User's manual
FLIR GF77a

Important note
Before operating the device, you must read, understand, and follow all instructions, warnings, cautions, and legal disclaimers.

Důležitá poznámka
Před použitím zařízení si přečtěte veškeré pokyny, upozornění, varování a vyvázání se ze záruky, ujistěte se, že jim rozumíte, a řiďte se jimi.

Vigtig meddelelse
Før du betjener enheden, skal du du læse, forstå og følge alle anvisninger, advarsler, sikkerhedsforanstaltninger og ansvarsfraskrivelser.

Wichtiger Hinweis
Bevor Sie das Gerät in Betrieb nehmen, lesen, verstehen und befolgen Sie unbedingt alle Anweisungen, Warnungen, Vorsichtshinweise und Haftungsausschlüsse

Σημαντική σημείωση
Πριν από τη λειτουργία της συσκευής, πρέπει να διαβάσετε, να κατανοήσετε και να ακολουθήσετε όλες τις οδηγίες, προειδοποιήσεις, προφυλάξεις και νομικές αποποιήσεις.

Nota importante
Antes de usar el dispositivo, debe leer, comprender y seguir toda la información sobre instrucciones, advertencias, precauciones y renuncias de responsabilidad.

Tärkeä huomautus
Ennen laitteen käyttämistä on luettava ja ymmärrettävä kaikki ohjeet, vakavat varoitukset, varoitukset ja lakitiedotteet sekä noudatettava niitä.

Remarque importante
Avant d'utiliser l'appareil, vous devez lire, comprendre et suivre l'ensemble des instructions, avertissements, mises en garde et clauses légales de non-responsabilité.

Fontos megjegyzés
Az eszköz használata előtt figyelmesen olvassa el és tartsa be az összes utasítást, figyelmeztetést, óvintézkedést és jogi nyilatkozatot.

Nota importante
Prima di utilizzare il dispositivo, è importante leggere, capire e seguire tutte le istruzioni, avvertenze, precauzioni ed esclusioni di responsabilità legali.

重要な注意
デバイスをご使用になる前に、あらゆる指示、警告、注意事項、および免責条項をお読み頂き、その内容を理解して従ってください。

중요한 참고 사항
장치를 작동하기 전에 반드시 다음의 사용 설명서와 경고, 주의사항, 법적 책임제한을 읽고 이해하며 따라야 합니다.

Viktig
Før du bruker enheten, må du lese, forstå og følge instruksjoner, advarsler og informasjon om ansvarsfraskrivelse.

Belangrijke opmerking
Zorg ervoor dat u, voordat u het apparaat gaat gebruiken, alle instructies, waarschuwingen en juridische informatie hebt doorgelezen en begrepen, en dat u deze opvolgt en in acht neemt.

Ważna uwaga
Przed rozpoczęciem korzystania z urządzenia należy koniecznie zapoznać się z wszystkimi instrukcjami, ostrzeżeniami, przestrogami i uwagami prawnymi. Należy zawsze postępować zgodnie z zaleceniami tam zawartymi.

Nota importante
Antes de utilizar o dispositivo, deverá proceder à leitura e compreensão de todos os avisos, precauções, instruções e isenções de responsabilidade legal e assegurar-se do seu cumprimento.

Важное примечание
До того, как пользоваться устройством, вам необходимо прочитать и понять все предупреждения, предостережения и юридические ограничения ответственности и следовать им.

Viktig information
Innan du använder enheten måste du läsa, förstå och följa alla anvisningar, varningar, försiktighetsåtgärder och ansvarsfriskrivningar.

Önemli not
Cihazı çalıştırmadan önce tüm talimatları, uyarıları, ikazları ve yasal açıklamaları okumalı, anlamalı ve bunlara uymalısınız.

重要注意事项
在操作设备之前，您必须阅读、理解并遵循所有说明、警告、注意事项和法律免责声明。

重要注意事項
操作裝置之前，您務必閱讀、了解並遵循所有說明、警告、注意事項與法律免責聲明。

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1 Disclaimers

1.1 Legal disclaimer

For warranty terms, refer to https://www.flir.com/warranty.

1.2 U.S. Government Regulations

This product may be subject to U.S. Export Regulations. Send any inquiries to export-questions@flir.com.

1.3 Patents

This product is protected by patents, design patents, patents pending, or design patents pending. Refer to the FLIR Systems' patent registry:

https://www.flir.com/patentnotices

1.4 Quality assurance

The Quality Management System under which these products are developed and manufactured has been certified in accordance with the ISO 9001 standard.

FLIR Systems is committed to a policy of continuous development; therefore we reserve the right to make changes and improvements on any of the products without prior notice.

1.5 Third-party licenses

Information about third-party licenses is available in the user interface of the product.

