

**THERMAL IMAGING OPTICS
FOR DEFENSE APPLICATIONS
YOUR OPTICS PARTNER FOR MISSION SUCCESS**



WIDEST SOLUTIONS FOR ALL DEFENSE APPLICATIONS



Unmanned
Aerial Systems



C-UAS Platforms



Security &
Surveillance



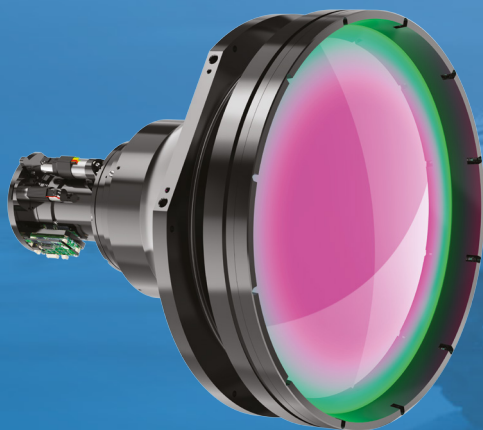
Driver Vision
Enhancement (DVE)
& Situational
Awareness



Armored
Vehicles



Hand Held
Thermal Imager



DECADES OF PARTNERSHIP WITH LEADING DEFENSE OEMs

Leading Provider of Defense Thermal Imaging with NATO Country Based Production Site

MKS Ophir brand is at the forefront of innovation in the field of advanced defense thermal imaging, with state-of-the-art manufacturing facilities in Romania, a NATO member country, as well as Israel. Our commitment to excellence is evident in our high-performance IR optical elements and assemblies, meticulously crafted to meet the rigorous demands of defense and security applications.

Decades of Experience and Unmatched Partnerships

With more than 40 years of experience in the field of electro-optics, shaped by extensive collaborations and strategic partnerships with leading defense OEMs, we are a trusted partner for our customers, providing innovative solutions based on unrivalled capabilities and expertise that support major defense platforms worldwide.

One-Stop-Shop Solutions Provider

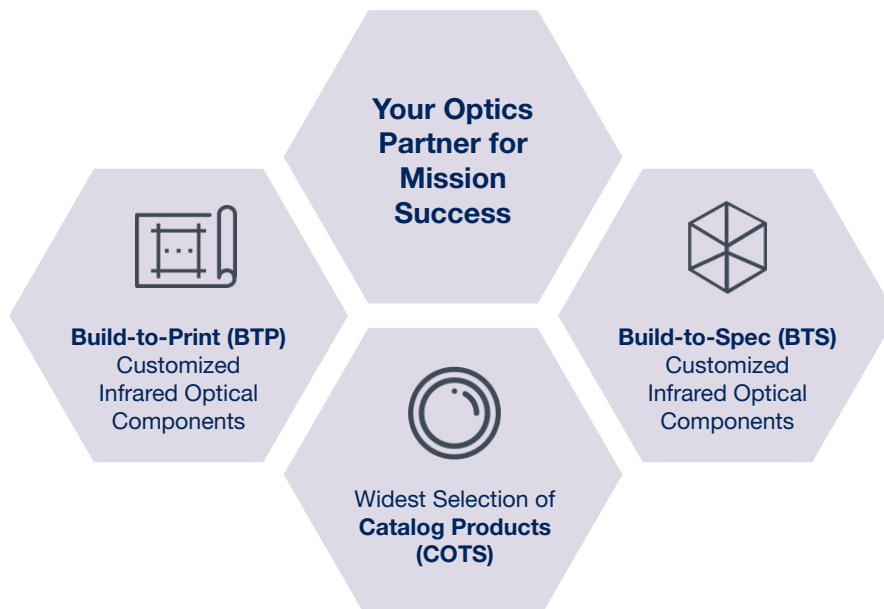
With a track record of designing and supplying thousands of thermal imaging optics for various defense applications, we have earned recognition as one of the world's leading one-stop-shop providers of infrared thermal imaging components for defense OEMs.

Collaborative R&D Approach

Our dedicated R&D engineering team collaborates closely with defense customers, leveraging their extensive experience to develop, design, and deliver high-performance optics tailored to meet the stringent requirements of high precision and environmentally challenging defense applications. This collaborative approach ensures that Ophir IR Optics product line solutions aligns perfectly with the evolving needs of defense customers, facilitating the deployment of today's most advanced aerospace and defense solutions.

