FLIR SYSTEMS
INDIGO OPERATIONS

FlashSight™
User's Guide

 431-0002-09-10

FlashSight User's Guide
431-0002-09-10
Version 100

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CAUTION

The FlashSight battery case will accommodate any standard 1.5V AA batteries. Care must be taken to align battery contacts in the direction depicted on the battery case. Replace all 4 batteries as a set. Do not mix new with used and do not mix battery types (e.g., alkaline and lithium). Do not install batteries directly into the battery compartment without the battery case.

CAUTION

Observe battery manufacturer's guidelines for safe handling and proper disposal of batteries.

CAUTION

FlashSight operates over a wide operating temperature range (-40 °C to +55 °C). Not all AA batteries are specified over this same temperature span. Check the manufacturer's specifications of your selected battery to verify the valid temperature range. For cold temperature operation, lithium cells are recommended[†].

NOTE

It is recommended to remove batteries prior to long-term storage of FlashSight, particularly if stored at elevated temperature.

CAUTION

It is not possible to charge batteries while they are installed in FlashSight. If using rechargeable batteries, remove them from the battery compartment before charging in the manner specified by the battery manufacturer.

CAUTION

Do not disassemble the FlashSight enclosure. Disassembly can cause permanent damage and will void the warranty.

† Energizer®-brand L91 lithium AA cells are capable of operating over the full temperature range of ThermoSight.

CAUTION

Operating FlashSight outside of its specified operating temperature range or voltage range can cause permanent damage and will void the warranty.

CAUTION

When not in use, replace the lens cap over the objective lens. When the lens cap is not in place, avoid pointing the sight directly at extremely high-intensity radiation sources, such as the sun, lasers, arc welders, etc. This warning applies whether or not the system is powered.

CAUTION

Only clean the lens in the manner prescribed in the Appendix of this document.

CAUTION

If you have questions that are not covered in this manual, or need service, contact Customer Support at (805) 964-9797 for additional information prior to returning your FlashSight.

1 Introduction

FlashSight is a completely self-contained infrared imaging device that includes a display, battery compartment, user controls, and internal image-capture memory. FlashSight is intended primarily for security and surveillance applications that demand portability and ruggedness, such as border / perimeter patrol and security inspection. Lightweight and ergonomically optimized for use as a handheld device. The heart of the FlashSight assembly is Indigo Systems Micron™ (Omega) core, the world's smallest, lightest, lowest powered infrared imager. Two lens options are available: 30 mm (13.9° x 9.9°) or 50 mm (8.3° x 6.3°).

2 Unpacking Your FlashSight

The items shown in Figure 1 come as part of the deluxe FlashSight kit. The FlashSight camera is also available as a stand alone OEM camera at a reduced cost.

1. FlashSight unit
2. SMA-to-BNC cable
3. USB2 cable
4. Two (2) battery cases.
5. Weather-proof storage case.
6. User's guide

If there is any discrepancy between this list and the contents of your shipment, please contact Indigo Systems Customer Support immediately at (805) 964-9797.

Figure 1: FlashSight Deluxe Kit

3 Quick-Start Information

The following instructions will get you started with basic operation of the FlashSight.

1. Insert 4 AA batteries inside the battery case as shown in Figure 2, being careful to align the positive and negative battery terminals as depicted in the embossed diagram on the case.

2. Insert the battery case into the FlashSight battery compartment as shown in Figure 3. The compartment is keyed to prevent the case from being inserted upside-down.

Note

The FlashSight battery compartment is designed to accept the included battery case only. Do not insert batteries directly into the compartment without using the case.

3. Press the on/off button on the left side of the FlashSight assembly as shown in Figure 4. You should hear one or more audible "clicks" from the sight. This is the internal shutter, which is used to automatically improve the uniformity of the detector array at periodic intervals. Open the lens cap by rotating it upward, as shown in Figure 5.

4. Hold the eyecup to your eye, pressing slightly against your face to open the eyecup flaps. Adjust the eyepiece focus by rotating the eyepiece, as shown in Figure 6. If necessary, also adjust the focus of the lens assembly as shown in Figure 7.

Note

The eyepiece focus adjustment optimizes the focus of the eyepiece for your vision and should only be required once. The lens focus adjustment optimizes the focus of the infrared imager, and can be varied during operation depending upon whether you are imaging distant or nearby targets. Begin by adjusting the eyepiece focus while looking at the crosshair on the display. Then adjust the lens focus while looking at the image of the object you are trying to see. If the crosshair is not displayed when you first power the unit, see Section 4.4 for directions on how to display it.

