

Application Note



Tactical Applications of Thermal Imaging in a Maritime Environment



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Introduction

Missions for public safety boats are expanding at a terrific rate beyond their traditional roles in enforcing the law and keeping the peace. With increased responsibility and shrinking budgets, maritime first responders find themselves involved in missions as diverse as law enforcement, search and rescue, SCUBA operations, conducting harbor safety patrols, helping out disabled boaters, lending a hand with homeland missions including port security, and even responding to HAZMAT emergencies.

Day and night, in good weather and bad, maritime public safety vessels like police boats, fireboats, harbor patrol vessels, and game and fish vessels need to be equipped to answer the call. By extending and expanding the utility of these craft, FLIR's maritime thermal imaging cameras have proven their worth, year after year. Maritime safety and law enforcement professionals can utilize the broad range of features provided by thermal imaging cameras to achieve critical mission success.

Limitations of the Human Eye and Visible-Light Cameras

Our eyes see reflected light. Daylight cameras, night-vision devices, and the human eye all work on the same basic principle: light energy hits something and bounces off it. A detector then receives it and turns it into an image. The ability of a given detector – be it

in an eyeball, or a camera – to create that image is directly related to the amount of light available. At night, in fog, or in smoke, we are limited to the light provided by starlight, moonlight and artificial lights. If there isn't enough, it's hard to see.

Night vision goggles (NVGs) make those greenish pictures we see in the movies and on TV. NVGs take in the small amount of visible light available, magnify it greatly, and project that image onto a display or an eyepiece. Unfortunately, NVGs have severe range limitations just like the naked eye in lowlight situations.

Image contrast is also critical in producing a useable image. If the object you are looking for has lots of contrast compared to its surroundings, you'll have a better chance of seeing it with a visible-light camera. If it doesn't, you won't see it. That's how camouflage works, by decreasing the visible contrast between an object and its surroundings, the object becomes harder to see, even if there is plenty of light. At night or in adverse environments, when the lack of visible light naturally decreases image contrast, visible-light cameras suffer even more in their ability to see.

No Light Needed: Thermal Imaging to the Rescue

Thermal imaging cameras do not suffer from any of these drawbacks because they see heat or thermal energy. Everything emits thermal energy

– even ice cubes – night and day, in good weather and bad. By sensing this thermal energy and displaying it as black and white video, thermal imagers allow

The same scene at night...



Night Vision (NVG)



Infrared Illuminated (I²)



Thermal Image

Maritime thermal imagers help boat operators see in total darkness. They have better range performance and provide more image detail than systems based on night vision goggle and I² technologies.

you to see things from farther away and with greater contrast than conventional visible-light cameras and night-vision technologies. Thermal imagers don't require external lighting, can't be fooled by camouflage, and can see man-sized targets from farther away than comparable TV cameras.

An added bonus to using thermal imaging is that the heat signatures of people, boats, marinas, docks, pilings and all the other things seen by maritime thermal cameras generally have better contrast at night than during the day. As long as there is the tiniest bit of temperature contrast between an object and its background, you can see it. In fact, many of the objects for which you could be looking, like people and boats, generate their own contrast because they generate their own heat. Thermal imagers can see them so well because thermal cameras don't just make pictures from heat, they make pictures from the minute differences in heat between objects.

Complement and Extend Radar Returns

Radar is a vital tool for today's first responder departments. However, a radar display requires trained interpretation and visualization skills. Thermal imaging, on the other hand, gives an immediate, easily interpreted image of the scene in real time, instantly giving you the information you need to decide on an appropriate course of action. Despite their utility, radar systems can also fail to detect structures, vessels, and floating debris. Thermal imagers can be used to verify radar returns, seeing things that radar might miss, and showing you things that a chart plotter can't.

Safe 24-Hour Response Capability

In order to maximize their considerable investment in a vessel, first responder agencies want to see that vessel working twenty-four hours a day, seven days a week. Unfortunately, after sunset, or in foul weather, in smoke or fog, her capabilities and mission effectiveness can be severely compromised. At the fraction of the cost of a new vessel, simply by adding a FLIR thermal imager, total on-mission hours and overall effectiveness are radically improved, saving lives and keeping waterways safe in all types of difficult scenarios without endangering either the vessel or her crew.

When operating close to shore at night or in adverse environments, a thermal

imager can give the crew important awareness of their surroundings so they can navigate confidently and safely. Uninterrupted, quality information is the key to good outcomes in critical situations: knowing how close the shoreline is, the distance from pilings, docks, floating debris, or boats riding at anchor, the ability to monitor the movements of fellow officers and/or offenders on land—nothing beats being able to "see" what is going on at all times.