Applications served

- **Ground-based:** Anti-drone IR systems (C-UAS), Enhanced Vision Systems (EVS), Driver Vision Enhancement (DVE), Situation Awareness Systems (SAS), Remote Controlled Weapon Stations (RCWS), Tank Gunner/Commander Sight, Thermal Goggles, Thermal Weapon Sight (TWS), Hand-Held Thermal Imagers (HHTI)
- **Airborne:** Unmanned Aerial Vehicles (UAV), Payloads and Forward-Looking IR Cameras (FLIR)
- **Naval:** Surveillance, Targeting
- **Missiles:** Optical build-to-print components for IR guided missiles, including domes, mirrors and Cassegrain telescopes



Build-To-Spec (BTS) & Build-to-Print (BTP) expertise

Advanced optical design technologies and innovative engineering are applied to our build-to-specification (BTS) development processes, allowing us to reach efficient design results with fewer elements, lighter components, and reduced-cost.

These same advanced capabilities and expertise are combined with cutting-edge manufacturing technologies such as MRF technology, diamond-turning machines, CNC generators and polishers, automated coating chambers, and advanced metrology and test equipment, to create our build-to-print components and assemblies, including aspheric, diffractive and spherical lenses, mirrors, domes, windows and prisms.

Widest IR assemblies product range

Our range of long-lasting products includes IR complex lens assemblies with various focus mechanisms:

- Fixed
- Manual
- Motorized focus
- Continuous zoom

From LWIR, MWIR to SWIR we excel in the production of the following product configurations:

- Single Field-of-View (FOV)
- Multiple FOV
- Zoom

Our knowledge and experience in motorized continuous zoom lens systems is recognized by customers around the world.

Meeting defense market strict demands

We harness innovative designs to provide the largest portfolio of products with field-proven performance, answering the strict demands of global defense customers for:

- Lightweight, compact designs answering the strict SWaP restraints
- Rugged design for durability in harshest environmental conditions
- Outstanding detection, recognition, and identification (DRI) ranges >28km
- Accurate Line on Sight (LOS)
- High precision optics with MTF close to the diffraction limit
- Focal length ranges from 1.8mm to 1350mm

STRICT QUALITY ASSURANCE (QA) PROCESSES

With rigorous QA testing throughout the production process, we ensure that any finished product is optimized for the defense market requirements with the highest performance requested.

From design to delivery, our material control, in-process testing, operator inspections and final inspections all ensure that Ophir products meet the highest specifications and quality standards.



LWIR

SupIR 40-300mm f/1.5
> 13km detection range
For 12 μ m pixel pitch LWIR uncooled detector



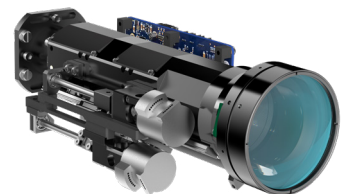
MWIR

SupIR 50-1350mm f/5.5
> 26.5km detection range
For 15 μ m pixel pitch MWIR uncooled detector



MWIR

SupIR 60-1200mm f/4
> 28km detection range
For 10 μ m pixel pitch MWIR cooled detector



SWIR

SWIR & NIR 25-250mm f/5.5 (NFOV) f/4 (WFOV)
> 26km detection range
For 5 μ m & 10 μ m pixel pitch SWIR detector

