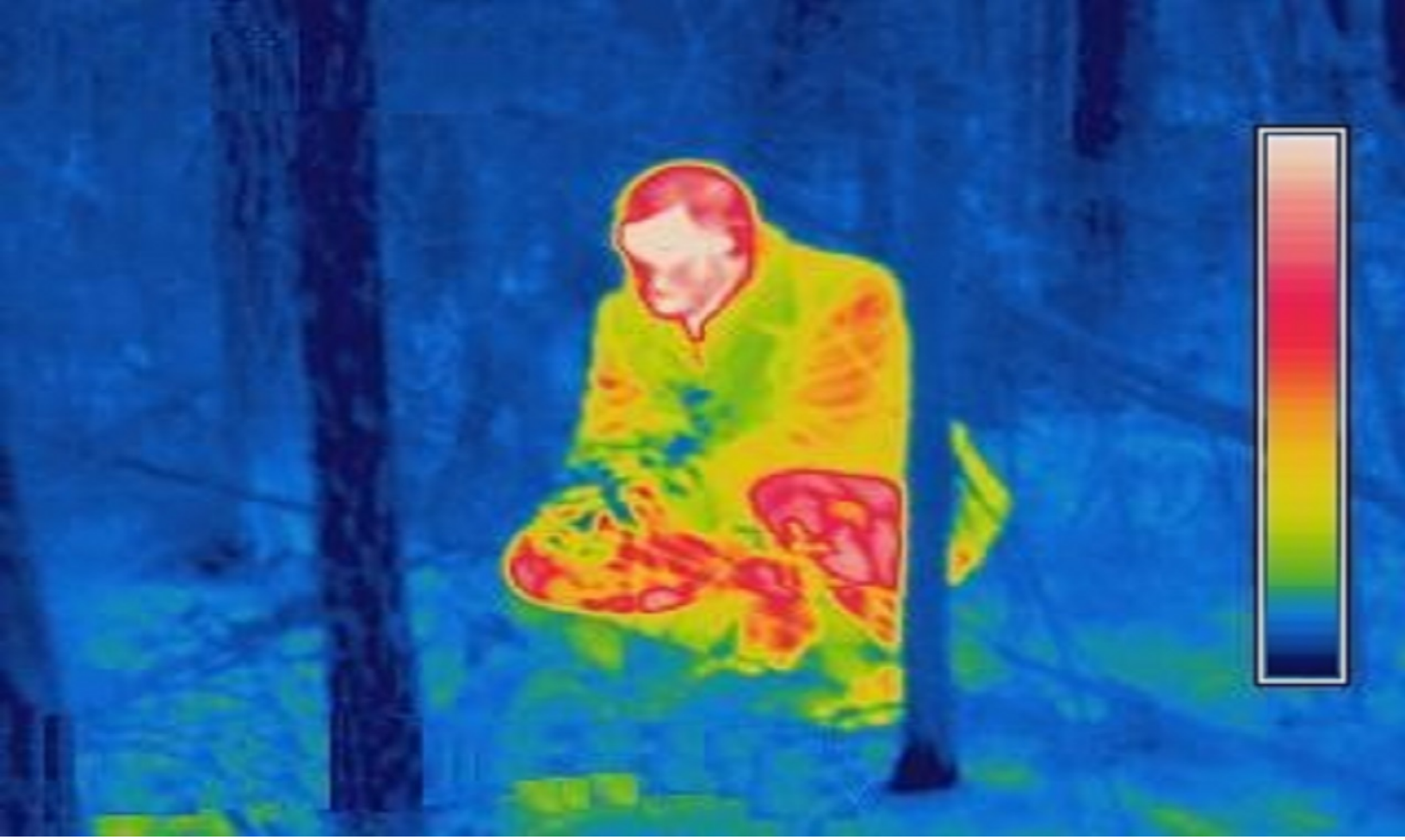

System Assessment and Validation for Emergency Responders (SAVER)

Handheld Thermal Imagers Market Survey Report

August 2015

Homeland Security

Science and Technology

U.S. Department of Homeland Security

SAVER

System Assessment and Validation for Emergency Responders

Prepared by Space and Naval Warfare Systems Center Atlantic

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The cover photo was provided by the Space and Naval Warfare Systems Center Atlantic. Product images are courtesy of the respective vendors, unless otherwise noted.

FOREWORD

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions. Located within the Science and Technology Directorate (S&T) of DHS, the SAVER Program conducts objective assessments and validations on commercially available equipment and systems and develops knowledge products that provide relevant equipment information to the emergency responder community. The SAVER Program mission includes:

- Conducting impartial, practitioner-relevant, operationally oriented assessments and validations of emergency response equipment
- Providing information, in the form of knowledge products, that enables decision-makers and responders to better select, procure, use, and maintain emergency response equipment.

SAVER Program knowledge products provide information on equipment that falls under the categories listed in the DHS Authorized Equipment List (AEL), focusing primarily on two main questions for the responder community: "What equipment is available?" and "How does it perform?" These knowledge products are shared nationally with the responder community, providing a life- and cost-saving asset to DHS, as well as to Federal, state, and local responders.

The SAVER Program is supported by a network of Technical Agents who perform assessment and validation activities. As a SAVER Program Technical Agent, the Space and Naval Warfare Systems Center (SPAWARSYSCEN) Atlantic has been tasked to provide expertise and analysis on key subject areas, including communications, sensors, security, weapon detection, and surveillance, among others. In support of this tasking, SPAWARSYSCEN Atlantic developed this report to provide emergency responders with information gathered during a market survey of commercially available handheld thermal imagers, which fall under AEL reference number 03OE-02-TILA titled Optics, Thermal Imaging and/or Light Amplification.

For more information on the SAVER Program or to view additional reports on handheld thermal imagers or other technologies, visit www.firstresponder.gov/SAVER.

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1. INTRODUCTION

Handheld thermal imagers display an object's heat signature and residual heat signature thereby making handheld thermal imagers a valuable investigative tool for law enforcement and fire service personnel. To provide emergency responders with information on handheld thermal imagers, the System Assessment and Validation for Emergency Responders (SAVER) Program conducted a market survey.

This market survey report is based on information gathered from December 2014 to May 2015 from vendors, Internet research, industry publications, an emergency responder focus group, and a government issued Request for Information (RFI) that was posted on the Federal Business Opportunities website. For inclusion in this report, the handheld thermal imagers had to meet the following criteria:

- A minimum refresh rate of 30 Hertz (Hz)
- Marketed to law enforcement or fire service
- Have an uncooled microbolometer.

Due diligence was performed to develop a report that is representative of products in the marketplace.