5. To turn the unit off, press and hold the on/off button for two seconds. The display will go black, indicating that the system is powered down.

You have now completed the basic steps for using the imager. However, it is recommended that you read the rest of this User's Manual to learn how to adjust the image according to your preferences, how to override automatic shutter operation, how to capture and download images, and how to maintain your FlashSight system.

Figure 2: Installing batteries in the battery case

Figure 3: Installing the battery case into FlashSight

Figure 4: Turning on FlashSight

Figure 5: Opening the lens cap

Figure 6: Adjusting the eyepiece focus

Figure 7: Adjusting the infrared lens focus

4 FlashSight User Controls

Figure 8 shows the location of all user controls on the FlashSight. Detailed descriptions for using these controls are described herein.

(a) Top

(b) Left side

(c) Right side

Figure 8: FlashSight User Controls

4.1 On/Off Button

The "on/off" button is located on the left-side of the FlashSight assembly. To turn the system on, simply press the button, then release. To prevent inadvertent turn-off, the button must be held for 2 seconds to power down FlashSight. The button delay is to prevent inadvertent system turn-off.

4.2 Shutter Button

The "shutter-control" button, which is located on the right-side of the FlashSight assembly, is used for advanced control of the system's shutter function. FlashSight includes an internal shutter for updating non-uniformity correction terms, which maintains image quality at a high level. Normally, the shutter operation is automatic, occurring every two minutes (or more often if the temperature of the sight is changing rapidly). The complete operation lasts approximately half a second, during which time the image is frozen on the display. As a warning the image is about to be frozen, a small square is visible in the upper-left corner of the display (see part (a) of Figure 9) two seconds before the shutter operation. This square remains displayed until the shutter operation is completed.

While it is recommended to leave FlashSight in its automatic shutter mode whenever possible, there are certain circumstances that call for a disabled shutter. One of these is covert operations in which one's position might be given away by sound – the shutter emits a faint "click". Another is targeting applications –the video image is temporarily frozen and can interfere with aiming and target tracking. To toggle between automatic and disabled shutter operation, hold the shutter-control button for two seconds. In disabled mode, a square marked through with an "x" is shown continuously in the upper left of the image (see part (b) of Figure 9), indicating that FlashSight will not perform automatic shuttering.

In either mode, automatic or disabled, pressing the button for less than two seconds will command FlashSight to do an immediate shutter correction, which can result in a slightly improved image.

(a) Automatic shutter operation in progress

(b) Automatic shutter operation is disabled

Figure 9: FlashSight shutter icons

4.3 Image Capture Button

FlashSight provides internal storage of up to 70 captured images. Image capture is accomplished by pressing then releasing the "Image Capture" button, located on the top of the FlashSight assembly. (Note that the image is captured when you release the button, not when you first press it.) Each time the button is released, a camera icon will appear in the bottom portion of the image, indicating the image has been captured and is being stored in internal memory; this typically takes several seconds. The FlashSight menu and crosshairs are not stored with the saved image. A gauge of remaining storage capacity is displayed, as shown in Figure 10. The gauge starts empty (0% full) and rises to 100% full as the storage capacity is filled. When the gauge reaches 100%, a "memory full" icon will appear when you attempt to capture another frame, which indicates no more images can be stored without first deleting the full contents of memory. The memory-full icon is shown in Figure 11.

Figure 10: FlashSight image-capture icon and capacity gauge.

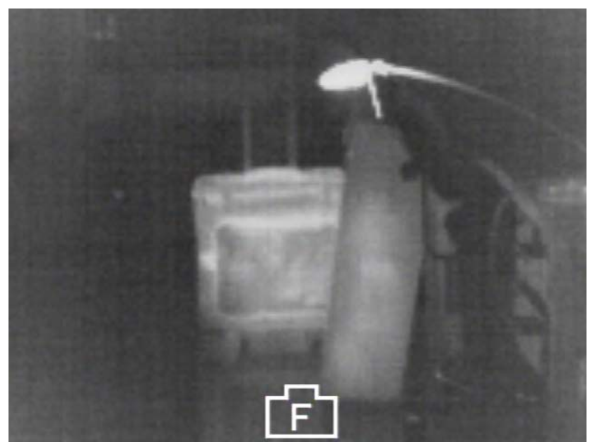

Figure 11: FlashSight 100% full icon.

To delete the image memory, hold the image-capture button continuously for six seconds. The camera icon will begin blinking on the screen after the first three seconds (which gives the user time to abort image delete mode) and it will turn solid once the delete operation is initiated. When the icon turns solid, the image-capture button can be released.