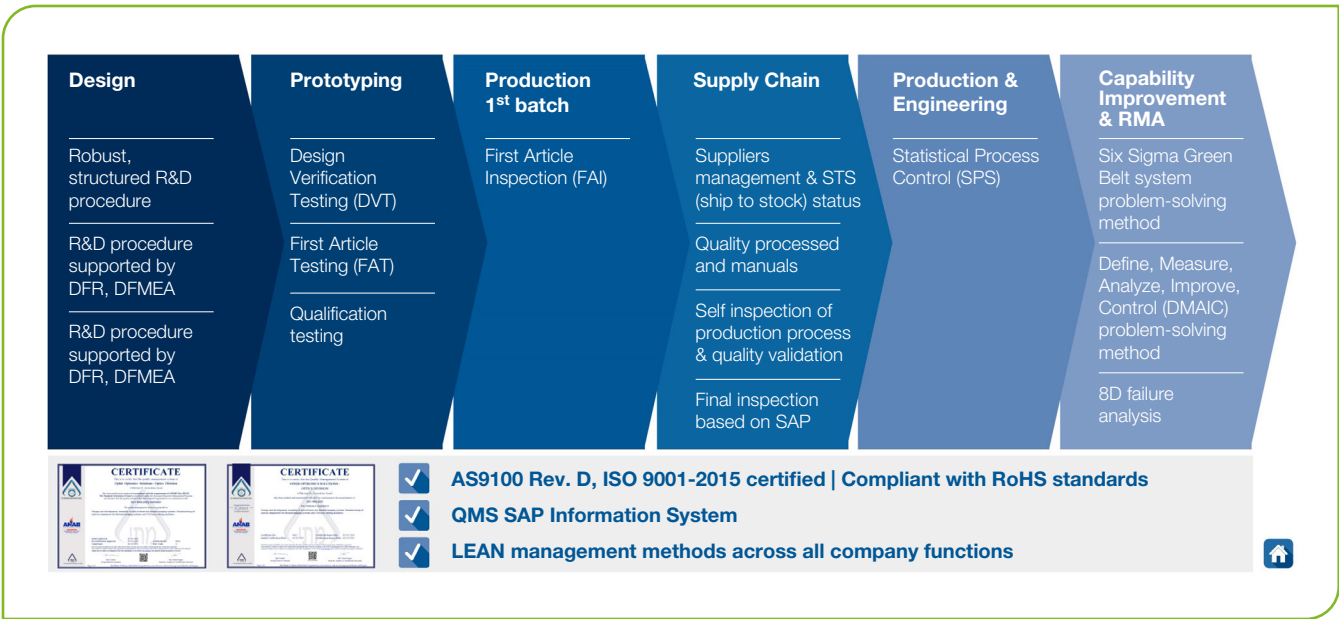


Figure 1: QA process throughout product manufacturing cycle

Our in-house testing tools are encompassing all required specifications and include the following:

Radius	IRR	Roughness	Angle	Spectrum	Environmental
Test glass IRS Computerized SAG Device	Interferometers 0.633, 1.54, 3.39 and 10.6µ CGH Talysurf Profilometers Aspheric Interferometer VFA Louphe Scan Profilometer technology	New View Talysurf Profilometers	Goniometer Prism Master	Perkin Elmer FTIR Photon RT UV, VIS and NIR	Humidity Salt spray Salt solubility Adhesion Abrasion Wiper Temperature cycles Chemical attack

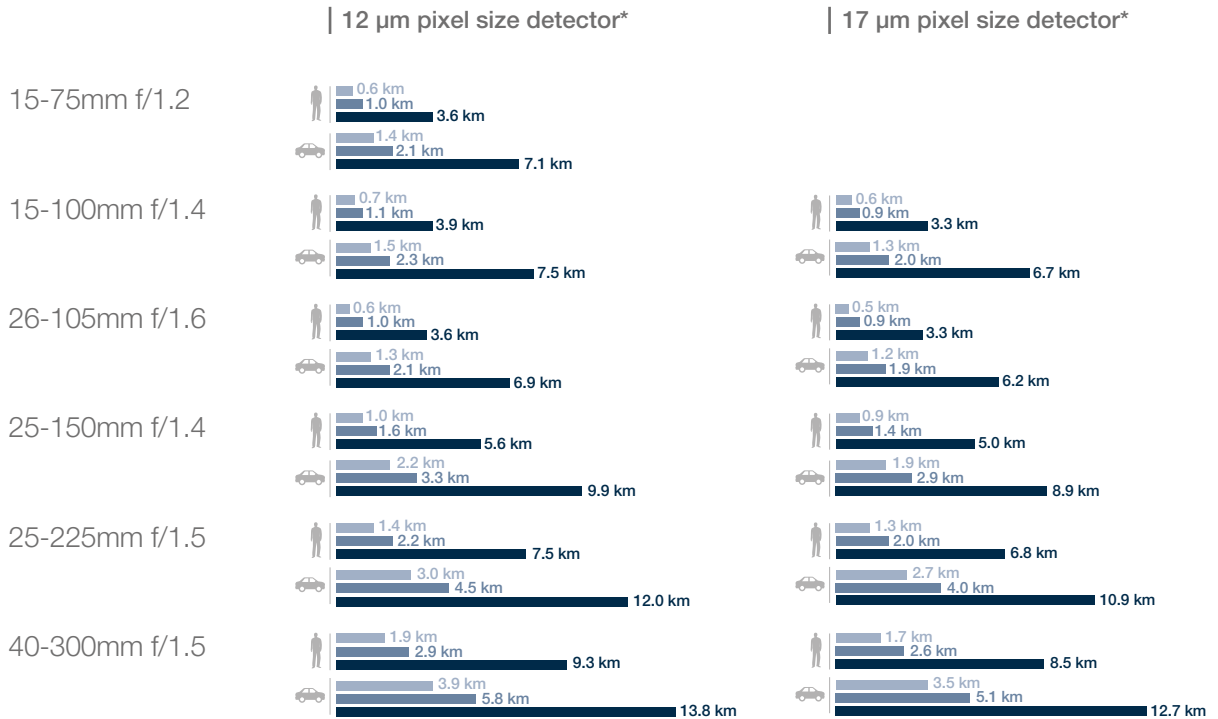
Figure 2: QA testing tools per specification requirements