1.6 Usage statistics

FLIR Systems reserves the right to gather anonymous usage statistics to help maintain and improve the quality of our software and services.

1.7 Copyright

© 2021 FLIR Systems, Inc. All rights reserved worldwide. No parts of the software including source code may be reproduced, transmitted, transcribed or translated into any language or computer language in any form or by any means, electronic, magnetic, optical, manual or otherwise, without the prior written permission of FLIR Systems.

The documentation must not, in whole or part, be copied, photocopied, reproduced, translated or transmitted to any electronic medium or machine readable form without prior consent, in writing, from FLIR Systems.

Names and marks appearing on the products herein are either registered trademarks or trademarks of FLIR Systems and/or its subsidiaries. All other trademarks, trade names or company names referenced herein are used for identification only and are the property of their respective owners.

2 Safety information

WARNING

Applicability: Class B digital devices.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

WARNING

Applicability: Digital devices subject to 15.19/RSS-GEN.

NOTICE: This device complies with Part 15 of the FCC Rules and with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

1. this device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

WARNING

Applicability: Digital devices subject to 15.21.

NOTICE: Changes or modifications made to this equipment not expressly approved by FLIR Systems may void the FCC authorization to operate this equipment.

WARNING

Applicability: Digital devices subject to 2.1091/2.1093/KDB 447498/RSS-102.

Radiofrequency radiation exposure Information: The radiated output power of the device is far below the FCC radio frequency exposure limits. Nevertheless, the device should be used in such a manner that the potential for human contact during normal operation is minimized.

WARNING

Make sure that you read all applicable MSDS (Material Safety Data Sheets) and warning labels on containers before you use a liquid. The liquids can be dangerous. Injury to persons can occur.

WARNING

Do not use screws that are too long. The depth of the holes in the camera is 4.0 mm (0.16 in) and 5.5 mm (0.22 in), see 13 *Mechanical drawings*, page 29. Damage to the camera will occur if you use screws that are too long.

CAUTION

Do not point the infrared camera (with or without the lens cover) at strong energy sources, for example, devices that cause laser radiation, or the sun. This can have an unwanted effect on the accuracy of the camera. It can also cause damage to the detector in the camera.

CAUTION

Do not use the camera in ambient temperatures higher than +40°C (+122°F), unless other information is specified in the user documentation or technical data. High temperatures can cause damage to the camera.

CAUTION

The surface of the camera becomes hot. Use protective equipment when handling the camera in ambient temperatures higher than +40°C (+122°F).

CAUTION

Do not apply solvents or equivalent liquids to the camera, the cables, or other items. For cleaning, refer to 16 *Cleaning the camera*.

CAUTION

Do not use too much force when you clean the infrared lens. Damage to the infrared lens or to the anti-reflective coating of the lens can occur. For cleaning, refer to 16 *Cleaning the camera*.

CAUTION

Applicability: Cameras where you can remove the lens and expose the infrared detector.

Do not use compressed air of lower quality than “Process air” when you remove dust from the detector. Air of lower quality than “Process air” can contain high levels of contaminants. Damage to the detector can occur.

CAUTION

Applicability: Cameras with an automatic shutter that can be disabled.

Do not disable the automatic shutter in the camera for a long time period (a maximum of 30 minutes is typical). This can have an unwanted effect on the accuracy of the camera.

CAUTION

Do not look into the camera torch LED when you operate it. Injury to your eyes and skin can occur.

Note The encapsulation rating is only applicable when all the openings on the camera are sealed with their correct covers, hatches, or caps. This includes the compartments for data storage, batteries, and connectors.

3 Notice to customer

3.1 Calibration

Gas detection: no re-calibration recommendation. The ability to detect gases is not influenced by the calibration and will not degrade over time.

Temperature measurement: annual re-calibration recommended. Contact your local sales office for instructions on where to send the camera.

3.2 Accuracy

For very accurate results, we recommend that you wait 5 minutes after you have started the camera before measuring a temperature.

3.3 Disposal of electronic waste

Electrical and electronic equipment (EEE) contains materials, components and substances that may be hazardous and present a risk to human health and the environment when waste electrical and electronic equipment (WEEE) is not handled correctly.

Equipment marked with the below crossed-out wheeled bin is electrical and electronic equipment. The crossed-out wheeled bin symbol indicates that waste electrical and electronic equipment should not be discarded together with unseparated household waste, but must be collected separately.

For this purpose all local authorities have established collection schemes under which residents can dispose waste electrical and electronic equipment at a recycling centre or other collection points, or WEEE will be collected directly from households. More detailed information is available from the technical administration of the relevant local authority.

3.4 Training

To read about infrared training, visit:

- http://www.infraredtraining.com
- http://www.irtraining.com
- http://www.irtraining.eu

3.5 Documentation updates

Our manuals are updated several times per year, and we also issue product-critical notifications of changes on a regular basis.