2. HANDHELD THERMAL IMAGERS OVERVIEW

Handheld thermal imagers are available in assorted styles with different features, configurations, and components, which address various law enforcement or fire service applications.

2.1 Current Technology

Handheld thermal imagers operate within the infrared (IR) bandwidth of the electromagnetic spectrum at the far-IR wavelength. Figure 2-1 illustrates that only certain wavelengths of the electromagnetic spectrum are visible to the human eye. Infrared wavelengths are not visible to the human eye, and these are the wavelengths detected by handheld thermal imagers.

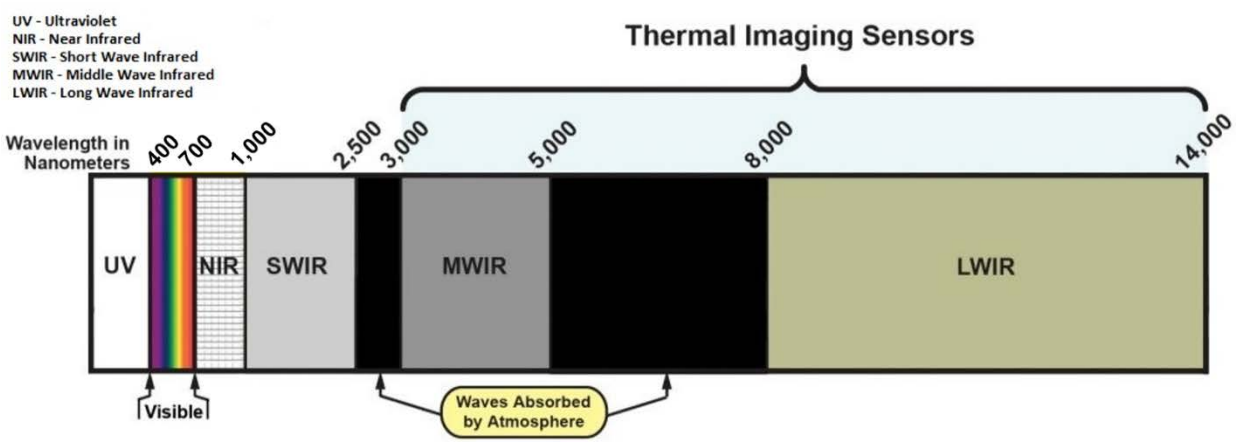

Figure 2-1. The Electromagnetic Spectrum

Image courtesy of Space and Naval Warfare (SPAWAR) Systems Center Atlantic

Handheld thermal imagers use a microbolometer detector to allow users to see thermal infrared radiation emitted by objects. The detector converts thermal energy photons to electrons in order to create an image corresponding to the temperature differences in the scene, but only photons at the energy level corresponding to the 3,000 to 14,000 nanometer (nm) wavelength are detected.

Handheld thermal imagers are lightweight and compact. Many handheld thermal imagers are equipped with a hand strap or over-the-shoulder strap for ease of use. Handheld thermal imagers often differ in video polarity, resolution, field of view, zoom capability, and display types.

2.1.1 Video Polarity

Video polarity is the color or shade displayed when infrared differences are detected. Video polarity aids in understanding the various heat levels emitted from people and objects in the surrounding area. The three most common video polarity display modes are white hot, black hot, and color, as illustrated in Figure 2-2.

White Hot | Black Hot | Color

Figure 2-2. Video Polarity

White Hot and Color images are courtesy of SPAWAR Systems Center Atlantic; Black Hot image is courtesy of E. D. Bullard Company.

2.1.2 Resolution, Field of View, and Zoom

The resolution of a handheld thermal imager is an indicator of its ability to resolve detail in an image. Although it is not the sole determining factor, a higher resolution greatly contributes to capturing a clear, high quality image. This is due to the fact that a higher resolution imager uses more pixels, allowing more detail of the scene to be captured and displayed. Field of view is the angle of observation visible through a thermal imager and varies depending on the model and/or the lens selected. Many handheld thermal imagers have an electronic zoom feature that magnifies the image by cropping and enlarging the viewed area.

2.1.3 Display Types

Common display types for handheld thermal imagers include LCD and organic light-emitting diode (OLED). Monocular and bi-ocular thermal imagers display the thermal image through the eyepiece, whereas other handheld thermal imagers feature a small screen to display the image. Some handheld thermal imagers have video/image capture capability. In addition, some thermal imagers are equipped with a video output option that enables the image to be displayed on an external display. Common video output options include National Television System Committee (NTSC), phase alternating line (PAL), and RS-170. Video may also be available in a digital

format via a USB connection. NTSC and RS-170 are standard video formats used widely in both North and South America, excluding Brazil. Most of Europe, Brazil, Australia, and Asia use the PAL standard.

2.2 Applications

Law enforcement and fire service personnel encounter various scenarios that could benefit from the use of handheld thermal imagers. Common law enforcement and fire service applications include:

Law Enforcement:

- Identifying suspicious activity in total darkness without drawing attention
- Building searches to find hostages or suspects
- SWAT and tactical operations
- Search and rescue
- Locating recently disturbed surfaces (e.g., overturned soil)
- Locating hidden items and/or heat sources behind walls
- Retrieving evidence discarded by suspects (e.g., recently fired weapons or ejected shell casings)
- Traffic investigations (e.g., locate and document tire skid marks).

Fire Service:

- Locating victims in poor visibility
- Detecting hot spots and hidden fires
- Identifying the source and spread of fires
- Aid in navigation of smoky environments
- Locating forensic evidence
- Assessing effectiveness of firefighting techniques and training.

2.3 Ingress Protection

The Ingress Protection (IP) rating, established by the International Electrotechnical Commission (IEC), is a standard for rating a product's protection against solids and liquids. Refer to Appendix A for an explanation of IP ratings.

2.4 Standards/Regulations

National Fire Protection Association (NFPA) 1801: Standard on Thermal Imagers for Fire Service, 2013 Edition, provides information that jurisdictions may find useful when selecting thermal imagers. This standard is included for reference purposes and only as it applies to the utilization of thermal imagers.

In addition to NFPA 1801, NFPA 1670: Standard on Operations and Training for Technical Search and Rescue Incidents, 2014 Edition, identifies and establishes levels of functional capability for conducting operations at technical search and rescue incidents while minimizing threats to rescuers. The requirements of this standard shall apply to organizations that provide response to technical search and rescue incidents, including those not regulated by governmental mandates. For additional information, including complete standards descriptions, refer to www.nfpa.org.