Standard Compliance

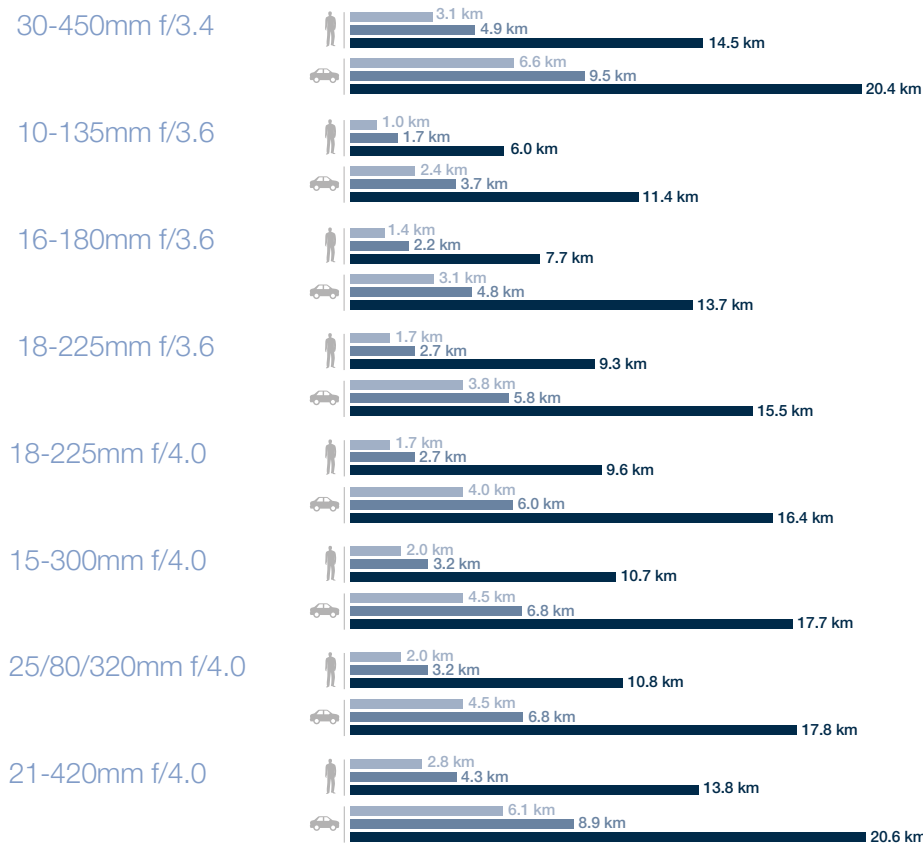
- AS9100 Rev. E and ISO 9001:2015 certified
- US and European military standards compliant with:
 - DIN 3140
 - IPC 620
 - MIL-PRF 13830
 - MIL-PRF 85285
 - MIL STD 810
 - MIL-C-48497
 - MIL-C-48616
 - ISO 10110 sections 1-19, ANSIVASQ Z1.4