To access the latest manuals, translations of manuals, and notifications, go to the Download tab at:

http://support.flir.com

In the download area you will also find the latest releases of manuals for our other products, as well as manuals for our historical and obsolete products.

3.6 Important note about this manual

FLIR Systems issues generic manuals that cover several cameras within a model line.

This means that this manual may contain descriptions and explanations that do not apply to your particular camera model.

3.7 Note about authoritative versions

The authoritative version of this publication is English. In the event of divergences due to translation errors, the English text has precedence. Any late changes are first implemented in English.

4 Customer help

4.1 General

Do not hesitate to contact our Customer Support Center if you experience problems or have any questions.

For customer help, go to http://support.flir.com.

4.2 Submitting a question

To submit a question to the customer help team, you must be a registered user. It only takes a few minutes to register online. If you only want to search the knowledgebase for existing questions and answers, you do not need to be a registered user.

When you want to submit a question, make sure that you have the following information to hand:

- The camera model.
- The camera serial number.
- The communication protocol, or method, between the camera and your device (e.g., SD card reader, HDMI, Ethernet, USB, or FireWire).
- Device type (PC/Mac/iPhone/iPad/Android device, etc.).
- Version of any programs from FLIR Systems.
- Full name, publication number, and revision number of the manual.

4.3 Downloads

On the customer help site you can also download the following, when applicable for the product:

- Firmware updates for your infrared camera.
- Program updates for your PC/Mac software.
- Freeware and evaluation versions of PC/Mac software.
- User documentation for current, obsolete, and historical products.
- Mechanical drawings (in *.dxf and *.pdf format).
- CAD data models (in *.stp format).
- Application examples.
- Technical datasheets.

5 Introduction

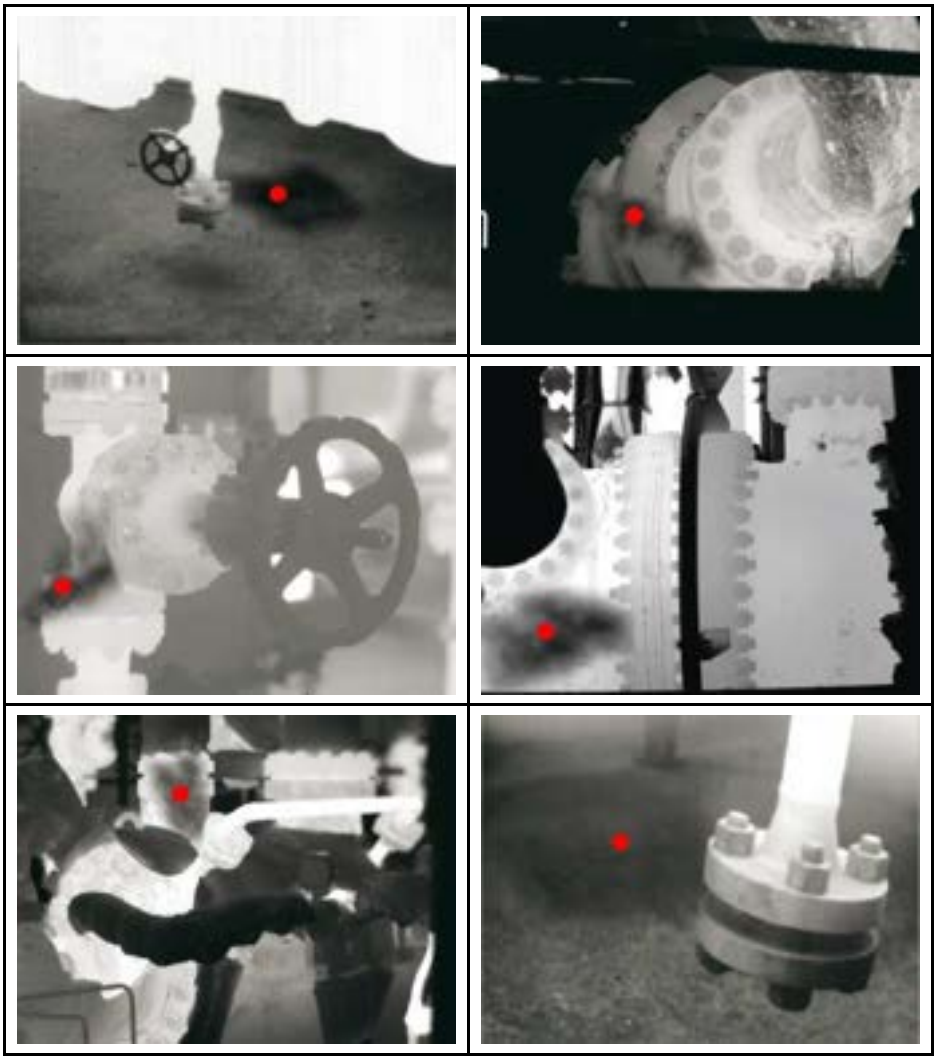
5.1 Optical gas imaging of methane

The FLIR GF77a is an infrared camera for optical gas imaging (OGI) that allows oil and gas operators and other industrial markets a solution for continuous and autonomous leak detection. The FLIR GF77a is used in industrial settings such as natural gas processing plants, biogas and power generation plants and helps to protect the environment by tracing leaks of methane.