Note

It is not possible to delete a single image – the entire image memory must be erased. It is recommended that the erase process be performed as a first step each time the sight is used so that the full memory is available. Images are NOT deleted during the download process. You must always use the delete process described above to clear image memory.

Downloading images from the FlashSight into a PC is accomplished via the USB cable. See Section 5 for detailed directions regarding the use of this accessory.

4.4 Menu Control

FlashSight provides a user control to select and adjust various items using an on-screen menu. This control, which is located on the front of the FlashSight assembly just below the camera lens, is a push-turn device (i.e., it can be rotated like a knob and also pushed like a button). Pressing the button will cause an on-screen menu as shown in Figure 12 to be displayed. Each row of the menu allows you to affect one of the following settings:

1. Toggle video polarity – hot objects displayed brighter or darker than cold objects.
2. Toggle video-optimization – automatic ("AUTO") or manual adjustment.
3. Adjust brightness / contrast (not available in "AUTO" mode).

Figure 12: FlashSight Menu

Note

The gauge showing the image-capture capacity is also shown when the menu is displayed. This allows you to verify the remaining capacity without having to capture an image.

When the menu is displayed, *rotating* the menu control will scroll the cursor (►) through the menu. Pressing the menu control will allow a particular setting to be adjusted. For example, when the cursor is pointing at the top row of the menu, depressing the menu control will allow video polarity to be changed. When the menu control is pressed, either the "white hot" or "black hot" icon will begin to blink, depending upon the current setting. While the icon is blinking, each rotation of the menu control will toggle between the two options – video polarity will reverse and the other icon will blink. After the desired video polarity has been selected, pressing the menu control knob again will "lock" the selection, and the icon will no longer blink. Rotating the menu control will now cause the cursor to scroll through the menu again. This identical procedure is used to toggle between automatic or manual video-optimization (row 2).

One row on the menu is for adjusting parameters, not for toggling between modes. This is row 3, which allows brightness and contrast to be adjusted.

Note

The cursor will skip over the third row when the sight is in automatic video-optimization mode. In this mode, brightness and contrast settings are updated automatically.

To adjust brightness and contrast, scroll the cursor to the third row and press the menu control. This will cause the "brightness" icon to begin blinking. Now rotating the menu control clockwise (as viewed from the eyecup) will make the displayed image brighter while a counter-clockwise rotation will make it darker. When the brightness is adjusted satisfactorily, pressing the menu control again causes the "contrast" icon to begin blinking. Rotating the menu control clockwise / counterclockwise will increase / decrease the displayed contrast. When contrast adjustment is completed, pressing the menu control once again will lock the settings. No icons will be blinking now, and rotating the menu control will again cause the cursor to scroll through the menu. To further fine-tune brightness and then contrast, press the menu control again, which restarts the adjustment process.

If the menu control is not rotated or pressed for 5 seconds, the menu will disappear. Also, the menu will disappear if the menu control is pressed while the cursor is pointing at the "EXIT" icon. When the menu is off the screen, rotating the menu control will have no effect.

4.5 Eyepiece Focus

The eyepiece can be focused by rotating the eyepiece barrel as shown in Figure 6. The nominal adjustment range is +2.75 to -1.35 diopters. Unlike lens focus, which might be varied during operation depending upon whether you are imaging distant or nearby targets, the eyepiece focus should only have to be adjusted once for your particular vision. It is recommended that you adjust the eyepiece focus while viewing the crosshair (or the menu) rather than objects in the infrared scene, which may be out of focus depending upon the focus-adjustment of the lens. The seal on the eyepiece can be tight so it may be necessary to squeeze the base firmly to adjust focus.

4.6 Lens Focus

The camera lens is focused by rotating the lens barrel. The nominal focus range of the 30mm lens configuration is from 1 meter (40 inches) to infinity. The nominal focus range of the 50mm lens configuration is from 1.5 meters (60 inches) to infinity.

5 FlashSight Image Download

Figure 13: FlashSight for Image Download

To complete the data download, simply plug the USB cable to the FlashSight as shown in Figure 13 and power it on. Windows recognizes the system as a write-protected file-storage device, and images can then be downloaded by copy and paste. Note that because it is write-protected, it is not possible to delete stored images via Windows or to add other files.

