PHYSICAL OPTICS CORPORATION

Technology that makes a difference.®

MILITARY & DEFENSE
Technology Summary

AIRBORNE SYSTEMS

DDS - DIGITAL DATA SET

- **Multichannel Digital Recorder**:
  - Video (2) - MPEG4, NTSC (RS-170)
  - Audio (4) - MPEG2, Layer 3 (MP3) and
  - Sensor data – (32 Hz sampling rate)
  - Communication Interface: Triple redundant MIL-1553, RS-422, RS-232 & commercial protocols available
- **Integrated** Navy TAWS (3.2D) and MDL (Mission Data Loader).
- **W-Link (Optional)**: IEEE 802.11n / 802.11i, FIPS 140-2 compliant, multi-frequency high speed wireless communication for data downloading (video/audio/data) and uploading (mission).
- 1 Gbps Ethernet: Included.
- **Wireless Sensors**: Can handle up to 256 sensors (wired and wireless), including engine diagnostics and fire detection.
- **Memory**: 128 GB Internal Memory, 8GB CSMU external memory – 32 GB USB RMU.
- **Encryption**: FIPS 140-2 level encryption. **MFOQA/FDM Enabler**: Complies with MFOQA high sampling rate data. RS422/GB Ethernet/USB maintenance access, reduces costs associated with maintenance/ aircrew manual download/upload of data and trouble-shooting. Real time sensor viewing, web interface enabled.
- **Modular System**: Configurable to meet customer requirements

CONTACT : Robert Waldo - rwaldo@poc.com

FAERITO®

The FAERITO®digital flight recorders provide over 30 hours of synchronous Digital Video/Audio/Data recording. This unique “All-In-One” digital flight recorder meets DO-160 environmental standards. FAERITO® is packaged into a single compact housing measuring 4.5” x 5”x 8” and weighs less than 9 lbs. The following options are included in the FAERITO®digital flight recorder: **MEMORY**: 32GB Crash Survivable Memory Unit (CSMU) to ED-112 standard, noncrash (protected) internal memory, and external USB removable flash memory. **VIDEO**: 2 channels of NTSC (RS170 standard) or PAL Video input with compressed 1 Mbps maximum data rate per channel, utilizing POC’s proprietary Wavelet video compression for the highest quality video recording and playback. **AUDIO**: Up to 4 channels of high quality compressed Digital Audio with the latest MPEG 1, Audio layer 3 standard at 16 Kbps per channel. DATA: Discrete sensors and full range analog channels with fully programmable dynamic range and sampling rate; **COMMUNICATION and DATA BUS**: Options include MIL-STD-1553B, RS422, RS232 and other commercial protocols.

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AIRBORNE SYSTEMS

DTS - DATA TRANSFER SYSTEM

The DTS is an In-Flight Data Loading & Digital Recorder. The primary function is to upload mission and map data, record in-flight avionics data, and record maintenance data during ground and flight operation for post flight information exchange.
Packaging: Single compact housing measures 9” x 5” x 3” and weighs <4 lbs. Suitable for MIL-STD-810G environments.
Memory: 3 independent 256 GB. Removable Memory Units (RMU) with 500 Mbps throughout (MIL-STD-1472 compliant).
Data Transfer: 4 channels of Gigabit Ethernet, each with 500 Mbps throughput (2 Gbps System).
Intelligent RMU insertion and software configures data routing to the appropriate channel.
Encryption: Enhanced encryption for mission and maintenance data.
Interfaces - DTS power supply (28V), zeroize / erase (manual), RMU interface (USB), Gigabit Ethernet.
Expandable: 2 additional slots are built in to accommodate future requirements and upgrades such as video / audio.

CONTACT : Robert Waldo - rwaldo@poc.com

HDVR - HIGH DEFINITION DATA & VIDEO RECORDER

The HDVR family of products provides best in class transfer, encryption, compression and storage of mission and maintenance data, including video, audio and digital platform information. The HDVR family provides up to 15 hours of secure storage. MIL-STD-810, 464, 461 and 704 compliant.
CAPABILITIES: Enhanced mission capabilities through fast ground data loading (a few minutes), long mission recording, superior availability and security.

