

# Review of Advanced Electro-Optical Surveillance System

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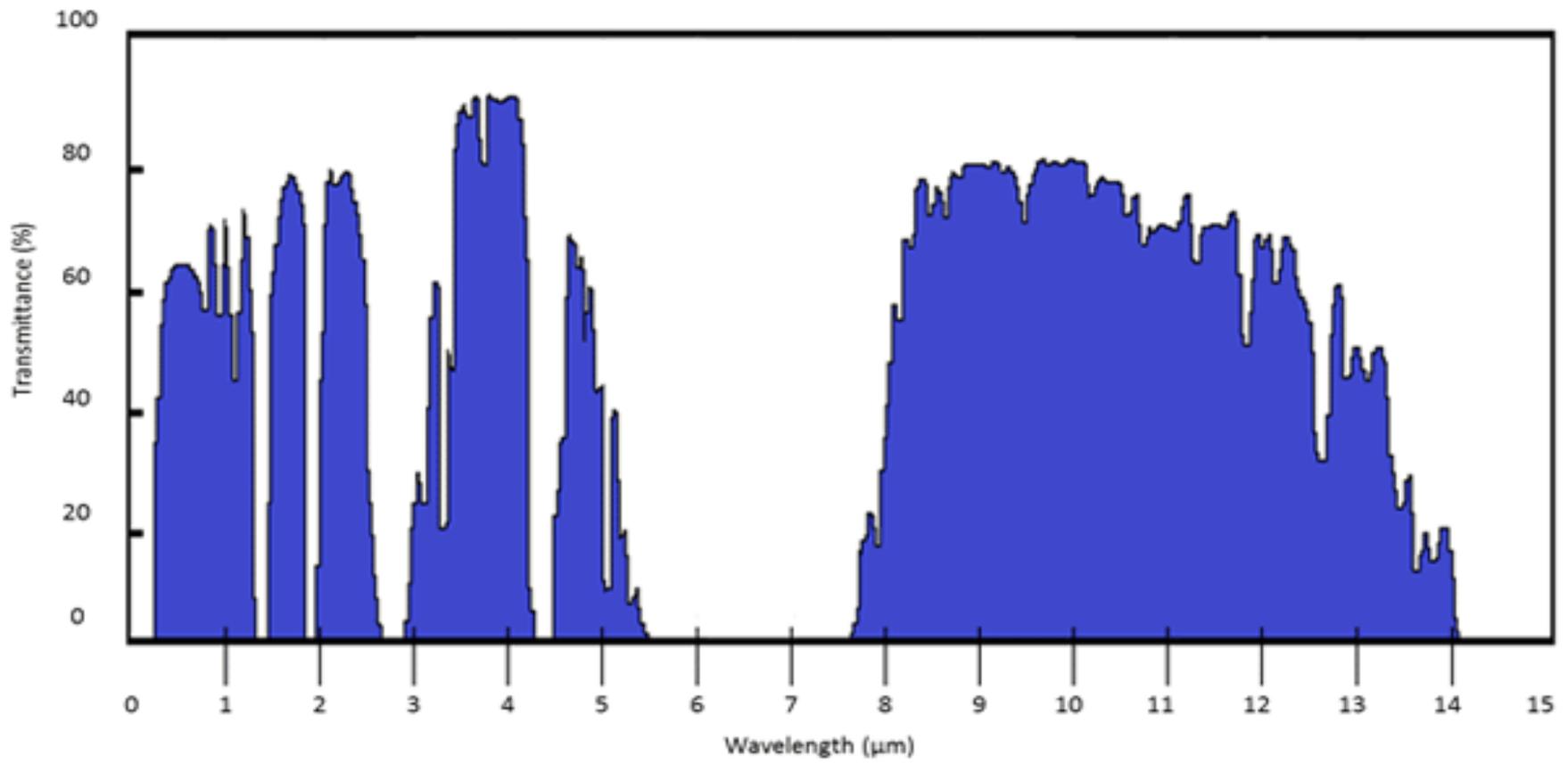
- Surveillance
- Surveillance, Acquisition and handing over target to Weapon system. Known as FCS
- Reconnaissance
- Search and Track
- Missile Warning System

## Sensor Technologies

- Thermal Camera
- Day Camera
- Day Spotter
- SWIR Camera/Spotter
- Eye-safe LRF
- Designator
- Laser Spotter
- Laser pointer
- Laser illuminator
- Low light Camera
- Gated SWIR
- Gyros / resolvers
- GPS / INS / IMU

Contd.