5.2 Gas leak example images

This section contains gas leak example images from various applications.

Note Gas leaks are easier to see in live mode, which is the reason the leaks are indicated with a red dot in the images below.



6 Camera parts

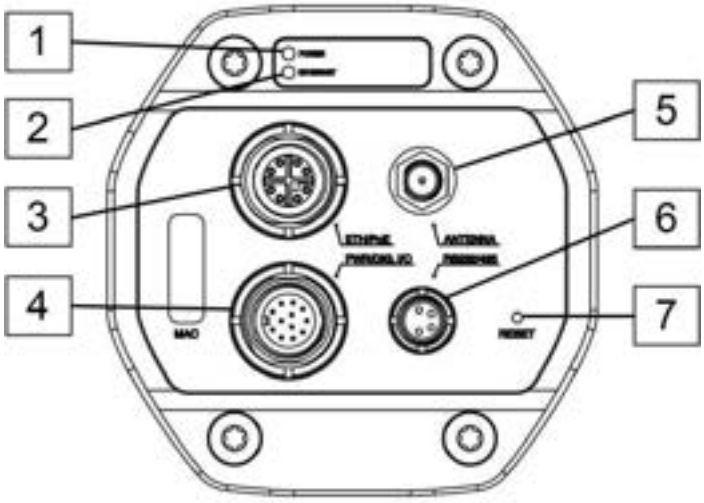


Figure 6.1 View from the rear

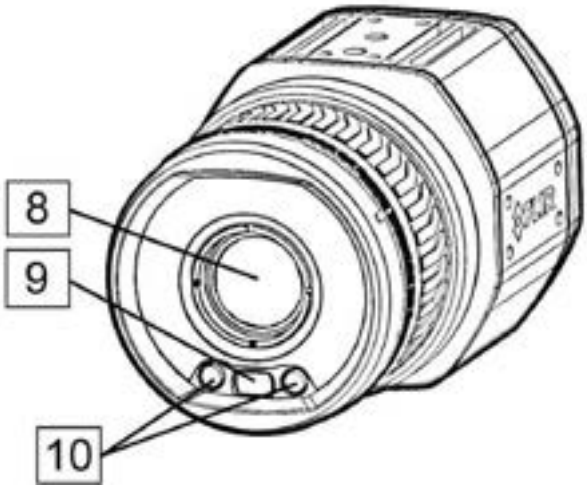


Figure 6.2 View from the front

1. Power/error indicator LED (blue/red).
   For details, see section 15 *Indicator LEDs and factory reset button*, page 34.
2. Ethernet communication indicator LED (green).
3. Ethernet/PoE connector, X-coded.
4. Power-I/O connector, A-coded.
5. Antenna.
6. RS232/485 connector, A-coded.
7. Factory reset button.
8. Infrared sensor.
9. Visual camera.
10. LED lamps.

7 Camera installation

Prior to installing the camera, the recommendation is to set it up on an existing network with a DHCP server, and then use the FLIR IP Config software to detect the camera on that network. The FLIR IP Config scans for cameras automatically and you can identify your camera by the MAC address printed on a label on the back of the camera. The camera is then configured from a web browser.

Note Use the latest version of FLIR IP Config.

You can power the camera by using either the Power-I/O connector (18–56 V DC) or the Ethernet/Power over Ethernet (PoE) connector (36–56 V DC) of the camera. See Figure 6.1 *View from the rear*, page 8 and 11 *Pin configurations*, page 25.

To install the camera, follow this procedure:

1. On the computer to be used for managing the camera, download FLIR IP Config from http://support.flir.com, and then install it.
2. Connect the camera to power and network. Do one of the following;
   a. Connect the power cable between the camera and a power source. Connect the network cable between the camera, and then either directly to the computer or to an Ethernet switch on the same network as the computer,
   b. Connect the PoE cable to the camera, and then to a PoE switch on the same network as the computer.
3. The camera is set to use DHCP. On the computer, use FLIR IP Config to identify the camera on the network and change IP settings, if necessary.
4. On the computer, do one of the following:
   a. Double-click on the camera in FLIR IP Config.
   b. Type the IP address of your camera into the address bar of a web browser.