- Encryption
- 4 HSDN/HSVN/Fiber
- 8 Video, 4 Audio
- 2 1000BaseT, 4 100BaseT
- 6 MIL-STD-1553
- Temperature -65 to 95°C
- 35-45W configurations
- MTBF>10,000 hours

EMERGING PLATFORMS: F-18, F-15 contracts, F-16, A10, C-130 available

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AIRBORNE SYSTEMS

DTM II - DATA TRANSFER MODULE II

DTM II is composed of a data loader receptacle and two data cartridges that are used to physically transport data between the aircraft and ground systems. The DTM II has a modular design that allows easy modification to other aircraft interfaces (Fibre Channel, Ethernet, 1553, etc.); first implementation is for F-15C/E, using Gigabit Ethernet over Fiber and FIPS-140 encryption.

- Packaging – Single compact housing measures 5.75”W x 5.25”H x 6”L,- weighs <8lbs (with 2 removable memory devices installed), and is qualified to MIL-STD-810. Power consumption approx. 17W.
- Data Transfer – Modular backplane design enables a variety of interfaces with an aircraft: GigE (copper or fiber) or MIL-STD-1553 are the most popular interfaces. The removable memory devices use USB 3.0 (5Gbps) to perform read/write data transfers with ground systems.
- Encryption – FIPS 140-2 with path to encryption.
- Interfaces (Current configuration):
  - 2 x optical gigabit Ethernet
  - 1 x gigabit Ethernet (copper)
  - 1 x serial port
  - 10 x discretes
  - 2 x USB 3.0

CONTACT : Ross Mohr - rmohr@poc.com

JARVIS - JOINT AVIONICS RECONFIGURABLE VIRTUAL INFORMATION SYSTEM

JARVIS provides decentralized processing through an Integrated Modular Avionics 2nd Generation (IMA-2G) approach. Architecture allows networked Processor Nodes to identify and dynamically migrate processing requirements from a failed processor node to a healthy node while using a common communication protocol and software interface. JARVIS can partition federated applications from the OFP to preserve red/black and safety level separation, providing a true modular software architecture.

CONTACT : Juan Gutierrez - jgutierrez@poc.com

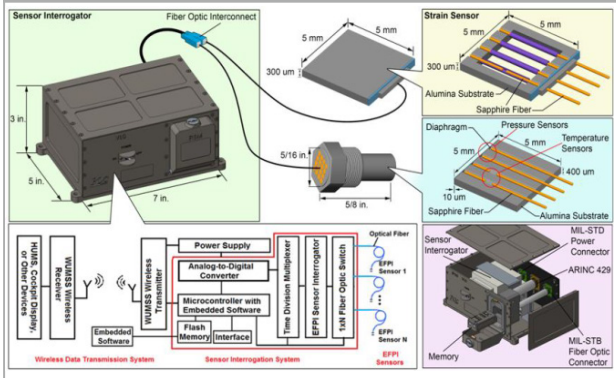
AIRBORNE SYSTEMS

MENTIS - REMOTE INTERFACE UNIT

Interoperability between subsystems is an increasingly nagging problem with modern military platforms. MENTIS overcomes these issues by providing a standardized solution that transparently adapts to unique connectorizations, and provides real-time translation between diverse data formats. With MENTIS, analog and digital inputs are internally rerouted using an embedded switching fabric, and the signals are transformed into a digital output that is passed to the platform's onboard computer for logging and/or analysis, eliminating the need to rewire input connectors for different payloads. The onboard processing provides translations between various input signal types, all in a package as small as 1" x 1" x ½". Three MENTIS configurations are available.

CONTACT : Ross Mohr - rmohr@poc.com

MAFOSS - MULTILAYERED AND ARRAYED FIBER OPTIC SENSOR SUITE



MAFOSS is based on a suite of different fiber optic Fabry-Perot (FP) sensors to simultaneously acquire multiple parameters such as temperature, vibration, strain, torque, heat flux, and pressure. The sensor heads can be fabricated by using sapphire optical fiber and high temperature-resistant ceramic materials for applications in ultra-high temperature (up to 1740 °C) environment.