Search and Rescue

Thermal imagers from FLIR are used all over the world in the maritime search and rescue role. In a man overboard scenario, the head of a person floating in the water is often the only part of him that is visible. Visible as a white ball against a black or dark gray background on the video display, the human head shows up clearly because its thermal heat is greater than that of the water. This is as true at night as it is during the day, creating a true 24-hour response capability.

Managing a rescue at sea is a complex undertaking. On-scene commanders can use thermal imaging to keep accurate track of victims and rescue personnel in the water alike. This improved situational awareness increases the safety of all involved. Thermal imagers also allow maritime personnel to see what is happening on land without the need of extra lighting, enabling the support of land-based officers while maintaining effective cordon and perimeter actions in and around a crime scene or search area. This allows the maritime and shore-bound teams to work together effectively and safely, as boat crews communicate possible safety issues to units in and around the search area.

Quite simply, thermal imaging works where the human eye and other technologies fail. Thermal cameras create images from heat that is always there, they produce their own contrast, and they work best when we need them the most. Thermal imaging is the only technology that provides true 24/7 capability.

Why FLIR

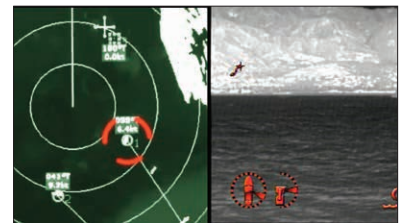
FLIR Systems is the largest commercial infrared company in the world. We have more people and more assets dedicated to helping law enforcement and public safety professionals do their job better and safer than anyone else. FLIR makes all of the critical parts of our thermal imaging cameras in-house, so we can build and service your products faster



FLIR's maritime thermal images let public safety vessels respond at night and in bad weather with greater safety than ever before.



Maritime thermal imagers are the best tools around for finding people in the water – even at night.



Thermal imaging can verify and clarify radar returns.



Select FLIR thermal imagers feature IP addressability that provides remote internet access so crews can operate the camera from any location with an internet connection, even when they're not on board.

and with a higher level of expertise than any of our competitors. FLIR Systems are the thermal imaging experts, and the no-risk solution in the industry.

Grants

FLIR has a dedicated grant expert ready to help you with the grant funding process. Much of this information is available online at www.flir.com.

Conclusion

Thermal imaging cameras are vital, force-multiplying pieces of equipment that can be used to enhance safety, efficiency, and accuracy in a wide variety of maritime crisis and law enforcement situations, significantly improving mission success rate. Use our specifications comparisons chart to point you toward the right correct thermal imager and appropriate options for your particular application.



Thermal Imaging Specifications	MS		MLS		BHM	
	MS-224b	MS-324b	MLS-317	MLS-618	BHM-3X	BHM-6XR
Detector Type	240 x 180 VOx Microbolometer	320 x 240 VOx Microbolometer	320 x 240 VOx Microbolometer	640 x 480 VOx Microbolometer	320 x 240 VOx Microbolometer	640 x 480 VOx Microbolometer
FOV	24° x 18° NTSC		17° x 13°	18° x 14°	13° x 10° NTSC	10° x 8° NTSC
System Specifications						
Size	6.70" x 2.31" x 2.44"		6.70" x 2.31" x 2.44"		10.5" x 6.5" x 2.6"	11.5" x 6.5" x 2.6"
Weight	12 oz.		12.9 oz		.84 lb (1290 g)	3.05 lb (1380 g)
Warranty	3 years					
MSRP	\$1,999	\$2,999	\$4,999	\$5,999	\$6,099	\$7,149



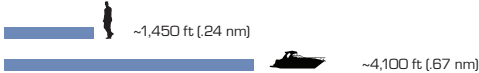
Thermal Imaging Specifications	HM-224 Basic	HM-224 Pro	HM-324 XP+	HM-307 XP+
Main Detector Type	240 x 180 Vox Microbolometer		320 x 240 Vox Microbolometer	
FOV (thermal)	24° x 18°			7° x 5°
System Specifications				
Size	9.4" x 3.3" x 2.6" (10.5" x 3.3" x 2.6" w/Extender)			11" x 3.3" x 2.7"
Weight	1.45 lbs. (653 g) with batteries			2.2 lbs. (984 g) with batteries
Warranty	3 Years			
MSRP	\$3,149	\$4,199	\$6,299	\$8,925

Thermal Range Performance[†]

MS-224 & HM-224 Pro (24° Lens)



MS-324, & HM-324 XP+ (24° Lens)



MLS-317



HM-324 XP+ with 2x Extender^{††} (12° Lens)