ZOOM LENSES DETECTION, RECOGNITION & IDENTIFICATION (DRI) PERFORMANCE

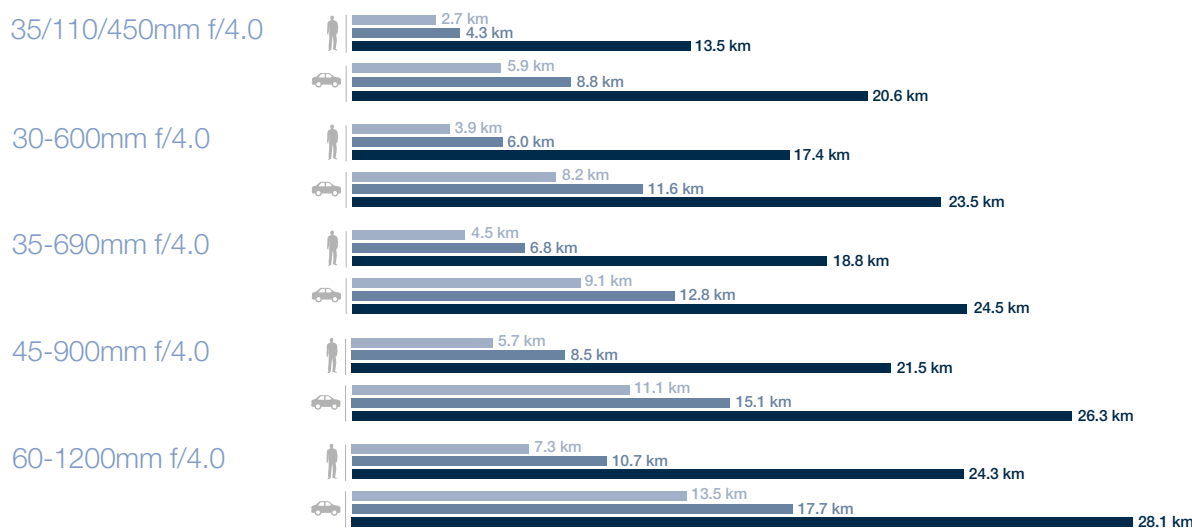
Uncooled LWIR



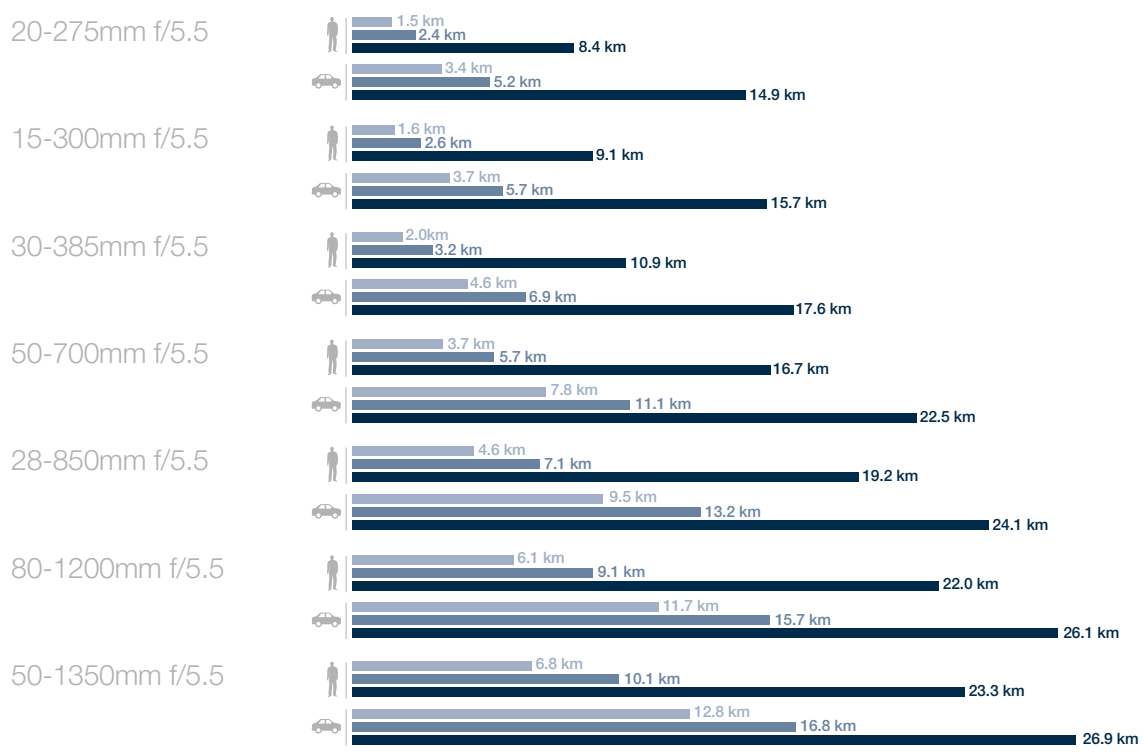
Cooled MWIR, 10µm pixel size detector*



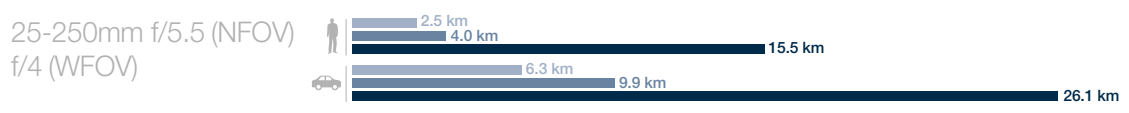
Cooled MWIR, 10µm*



Cooled MWIR, 15µm pixel size detector*



SWIR



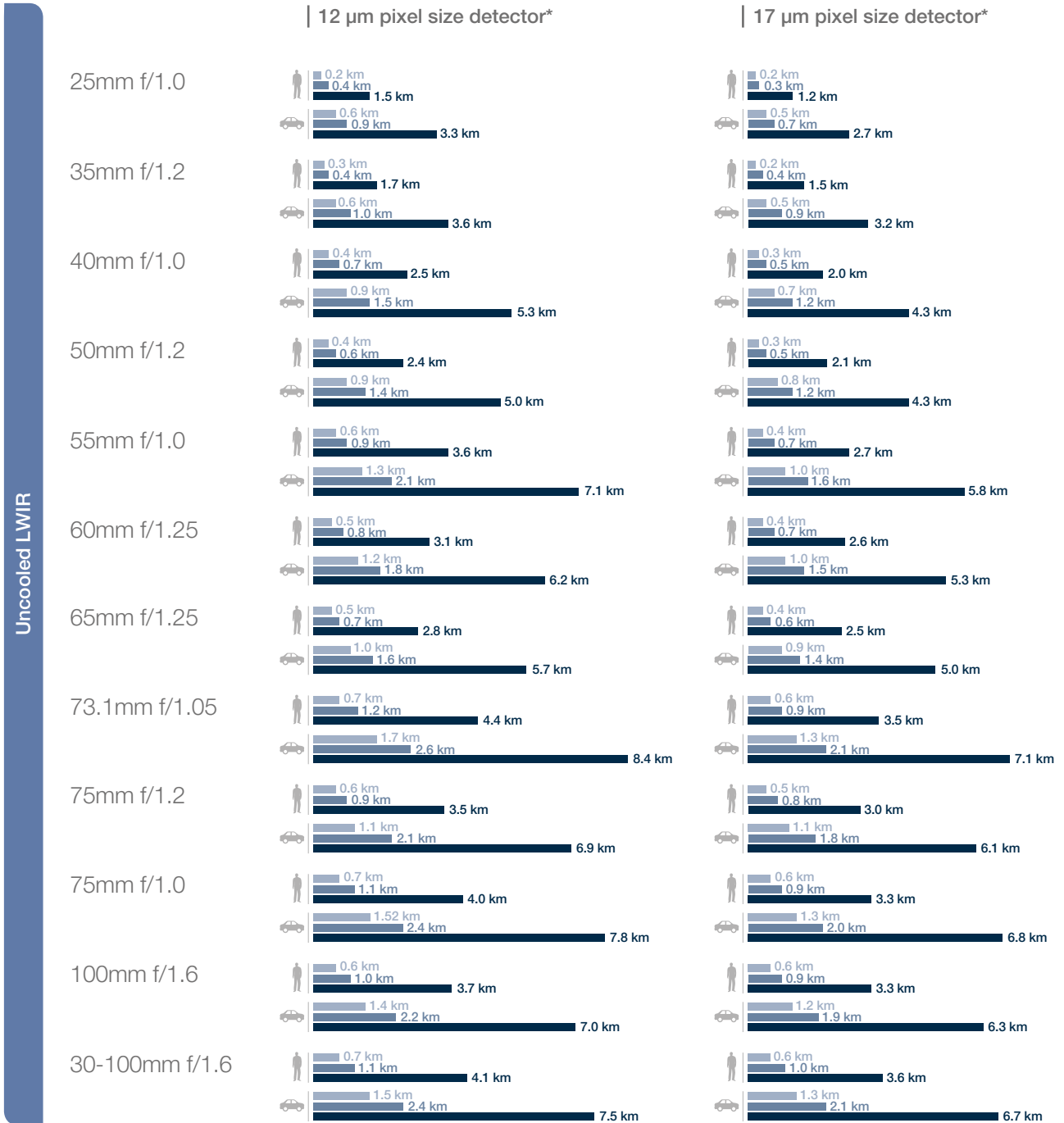
Identification
 Recognition
 Detection

Vehicle size 2.3m x 2.3m
 Human size 1.7m x 0.5m

Note: Calculations used are based on "Johnson Criteria" | Real world performance may vary depending on the weather conditions
 Assumptions: 23mK NETD (f/4 & f/5.5) for MWIR cooled detectors | 35.5mK NETD (f/3.4) | 32mK NETD (f/3.6) | 50mK NETD (f/1.0) for LWIR uncooled detectors | 30Hz frame rate | 50% detection probability | 0.2km⁻¹ atmospheric attenuation coefficient | Human ΔT = 5°C | vehicle ΔT = 2°C

SWIR assumptions: 1280 detector | TRM4 model | Day mode | 0.7µm to 1.7µm spectral range | 25Hz frame rate | Overcast daylight irradiance | 0.2 path radiance factor | 0.2km⁻¹ atmospheric attenuation coefficient | 50% detection probability | Human and vehicle target 50% reflectivity | 15% background reflectivity