# Atmospheric Window



Visible	NIR	SWIR	MWIR	LWIR
(.4-.7)	(.7-.9)	(.9-1.3)	(3-5)	(8 - 12)

## Engineering

- Size & Weight
- Robustness

## Electrical Engineering

- Actuators
- SSPA

## Control Engineering

## Electronics

## Software

- Image Processing
- Change Detection
- Geo Pointing / Geo location
- Image stabilization
- Track before detection
- Passive Tracking

## Display

## Advanced Thermal Sensor

- MWIR HD format detector with 10 or 12  $\mu$  pixel for better image quality & resolution
- IR Zoom Lenses with diffractive optics for compact size
- Ruggedized split micro cooler for longer life (20 thousand Hrs.)
- Uncooled camera with 17  $\mu$  pixel for small UAV application

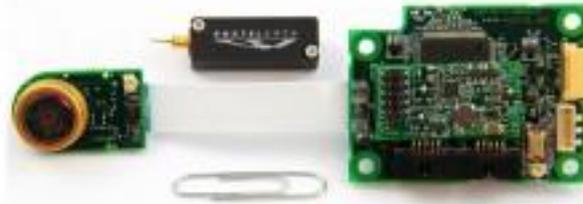


MWIR Detectors with Micro-coolers

Contd.

## Laser Range Finder

- Eye safe LRFs from Diode lasers and Er:Yb glass lasers are common and are being used.
- Disc Laser is better option for eye safe LRF as it is compact and heat management is better



### Disc Laser LRF modules

## Day Color Camera

- Block cameras are better solution
- They have better resolution as their pixel size is small
- They have high optical and digital zoom
- Both, integration time and iris can be controlled for wide dynamic range
- They are small in size & weight



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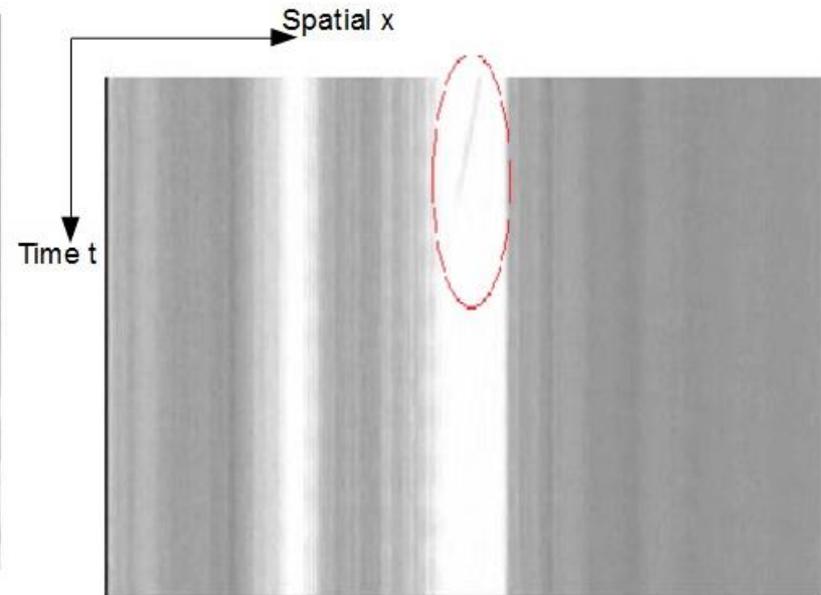
## Track Before Detection

- Tracking is a common feature but it becomes difficult to track the target when it is just detected.
- New algorithm is developed for such targets.



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## Track Before Detect



- The path of the target is circled as red.
- The target (size 3x3) starts from the curvature of the road.

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## Geo-pointing and Geo-location

- In Geo-pointing mode, a command is given to orient the Gimbal toward a particular GPS coordinates. System calculates the angle in Az & El to orient the Gimbal toward that point.
- While, in Geo-location mode, system finds out the GPS coordinates of the target where Gimbal line of sight is pointing. GPS mapping of the terrain improves the accuracy.

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## Overlay of image on Geo map

- This is an advanced feature which EO system can provide.
- In this, a real image of sensor is superimposed on Geo map by matching the GPS coordinates.
- When line of sight moves or zoomed, Geo map also moves or zooms accordingly.

## Search and track

- Known asIRST if MWIR camera is used.
- EO system continuously scans  $n \times 360^\circ$  and stitched the image frames in 2 or 4 strips.
- It also detects position change of any target in next frame and marks, known as change detection.
- Algorithm can remember history of movements of many targets and can passively track them.
- Target of interest can be zoomed and tracked.