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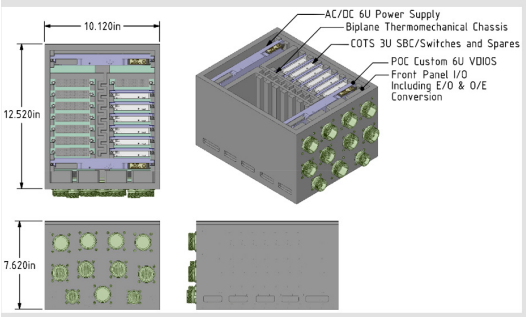
AIRBORNE SYSTEMS

SMPX - SPECIAL MISSION PROCESSOR EXTENDED



SMPX provides reconfigurable and flexible special mission processing capabilities based on JARVIS's integrated modular avionics architecture. The modular architecture of SMPX significantly decreases logistical and maintenance foot prints, which will also lower the life cycle costs because of identical but reconfigurable general processing and display node configuration. The system monitors the runtime processes to optimize the processor and graphics processing unit utilization, thus it minimizes power consumption. Software architecture allows easy application insertion and removal without affecting the system performance and safety.

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NAS - NETWORK ATTACHED STORAGE

The design of the POC NAS minimizes SWaP-C while meeting thermal, structural, and environmental requirements (both operational and storage) of this product. Despite the appearance of simplicity, sophisticated engineering has been applied (based on prior development efforts) to the cards and connectors to ensure consistent and solid mating of the cartridge connectors (a patented design), thermal management of the cards, power management of the system, and proven environmental and EMI-focused design features to minimize problems in the field.

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AGILEPOD™

To increase the capability, affordability and flexibility of podded intelligence, surveillance, and reconnaissance, the Air Force Research Laboratory (AFRL) has developed and demonstrated the AgilePod™, the multiintelligence (multi-INT), modular, open architecture pod.

POC modules add strong capabilities to the AgilePod™

- Storage, in ruggedized, airborne-tested, solid state memory modules
- Data at rest and future data in transit encryption
- Video compressions, processing and storage for RECCE operations
- Multi-node, multi-enclave, multi-application processing with POC's JARVIS technology for graceful degradation and availability
- Cognitive software defined radio and POC's proven low power electronics

CONTACT : Eric Rucker - erucker@poc.com

AIRBORNE SYSTEMS

ETMR - ENGINE TREND MONITORING RECORDER

The ETMR unit is housed in an aluminum chassis qualified to DO-160G environmental requirements and can be mounted in any orientation. It measures 6.3” x 9.3” x 4” and weighs 3 lbs. The unit is configured with all connectors on the front panel for ease of access to power, electrical interfaces and either USB or Ethernet interfaces for data retrieval. The ETMR is compliant to Pratt Whitney Canada Service Bulletin No. 1703R6 for the PT-6A engine. The unit supports performance and maintenance analysis and provides storage for >10,000 hours of flight information. Optional: crash hardened memory unit.

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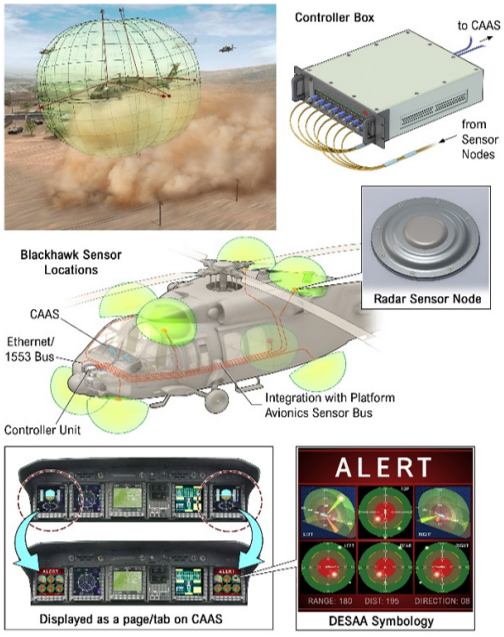
DESAA - DISTRIBUTED PHASED ARRAY ENHANCED SENSE AND AVOID SYSTEM