ZOOM LENSES DETECTION, RECOGNITION & IDENTIFICATION (DRI) PERFORMANCE



■ Identification
■ Recognition
■ Detection

Vehicle size 2.3m x 2.3m
 Human size 1.7m x 0.5m

Note: Calculation used are based on "Johnson Criteria" | Real world performance may vary depending on the weather conditions
 Assumptions: 30Hz frame rate | 0.2km⁻¹ atmospheric attenuation coefficient | 50% detection probability | 1.74x0.46m human size and ΔT = 5°C | 2.3x2.3m vehicle size and ΔT = 2°C | 50mK NETD.

CUSTOM OEM COMPONENT MANUFACTURING PER ANY SPECIFICATION

Vast versatility

- Manufacturing large size mirrors, lenses, mirrors, domes, windows, and prisms, supporting multispectral optics and emerging applications
- VIS to LWIR wavelengths
- Spherical, aspherical, diffractive, flat, and free-form shapes
- Doublets and triplets
- Substrates: Germanium, Silicon, Zinc selenide, Zinc sulfide (IR & multispectral), Calcium fluoride, Chalcogenide materials such as IG materials

Core capabilities

- In-house, cutting-edge manufacturing technologies:
 - MRF
 - Lupho Scan Profilometers
 - Diamond turning
 - CNC polishing
 - Coating
 - Metrology
- Highest development standards including Design for Manufacturability and Assembly (DFMA) as well as highest production standards including risk analysis.

- Complete control of production processes
- Statistical Process Control (SPC) over full production cycle
- Innovative engineering
- Large volume high-end production capabilities
- Manufacturing sites in Israel and Europe (Romania) with a clean room for the coating, inspection and packing processes

Superior components manufacturing

- MRF strict irregularity
- Large optics up to 400mm dia
- Dual A-spherical elements
- Freeform (non-radial or matrix)
- Off axis parabolas
- Special truncated shapes
- Doublets and triplets
- Prisms of all types
- Mass production of low-cost IR small lenses

Tolerances (typical | high-end):