   This displays the login view.
5. Log in using the provided username and password. This displays the web interface of the camera.
6. Use the web interface to configure the camera.

8 Mechanical installation

The camera unit has been designed to allow it to be mounted in any position. It has mounting interfaces on all sides, but not on front or back. For details, see 13 *Mechanical drawings*, page 29.

⚠ **WARNING**
Do not use screws that are too long. Damage to the camera will occur if you use screws that are too long.

The camera generates a considerable amount of heat during operation. This is normal. In order to transfer this heat, it is recommended that the camera is mounted on a bracket or heat sink made of a material with a high capacity to transfer heat, e.g., aluminum. The use of a cooling bracket or a heat sink is also strongly recommended in order to minimize the temperature drift of the infrared detector in the camera.

For further information regarding mounting recommendations, contact FLIR Systems.

9 RTSP Streams

It is possible to establish streaming sessions with the FLIR GF77a camera.

The following URLs can be used:

- rtsp://<IP>/avc/
- rtsp://<IP>/mpeg4/
- rtsp://<IP>/mjpg/
- rtsp://<IP>/avc/ch1
- rtsp://<IP>/mpeg4/ch1
- rtsp://<IP>/mjpg/ch1

The section after IP address refers to the encoding:

- /avc = H264 encoding
- /mpeg4 = MPEG4 encoding
- /mjpg = Motion JPEG encoding

The section after the encoding refers to the source, which can be either / or /ch1:

- **/** will start a streaming session giving you the identical video as seen in the web interface. This can be IR, visual, MSX, or FSX, and the feed is 640 x 480 pixels.
  Add the &overlay=off argument in the URL to receive a feed without overlay.
- **/ch1** will start a streaming session giving you the uncropped visual image at 1280 x 960 pixels.

A radiometric 16-bit stream is also available for software supporting it.

10 Camera web interface

10.1 Supported browsers

The camera web interface supports the following browsers and versions:

- Google Chrome 77 and higher,
- Microsoft Edge 17 and higher,
- Mozilla Firefox 69 and higher.

Note Microsoft Internet Explorer is not supported.

10.2 Login

Log in to the camera web interface by using the IP address of your camera.

Follow this procedure:

1. Do one of the following:
   a. Identify your camera by the MAC address (printed on the back of the camera) in FLIR IP Config, and then double-click it.
   b. Type the IP address of your camera into the address bar of a web browser.

   This displays the login view.
2. When logging in for the first time, log in with the username *admin* and the default administrator password provided by FLIR (available on the camera calibration certificate).

Note

- The users *viewer* and *user* are disabled by default, but can be enabled by an *admin* user.
- It is possible for several users of the type *viewer* and *user* to log in to the camera at the same time. Any changes to the settings and adjustments to an image made by one *user* will be seen by the other logged in users.
- If you are logged in as an *admin* user, you will be logged out if another *admin* logs in.

10.3 Navigation

This image shows what the camera web interface looks like when you have logged in.

Note Depending on the size of the camera web interface window, the layout may be different.

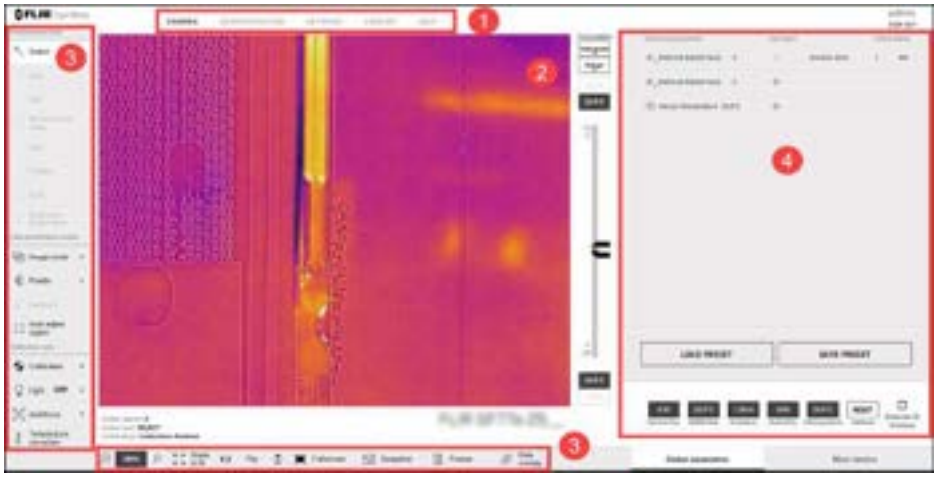


Figure 10.1 Camera web user interface

1. Tabs
   Available tabs depend on user type;
   - An *admin* sees the *Camera*, *Administration*, *Settings*, and *Library* tabs.
   - A *user* sees the *Camera*, *Settings*, and *Library* tabs.
   - A *viewer* sees the *Camera* tab.
2. Live image
   This is where the live image is presented of what the camera is currently targeting.
3. Toolbar
   The toolbar options are grouped into the following categories;
   - *Measurement tools*
   - *Data presentation modes*
   - *Calibration tools*
   - *View modes*
4. Active measurements
   Digital input configuration and Camera internal temperature monitoring.