DESAA is a ruggedized 360° sense and avoid system that innovatively fuses eight sensor nodes consisting of Phased Array Sensor (PAS) systems distributed strategically around the platform to provide a complete 360° FOV within a ~500 ft radius. This information is processed and will be graphically presented in the cockpit, with the additional capability of having visual and aural alerts of objects within the sense and avoid area.

Benefits

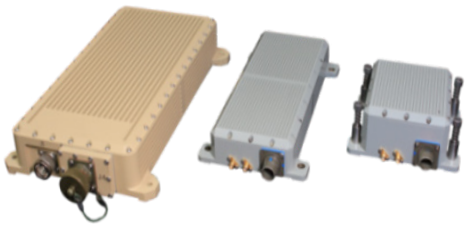
- Improves Situational Awareness in Degraded Visual Environment (DVE) conditions
- Range of 500ft around aircraft with possibility of extended ranges in a forward and downward FOV
- Functional for Day/Night Operations

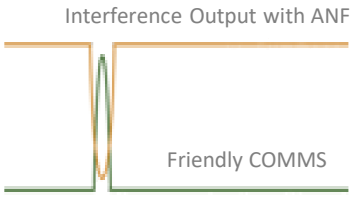
CONTACT : Juan Gutierrez - jgutierrez@poc.com

ELECTRONIC WARFARE/RF SYSTEMS

HIGH POWERED TUNABLE AGILE RF FILTERS

POC's family of Agile RF Filters can be synchronized to frequency-hopping radios, Data or SIGINT Systems and dynamically create notches in the full output energy of most EW Assets, thus removing harmful interference from communication Data or SIGINT frequencies. It operates in the analog domain, and can provide over 100 dB of in-band attenuation, with minimal reflected power (VSWR <1.4), and low out-of-band insertion loss (<1.0 dB), while passing over 1kW of power to the emitter. It is capable of creating frequency tunable filters and/or dynamically configurable widths and depths. Agile RF Filter performance has been validated in US Navy and US Army EW labs using military radios and EW Assets.





CONTACT : Scott Fitzgerald - sfitzgerald@poc.com

WISDEM - WIDEBAND INTELLIGENT RF SPECTRUM DETECTION EXPLOITATION AND MONITORING

WISDEM is a system used to reliably characterize the RF spectrum in an area and provide the data in real-time to a central control over band-width limited communications channels.

Features

- Frequency Range: 1 MHz to 7 GHz (expandable to 18 GHz)
- Instantaneous Bandwidth: 2 GHz
- Frequency Resolution: 10 kHz
- Real-time detection of signal strength, center frequency, and bandwidth, with timestamp for all signal content within IBW
- Adaptive thresholding
- Detection of overlapping wideband/narrowband signal content
- Differential monitoring (to identify changes in signal content)
- Compensation of analog RF front-end impairments
- Output data rates compatible with GbE or 802.11

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ELECTRONIC WARFARE/RF SYSTEMS

SDMRD - SOFTWARE DEFINED MULTIPLE RADIO DEVICE

POC's SDMRD integrate several radio functionalities (Iridium, 4G LTE, P25 and PRC-148B) into a single handheld communications device that allows you to talk anywhere in the world and anytime On-the-move (OTM) and over-the-horizon (OTH). The SDMRD MM is designed as an add on to a host radio, like the MBITR2. The SDMRD MM provides position and time data and will support unencrypted plain-text data over GSM/4G-LTE and encrypted voice Iridium communications over the Distributed Tactical Communication System (DTCS) network and access to worldwide cellular VoIP data networks through a user-replaceable Subscriber Identification Module (SIM) card.

