



Homeland  
Security

# TechNote



The U.S. Department of Homeland Security, Preparedness Directorate, Office of Grants and Training (G&T) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders in performing their duties. The mission of the SAVER Program is to

- Provide impartial, practitioner relevant, and operationally oriented assessments and validations of emergency responder equipment.
- Provide information that enables decision-makers and responders to better select, procure, use, and maintain emergency responder equipment.
- Assess and validate the performance of products within a system, as well as systems within systems.
- Provide information and feedback to the user community through a well-maintained, Web-based database.

The SAVER Program established and is supported by a network of technical agents who perform the actual assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community, "What equipment is available?" and "How does it perform?"

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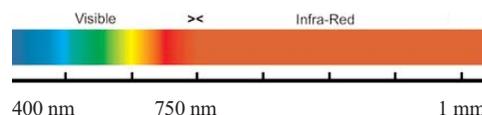
## Hand-Held Thermal Imaging Cameras for Law Enforcement

Criminals have often benefited from the concealment darkness provides. Thermal imaging cameras, also known as thermal imagers, provide law enforcement with a tool for eliminating this advantage. There are two major types: larger, more sensitive and cryogenically cooled devices; and smaller uncooled hand-held devices. These smaller hand-held devices have evolved into affordable systems that offer high contrast images in most situations, making them the primary choice for law enforcement officials.



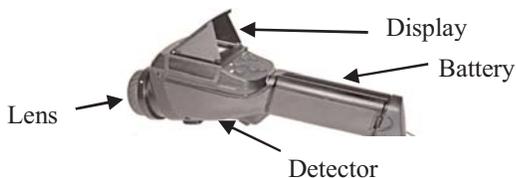
## How Hand-Held Thermal Imaging Cameras Work

Hand-held thermal imaging cameras can easily detect people and vehicles and are not affected by bright light sources. They can be used during the day and night. Thermal imagers operate within the Infrared (IR) bandwidth of the electromagnetic spectrum and display the differences in radiated energy emitted by the various temperatures of an object's surface. IR wavelengths are located on the electromagnetic spectrum between red visible light at 750 nanometers (nm) to far IR at 1 millimeter (mm).



Thermal imaging cameras consist of the same fundamental components as a modern day digital camera. They produce a usable thermal image (a map of temperatures in the scene) in a small compact device.

- **Lens**—The lens is made of special germanium glass in an expensive manufacturing process. Multiple magnification or focal lengths are generally offered, however, only one is usually purchased because of the high cost.
- **Detector**—Either pyroelectric detectors, which measure the electrical capacitance across the detector, or microbolometers, which measure the electrical resistance across the detector, are used in a thermal imaging device. Microbolometers are the most widely used detectors for measuring heat signatures.
- **Signal Processing**—Once the detector has been turned on, it must reference its temperature sensing to a known baseline. A Non-Uniform Correction (NUC) is performed periodically, enabling the thermal imager to provide a more precise image.
- **Display**—Hand-held devices for law enforcement personnel display the thermal image through a small optical eyepiece or on a Liquid Crystal Display (LCD).
- **Power**—A hand-held device is usually powered by a battery pack. This pack may consist of conventional AA, custom lithium, or nickel metal hydride (NiMH) batteries. If battery longevity is a concern, a power cord with a 12-volt DC cigarette lighter style connector is often an available accessory.



## Hand-Held Thermal Imaging Camera Features

Law enforcement personnel often seek unique features or characteristics in a hand-held thermal imaging camera that will map to specific applications. Features typically given high consideration prior to purchasing a device are magnification, resolution, and image/video recording capability. An initial consideration is the ability to provide magnification either by lens selection or digital zoom. Thermal imaging cameras are usually offered in 50 mm telephoto or 25 mm wide-angle lenses. The most common thermal imaging detectors have a display resolution of 160 x 120 individual picture elements (pixels). A resolution of 320 x 240 with four times digital zoom is available and offers good pixel magnification. Most LCD displays can be dimmed or turned off completely for more covert operation and to minimize the effects of night blindness (re-adjusting to darkness).

The importance of documenting and preserving evidence makes image recording a necessary option. Many devices offer flash memory for internal storage, and can transfer images to a computer via a Universal Serial Bus (USB) connection or a



docking station. Some systems also provide the ability to transfer images to an external recording device through a video output connection or wireless transmission. Other systems provide the ability to display several wireless transmissions on separate frequency channels to a single hand-held monitor.