2.5 Emerging Technologies

Recent developments allow for thermal imager integration with smartphones. This technology is now available for use on multiple models of smartphones by means of a protective case, a modular component that connects to the bottom of the smartphone, or as an attachment that covers the smartphone camera. Smartphone thermal imaging is primarily used for commercial purposes (e.g., detecting heat loss in buildings, plumbing applications). Smartphone thermal imaging technology is not as advanced as the handheld thermal imagers discussed in this market survey. However, agencies may find this an inexpensive and useful tool to supplement their standard issue equipment for patrol officers and fire service personnel.

3. PRODUCT INFORMATION–VENDOR PROVIDED

This section provides information on more than 30 handheld thermal imagers that range in price from $2,295 to $15,329. Table 3-1 and Table 3-2 provide general product specifications for handheld thermal imagers marketed to law enforcement and fire service respectively. Product information presented in this section was obtained from an RFI and directly from vendors and their websites. The information has not been independently verified by the SAVER Program.

Table 3-1. Law Enforcement Handheld Thermal Imagers – Vendor Provided

Vendor: American Technologies Network (ATN) Corp.		
 OTS-X-E314 1X MSRP: $3,695	**Warranty Duration:** 3 years **Display:** Monocular OLED **Video Output:** RS-170 **Field of View:** 25° **Optical Magnification**[1]**:** 1x **Electronic Zoom**[2]**:** 2x, 4x **Resolution:** 336x256 **Refresh Rate:** 60Hz **Video Polarity:** White hot, black hot, color	**Battery Type:** CR123A Lithium **Startup Time:** 4 seconds **Battery Runtime:** 2 hours **Weight:** 0.83 pounds **Dimensions (LxWxH):** 4.0x2.4x3.3 inches **Color:** Black **IP Rating:** NP **Image Capture:** Yes **Video Capture:** No
 OTS-X-E330 2X MSRP: $4,199	**Warranty Duration:** 3 years **Display:** Monocular OLED **Video Output:** RS-170 **Field of View:** 11° **Optical Magnification**[1]**:** 2x **Electronic Zoom**[2]**:** 4x, 8x **Resolution:** 336x256 **Refresh Rate:** 60Hz **Video Polarity:** White hot, black hot, color	**Battery Type:** CR123A Lithium **Startup Time:** 4 seconds **Battery Runtime:** 2 hours **Weight:** 1.1 pounds **Dimensions (LxWxH):** 5.75x2.4x3.3 inches **Color:** Black **IP Rating:** NP **Image Capture:** Yes **Video Capture:** No
 OTS-X-E350 4X MSRP: $4,695	**Warranty Duration:** 3 years **Display:** Monocular OLED **Video Output:** RS-170 **Field of View:** 7° **Optical Magnification**[1]**:** 4x **Electronic Zoom**[2]**:** 8x, 16x **Resolution:** 336x256 **Refresh Rate:** 60Hz **Video Polarity:** White hot, black hot, color	**Battery Type:** CR123A Lithium **Startup Time:** 4 seconds **Battery Runtime:** 2 hours **Weight:** 1.4 pounds **Dimensions (LxWxH):** 6.5x2.4x3.3 inches **Color:** Black **IP Rating:** NP **Image Capture:** Yes **Video Capture:** No
 OTS-X-E370 6X MSRP: $5,195	**Warranty Duration:** 3 years **Display:** Monocular OLED **Video Output:** RS-170 **Field of View:** 4.5° **Optical Magnification**[1]**:** 6x **Electronic Zoom**[2]**:** 12x, 24x **Resolution:** 336x256 **Refresh Rate:** 60Hz **Video Polarity:** White hot, black hot, color	**Battery Type:** CR123A Lithium **Startup Time:** 4 seconds **Battery Runtime:** 2 hours **Weight:** 1.75 pounds **Dimensions (LxWxH):** 7.0x3.0x3.3 inches **Color:** Black **IP Rating:** NP **Image Capture:** Yes **Video Capture:** No

See page 10 for notes and definitions of the abbreviations used throughout this table.

Vendor: American Technologies Network (ATN) Corp. (continued)		
 OTS-X-F614 0.5X MSRP: $5,195	**Warranty Duration:** 3 years **Display:** Monocular OLED **Video Output:** RS-170 **Field of View:** 45° **Optical Magnification[1]:** 0.5x **Electronic Zoom[2]:** 1x, 2x, 4x **Resolution:** 640x512 **Refresh Rate:** 30Hz **Video Polarity:** White hot, black hot, color	**Battery Type:** CR123A Lithium **Startup Time:** 4 seconds **Battery Runtime:** 2 hours **Weight:** 0.83 pounds **Dimensions (LxWxH):** 4.0x2.4x3.3 inches **Color:** Black **IP Rating:** NP **Image Capture:** Yes **Video Capture:** No
 OTS-X-F630 1.5X MSRP: $5,695	**Warranty Duration:** 3 years **Display:** Monocular OLED **Video Output:** RS-170 **Field of View:** 22° **Optical Magnification[1]:** 1.5x **Electronic Zoom[2]:** 3x, 6x, 12x **Resolution:** 640x512 **Refresh Rate:** 30Hz **Video Polarity:** White hot, black hot, color	**Battery Type:** CR123A Lithium **Startup Time:** 4 seconds **Battery Runtime:** 2 hours **Weight:** 1.1 pounds **Dimensions (LxWxH):** 5.75x2.4x3.3 inches **Color:** Black **IP Rating:** NP **Image Capture:** Yes **Video Capture:** No
 OTS-X-F650 2.5X MSRP: $6,195	**Warranty Duration:** 3 years **Display:** Monocular OLED **Video Output:** RS-170 **Field of View:** 14° **Optical Magnification[1]:** 2.5x **Electronic Zoom[2]:** 5x, 10x, 20x **Resolution:** 640x512 **Refresh Rate:** 30Hz **Video Polarity:** White hot, black hot, color	**Battery Type:** CR123A Lithium **Startup Time:** 4 seconds **Battery Runtime:** 2 hours **Weight:** 1.4 pounds **Dimensions (LxWxH):** 6.5x2.4x3.3 inches **Color:** Black **IP Rating:** NP **Image Capture:** Yes **Video Capture:** No
 OTS-X-F670 3.5X MSRP: $6,695	**Warranty Duration:** 3 years **Display:** Monocular OLED **Video Output:** RS-170 **Field of View:** 9° **Optical Magnification[1]:** 3.5x **Electronic Zoom[2]:** 7x, 14x, 28x **Resolution:** 640x512 **Refresh Rate:** 30Hz **Video Polarity:** White hot, black hot, color	**Battery Type:** CR123A Lithium **Startup Time:** 4 seconds **Battery Runtime:** 2 hours **Weight:** 1.75 pounds **Dimensions (LxWxH):** 7.0x3.0x3.3 inches **Color:** Black **IP Rating:** NP **Image Capture:** Yes **Video Capture:** No

See page 10 for notes and definitions of the abbreviations used throughout this table.

