



LOCKHEED MARTIN CDL SYSTEMS

Software Solutions for
Unmanned Vehicle Systems

LOCKHEED MARTIN
We never forget who we're working for®

Lockheed Martin

CDL Systems

CDL Systems specializes in development, deployment, sales and application of unmanned systems for commercial, civil and military applications. Our primary focus is developing software that helps our customers become highly effective using unmanned vehicles and the data they gather. Once a small technology start-up, we are a 75-employee workforce in Calgary, Alberta, and Huntsville, Alabama.

We leverage international standards and design our software to run on easy-to-find hardware. This provides our customers low lifecycle costs and long-term options for growth, sustainment and flexibility. Our software has been integrated with, and used to control, over 40 unmanned vehicle systems including propeller-driven aircraft, helicopters, jet target drones, airships, convertible aircraft, rigid hull and inflatable boats, large-scale ground robots, quad-copters and submersibles. Our customer set is equally diverse including the U.S. Department of Defense, Canadian Forces, UK Ministry of Defense and commercial drone operators. Our combined flight hours exceed 1.2 million.

With an emphasis on low cost, interoperability, automation and low-dependency architecture we support emerging technologies, safety and a growing dependency for actionable intelligence. We look forward to working with you in developing an unmanned future.



Our Software

Vehicle Control Station (VCS)

Our VCS software is a fully integrated command, control, and information ground control system designed for operating and monitoring unmanned vehicles. In operation around the world, VCS controls UAVs, UGVs, high-speed air and sea target-drones, and loitering munitions in a variety of roles. VCS supports operation of multiple vehicles, sensors, payloads, data links, and other subsystems from as few as one operator workstation.

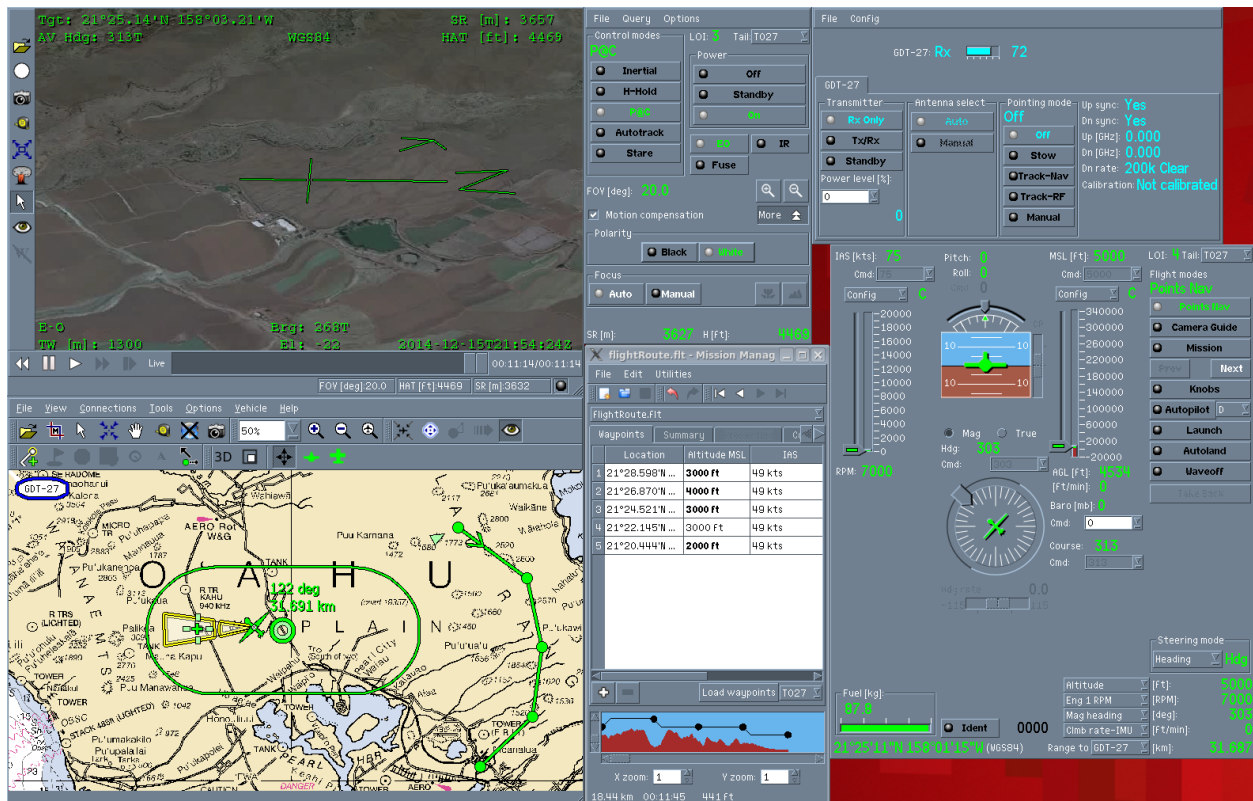
Commonly integrated as a ground control system for UAVs, VCS increases autonomy by automatically managing basic piloting tasks. Operators enjoy real-time control and monitoring through an intuitive point-and-click user interface requiring only a keyboard and mouse. Years of R&D led us to design a product tailored to operators with or without piloting experience. The automation of flight tasks allows operators to focus on their main objective: the mission.