# Law Enforcement Applications

Thermal imaging cameras can be used in a variety of law enforcement applications which include patrol operations, criminal investigations, and specialty units. For each of these applications, different sets of equipment characteristics are important.

**Patrol Operations** include officers on road patrol and community/neighborhood policing. Search and Rescue (SAR), apprehension, and surveillance are common activities performed by a uniformed officer. For these applications, a thermal imager that is small and lightweight (two pounds or less) will provide single-hand operation for easy handling. These devices may also be durable, able to withstand up to a 6-foot drop; be waterproof to a depth of 9 feet; and have an initial startup time of 3 seconds or less.



**Criminal Investigations** include internal affairs and crimes against persons and property. Use of a thermal imager with a larger, high resolution display (3.5-inch diagonal measurement) and the ability to capture and record video images is appropriate for these applications.



**Specialty Units** include canine (K9), aviation, Special Weapons and Tactics (SWAT), hazardous materials, equestrian, and bomb disposal. Thermal imagers may have a long detection range or may be equipped with a built-in Global Positioning System (GPS). These devices are required to perform numerous functions and possess many of the features described in both patrol operations and



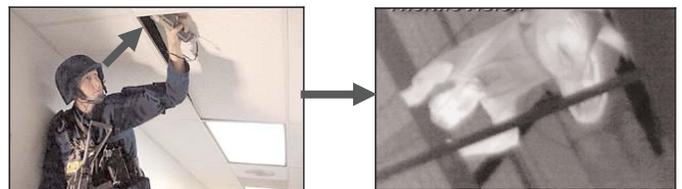
criminal investigations. A variety of thermal imagers with different characteristics may be required to satisfy all the applications within this category.

# Thermal Imager Capabilities

Surveillance and the ability to find a suspect in complete darkness while maintaining a safe distance, outside of perceived handgun range, is a common application of law enforcement personnel. Although thermal imaging cameras are highly effective surveillance instruments, they are incapable of seeing through common glass because emitted IR energy generated by an object cannot penetrate glass. Thermal imagers are, however, able to see through limited amounts of smoke and fog. (Covert surveillance through windows of automobiles or buildings requires the use of intensified night vision equipment.)

Thermal imagers are used by law enforcement officials searching for illegal drug activity, such as growing marijuana in remote or hidden locations. In suburban environments, thermal imagers have been used to locate unusual heat emanating from an attic, a strong indication of indoor marijuana cultivation. They also provide the ability to detect disturbed earth in tracking applications.

The small size of a hand-held thermal imaging camera provides the ability to approach covertly during tactical operations. This ability allows officers to scan areas before walking blindly into an area that places them in a dangerous situation.



Thermal imagers can be used for a variety of applications in automobile accident investigations. Thermal signatures of people or items left behind can be detected on car seats

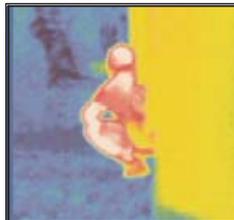
to determine the number of occupants that were in a vehicle. Once the number of passengers is determined, a thermal imager can be used to scan the area for vehicle occupants possibly ejected from the vehicle. Another critical aspect of accident reconstruction is the analysis of skid mark information to determine the speed of the vehicle before an accident. The origin of a skid mark is often not visible to the naked eye, but does produce a thermal signature that is readily apparent to the user of a thermal imaging device. A thermal imager will enable the total length of the skid mark to be measured from the point of origin to the vehicle at rest.

Much like skid marks on a roadway, once undetectable forensic evidence can now be located with a thermal imager. This evidence includes blood splatter, bullets, and shell casings. Forensic investigators have also used thermal imaging cameras to record the thermal signature of a deceased individual to estimate the time of death, based on the current body temperature.

For more information on law enforcement thermal imager use, visit the Law Enforcement Thermography Association's (LETA) Web site, <http://www.leta.org/>.

## Emerging Technologies

Hand-held thermal imaging cameras are beginning to utilize color displays to aid in understanding the various heat levels emitted from objects in the surrounding area.



Higher resolution (320 x 240) detectors are becoming more common as well. Digital zoom and longer life lithium ion batteries are becoming an industry standard. As batteries become smaller, detectors and displays improve in resolution, and internal memory increases, the hand-held thermal imaging camera will truly evolve into a valuable tool for many law enforcement agencies.

SAVER is sponsored by the U.S. Department of Homeland Security, Preparedness Directorate, Office of Grants and Training.

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