6 FlashSight Specifications

- Weight (excluding batteries):

Configuration	Weight
30 mm	≤ 800 g (1.76 lbs)
50 mm	≤ 840 g (1.85 lbs)

- Nominal battery life:

Lithium Cells	Alkaline Cells
7+ hours	~2.5 hours

- Number of pixels: 160 x 120 (uncooled microbolometer)
- Field-of-View:

Configuration	Degrees
30 mm	13.3° x 9.9°
50 mm	8.3° x 6.3°

- Eyepiece eye relief: 25 mm (1 inch)
- Temporal NEdT:

Configuration	Sensitivity (NEdT)
30 mm - f/1.6	<85 mK
50 mm - f/2.0	<85 mK

- Turn-on time:

Time	Degrees
≤4 seconds	above -10°C (14°F)
<30 seconds	at -32°C (-26°F)

Note: The unit cold starts at -32°C and then operates from -40°C to +55°C

- Image-storage capacity: ≤70 frames
- Format of stored images: 8-bit uncompressed bit-map (.BMP), approx. 20 kBytes each
- Operating Temperature Range: -40°C to +55°C (-40°F to +131°F)
- IP rating: 65

- Shock resistance:

• 10,000 rounds M16 weapon-firing
• 70g half-sine, 11msec period, all axes
• Bench-handling per MIL-STD-810E, Method 516.4, Proc. VI

- EMI / EMC: CE Mark certified

Note

These specifications are subject to change without notice. See the FlashSight Product Specification (ISC doc. 431-0001-01-09) for detailed requirements.

7 FlashSight Interfaces

- RS170A (NTSC) compatible-output (75-ohm load impedance) on an SMA connector. (See Figure 14.) CCIR/PAL is available as an option.

Note

See the FlashSight Interface Control Document (ISC doc. 431-0001-01-20) for detailed interface data.

Figure 14: Analog output connector. Note that the rubber covering must be rotated up to expose the connector.

8 Maintenance

8.1 Lens Cleaning

Materials:

- Optical-grade tissue (e.g., Edmund Industrial Optics part number 52105 or any similar product)
- Pure water (de-ionized or other)
- Isopropyl alcohol (IPA)

Procedure:

1. Saturate a piece of the lens tissue with the water and drape it over the lens. Let the surface tension of the water pull the tissue onto the lens surface and then drag the tissue across the lens surface. Repeat several times with different pieces of tissue.

2. Repeat the same step using IPA instead of water. Drag the final piece of tissue over the lens several times to prevent pooling, which could leave a residue behind.

8.2 Eye Cap Cleaning

Materials:

- Mild soapy water
- Paper towel

Procedure:

1. Remove eye cup.

2. Clean plastic eye piece.

3. Clean rubber eye cup.

4. Reinstall.

9 History of Infrared

Less than 200 years ago the existence of the infrared portion of the electromagnetic spectrum wasn't even suspected. The original significance of the infrared spectrum, or simply 'the infrared' as it is often called, as a form of heat radiation is perhaps less obvious today than it was at the time of its discovery by Herschel in 1800.

Figure 15: Sir William Herschel (1738–1822)

The discovery was made accidentally during the search for a new optical material. Sir William Herschel – Royal Astronomer to King George III of England, and already famous for his discovery of the planet Uranus – was searching for an optical filter material to reduce the brightness of the sun's image in telescopes during solar observations. While testing different samples of colored glass which gave similar reductions in brightness he was intrigued to find that some of the samples passed very little of the sun's heat, while others passed so much heat that he risked eye damage after only a few seconds' observation.

Herschel was soon convinced of the necessity of setting up a systematic experiment, with the objective of finding a single material that would give the desired reduction in brightness as well as the maximum reduction in heat. He began the experiment by actually repeating Newton's prism experiment, but looking for the heating effect rather than the visual distribution of intensity in the spectrum. He first blackened the bulb of a sensitive mercury-in-glass thermometer with ink, and with this as his radiation detector he proceeded to test the heating effect of the various colors of the spectrum formed on the top of a table by passing sunlight through a glass prism. Other thermometers, placed outside the sun's rays, served as controls.

As the blackened thermometer was moved slowly along the colors of the spectrum, the temperature readings showed a steady increase from the violet end to the red end. This was not entirely unexpected, since the Italian researcher, Landriani, in a similar experiment in 1777 had observed much the same effect. It was Herschel, however, who was the first to recognize that there must be a point where the heating effect reaches a maximum, and those measurements confined to the visible portion of the spectrum failed to locate this point.

Figure 16: Marsilio Landriani (1746–1815)

Moving the thermometer into the dark region beyond the red end of the spectrum, Herschel confirmed that the heating continued to increase. The maximum point, when he found it, lay well beyond the red end – in what is known today as the 'infrared wavelengths'.