VCS is built on a low-dependency architecture that can be adapted to any unmanned vehicle system. We support commercial off-the-shelf hardware running Windows or Linux. With tools and support for customer's vehicle integration, we can integrate and add credibility to your unmanned vehicle program.

VCS-4586

Overview

Supporting STANAG 4586, VCS-4586 is the industry-leading commercial off-the-shelf operator ground control software for multiple vehicle operations ranging from civil to military, mini to large.



Real-Time Video

Real-time sensor video and telemetry is essential to virtually every ISR mission. VCS-4586 features an integrated video suite that displays real-time EO/IR video and associated metadata. VCS-4586 can interface with virtually any vehicle-mounted EO/ IR sensor and geo-references the video allowing operators to command the sensor to “look” by clicking directly on desired points of interest. NTSC and PAL analog streams are supported along with MPEG-2 and H.264 digital streams with KLV metadata (MISB 601.2) in accordance with STANAG 4609.

Mission Management

To reduce operator workload, flight routes and sensor tasks in integrated systems can be automated using the mission management system. Operators create, manage and modify tasks in real-time to adjust to changing mission priorities. Flight routes are validated against terrain violations, airspace constraints, and data link coverage outages to increase mission effectiveness and operational safety.

Vehicle Management

VCS-4586 allows for multi-vehicle control from as few as one ground control operator workstation. To make this possible, the software assists with a high level of autonomous vehicle control. Operators simply use the point-and-click user interface to control vehicle navigation. Operators assume the role of “system managers” and focus on mission objectives while the software manages specific operation details.

Interactive Map

The interactive map displays vehicles, sensors, payloads, data links, and other vehicle systems as geo-referenced objects on a mission-specific map background. Operators can command and control integrated vehicle and sensor functions directly through the map. Maps can be imported from virtually any image and latitude/longitude, UTM, and MGRS coordinate systems. NGA map formats and DTED are natively supported. Any map can be re-projected into three dimensions to enhance situational awareness. Target markers, MIL-STD-2525B tactical graphics and symbols, restriction zones, flight plans, and a customized overlays can be displayed to enhance tactical understanding of an area.

Operational Safety

A number of behind-the-scenes features assist the operator in maintaining safe and optimal operations. A warning, caution and advisory system informs the operator of system status and abnormalities. VCS-4586 employs a consistent software-wide color scheme, based on human factors research that makes distinguishing between different operational parameters intuitive to the operator.

System Integration

VCS-4586 operates as a ground control solution with virtually any UAS. Our VSM Development Kit (VDK) allows third-party integrators to easily develop VSMs for their specific vehicle systems. Our API enables the interfacing of VCS-4586 to third-party applications and C4I infrastructures.