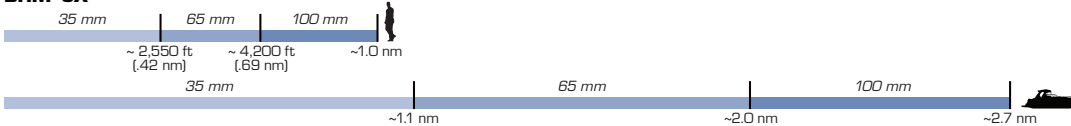
MLS-618



HM-307XP (7° Lens)



BHM-3X



BHM-6XR

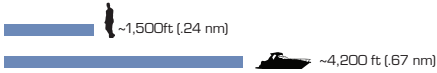




Thermal Imaging Specifications	M-Series (Dual Payload)			M-Series (Single Payload)		M-Series (Gyro-stabilized)	Voyager
	M-625L	M-612L	M-324L	M625XP	M-324XP	M-618CS	
Main Detector Type	640 x 480 Vox	640 x 480 Vox	320 x 240 Vox	640 x 480 Vox	320 x 240 Vox	640 x 480 Vox	Two 320 x 240 Vox
FOV (thermal)	25° x 20°	12° x 10°	24° x 15°	25° x 20°	24° x 18°	18° x 14°	21.7° x 16.4° (Wide) to 1.2° x 0.9° (Narrow)
Daylight Imaging Specifications	Microlux	Microlux	Microlux	N/A	N/A	Daylight/Lowlight	Daylight/Lowlight
System Specifications							
Size	7" dia. x 11.2" ht.					7" dia. X 11.4" ht.	15.18" x 18.68"; 15.5" x 22" Swept Volume Cylinder
Weight	~ 9 lbs.					~ 11.5 lbs.	45 lbs.
Warranty	3 Years						
MSRP	\$20,995	\$23,095	\$14,995	\$14,695	\$8,995	\$39,995	Voyager II \$84,000 Voyager III \$105,000 (Adds video object tracking, firefighting features)

Thermal Range Performance[†]

M-324L & M-324XP



M-625L & M-625XP



M-618CS^{†††}



M-612L^{†††}



Thermal Range Performance[†]

Voyager II/ Voyager III



[†] = Actual object detection range performance may vary depending on camera set-up, environmental conditions, user experience, and type of display used.

^{††} = 2x Extender pertains to HM-Series only.

^{†††} = The M-612L provides extremely long-range imaging and should only be used on stable platforms for best performance. Standard analog video output for viewing on any monitor with an analog video input.

All specifications are subject to change without notice. Visit www.flir.com for the most up-to-date specifications.





Thermal Imaging Specifications	MD		MU	MV	SeaFLIR
	MD-324	MD-625	MU-602C	MV604C	
Main Detector Type	320 x 240 VOx Microbolometer	640 x 480 VOx Microbolometer	Focal Plane Array (FPA), Cooled MWIR 640 x 512 pixels	Focal Plane Array (FPA), Uncooled LWIR 640 x 480 pixels	Cooled InSb; 320 x 240 or 640x480
Visible Color Camera	NA	NA	550 TV lines		1/4" Super HAD Daylight/Lowlight Color CCD
FOV (thermal)	24° x 18° (NTSC)	25° x 20° (NTSC)	Continuous Optical Zoom from WFOV 28° to NFOV 2°	Continuous Optical Zoom from WFOV 24.5° to NFOV 4.1°	21.7° x 16.4° (Wide) to 1.2° x 0.9° (Narrow)
FOV (visible light camera)	NA		~56° to 2° (H) 28X optical zoom		48° (h) to 1.2° (h)
System Specifications					
Size	6" dia. x 7" ht.		20" wide x 17.9" tall (nominal)	20" wide and 17.9" tall	9.0" x 15.2"
Weight	~ 3 lbs		60 lbs		28 lb
Warranty	3 Years		1.5 years		1 Year
MSRP	\$3,499	\$4,499	\$196,000 (Cooled and daylight cameras standard), \$216,000 (plus lowlight camera), or \$230,000 (plus lowlight and wide FOV uncooled camera)	\$135,000 or \$150,000 (with lowlight camera)	Contact your FLIR representative

Thermal Range Performance †

MD-324 †



MD-625 †



Thermal Range Performance †

MV (Uncooled)



MU (Cooled)



Thermal Range Performance †

SeaFLIR



† = Actual object detection range performance may vary depending on camera set-up, environmental conditions, user experience, and type of display used.

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 ~6.8 nm

 ~8.3 nm

 ~11.3 nm



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