CONTACT : Scott Fitzgerald - sfitzgerald@poc.com

PALM - PREDISTORTION-BASED AMPLIFIER LINEARIZATION MODULE

POC's PALM is a wideband, signal-agnostic, linearization module which can be integrated with or attached to an existing RF high power amplifier with no modification, compatible with high power amplifiers operable in the HF, VHF, UHF and low microwave.

- Operates across the entire HF/VHF/UHF/L-band (2-2500 MHz) simultaneously
- Operates on an entire signal environment (i.e. multiple simultaneous signals within the operating band)
- Targeted reduction of user-selectable nonlinear spurious signals) by 40 dB or more
- Signal agnostic: operates on any signal type within 2-2500 MHz band including high peak-to-average power ratio (PAPR) signals such as OFDM
- Versatile integration in RF chain: can operate on the Tx or Rx side
- Self-calibrating: automatically optimizes nonlinear compensation based on user specifications
- High fidelity: does not affect fundamental signals
- Real-time adjustment: to account for real-time changes in amplifier nonlinearity
- Compatible with up to 500 W amplifier RF output power.

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A2D - ACTIVE INTERFERENCE CANCELLER

POC's Active Interference Canceller is based on a feedforward automated two-tone very-high dynamic range measurement instrument (A2D). Although initially designed for two-tone cancellation, the A2D software-defined architecture is signal-agnostic and readily-adaptable to dynamic interference cancellation of arbitrary wideband waveforms in both analog RF and digital RF domains.

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ELECTRONIC WARFARE/RF SYSTEMS

CONFORMAL ANTENNA TECHNOLOGIES

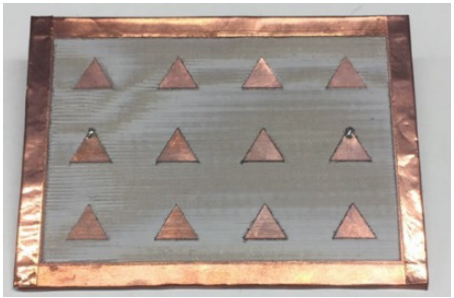
BEAST

(17 and 34 GHz)

Conformal Antenna Array for Air to Ground Missiles

- **Multi-missile guidance** Conformal Antenna Array
- Applicable for air to ground missiles, Electronic Warfare (EW), and biomedical
- Low SWAP phased array that can control multiple elements with 1 phase shifter

BEAST	
Platform	Conformal Antenna Array for Air to Ground Missiles
Frequency	17 and 34 GHz
Polarization	Linear
Gain	>20 dBi
Size	Compact
Field of View	7°
Field of Regard	±35°
Beam Forming	Analog (RF)



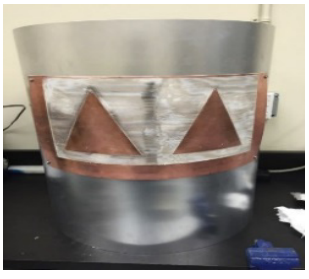
BEAMER

(S-band, X-band, K-band)

Conformal Multiband Antenna Array for EKVs

- Long Range ballistic missile Conformal Multiband Antenna
- Applicable for Exoatmospheric Kill Vehicle (EKV) and Relativistic Kinetic Kill Vehicle (RKKV)
- Replaces existing high latency, excessive SWAP Phased Array Antennas with a multiband, multi-frequency, 360 FOV Antenna

BEAMER	
Platform	Conformal Multiband Antenna Array for EKVs
Frequency	S-band (2.2 - 2.3 GHz) X-band (7.9 - 8.4 GHz) K-band (21.1 - 21.2 GHz)
Polarization	Linear
Gain	>7 dBi
Size	Compact
Field of View	360°
Field of Regard	N/A
Beam Forming	N/A



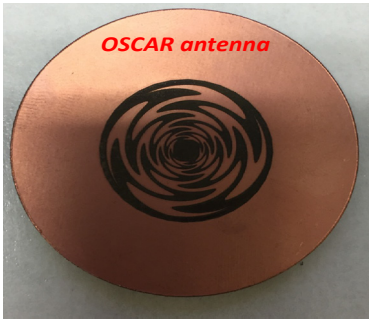
OSCAR

(X-band, Ku-band, Ka-band)