10.4 *Camera* tab

The *Camera* tab is the default tab after logging in. Here it is possible to view the video stream from the camera, set alarms, take snapshots, calibrate the camera, manage image settings, etc.

10.4.1 Working with alarms

You can make the camera trigger an alarm when certain conditions are met. An alarm can be triggered by different sources, such as a digital input or an internal temperature sensor.

When an alarm is triggered, the camera can perform one or more tasks, e.g. save an image or video sequence to camera memory, or send the image/video by e-mail to predefined recipients or to an FTP site. The camera can also further trigger a variety of external devices, using the digital output.

All active alarms are listed in the *Active alarms* section and any triggered alarms are indicated in red.

10.4.1.1 Setting an alarm based on the digital input

To configure an alarm based on the digital input, follow this procedure:

1. In the *Active Measurements* section, click the plus sign under *Add alarm* next to the digital input result to be used for the alarm. The *Alarm* dialog box appears.
2. In the *Alarm label* section, type an *Alarm name*.
3. In the *Trigger* section and in the *Value* list; select “0” to trigger the alarm on a low signal or select “1” to trigger on a high signal.

4. In the *Action* section, select which actions the camera will perform when an alarm is triggered:

Digital OUT	Outputs a digital pulse. Also, type a pulse length (in milliseconds) in the *Pulse time* box.
E-mail	Automatically sends the captured *Image*, *Result*, or *Video* to the recipients defined in *Settings* > *Alarm recipients*.
Send to FTP	Automatically sends the captured *Image* or *Video* to the FTP site defined in *Settings* > *Alarm recipients*.
Save to camera	Automatically saves the captured *Image* or *Video* to the memory of the camera.
During alarm	Temporarily disables the periodic calibration while the image/video is being captured.

   The image/video can later be viewed and managed under the *Library* tab:

   - the captured image frame that triggered the alarm,
   - the 5 second video sequence when the alarm was triggered.

5. When completed, click *Set alarm*. The alarm is now listed under *Active alarms*.

10.4.1.2 Setting an alarm based on sensor temperature

The internal temperature sensor can act as a thermometer for the ambient temperature. To configure an alarm based on the internal temperature sensor, follow this procedure:

1. In the *Active Measurements* section, click the plus sign under *Add alarm* next to the *Sensor temperature*. The *Alarm* dialog box appears.
2. In the *Alarm label* section, type an *Alarm name*.
3. In the *Trigger* section, select the *Condition* and temperatures that will trigger this alarm:

Below	Triggers an alarm when the temperature is below the specified *Threshold* value. Also type a *Hysteresis* value.
Above	Triggers an alarm when the temperature is above the specified *Threshold* value. Also type a *Hysteresis* value.
Interval	Triggers an alarm when the temperature is within the specified *Min value* and *Max value*.

   Hysteresis is the interval within which the temperature value is allowed to vary without causing a change in the trigger. If the threshold is set above 30.0°C and the hysteresis is set at 2.0°C, the trigger goes high when the temperature rises above 30.0°C and stays high until the temperature drops below 28.0°C. In contrast, if the threshold is set below 30.0°C, and the same hysteresis value is kept, the trigger goes high if the temperature drops below 30.0°C and stays high until the temperature rises above 32.0°C.
4. In the *Threshold time* box, type the amount of time that has to pass before an alarm is triggered. This can be used to avoid false alarms.

5. In the *Action* section, select which actions the camera will perform when an alarm is triggered:

Digital OUT	Outputs a digital pulse. Also, type a pulse length (in milliseconds) in the *Pulse time* box.
E-mail	Automatically sends the captured *Image*, *Result*, or *Video* to the recipients defined in *Settings* > *Alarm recipients*.
Send to FTP	Automatically sends the captured *Image* or *Video* to the FTP site defined in *Settings* > *Alarm recipients*.
Save to camera	Automatically saves the captured *Image* or *Video* to the memory of the camera.
During alarm	Temporarily disables the periodic calibration while the image/video is being captured.

   The image/video can later be viewed and managed under the *Library* tab:

   - the captured image frame that triggered the alarm,
   - the 5 second video sequence when the alarm was triggered.