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EO Systems developed

At

VEM Technologies, Hyderabad



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# Electro-Optics

16X , 20X MWIR Zoom lenses

Dual mode Seeker

Semi Active Laser Seeker

Various Range of Stabilized Gimbals

VEM Gimbal Family

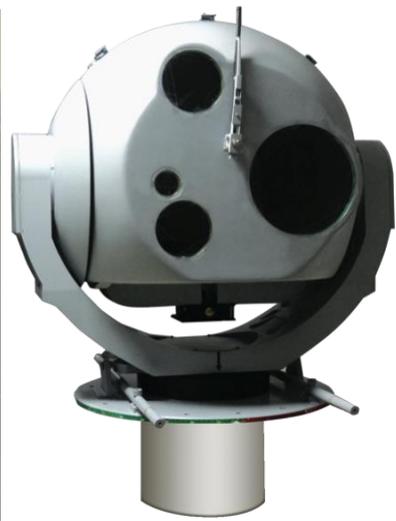
# EO-Systems



VEM Gimbal Family



SGA



EON-51



SEOS



IR Zooms



SAL Seeker



DM Seeker

## Salient Features:

- 3 axis 5 Gimbal Stabilization
- Surveillance & Target Acquisition
- Auto Tracking
- Scene lock & Geo Location
- Range : 40 km

## Performance Specifications:

- LOS Freedom
  - AZ. : n x 360° & EL.: +10°to-100°
- Angular Velocity: 60° / sec
- Size : 550 mm(D) x 775 mm(H)
- Weight : 100 kg

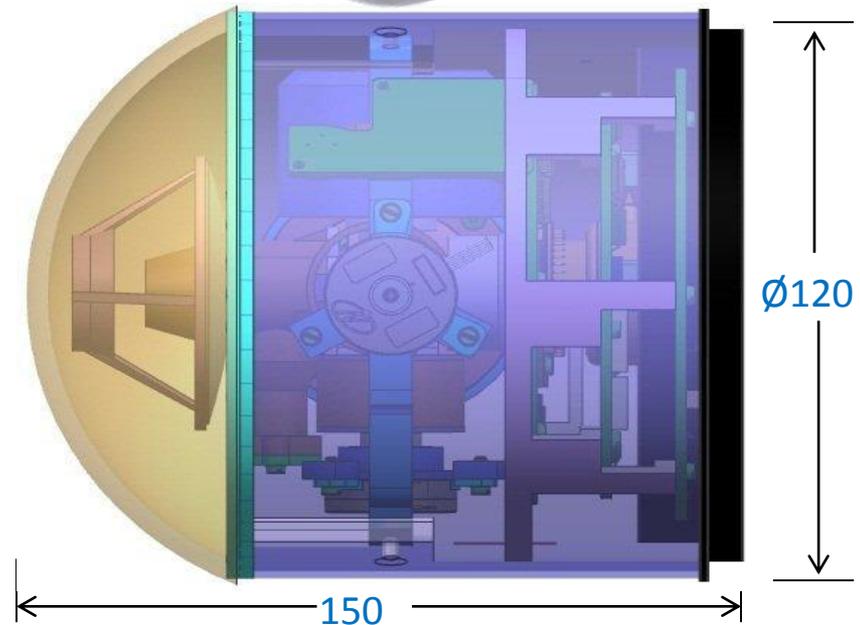
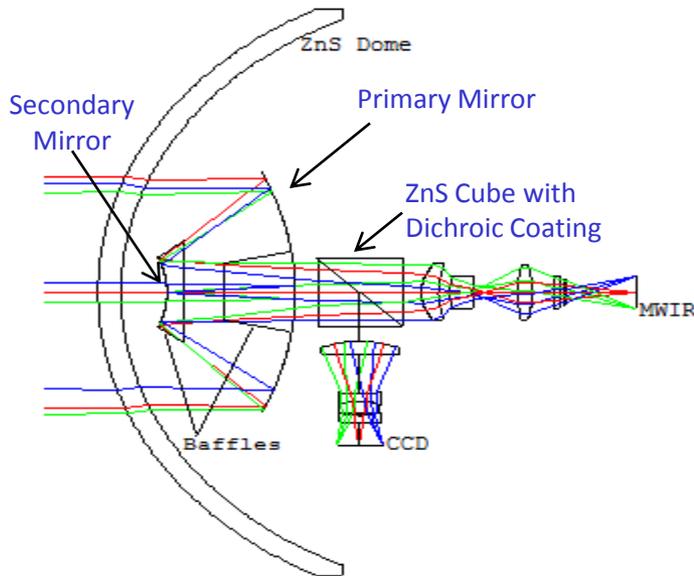
## Sensor Specifications

- Day Camera 1 : 35 x CMOS Color camera
- Spotter : Day Camera
- Thermal Imaging Sensor
  - Detector : InSb FPA 640 x 512 pixels (3.0 – 5.0  $\mu\text{m}$ )
  - Continuous Optical Zoom ( 16 x)
- LDRF / Eye-Safe LRF (ELRF) : 100 mj, 16 ns, 20 pps