Vendor: E. D. Bullard Company		
 Edge MSRP: NP	**Warranty Duration:** 1 year **Display:** 2.4-inch LCD **Video Output:** NTSC **Field of View:** 15.75°x21° **Optical Magnification:** 1x **Resolution:** 80x60, 160x120 (selected at purchase) **Refresh Rate:** 30Hz **Video Polarity:** White hot, black hot, nocturnal (colors the image in red)	**Battery Type:** Proprietary rechargeable NiMH **Startup Time:** 4 seconds **Battery Runtime:** 3 hours **Weight:** 1.5 pounds **Dimensions (LxWxH):** 6.5x4.0x3.4 inches **Color:** Black **IP Rating:** IP67 **Image Capture:** No **Video Capture:** No
 TacSight SE35 MSRP: NP	**Warranty Duration:** 5 years **Display:** 3.5-inch LCD **Video Output:** NTSC **Field of View:** 13°x9.8° **Optical Magnification:** 1x **Electronic Zoom**[2]**:** 4x **Resolution:** 320x240 **Refresh Rate:** 30Hz **Video Polarity:** White hot, black hot	**Battery Type:** Proprietary rechargeable NiMH **Startup Time:** 30 seconds **Battery Runtime:** 3 hours **Weight:** 3.5 pounds **Dimensions (LxWxH):** 4.25x7.5x6.0 inches **Color:** Black **IP Rating:** IP65 **Image Capture:** Optional **Video Capture:** Optional
Vendor: FLIR Systems Inc.		
 BHS-X Series: QD35 MSRP: $8,188 **BHS-X Series: QD65** MSRP: $9,448 **BHS-X Series: QD100** MSRP: $11,548	**Warranty Duration:** 1 year **Display:** Bi-ocular LCD **Video Output:** NTSC or PAL **Field of View**[1]**: QD35** lens 13°x10°; **QD65** lens 7°x5°; **QD100** lens 5°x3° **Optical Magnification:** NP **Electronic Zoom**[2]**:** 2x **Resolution:** 320x240 **Refresh Rate:** 30Hz **Video Polarity:** White hot, black hot	**Battery Type:** AA NiMH or Alkaline **Startup Time:** 90 seconds **Battery Runtime:** 4 hours (NiMH) **Weight:** 2.2 pounds[3] **Dimensions (LxWxH)**[4]**:** 11.0x6.5x2.63 inches **Color:** Black **IP Rating:** IP66 **Image Capture:** Yes **Video Capture:** Yes
 BHS-XR Series: QD35 MSRP: $9,238 **BHS-XR Series: QD65** MSRP: $10,498 **BHS-XR Series: QD100** MSRP: $12,598	**Warranty Duration:** 1 year **Display:** Bi-ocular LCD **Video Output:** NTSC or PAL **Field of View**[1]**: QD35** lens 18°x13°; **QD65** lens 10°x8°; **QD100** lens 6°x4° **Optical Magnification:** NP **Electronic Zoom**[2]**:** 2x, 4x **Resolution:** 640x480 (sensor); 320x240 (viewfinder) **Refresh Rate:** 30Hz **Video Polarity:** White hot, black hot	**Battery Type:** AA NiMH or Alkaline **Startup Time:** 90 seconds **Battery Runtime:** 4 hours (NiMH) **Weight:** 2.2 pounds[3] **Dimensions (LxWxH)** [4]**:** 11.0x6.5x2.63 inches **Color:** Black **IP Rating:** IP66 **Image Capture:** Yes **Video Capture:** Yes

See page 10 for notes and definitions of the abbreviations used throughout this table.

Vendor: FLIR Systems Inc. (continued)		
 HS-307 Patrol MSRP: $7,899 **HS-307 Command** MSRP: $8,929	**Warranty Duration:** 1 year **Display:** Monocular LCD **Video Output:** NTSC or PAL **Field of View:** 7°x5° **Optical Magnification:** 1x **Electronic Zoom**[2]**:** 2x **Resolution:** 320x240 **Refresh Rate:** 30Hz **Video Polarity:** White hot, black hot	**Battery Type:** AA NiMH or Alkaline **Startup Time:** 90 seconds **Battery Runtime:** 4 hours (NiMH) **Weight:** 2.17 pounds **Dimensions (LxWxH):** 10.96x3.33x2.62 inches **Color:** Black **IP Rating:** IP67 **Image Capture:** Yes (Command) **Video Capture:** Yes (Command)
 HS-324 Patrol MSRP: $5,249 **HS-324 Command** MSRP: $6,299	**Warranty Duration:** 1 year **Display:** Monocular LCD **Video Output:** NTSC or PAL **Field of View:** 24°x18° **Optical Magnification**[5]**:** 1x **Electronic Zoom**[2]**:** 2x **Resolution:** 320x240 **Refresh Rate:** 30Hz **Video Polarity:** White hot, black hot	**Battery Type:** AA NiMH or Alkaline **Startup Time:** 90 seconds **Battery Runtime:** 5 hours (NiMH) **Weight:** 1.59 pounds **Dimensions (LxWxH):** 9.36x3.33x2.62 inches **Color:** Black **IP Rating:** IP67 **Image Capture:** Yes (Command) **Video Capture:** Yes (Command)
 LS-X MSRP: $3,499 **LS-XR** MSRP: $5,999	**Warranty Duration:** 1 year **Display:** Monocular OLED **Video Output:** USB **Field of View: LS-X** 17°x13°; **LS-XR** 18°x14° **Optical Magnification:** 1x **Electronic Zoom**[2]**: LS-X** – 2x, 4x**;** **LS- XR** – 2x, 4x, 8x **Resolution: LS-X** 336x256; **LS- XR** 640x512 **Refresh Rate: LS-X** 60Hz; **LS-XR** 30Hz **Video Polarity:** White hot, black hot	**Battery Type:** Proprietary rechargeable Li-ion **Startup Time:** 2 seconds **Battery Runtime:** 5 hours **Weight:** 0.81 pounds **Dimensions (LxWxH):** 6.7x2.31x2.44 inches **Color:** Black **IP Rating:** IP67 **Image Capture:** No **Video Capture:** No
 Recon M18 MSRP: $11,025	**Warranty Duration:** 1 year **Display:** Monocular OLED **Video Output:** NTSC or PAL **Field of View:** 18.7°x14° **Optical Magnification:** 1x **Electronic Zoom**[2]**:** 2x, 4x **Resolution:** 640x480 **Refresh Rate:** 30Hz **Video Polarity:** White hot, black hot	**Battery Type:** CR123A Lithium **Startup Time:** 3 seconds **Battery Runtime:** 3 hours **Weight:** 1.06 pounds **Dimensions (LxWxH):** 5.0x3.25x2.25 inches **Color:** Black **IP Rating:** NP **Image Capture:** No **Video Capture:** No

See page 10 for notes and definitions of the abbreviations used throughout this table.

