from a mobile platform, with the ability to detect, track, and defeat drones in seconds up to 10 km. The AUDS tracks drones using high-precision infrared (IR), daylight cameras, and advanced video tracking software before using a nonkinetic RF inhibitor to defeat the drone. Operators can then effectively take control of the drone and force a safe landing.

The AUDS has proved to be highly effective against swarm attacks and has successfully defeated approaching 2,000-drone sorties. It has been tested against more than 60 types of drones, including fixed wing and quadcopters.

## 2.2 NORTHROP GRUMMAN

Northrop Grumman offers an integrated, layered solution across their C-UAS architectures and systems, including a full complement of kinetic and nonkinetic effects.

### 2.2.1 Epirus, Inc. Electromagnetic Pulse (EMP) C-UAS

Leonidas is Epirus' C-UAS EMP capability now offered as part of Northrop Grumman's C-UAS portfolio [3]. Leonidas is designed for static and mobile C-UAS defense while using solid-state commercial technology to deliver capabilities with reduced size and weight. This allows increased standoff ranges and speed-of-light engagements that do not suffer from issues with magazine depth and capacity. When fired, Leonidas creates an EMP that can be steered for precision engagements or adjusted to sanitize a volume of air terrain or sky, creating a force-field effect.

### 2.2.2 Mobile Application for UAS Identification (MAUI)

MAUI is a mobile acoustic sensor that operates on Android cell phones and uses the phone's microphone to detect Group 1 drones flying lower than 1,200 ft and flying slower than 100 knots [4]. The MAUI software-based approach leverages commercial off-the-shelf mobile devices to provide beyond-line-of-sight detection and identification of UAS threats in high-noise environments. The company's Drone Restricted Access Using Known Electronic Warfare (EW) system, known as DRAKE, is an RF negation system that delivers a nonkinetic, selective electronic attack (EA) of Group 1 drones.

## 2.3 ETLA NORTH AMERICA, INC.

The U.S. Air Force awarded ETLA North America Inc. the U.S. subsidiary of Israeli Aerospace Industries (IAI), a \$15.6 million contract for Drone Guard systems delivered in July 2017 [5]. The system employs EO sensors to track drones and EA jammers as a nonkinetic approach to down any UAS flying in a protected airspace.

To detect low-signature, low-level, and low-speed airborne targets, ETLA has adapted its three-dimensional (3-D) radars for short (10 km), medium (15 km), and long (20 km) ranges [6]. They have also been adapted with EO sensors for visual identification of the target. To disrupt hostile drones, ETLA developed adaptive jamming systems to use with its detection and identification sensors or as a continuously operated stand-alone system. The jamming disrupts the drone's

flight and can either cause it to return to its point of origin or shut down and make a crash landing.

## 2.4 DRONEDEFENDER

The DroneDefender C-UAS Device (now owned by Dedrone) uses a nonkinetic solution to defend airspace against UASs, such as quadcopters and hexacopters. The device operates without compromising safety or risking collateral damage [7]. The easy-to-use, lightweight, point-and-shoot system requires no extensive training and provides instantaneous disruption of unwanted UASs using remote control drone and Global Positioning System disruptions. Features include the following:

- two continuous hours of operation
- 15-lb weight
- multiple antennas
- disruption electronics
- battery operated

## 2.5 DEPARTMENT 13 MESMER COUNTER DRONE SYSTEM

MESMER is a patented, low-power, nonjamming, non-line of sight, nonkinetic drone mitigation solution [8]. The key differentiator for MESMER is its ability to manipulate weaknesses in all digital radio protocols. MESMER uses sophisticated automated detection and mitigation strategies to stop, redirect, land, or take control of drones across a range of national security and defense scenarios. The MESMER v1.0 system has the following three key components:

1. General-purpose, computer-server running, Linux operating system
  - a. Multiple Ethernet ports are utilized for intrasystem communication.
2. Software-defined radios (SDRs)
  - a. MESMER utilizes commercially available SDRs for RF signal reception and generation.
  - b. SDRs can generate arbitrary waveforms used for drone detection, identification, and mitigation.
3. RF front end
  - a. Provides signal conditioning on receive and transmit channels and allows MESMER to perform optimally in a real-world environment. The system can be operated using a graphical user interface—a tablet with a touchscreen or a standard desktop monitor with a keyboard and mouse.
  - b. The system can also be operated in automitigation mode that does not require operator intervention to initiate a drone mitigation.