Conformal Limited Aperture Antenna Array for UAVs

- UAV mounted 4” diameter, lightweight, Conformal Limited Aperture Antenna Array
- Applications include UAV’s, HELO’s, Fixed wing and RADAR
- Replaces existing multiple antennas, providing multiband, dual polarization, and true time delay

OSCAR	
Platform	Conformal Limited Aperture Antenna Array for UAVs
Frequency	X-band (7.25 - 8.4 GHz) Ku-band (10.9 - 12 GHz) Ka-band (17.7 - 20.2 GHz)
Polarization	LHCP & RHCP
Gain	>45 dBi
Size	Compact
Field of View	N/A
Field of Regard	20° - 90°
Beam Forming	Optical



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ELECTRONIC WARFARE/RF SYSTEMS

LOW PROFILE ANTENNA TECHNOLOGIES

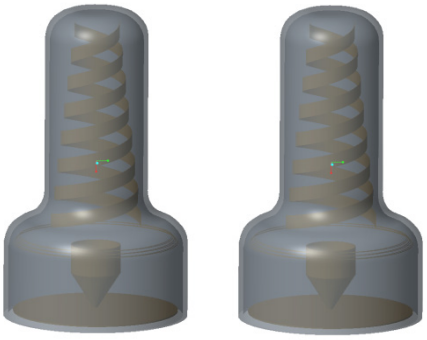
HITRA

(VHF/UHF/L-band)

Low Profile VHF/UHF/L-band Antenna System

- Supports tactical radio waveforms for vehicular-mounted applications
- Replaces standard, tall whip Antennas

HITRA	
Platform	Vehicular
Frequency	VHF (30-88 MHz) UHF (225-450 MHz) L-band (1250-2110 MHz)
Polarization	Vertical, maybe elliptical or circular
Gain	> -5 dBi (VHF) > 0 – 1 dBi (UHF) > 0 – 1 dBi (L-Band)
Size	12” height x 7” dia
Field of View	Omni -directional, 360° Azimuth
Field of Regard	N/A
Beam Forming	N/A



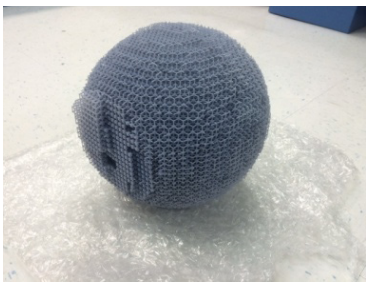
GILA

(1.8GHz - 8GHz)

Ground-based Low-profile Antenna For Telemetry Applications

- 360º Field of View additive manufacturing Ground based Low-profile Antenna
- Applications include telemetry for simultaneous tracking airborne objects and threats
- Replaces cumbersome dish antennas providing higher power handling, multi-tracking and higher gain

GILA	
Platform	Ground-based Low-Profile Antenna for Telemetry Applications
Frequency	1.8GHz – 8GHz
Polarization	Linear LHCP & RHCP
Gain	>43 dBi
Size	Compact
Field of View	360°
Field of Regard	180°
Beam Forming	Analog (RF)



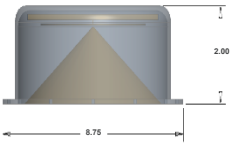
LOMUA

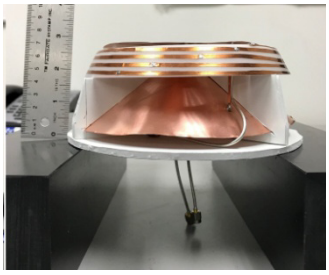
(UHF, L-band)

Low Profile VHF/UHF/L-band Antenna System

- Supports Blue Force Tracking and Production Rifleman Radio
- Replaces BFT2 tracking module antenna system
- Allows operation with UHF and L-band satellites such as MOUS, Iridium, Inmarsat III and Imarsat IV, Light Squared, and Thuraya constellations