Vendor: FLIR Systems Inc. (continued)		
 Recon M24 MSRP: $5,880	**Warranty Duration:** 1 year **Display:** Monocular LCD **Video Output:** RS-170 or PAL **Field of View:** 24°x18° **Optical Magnification:** 1x **Electronic Zoom^2:** 2x, 4x **Resolution:** 320x240 **Refresh Rate:** 30Hz **Video Polarity:** White hot, black hot	**Battery Type:** CR123A Lithium **Startup Time:** 3 seconds **Battery Runtime:** 3 hours **Weight:** 0.88 pounds **Dimensions (LxWxH):** 4.6x2.5x3.0 inches **Color:** Black **IP Rating:** NP **Image Capture:** No **Video Capture:** No
Vendor: L-3/EOTech Inc.		
 X320 MSRP: $3,799	**Warranty Duration:** 3 years **Display:** Monocular LCD **Video Output:** NTSC **Field of View:** 12°x9° **Optical Magnification:** 1x **Electronic Zoom^2:** 2x, 3x, 4x **Resolution:** 320x240 **Refresh Rate:** 30Hz **Video Polarity:** White hot, black hot, color	**Battery Type:** AA Lithium **Startup Time:** 5 seconds **Battery Runtime:** 6 hours **Weight:** 0.83 pounds **Dimensions (LxWxH):** 5.25x4.5x2.0 inches **Color:** Black **IP Rating:** IP67 **Image Capture:** No **Video Capture:** No
 X640 (5002331-1) MSRP: $5,499 **X640 (5002330-1)** MSRP: $5,699	**Warranty Duration:** 3 years **Display:** Monocular LCD **Video Output:** NTSC **Field of View: 5002331-1** 18°x13.5°; **5002330-1** 24°x18° **Optical Magnification:** 1x **Electronic Zoom^2:** 2x, 3x, 4x **Resolution:** 640x480 **Refresh Rate:** 30Hz **Video Polarity:** White hot, black hot, color	**Battery Type:** AA Lithium **Startup Time:** 5 seconds **Battery Runtime:** 5 hours **Weight:** 0.83 pounds **Dimensions (LxWxH):** 5.25x4.5x2.0 inches **Color:** Black/Tan **IP Rating:** IP67 **Image Capture:** No **Video Capture:** No
Vendor: L-3/Insight Technology		
 CRATOS Handheld MSRP: $13,860	**Warranty Duration:** 1 year **Display:** Monocular OLED **Video Output:** RS-170 **Field of View:** 26.2° **Optical Magnification:** 1x **Electronic Zoom^2:** 2x **Resolution:** 640x480 **Refresh Rate:** 60Hz **Video Polarity:** White hot, black hot, color	**Battery Type:** AA Lithium **Startup Time:** 5 seconds **Battery Runtime:** 4 hours **Weight:** 1.03 pounds **Dimensions (LxWxH):** 3.75x2.95x2.7 inches **Color:** Tan **IP Rating:** IP68 **Image Capture:** Yes **Video Capture:** No

See page 10 for notes and definitions of the abbreviations used throughout this table.

Vendor: L-3/Insight Technology (continued)		
 MTM MSRP: $10,999	**Warranty Duration:** 1 year **Display:** Monocular OLED **Video Output:** RS-170 **Field of View:** 23.6° **Optical Magnification**[5]**:** 1x **Electronic Zoom**[2]**:** 2x, 4x **Resolution:** 320x240 **Refresh Rate:** 60Hz **Video Polarity:** White hot, black hot, color	**Battery Type:** CR123A Lithium **Startup Time:** 5 seconds **Battery Runtime:** 4.5 hours **Weight:** 0.81 pounds **Dimensions (LxWxH):** 5.0x2.8x2.2 inches **Color:** Black **IP Rating:** IP68 **Image Capture:** No **Video Capture:**No
 MTM-PI MSRP: $15,329	**Warranty Duration:** 1 year **Display:** Monocular OLED **Video Output:** RS-170 **Field of View:** 30° **Optical Magnification**[6]**:** 1x **Electronic Zoom**[2]**:** 2x, 4x **Resolution:** 640x480 **Refresh Rate:** 60Hz **Video Polarity:** White hot, black hot, color	**Battery Type:** CR123A Lithium **Startup Time:** 5 seconds **Battery Runtime:** 4 hours **Weight:** 0.81 pounds **Dimensions (LxWxH):** 5.0x2.8x2.2 inches **Color:** Black **IP Rating:** IP68 **Image Capture:** Yes **Video Capture:** Yes

Notes:
NP—information not provided
Display—organic light-emitting diode (OLED)
Video Output—National Television System Committee (NTSC); phase alternating line (PAL)
Battery Type—lithium-ion (Li-ion); nickel metal hydride (NiMH)
Dimensions—L—length; W—width; H—height
IP Rating—ingress protection (IP)
[1]Lenses are interchangable and may be purchased seperately.
[2]Electronic zoom includes optical magnification.
[3]Weight without lens.
[4]Dimensions without lens.
[5]Optional 3x extender lens available for $1,999.
[6]Optional 2x extender lens available for $1,399.

Information in the table is based on data gathered from vendors and their websites from December 2014 to May 2015.