System Requirements

VCS-4586 is configured to operate effectively on Linux operating systems.





U.S. Army MQ-1C Gray Eagle

VCS and the U.S. Army

One System Ground Control Station

OSGCS is the U.S. Army's interoperable control station for operating the RQ-7B Shadow, MQ-5B Hunter, and MQ-1C Gray Eagle UAS. Our VCS software is installed in every OSGCS shelter to conduct intelligence, surveillance, reconnaissance, and other tactical UAS missions. To date, the U.S. Army and U.S. Marine Corps have accumulated over 1,200,000 operational flight hours using VCS in-theater. The OSGCS helps the U.S. Army control their fleet of dissimilar UAV platforms from a common operator-interface.

The next generation of the OSGCS, the Universal Ground Control Station (UGCS), increases interoperability via a common communication layer using the Tactical Common Data Link (TCDL), common interface protocols, and common operator interfaces. Our VCS-4586 software unifies UGCS objectives and enables system-wide interoperability.



RQ-7B Shadow



MQ-5B Hunter

VCS and Fire Shadow

Loitering Munition

Fire Shadow is a loitering munition weapon system, designed by MBDA, for the land domain, with an operating range of approximately 60 miles (100 km). It offers precision attack capabilities against time-sensitive static and moving targets with minimal collateral damage. Once launched over a battle zone, it can loiter several hours before engaging a target.

Our ground station software VCS-4586 provides Fire Shadow's command, control and monitoring capabilities. Operators control the weapon with VCS-4586 integrated into the ground control station, which provides real-time situational awareness in complex scenarios.

Fire Shadow has entered service with the Royal Artillery and is part of the UK Ministry of Defence (MOD) evolutionary strategy for developing affordable complex weapons.





Meggitt Target Systems Barracuda

VCS and the UTCS

Universal Target Control Station

The Universal Target Control Station (UTCS) is a ground control solution developed collaboratively by Meggitt Target Systems Canada and CDL Systems to control multiple air and sea-surface target drones for military target training against asymmetric aerial and naval threats. We provide the VCS software installed in the UTCS to operate Barracuda and Hammerhead sea-surface targets in addition to the Vindicator aerial target drone, Airbus jet powered Direct Targets, and Mosquito Helicopter. The UTCS' interoperable architecture uses common hardware and software interfaces and analogous communications protocols.

The UTCS has gained industry recognition for simultaneously controlling up to four targets from a single operator workstation. The UTCS is deployed in military target operations worldwide: Canada, Greece, Japan, Norway, Saudi Arabia, Singapore, Sweden, Germany, Korea and U.S.