LOMUA	
Platform	Vehicular
Frequency	UHF (200-440 MHz) L-Band (950-2150 MHz)
Polarization	RHCP and LHCP
Gain	> -3 dBi (UHF) > 0 dBi (L-Band)
Size	3” height x < 9” dia.
Field of View	Omni-directional, 360º azimuth
Field of Regard	N/A
Beam Forming	N/A





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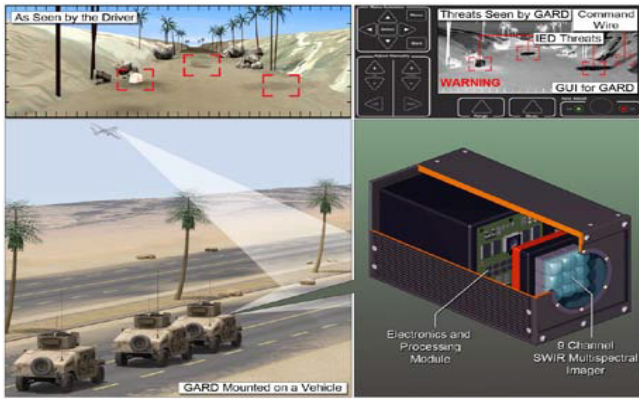
EMERGING TECHNOLOGIES

GARD - GROUND ANOMOLY RECOGNITION AND DETECTION SYSTEM



GARD identifies buried IEDs and IED-initiators such as command wires and pressure switches that come across its path, from a standoff distance of 50-100 m. It implements POC's compound eye multispectral sensor design in the shortwave infrared (SWIR) to offer detection of disturbed ground (via spectral discrimination of the soil's moisture content) day or night with high probability of detection and entirely passive operation (no radiation emitted). All weather operation – conduction cooled sealed package for all weather operation. Size, weight and power design for both man-portable and vehicle-mounted application: - Compact size (16 in. × 12 in. × 8 in.) - Light weight (15 lb) - Low power (28 DC, <1 A)

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METS - MAN-PACKABLE EXPEDITIONARY TACTICAL SERVER

METS is designed using Modeling and Simulation-based Systems Engineering (M&SBSE) approach. METS hardware uses state-of-the-art multiprocessor design leveraging NVIDIA K1/X1 processors and includes radio interfaces for tactical/reach-back communication and data distribution, solid-state disk storage for speed and ruggedness, and a power manager allowing recharging from multiple tactical edge power sources. METS is designed to support an extensive framework to form fully operational METS cluster in a mesh networking configuration, at the tactical edge.

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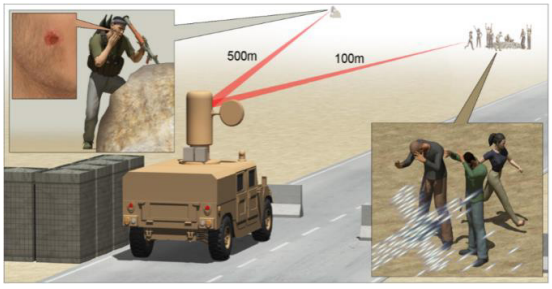
RESLIFE - RANGED EYE-SAFE LASER-INDUCED FLASHBANG ENABLING SYSTEM



POC has designed RESLIFE as a non-lethal, precision pointing, flash/bang light and sound effect system that uses a high energy, high pulse rate eye-safe lasers as the deterrent system. This capability extends the time line before lethal means would be deployed. Currently POC has successfully demonstrated this effect at 50 m range and 140 db audible sound. RESLIFE can be deployed on ground vehicles or fixed mounted for force and high value asset protection.