MESMER can be installed in ruggedized enclosures equipped with climate control for fixed sites or used for mobile applications. It can be used as a stand-alone system or integrated into command-and-control systems (security) via RJ45 cable and standard IP-based networking.

## 2.6 SRC INC. SILENT ARCHER C-UAS

Silent Archer technology delivers a turnkey C-UAS solution comprised of radar, EW systems, direction finding, camera, and a 3-D user display to detect, track, classify, identify, and disrupt hostile drones [9]. It is successful against lone targets or a UAS swarm. The technology also includes frequency, spatial, and optical surveillance features. The following components are also featured:

- Air surveillance radars
  - AN/TPQ-50 with LSTAR air surveillance software
  - AN/TPQ-49A with LSTAR air surveillance software
  - Gryphon R1410 multimission radar
  - Precision fire control radar
  - SkyChaser on-the-move radar
- EW systems
  - Silent Thunder Multimission EW System
  - Silent Resolve Navigation Warfare System
  - SRC5986E Rugged Microtransceiver
  - ANCILE by Allen-Vanguard
- Direction-finding units
  - Whisper Hunter direction finding unit
  - Gryphon S1200 spectrum sensor
  - TCI Model 280 system
- EO/IR camera
- User displays
  - SRC 3-D user display
  - Gryphon SAME display

## 2.7 CACI CORIAN

CORIAN, part of the SkyTracker Technology Suite, is a C-UAS/counterdrone capability comprised of multiple form factors designed to protect against UAS threats [10]. It is a modular, scalable system of systems with interoperable fixed site, mobile, and packable form factors that scale to meet the C-UAS defense needs of any installation or operation. EW and signals intelligence RF systems are integrated to support CORIAN's detection, identification, and mitigation capabilities.

The SkyTracker technology suite provides a continuous, automated monitoring and CACI claims it readily integrates into existing command and control or security systems. CACI's architecture

allows quick adaptation to counter evolving threats while using data links to precisely identify and locate aircraft flying in banned or protected airspace. It also has the capability to locate the ground controller, enhancing responders' abilities to engage only those operators inadvertently or unlawfully misusing their aircraft. The SkyTracker system can also accurately geolocate the position of misused UASs while differentiating them from other UASs in the same area. CORIAN's fixed site capability detects, identifies, tracks, and mitigates UAS threats using precision neutralization techniques that ensure little-to-no collateral damage to the surrounding RF spectrum and existing communications. The CORIAN M (mobile) system provides on-the-move force or facility protection against UAS threats. The ruggedized, portable mobile platform leverages the CORIAN software baseline to precisely detect, identify, and mitigate UASs through various signal load sets, along with a range of other threats configurable to customer requirements. The system can be easily deployed on a vehicle or marine vessel, providing both ground and maritime convoy protection.

According to CACI, the CORIAN D (dismount) is the smallest, man-packable, C-UAS attack system with the longest detection and mitigation range currently available on the market. CORIAN D surveys the environment to enable deployed units to counter UASs, Wi-Fi, range extenders, data links, analog/digital video, and other signals of interest. It is configurable to customer requirements and can operate autonomously to deliver precision distributed attacks and provide rapid, responsive force protection capability in hostile environments. It also integrates with additional CORIAN and SkyTracker Technology Suite devices to provide modular, extended perimeter protection.

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