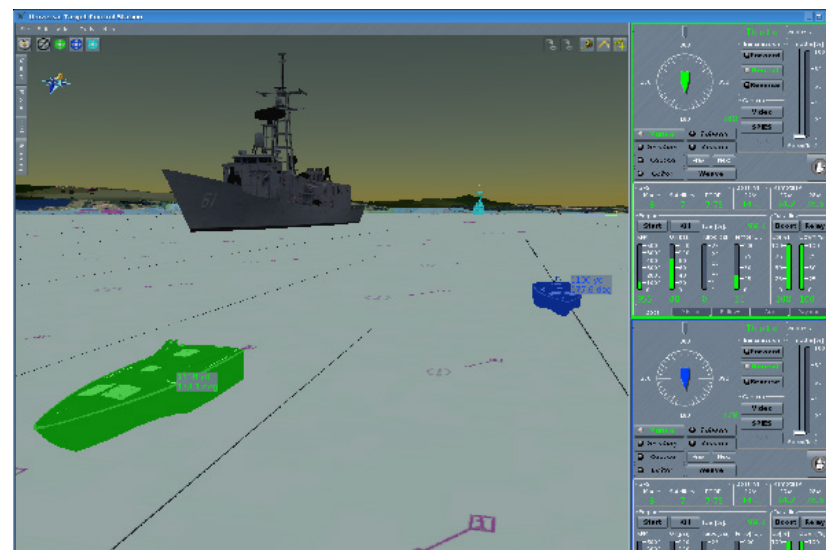
Meggitt Target Systems Hammerhead



Airbus Do-DT 25



Meggitt Target Systems Mosquito



Indago

Lockheed Martin CDL Systems is a reseller and distributor of the Lockheed Martin Indago™. Combined with our mobile Ground Control Station (mGCS) software, and Hydra Fusion Tools, the Indago transforms into an advanced surveillance, mapping and tracking asset with flight time, stability and stealth.

The Indago is a surveillance and mapping machine. It is proven reliable in operations from the Canadian tundra to the African jungle; the Norwegian Nordland to the Arabian desert – in rain, snow, sand and wind. Rugged and tested for your application, Indago maximizes performance with high intelligence and safety.

Class leading performance characteristics

- Top Speed of 38 kts (measured)
- Operational to 18,000 feet MSL (measured)
- Flight time exceeding 45 minutes with payload (measured)
- Whisper quiet, stable, rugged, and all weather capable

Benchmark level of safety

- Lockheed Martin Kestrel Autopilot
- Automated pre-programmed fail-safe routines
- Advanced flight control modes for autonomy
- Automatic pre-flight validations
- Visual and audible warning and alert system

All Mission Ready

- Mapping and surveying
- Infrastructure inspection
- Tactical ISR
- Persistent Surveillance

Indago can be fitted with hot-swappable payloads for different missions: electro-optic and infrared cameras, laser pointers, multi-spectral cameras, normalized difference vegetation index cameras, as well as dedicated mapping and survey cameras. A community of Indago distributors and users constantly evolve the Indago's sensors and software.