Table 3-2. Fire Service Handheld Thermal Imagers – Vendor Provided

Vendor: Avon Protection Systems Inc.		
 nVision XTP MSRP: $10,000	**Warranty Duration:** 1 year **Display:** 3.5-inch LCD **Video Output:** NTSC or PAL **Field of View:** 50°x37.5° **Optical Magnification:** 1x **Electronic Zoom**[1]**:** 2x, 4x **Resolution:** 320x240 **Refresh Rate:** 30Hz **Video Polarity:** White hot, color	**Battery Type:** Proprietary rechargeable NiMH **Startup Time:** 3 seconds **Battery Runtime:** 4 hours **Weight:** 3.8 pounds **Dimensions (LxWxH):** 8.0x6.25x5.25 inches **Color:** Grey **IP Rating:** IP67 **Image Capture:** No **Video Capture:** Optional
Vendor: E. D. Bullard Company		
 Eclipse MSRP: NP	**Warranty Duration:** 1 year **Display:** 2.4-inch LCD **Video Output:** NTSC **Field of View:** 33°x45° **Optical Magnification:** 1x **Resolution:** 80x60, 160x120 (selected at purchase) **Refresh Rate:** 30Hz **Video Polarity:** White hot	**Battery Type:** Proprietary rechargeable NiMH **Startup Time:** 4 seconds **Battery Runtime:** 3 hours **Weight:** 1.5 pounds **Dimensions (LxWxH):** 6.5x4.0x3.4 inches **Color:** Red, yellow, black, white, orange, blue, or lime-yellow (selected at purchase) **IP Rating:** IP67 **Image Capture:** No **Video Capture:** No
 Eclipse LDX MSRP: NP	**Warranty Duration:** 5 years **Display:** 3.5-inch LCD **Video Output:** NTSC **Field of View:** 31°x40° **Optical Magnification:** 1x **Resolution:** 240x180 **Refresh Rate:** 60Hz **Video Polarity:** White hot	**Battery Type:** Proprietary rechargeable NiMH **Startup Time:** 4 seconds **Battery Runtime:** 2 hours **Weight:** 1.9 pounds **Dimensions (LxWxH):** 7.7x5.2x4.3 inches **Color:** Metallic blue, red, yellow, black, white, orange, blue, or lime-yellow (selected at purchase) **IP Rating:** IP67 **Image Capture:** Optional **Video Capture:** Optional

See page 13 for notes and definitions of the abbreviations used throughout this table.

Vendor: E. D. Bullard Company (continued)		
 T3X MSRP: NP	**Warranty Duration:** 5 years **Display:** 3.5-inch LCD **Video Output:** NTSC **Field of View:** 31°x40° **Optical Magnification:** 1x **Resolution:** 240x180 **Refresh Rate:** 30Hz **Video Polarity:** White hot	**Battery Type:** Proprietary rechargeable NiMH **Startup Time:** 5 seconds **Battery Runtime:** 5 hours **Weight:** 2.56 pounds **Dimensions (LxWxH):** 7.3x5.7x4.0 inches **Color:** Metallic blue, red, yellow, black, white, orange, blue, or lime-yellow (selected at purchase) **IP Rating:** IP67 **Image Capture:** Optional **Video Capture:** Optional
 T4MAX MSRP: NP	**Warranty Duration:** 1 year **Display:** 4.3-inch LCD **Video Output:** NTSC **Field of View:** 32°x50° **Optical Magnification:** 1x **Electronic Zoom**[1]**:** 2x, 4x **Resolution:** 320x240 **Refresh Rate:** 30Hz **Video Polarity:** White hot	**Battery Type:** Proprietary rechargeable NiMH **Startup Time:** 4 seconds **Battery Runtime:** 3 hours **Weight:** 3.7 pounds **Dimensions (LxWxH):** 5.8x7.9x5.5 inches **Color:** Metallic blue, red, yellow, black, white, orange, blue, or lime-yellow (selected at purchase) **IP Rating:** IP67 **Image Capture:** Optional **Video Capture:** Optional
 T4N MSRP: NP	**Warranty Duration:** 1 year **Display:** 4.3-inch LCD **Video Output:** NTSC **Field of View:** 32°x50° **Optical Magnification:** 1x **Electronic Zoom**[1]**:** 2x, 4x **Resolution:** 320x240 **Refresh Rate:** 30Hz **Video Polarity:** White hot	**Battery Type:** Proprietary rechargeable NiMH **Startup Time:** 4 seconds **Battery Runtime:** 2.5 hours **Weight:** 3.9 pounds **Dimensions (LxWxH):** 6.0x7.9x5.5 inches **Color:** Red, yellow, black, white, orange, blue, or lime-yellow (selected at purchase) **IP Rating:** IP67 **Image Capture:** Optional **Video Capture:** Optional

See page 13 for notes and definitions of the abbreviations used throughout this table.

Vendor: FLIR Systems Inc.		
 K Series K45 MSRP: $4,195 **K Series K55** MSRP: $5,495	**Warranty Duration:** 2 years **Display:** 4.0-inch LCD **Video Output:** NTSC or PAL **Field of View:** 51°x38° **Optical Magnification:** 1x **Electronic Zoom**[1]**:** 2x **Resolution: K45** 240x180; **K55** 320x240 **Refresh Rate:** 60Hz **Video Polarity:** White hot, black hot, color	**Battery Type:** Proprietary Li-ion **Startup Time:** 17 seconds **Battery Runtime:** 4 hours **Weight:** 2.43 pounds **Dimensions (LxWxH):** 4.72x4.9x11.0 inches **Color:** Black **IP Rating:** IP67 **Image Capture:** Yes **Video Capture:** Yes (K55)
Vendor: Palmer Wahl Instrumentation Group		
 Heat Spy Z30 MSRP: $2,295 **Heat Spy Z50** MSRP: $2,995	**Warranty Duration:** 2 years **Display:** 3.5inch LCD **Video Output:** NTSC or PAL **Field of View:** 17.5°x13° **Optical Magnification:** 1x **Electronic Zoom**[1]**:** 2x **Resolution:** 160x120 **Refresh Rate:** 30Hz **Video Polarity: Z30** – 4 color palettes; **Z50** – 11 color palettes	**Battery Type:** Rechargeable Li-ion **Startup Time:** 50 seconds **Battery Runtime:** 3 hours **Weight:** 1.65 pounds **Dimensions (LxWxH):** 5.9x4.5x9.0 inches **Color:** Blue **IP Rating:** IP54 **Image Capture:** Yes (optional for Heat Spy Z30) **Video Capture:** No
 Heat Spy Z70 MSRP: $4,495	**Warranty Duration:** 2 years **Display:** 3.5inch LCD **Video Output:** NTSC or PAL **Field of View:** 25°x19° **Optical Magnification:** 1x **Electronic Zoom**[1]**:** 2x, 4x **Resolution:** 384x288 **Refresh Rate:** 30Hz **Video Polarity:** Color	**Battery Type:** Rechargeable Li-ion **Startup Time:** 50 seconds **Battery Runtime:** 4 hours **Weight:** 1.65 pounds **Dimensions (LxWxH):** 5.9x4.5x9.0 inches **Color:** Blue **IP Rating:** IP54 **Image Capture:** Yes **Video Capture:** No
 Heat Spy Z150 MSRP: $3,495 **Heat Spy Z170** MSRP: $6,495	**Warranty Duration:** 2 years **Display:** 3.6-inch LCD **Video Output:** NTSC or PAL **Field of View:** 25°x19° **Optical Magnification:** 1x **Electronic Zoom**[1]**:** 2x, 4x **Resolution: Z150** 160x120; **Z170** 384x288 **Refresh Rate:** 60Hz **Video Polarity:** Color	**Battery Type:** Rechargeable Li-ion **Startup Time:** 50 seconds **Battery Runtime:** 3 hours **Weight:** 2.16 pounds **Dimensions (LxWxH):** 9.64x4.13x9.0 inches **Color:** Blue **IP Rating:** IP54 **Image Capture:** Yes **Video Capture:** Yes

Notes:
Video Output—National Television System Committee (NTSC); phase alternating line (PAL)
Battery Type—lithium-ion (Li-ion); nickel metal hydride (NiMH)
IP Rating—ingress protection (IP)
[1]Electronic zoom includes optical magnification.