	Windows	Lenses		Mirrors
Dimensional	± 0.05mm ± 0.01mm	± 0.05mm ± 0.01mm		± 0.05mm ± 0.01mm
Surface Figure (P-V)	Flatness 0.5 0.2Fr Irregularity 0.2 0.1Fr	Spherical Power 2Fr 1Fr Irregularity 0.5Fr 0.2Fr	Aspherical Radius tolerance 0.1% 0.05% Irregularity 1Fr 0.5Fr	Flatness 0.5Fr 0.2Fr
Parallelism	3 5 arc sec.	3 5 arc sec.		3 5 arc sec.
Surface Quality (S-D)	80-50 10-5	80-50 10-5		80-50 10-5
Roughness nm, RMS	2 0.5	2 0.5		2 0.5



Figure 3: Ophir components: mirrors, domes, truncated shapes, prisms

Advanced optical coatings

Coating types:

- Anti-reflective (AR), mirrors and filters
- UV, VIS, NIR, SWIR, MWIR, LWIR
- Multispectral coatings
- High efficiency and high durability coatings
- DLC (HC) coatings and Low Reflectance HC (LRHC)
- Laser coatings YAG and CO₂

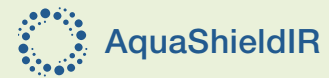
Coating performance:

- Broadband AR:
 - Ref < 0.5% to 0.2%
 - Tra > 98% to 99%
- Broadband mirror: Ref > 98% to 99%
- Windscreen Wiper Test TS1888 / P 5.4.3 – DLC coatings



Figure 4: Ophir 1,000 clean room coating chambers

New! AquaShieldIR™ lens coating for long-lasting protection and enhanced IR imaging lenses capabilities in maritime environments.



Knowing firsthand the unique challenges posed by wet, humid, and salty coastal environments, we have meticulously crafted the new AquaShieldIR lens coating to tackle the challenges of maritime environments head-on.

With its advanced hydrophobic properties, the AquaShieldIR lens coating provides unparalleled protection and boosts the performance of your IR imaging system for the long run.

Key capabilities & benefits:

- Exceeds MIL-STD 810 for durability testing in salt fog and salt solution
- Creates a water-repellent surface on IR imaging lenses
- Enables high performance in wet conditions, including rain and fog
- Provides clear imaging and reliable performance in maritime environments

AquaShieldIR Coating Specifications:

LWIR Ge Coatings					
Family	Spec	Standard			AquaShieldIR (WA*>110deg)
Durability Type		HD	LRHC	HC	HD
		1006	1290	1007	1557
		High Durability	Low Reflectance Hard Carbon	Hard Carbon	High Durability Hydrophobic
Severe Abrasion	MIL STD 675 & MIL STD 810	V	V	V	V
Adhesion		V	V	V	V
Humidity		1 day	1 day	1 day	1 day
Salt Fog		1+1 day	1+1 day	7 day	14 day
Salt Solution		1 day	1 day	1 day	1 day
Wiper		-	V	V	-
Acid Attack		-	V	V	-
AVG Transmittance 8-12µm			96%	91%	88%

MWIR Si Coatings							
Family	Spec	Standard			AquaShieldIR (WA*>110deg)		
Durability Type		HD	LRHC	HC	AquaShieldIR HD	AquaShieldIR LRHC	AquaShieldIR HC
		1178	1221	1039	1558	1564	1566
		High Durability	Low Reflectance Hard Carbon	Hard Carbon	High Durability Hydrophobic	Low Reflectance Hard Carbon Hydrophobic	Hard Carbon Hydrophobic
Severe Abrasion	MIL STD 675 & MIL STD 810	V	V	V	V	V	V
Adhesion		V	V	V	V	V	V
Humidity		1 day	1 day	1 day	1 day	1 day	1 day
Salt Fog		1+1 day	1+1 day	14 day	14 day	14 day	21 days
Salt Solution		1 day	1 day	1 day	1 day	1 day	1 day
Wiper		-	V	V	-	V	V
Acid Attack		-	V	V	-	V	V
AVG Transmittance 3.4-5µm			98%	97%	93%	97%	96%

* WA = Wetting Angle



About Ophir IR Optics

Ophir is a brand within the MKS Instruments Photonics Solutions Division. The Ophir IR Optics product portfolio consists of world-leading high performance thermal IR lenses and optical elements for SWIR, MWIR and LWIR imaging. Based on decades of experience in the design and manufacture of IR components and complex lens assemblies with fixed or motorized zoom lenses, the Ophir IR Optics products enhance the capabilities and productivity of our customers in the homeland security, surveillance, commercial and defense markets.

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