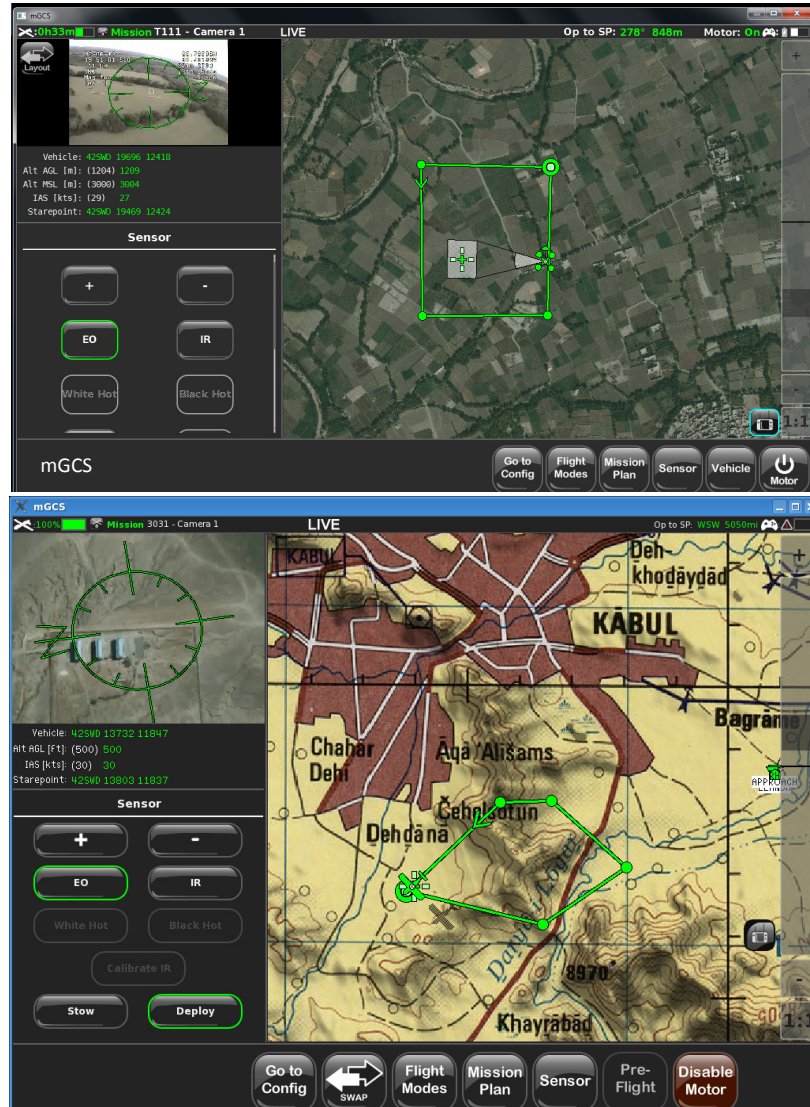
mGCS

Mobile Ground Control Station (mGCS) builds on the million flight hour legacy of its big brother, VCS-4586. mGCS is universal, supporting STANAG 4586 interoperability. When you buy mGCS, you don't get a controller for just one aircraft, you get a proven platform that grows with your stable of aircraft.

Features:

- Mobility oriented: designed to operate on portable tablet computers running Windows or Linux
- Mission Centric: flies the mission so you don't have to
- Safety First: conducts pre-flight checks and constantly monitors your system for safe operation
- Ease of Use: uses a simple touch screen with commercial gaming joysticks and advanced automation
- Live Video: shows you what the aircraft is seeing in real-time and geographically referenced
- Standards Based: supports STANAG 4586, STANAG 4609, H.264/5, MISB 0601.2, DTED, DEM, and dozens of map formats
- Real-time Mapping: coordinates your flight to optimize map gathering and searching

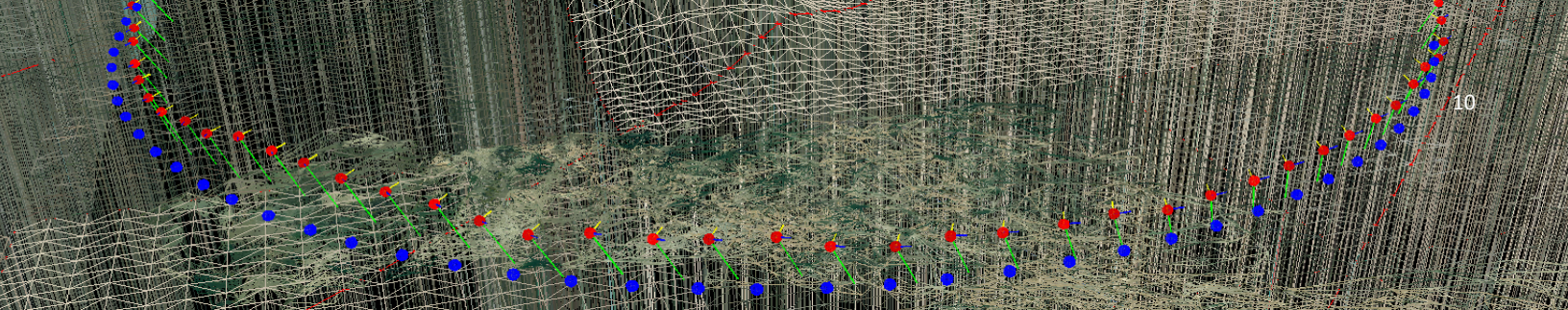
mGCS also works with our Hydra Fusion Tools software to generate real-time, three dimensional tactical situation maps which can be used for adaptive mission planning.



System Requirements

Indago and mGCS is configured to operate effectively on Windows and Linux operating systems.