## Special Features of Seeker:

<b>Optics:</b>	Dual Band –	Visible & MWIR
<b>Field of Regard:</b>		AZ: $\pm 17^\circ$ EL: $+20^\circ$ & $-33^\circ$
<b>Stabilization accuracy:</b>		$< 50 \mu \text{ rad}$
<b>Range</b>	- Track able:	6.0 Km
	- Recognition:	4.0 Km
<b>Sealing:</b>		Hermetically Sealed



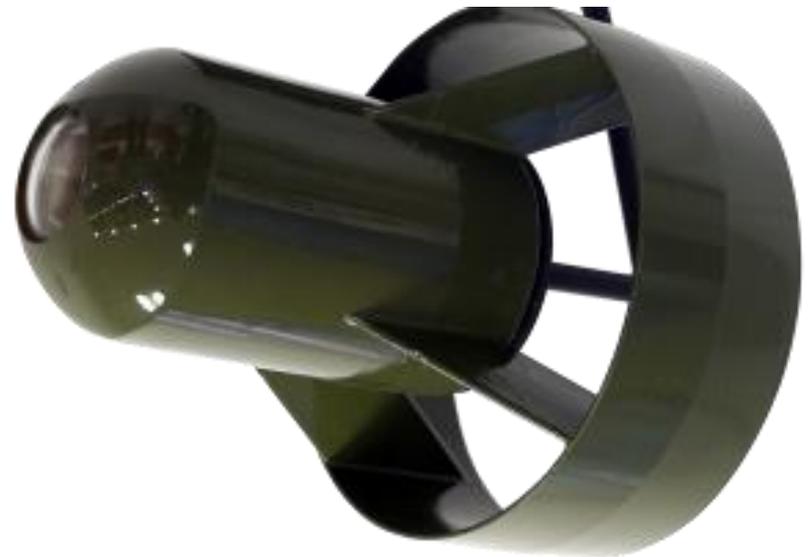
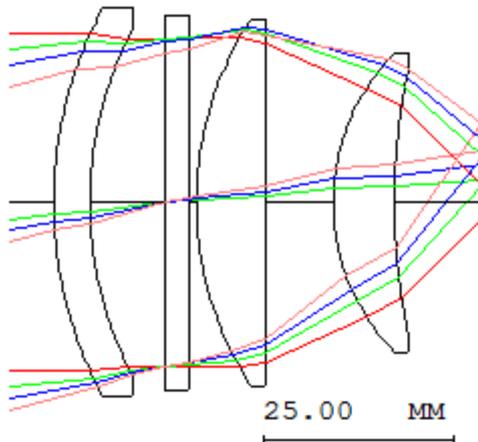
**Weight : 2.5 Kg (approx.)**

## Specifications

Optics Type  
Focal length, fmm  
FOV  
Operating wavelegh  
Detector  
Detector Active area  
Weight  
Dimenstions  
Range

## Parameters

Refractive Optics  
28  
30 deg  
1064nm  
Four-quadrant  
14mm  
<1kg  
Dia <105mm; Length <260mm  
<4km



Specifications	20 x IR Zoom	16 x IR Zoom
Spectral Range	3.6 to 4.9 $\mu\text{m}$ (MWIR)	
Focal Length, f mm	15mm – 300mm	17.5mm - 275
# F Number	4	5.5
Cold stop to FPA dist mm	19.2	19.2
Image format	640x512, 15 $\mu$	
Detector Diagonal, mm	$\pm 1.28^\circ$ to $\pm 19.67^\circ$	$\pm 1.17^\circ$ to $\pm 22.3^\circ$
Distortion	<1% (NFOV) <3%(WFOV)	<1% (NFOV) <3%(WFOV)
On-axis MFT at 25cyc/mm	> 20% at all zoom positions	
Min. Focus Range	50m (NFOV) to 5m (WFOV)	





- Interferometer 3.39  $\mu$  (Zygo )
- Cooled IR Detector (SCD)
- Collimator (CI systems)
- Power suppliers
- Oven + tester & Controller
- Floating interferometer bench (Newport)
- 5 degree testing bracket (Newport)
- Assembly & testing tools & equipment (Ophir)
- Beam Extender (Ophir)
- Collimator stand /table (Newport)
- Optical testing Bench (Newport)
- Controller
- PCB Burning Device
- Sealing Testing Device & Glue Dispenser Device

- FLIR, USA
- Wescam, Canada
- Tamam, Israel
- Lockheed Martin, USA
- Raytheon, USA
- Controp, Israel
- Elbit (Elop), Israel
- Carlziess, West Germany
- Sagem, France
- Thales, UK
- Goodrich, USA
- RAFAEL , Israel
- **VEM, Technologies, Hyderabad, INDIA**

# Thanks