6. When completed, click *Set alarm*. The alarm is now listed under *Active alarms*.

10.4.2 Changing object parameters

For accurate measurements, the camera must be provided with certain object parameters:

- *Emissivity*
  How much radiation an object emits, compared with the radiation of a theoretical reference object at the same temperature (called a “blackbody”). The opposite of emissivity is reflectivity. The emissivity determines how much of the radiation originates from the object as opposed to being reflected by it.
- *Reflected temperature*
  This is used when compensating for the radiation from the surroundings reflected by the object into the camera. This property of the object is called reflectivity.
- *Distance*
  The distance between the camera and the object of interest.
- *Relative humidity*
  The relative humidity of the air between the camera and the object of interest.
- *Atmospheric temperature*
  The temperature of the air between the camera and the object of interest.
- *External IR window*
  Used if any protective windows etc. are set up between the camera and the object of interest. When the setting is on, the following parameters can be set:
  - *Transmission*: How much of the thermal radiation passes through the window.
  - *Temperature*: The temperature of the window.

You can set the object parameters globally.

Note Of the object parameters, *Emissivity* and *Reflected temperature* are the two most important to set correctly in the camera.

10.4.2.1 Global parameters

The global parameters are shown in the bottom right corner of the screen, below the *Active measurements* section.

To change the global parameters, follow this procedure:

1. In the bottom right corner of the screen, click to select the parameter to change.

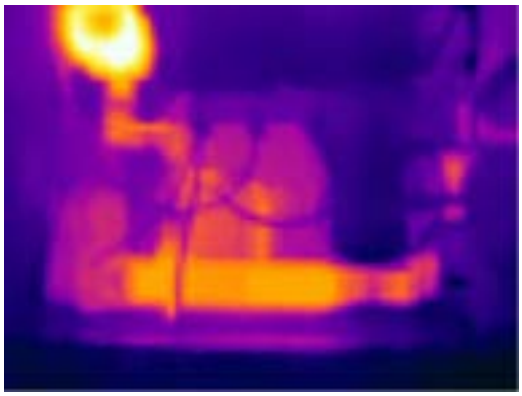
2. Change the parameter to the desired value, and then press Enter or click anywhere on the screen.
3. To reset the global parameters to the default values provided by FLIR, click *Reset*.

10.4.3 Working with image modes

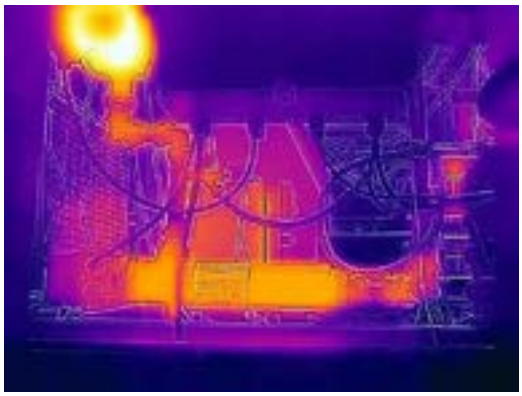
The camera captures both thermal and visual images at the same time. By your choice of image mode, you select which type of image to display on the screen.

The camera supports the following image modes:

- *Thermal*: The camera displays a fully thermal image.



- *MSX* (Multi Spectral Dynamic Imaging): The camera displays the thermal image where details from the visual image have been added.



- *Visual*: The camera displays the visual image captured by the visual camera.

To select the image mode, follow this procedure:

1. On the toolbar and in the *Data presentation modes* section, click *Image mode*.

2. Select one of the available image modes.

10.4.4 Colorizing the image

10.4.4.1 Palette

You can change the palette that the software uses to display the different temperatures within an image. A different palette can make it easier to analyze the image. The most suitable palette for a certain application depends on many different factors, such as the target temperature and emissivity, the ambient temperature, and the distance to the target. You will need to test different palettes in order to find the one that best suits your application.

To change the palette, follow this procedure:

1. On the toolbar and in the *Data presentation modes*, click *Palette*.
2. Select one of the available palettes.

10.4.5 Auto-adjust region

By using the *Auto-adjust region* feature it is possible to select an area of the image, and then have the colorization of the image adjusted based on the temperatures within that selected area.

To configure an auto-adjust region, follow this procedure:

1. On the toolbar and in the *Data presentation modes* section, click *Auto-adjust region*.
2. In the image, click and then draw a region of a desired size.
3. To move the region, click and hold the region label in the image, and then move it into position.
4. To resize the region, click and hold one of the corners of the region in the image, and then move it to the desired size and shape.
5. To remove the region, click *X* in the region label.

10.4.6 Calibrating the camera

The calibration of the camera is performed as a non-uniformity correction (NUC). A NUC is *an image correction carried out by the camera software to compensate for different sensitivities of detector elements and other optical and geometrical disturbances*[1].

Calibration is needed whenever the output image becomes spatially noisy. This may, for example, happen when the ambient temperature changes. The calibration can be carried out automatically with different selectable intervals. It is also possible to perform a calibration manually.