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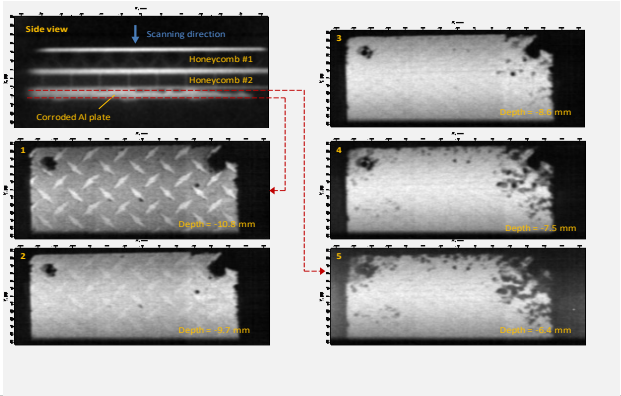
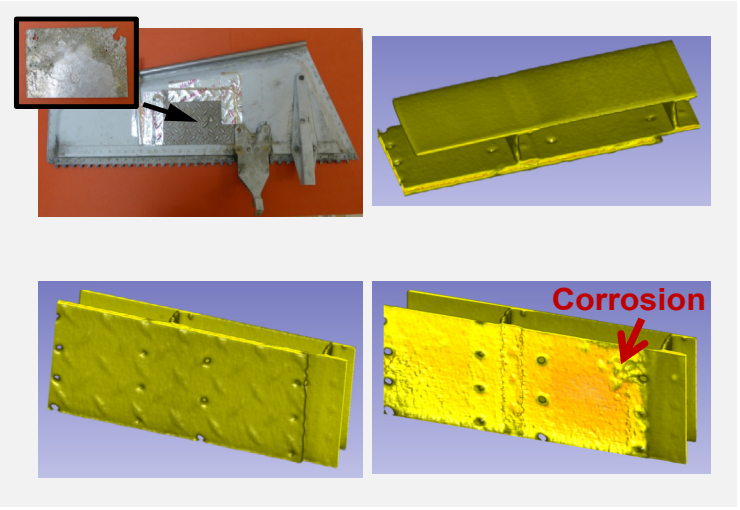
EMERGING TECHNOLOGIES

CIT X-RAY - COMPTON IMAGING TOMOGRAPHY X-RAY

The CIT X-Ray is a compact, robust, fully integrated, and high-resolution 3-D imaging system that can be used for Non-Destructive Evaluation of Thermal Protection System materials, composite materials and other structural materials during manufacturing and assembly processes. The CIT X-Ray provides the following unique capabilities:

- Produces 3-D CIT images of complex components and structures with high resolution and contrast from one side
- Inspection of non-uniform, multilayer, or complex structures including structures with air/vacuum voids
- Works with multilayer non-uniform structures including aluminum, titanium, composite, and plastics through air gaps
- Identifies liquid intrusion and differentiates between water, fuels and oils based on density
- Provides accurate detection, localization and measurement of corrosion, contamination and other defects in-situ
- Eliminates unnecessary tear-downs, lowering costs and improving aircraft availability





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NOTES

ABOUT POC

Physical Optics Corporation is a systems integrator of advanced technology serving the military, defense, security and commercial markets. Since its founding in 1985, the company has grown to over $84M with 293 employees, which includes 137 engineers and 37 Ph.Ds. POC is a highly innovative, small business, employee owned company, and is located in Torrance, CA. POC houses some of the most highly advanced and unique research laboratories, as well as engineering, prototyping, development, testing and production facilities. The company has launched seven (7) spin-off companies and holds 228 issued patents worldwide, covering over 60 technologies. To date, POC has shipped over $491 million in commercial and government products. Financially, POC has been profitable every year since its founding, and is now planning for its next wave of growth. As POC moves forward, it will continue its work in innovative research and development, focusing on several strategic thrust areas and advanced programs. This includes developing and producing next generation airborne systems, such as flight data recorders, advanced data transfer systems, mass storage units, and mission computer systems for both military and commercial aircraft. Other areas of growth include ground systems, encryption, EW, and X-Ray inspection systems.

POC'S MISSION

We are an innovative, agile and trusted partner in the development and production of technology that makes a difference for our customers and the world. We are committed to sustaining our high performance culture in order to accomplish our mission.

POC'S VISION

To be the preferred choice for solving our customer's most challenging problems through efficient applications of POC's innovative technologies.

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