Information in the table is based on data gathered from vendors and their websites from December 2014 to May 2015.

4. PRODUCT INFORMATION–RESEARCHED

This section provides general product specifications on more than 30 handheld thermal imagers. All products feature user-replaceable batteries and all of the thermal imagers for law enforcement are black in color. All products listed for fire service have an IP67 rating with the exception of the Scott Safety Eagle Imager 320, which has an IP54 rating. Contact the vendor for pricing of these products. Table 4-1 and Table 4-2 provide general product specifications for handheld thermal imagers marketed to law enforcement and fire service, respectively. Specifications presented in this section were obtained from Internet and industry publication research. The information has not been independently verified by the SAVER Program.

Table 4-1. Law Enforcement Handheld Thermal Imagers – Researched

Vendor	Product	Warranty (years)	Display	Field of View	Zoom	Resolution	Video Polarity	Battery Type	Commercially Available Battery	Battery Runtime (hours)	Startup Time (seconds)	Dimensions (inches, LxWxH)	Weight (pounds)	Ingress Protection (IP) Rating
e2v Inc.	Argus 160 P Type series	2	Monocular OLED	3.5°, 6.5°, 12°, or 26°		160x120	W, B	DR5 Li-ion	✓	5	5	9.1x3.7x3.0	2.1	IP65
	Argus 160 TT Type series	2	3.5-inch LCD	26° or 50°		160x120	W, B	DR5 Li-ion	✓	5	5	11.1x3.6x2.9	1.6	IP65
	Argus 320 P Type series	2	Monocular OLED	7°, 10°, 13°, 24°, or 50°		320x240	W, B	DR5 Li-ion	✓	5	5	9.1x3.7x3.0	2.1	IP65
	Argus 320 TT Type series	2	3.5-inch LCD	24° or 50°		320x240	W, B	DR5 Li-ion	✓	5	5	11.1x3.6x2.9	1.6	IP65
	Argus F Type series	2	3.5-inch LCD	25° or 50°	2x, 4x	320x240	NP	NiMH	NP	4	5	5.1x7.2x7.2	3.4	IP67
General Starlight Company Inc. (GSCI)	TIM-14CGAA	7	Monocular OLED	23°x17°	2x, 4x	384x288	W, B	AA Lithium	✓	7	4	5.3x2.0x1.8	0.8	NP
	TIM-14CGAA-17	7	Monocular OLED	23°x17°	2x, 4x	640x480	W, B	AA Lithium	✓	7	4	5.3x2.0x1.8	0.8	NP
	TIM-14DXAA	7	Monocular OLED	23°x17°	2x, 4x	384x288	W, B	AA Lithium	✓	7	4	5.3x2.0x1.8	0.8	NP
	TIM-14DXAA-17	7	Monocular OLED	23°x17°	2x, 4x	640x480	W, B	AA Lithium	✓	7	4	5.3x2.0x1.8	0.8	NP
Integrated Technology Systems LLC	T5 Thermal All-in-One	NP	3.5-inch LCD	NP	2x, 4x	320x240	C	Li-ion	NP	10	NP	12.5x10.0x5.5	3.0	NP
Scott Safety	Eagle Attack	2	NP	NP		160x120	W	Li-ion		5	NP	NP	1.7	IP67

Notes:
Blank Cell—product is not equipped with corresponding feature
✓—system is equipped with corresponding feature
NP—information not provided

Display—organic light-emitting diode (OLED)
Video Polarity—white hot (W); black hot (B); color (C)
Battery Type—lithium-ion (Li-ion); nickel metal hydride (NiMH)

Information in the table is based on data gathered from Internet and industry publication research from December 2014 to May 2015.

Table 4-2. Fire Service Handheld Thermal Imagers – Researched

Vendor	Product	Warranty Duration (years)	Display	Video Output	Field of View	Zoom	Resolution	Video Polarity	Battery Type	Commercially Available Battery	Battery Runtime (hours)	Startup Time (seconds)	Dimensions (inches, LxWxH),	Weight (pounds)	Color
Draeger Safety Inc.	UCF-6000	NP	3.5-inch LCD	USB	47°x32°		160x120	NP	Alkaline or Li-ion	✓	2 or 4[1]	NP	4.9x11.0x4.3	2.9	Blue
	UCF-7000	NP	3.5-inch LCD	USB	47°x32°	2x	160x120	NP	Alkaline or Li-ion	✓	2 or 4[1]	NP	4.9x11.0x4.3	2.9	Blue
	UCF-9000	2	3.5-inch LCD	USB	57°x41°	2x, 4x	384x288	NP	Alkaline or Li-ion	✓	2 or 4[1]	NP	4.9x11.0x4.3	2.9	Blue
	UCF-9000-(NFPA Certified)	2	3.5-inch LCD	USB	57°x41°	2x, 4x	384x288	NP	Alkaline or Li-ion	✓	2 or 4[1]	NP	4.9x11.0x4.3	2.9	Blue
e2v Inc.	Argus MI-TIC (MI-160)	2	2.7-inch LCD	USB	50°x37.5°		160x120	W, B	Lithium Iron Phosphate	NP	2 or 5[2]	5	8.0x3.8x3.35	1.7	Red
	Argus MI-TIC (MI-320)	2	2.7-inch LCD	USB	50°x37.5°		384x288	W, B	Lithium Iron Phosphate	NP	2 or 5[2]	5	8.0x3.8x3.35	1.7	Red
	Argus4 160	2	3.5-inch LCD	NTSC	50°x37.5°	2x	160x120	W, B	NiMH	NP	4	5	5.1x7.2x7.2	3.4	Red
	Argus4 320	2	3.5-inch LCD	NTSC	50°x37.5°	2x, 4x	320x240	W, B	NiMH	NP	4	5	5.1x7.2x7.2	3.4	Red
	Argus4 HR320	2	3.5-inch LCD	NTSC	50°x37.5°	2x, 4x	320x240	W, B	NiMH	NP	4	5	5.1x7.2x7.2	3.4	Red
ISG Infrasys[3]	E380	1	3.5-inch LCD	NP	54° Diagonal	2x, 4x	384x288	W	Li-ion	NP	4	10	NP	2.9	Black
	Elite XR	1	3.5-inch LCD	NTSC	50° Diagonal		384x288	NP	Alkaline or NiMH	✓	3 or 5[4]	5	5.4x6.5x4.5	2.6	Black