When Herschel revealed his discovery, he referred to this new portion of the electromagnetic spectrum as the 'thermometrical spectrum'. The radiation itself he sometimes referred to as 'dark heat', or simply 'the invisible rays'.

Ironically, and contrary to popular opinion, it wasn't Herschel who originated the term 'infrared'. The word only began to appear in print around 75 years later, and it is still unclear who should receive credit as the originator.

Herschel's use of glass in the prism of his original experiment led to some early controversies with his contemporaries about the actual existence of the infrared wavelengths. Different investigators, in attempting to confirm his work, used various types of glass indiscriminately, having different transparencies in the infrared. Through his later experiments, Herschel was aware of the limited transparency of glass to the newly-discovered thermal radiation, and he was forced to conclude that optics for the infrared would probably be doomed to the use of reflective elements exclusively (i.e. plane and curved mirrors). Fortunately, this proved to be true only until 1830, when the Italian investigator, Melloni, made his great discovery that naturally occurring rock salt ($NaCl$) – which was available in large enough natural crystals to be made into lenses and prisms – is remarkably transparent to the infrared. The result was that rock salt became the principal infrared optical material, and remained so for the next hundred years, until the art of synthetic crystal growing was mastered in the 1930's.

Figure 17: Macedonio Melloni (1798–1854)

Thermometers, as radiation detectors, remained unchallenged until 1829, the year Nobili invented the thermocouple. (Herschel's own thermometer could be read to 0.2 °C (0.036 °F), and later models were able to be read to 0.05 °C (0.09 °F)). Then a breakthrough occurred; Melloni connected a number of thermocouples in series to form the first thermopile. The new device was at least 40 times as sensitive as the best thermometer of the day for detecting heat radiation – capable of detecting the heat from a person standing three meters away.

The first so-called 'heat-picture' became possible in 1840, the result of work by Sir John Herschel, son of the discoverer of the infrared and a famous astronomer in his own right. Based upon the differential evaporation of a thin film of oil when exposed to a heat pattern focused upon it, the thermal image could be seen by reflected light where the interference effects of the oil film made the image visible to the eye. Sir John also managed to obtain a primitive record of the thermal image on paper, which he called a 'thermograph'.

Figure 18: Samuel P. Langley (1834–1906)

The improvement of infrared-detector sensitivity progressed slowly. Another major breakthrough, made by Langley in 1880, was the invention of the bolometer. This consisted of a thin blackened strip of platinum connected in one arm of a Wheatstone bridge circuit upon which the infrared radiation was focused and to which a sensitive galvanometer responded. This instrument is said to have been able to detect the heat from a cow at a distance of 400 meters.

An English scientist, Sir James Dewar, first introduced the use of liquefied gases as cooling agents (such as liquid nitrogen with a temperature of -196 °C (-320.8 °F)) in low temperature research. In 1892 he invented a unique vacuum insulating container in which it is possible to store liquefied gases for entire days. The common 'thermos bottle', used for storing hot and cold drinks, is based upon his invention.

Between the years 1900 and 1920, the inventors of the world 'discovered' the infrared. Many patents were issued for devices to detect personnel, artillery, aircraft, ships – and even icebergs. The first operating systems, in the modern sense, began to be developed during the 1914–18 war, when both sides had research programs devoted to the military exploitation of the infrared. These programs included experimental systems for enemy intrusion/detection, remote temperature sensing, secure communications, and 'flying torpedo' guidance. An infrared search system tested during this period was able to detect an approaching airplane at a distance of 1.5 km (0.94 miles), or a person more than 300 meters (984 ft.) away.

The most sensitive systems up to this time were all based upon variations of the bolometer idea, but the period between the two wars saw the development of two revolutionary new infrared detectors: the image converter and the photon detector. At first, the image converter received the greatest attention by the military, because it enabled an observer for the first time in history to literally 'see in the dark'. However, the sensitivity of the image converter was limited to the near infrared wavelengths, and the most interesting military targets (i.e. enemy soldiers) had to be illuminated by infrared search beams. Since this involved the risk of giving away the observer's position to a similarly-equipped enemy observer, it is understandable that military interest in the image converter eventually faded.

The tactical military disadvantages of so-called 'active’ (i.e. search beam-equipped) thermal imaging systems provided impetus following the 1939–45 war for extensive secret military infrared-research programs into the possibilities of developing ‘passive’ (no search beam) systems around the extremely sensitive photon detector. During this period, military secrecy regulations completely prevented disclosure of the status of infrared-imaging technology. This secrecy only began to be lifted in the middle of the 1950’s, and from that time adequate thermal-imaging devices finally began to be available to civilian science and industry.