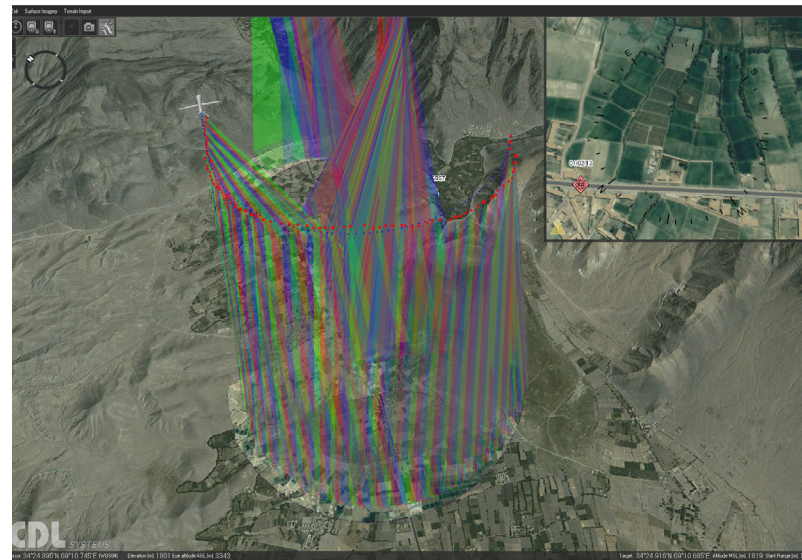


Actionable Intelligence

Most unmanned systems capture data. However, large volumes of data are a problem in their own right. What users want is actionable intelligence – data condensed and presented to the decision maker which can immediately answer questions, solve problems, and spur immediate action. Gathering data is useful, but the immediacy of decision-making transforms the value of an unmanned vehicle.

Lockheed Martin CDL Systems is leading efforts to extract actionable intelligence from UAS data by investing in advanced technology. Terms such as Structure from Motion, Simultaneous Localization and Mapping (SLAM), Monocular Visual Odometry, Point Clouds, Orthomosaics, Photogrammetry – are all advanced mathematical concepts raising the bar. We are turning those concepts into reality with a new product offerings that convert this technology into easy-to-use solutions.

- **Real-time structure from motion:** the ability to generate 3D point clouds and 3D imagery in real-time as a vehicle flies.
- **GPS Denied operation:** using imagery to track the real-time position of an aircraft from what it “sees” and not from satellite based triangulation.
- **Construction site mapping:** the ability to compare architectural drawings to actual 3D imagery to gather daily progress updates.
- **Plant Health:** We are working with leading Universities to develop sensors and algorithms to diagnose plant health in agriculture and forestry.
- **Infrastructure Inspection:** We are working on automation to map and inspect large, critical infrastructure.
- **Surveying:** the ability to product wide area maps of tactical situations or installations.



Our Portfolio

We have worked alongside a diverse group of international clients on an array of unmanned vehicles and simulation platforms.

AAI Aerosonde	Airbus Do-DT 25/35/45/55
AAI Shadow 200 (U.S. Army RQ-7B)	E.M.I.T. Sparrow
AAI Shadow 400	General Atomics ASI Gray Eagle (U.S. Army MQ-1C)
Advanced Subsonics Grasshopper	General Dynamics Canada FORESIGHT
AeroVironment Raven B	Lockheed Martin Fury
ATK Outrider	Lockheed Martin Indago
Aurora Flight Sciences Excalibur	Lockheed Martin Desert Hawk (and EER)
Aurora Flight Sciences GoldenEye 80	MBDA Fire Shadow
BAE Systems Kingfisher	Meggitt Target Systems Barracuda
BAE Systems (ACR) Silverfox	Meggitt Target Systems Hammerhead
Boeing A160 Hummingbird	Meggitt Target Systems Vindicator
Boeing (Insitu) ScanEagle	Meggitt Target Systems Mosquito
Bosh Swiper	MetaVR VRSG
CAE STRIVE	Northrop Grumman Hunter B (U.S. Army MQ-5B)
CAE UAV Simulator	Simlat STS-Pro

We have gained recognition for our strong understanding of ground control software unmanned vehicle systems, experience in on-site integration and testing, and our personalized and long-term customer relationships. Our dedicated team of highly skilled engineers brings a wealth of expertise and innovation to the products and services we provide.

Lockheed Martin

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