Vendor	Product	Warranty Duration (years)	Display	Video Output	Field of View	Zoom	Resolution	Video Polarity	Battery Type	Commercially Available Battery	Battery Runtime (hours)	Startup Time (seconds)	Dimensions (inches, LxWxH),	Weight (pounds)	Color
ISG Infrasys[3]	K85ST	1	3.5-inch LCD	NTSC	59° Diagonal		160x120	NP	Alkaline or NiMH	✓	3 or 5[4]	5	5.4x6.5x4.5	3.0	Yellow
	X380	1	3.5-inch LCD	NP	54° Diagonal	2x, 4x	384x288	NP	Li-ion	NP	4	10	5.0x4.5x9.0	2.1	Black
MSA Safety Incorporated	Evolution 5600	2	3.5-inch LCD	NTSC	39°x39°		120x120	NP	Li-ion	NP	2	2	10.8x8.1x4.4	2.8	Black
	Evolution 6000 Basic	2		USB	48°x37°		320x240	NP	Li-ion	NP	3.5	NP	7.3x4.8x11.6	2.7	Black
	Evolution 6000 Extreme	2		USB	48°x37°	2x, 4x	320x240	C	Li-ion	NP	3	NP	7.3x4.8x11.6	2.8	Black
	Evolution 6000 Plus	2		USB	48°x37°	2x, 4x	320x240	C	Li-ion	NP	3.5	NP	7.3x4.8x11.6	2.7	Black
Scott Safety	Eagle Imager 320	2	4-inch LCD	NP	NP	2x, 4x	320x240	C	NiMH	NP	4	3	8.0x6.3x5.3	3.8	Black

Notes:
Blank Cell—product is not equipped with corresponding feature
✓—system is equipped with corresponding feature
NP—information not provided
Video Output—National Television System Committee (NTSC)
Video Polarity— white hot (W); black hot (B); color (C)
Battery Type—lithium-ion (Li-ion); nickel metal hydride (NiMH)

[1]Battery runtime is dependent on battery type; 2 hours for alkaline batteries and 4 hours for Li-ion batteries.
[2]Battery runtime is dependent on battery type; 2 hours for standard batteries and 5 hours for high-capacity batteries.
[3]ISG Infrasys purchased by Scott Safety in November 2014.
[4]Battery runtime is dependent on the battery type; 3 hours for alkaline batteries and 5 hours for NiMH batteries.

Information in the table is based on data gathered from Internet and industry publication research from December 2014 to May 2015.

5. VENDOR CONTACT INFORMATION

Additional information on the handheld thermal imagers included in this market survey report can be obtained from the vendors listed in Table 5-1.

Table 5-1. Vendor Contact Information

Vendor	Phone Number	Website/E-Mail Address
American Technologies Network (ATN) Corp.	(800) 910-2862	www.atncorp.com sales@atncorp.com
Avon Protection Systems Inc.	(888) 286-6440	www.avon-protection.com customerservice@avon-protection.com
Draeger Safety Inc.	(800) 858-1737	www.draeger.com
E. D. Bullard Company	(877) 285-5273	www.bullard.com info@bullard.com
e2v Inc.	(800) 342-5338	www.argusdirect.com enquiries@e2v-us.com
FLIR Systems Inc.	(877) 595-1989	www.flir.com sales@flir.com
General Starlight Company Inc. (GSCI)	(905) 850-0990	http://gsci1.com gsci@gsci1.com
Integrated Technology Systems LLC	(770) 307-1467	www.itssales.com
ISG Infrasys[1]	(877) 733-3473	www.scottsafety.com www.isgfire.com info@isgfire.com
L-3/EOTech Inc.	(888) 368-4656	www.eotechinc.com support.EOTech@L-3com.com
L-3/Insight Technology	(877) 744-4802	www.insighttechnology.com quotes.insight@L-3com.com
MSA Safety Incorporated	(877) 672-3473	http://us.msasafety.com fire.CS@msasafety.com
Palmer Wahl Instrumentation Group	(800) 421-2853	www.wahlheatspy.com sales@palmerwahl.com
Scott Safety	(800) 247-7257	www.scottsafety.com sh-sale@tycoint.com

Notes:
[1]ISG Infrasys purchased by Scott Safety in November 2014.

6. SUMMARY

This market survey report provides information on over 60 handheld thermal imagers. Handheld thermal imagers are designed to be lightweight, compact, and easy to use. Many handheld thermal imagers are equipped with a hand strap or over-the-shoulder strap for ease of use. Handheld thermal imagers often differ in video polarity, resolution, field of view, zoom capabilities, and display types. Most of the handheld thermal imagers in this market survey report feature zoom, video/image capture capability, a video output option, and an IP65 rating or higher. Considerations in purchasing a handheld thermal imager vary by user preference and application. The preferred color of the handheld thermal imager varies by application. Those designed for fire service use are typically available in bright colors, whereas handheld thermal imagers designed for law enforcement use are typically available in more covert colors, such as black or gray.

Emergency responder agencies that consider purchasing handheld thermal imagers should carefully research each product's overall capabilities and limitations in relation to their agency's operational needs.

APPENDIX A. INGRESS PROTECTION (IP) RATING

The International Electrotechnical Commission (IEC) Ingress Protection (IP) Rating specifies the level of protection an enclosure provides against solid foreign objects and liquids. The first number refers to protection against solid foreign objects, and the second number refers to protection against liquids. The highest possible rating is IP68.

First Number	Meaning	Second Number	Meaning
(Protection against solid foreign objects)		(Protection against liquids)	
0	No protection.	0	No protection.
1	Protected against solid objects over 50 mm (e.g., accidental touch by hand).	1	Protected against water falling vertically.
2	Protected against solid objects over 12 mm (e.g., accidental touch by finger).	2	Protected against direct sprays up to 15 degrees from vertical.
3	Protected against solid objects over 2.5 mm (e.g., tools, wires).	3	Protected against direct sprays up to 60 degrees from vertical.
4	Protected against solid objects over 1 mm (e.g., small wires).	4	Protected against sprays from all directions. Limited ingress permitted.
5	Protected against dust-limited ingress (no harmful deposit).	5	Protected against low pressure jets of water from all directions. Limited ingress permitted.
6	Totally protected against all dust.	6	Protected against strong jets of water. Limited ingress permitted (e.g., acceptable for use on ship decks).
		7	Protected against temporary effects of immersion between 15 cm and 1 m for 30 minutes.
		8	Protected against long periods of immersion under pressure.