10.4.6.1 Automatic calibration

To set the automatic calibration, follow this procedure:

1. On the toolbar and in the *Calibration tools* section, click *Calibration*. This displays a list of calibration options.

1. Definition from the impending international adoption of DIN 54190-3 (Non-destructive testing—Thermographic testing—Part 3: Terms and definitions).

2. Click one of the options:

Option	Calibration is automatically carried out:
Auto	when needed.
Every 10 min	approximately every 10 minutes.
Every 30 min	approximately every 30 minutes.
Every 60 min	approximately every 60 minutes.
Every [type your value]	at any set interval.
OFF	never (automatic calibration disabled).

3. While the automatic calibration is in progress, the *Notification* text *Calibration in progress ...* is temporarily displayed under the live image.

10.4.6.2 Manual calibration

To perform a manual calibration, follow this procedure:

1. On the toolbar and in the *Calibration tools* section, click *Calibration*. This displays a list of calibration options.
2. Click *Calibrate now*.
3. While the manual calibration is in progress, the *Notification* text *Calibration in progress ...* is temporarily displayed under the image on the screen

10.4.7 Using the camera lamp

The camera is equipped with a lamp. To turn the lamp on or off, follow this procedure:

1. On the toolbar and in the *Calibration tools* section, click *Light*.
2. Click *ON* or *OFF*.

10.4.8 Changing the temperature range

For accurate measurements, it is recommended to use the temperature range closest to the temperature of the object being monitored. For example, if the hottest object in the scene is 87°C, the temperature range “-20°C to 120°C” should be used.

The temperature range is visible to the right of the live image. Click *Range* and select a suitable range from the list.

The temperature range can also be changed over GenICam.

10.4.9 Adjusting the temperature scale

The camera continuously auto-adjusts the image for the best image brightness and contrast. In some situations, manual adjustments can make it easier to analyze details in the image. For example, by manually changing the maximum and/or minimum temperature levels to levels near a certain object in the image, you can study temperature variations in the object.

The temperature scale is visible to the right of the live image. When a temperature level is manually adjusted, the *Auto* button is displayed next to the temperature scale box.

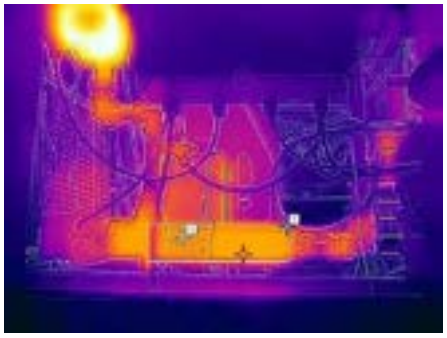
To manually adjust the image, follow this procedure:

1. To change the **maximum** temperature level, type the temperature in the upper temperature scale box. As an alternative, click and hold the upper temperature bar on the scale, and then move it into position. Watch the temperature in the scale box change as you move the bar.
2. To change the **minimum** temperature level, type the temperature in the lower temperature scale box.As an alternative, click and hold the lower temperature bar on the scale, and then move it into position. Watch the temperature in the scale box change as you move the bar.
3. To return to auto-adjustment, click the *Auto* button(s).

10.4.10 Flipping the image

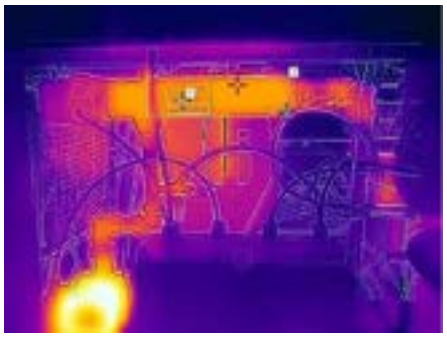
The image can be flipped horizontally or vertically.

Normal

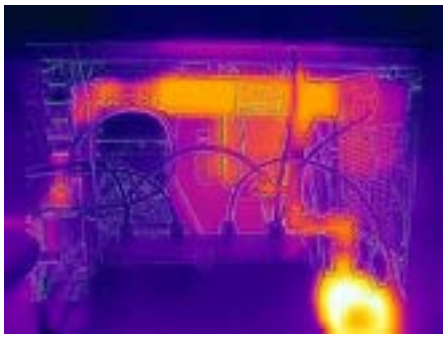


Horizontal flip

Vertical flip



Horizontal + vertical flip



To change the flip setting, follow this procedure:

1. On the toolbar and in the *View modes* section, click to flip the image horizontally or click to flip the image vertically.

10.4.11 Full screen view

To view the image in full screen, follow this procedure:

1. On the toolbar and in the *View modes* section, click *Full screen*.
2. To return to normal view, press the Esc (Escape) key on the computer keyboard.

10.4.12 Saving a snapshot

It is possible to take a snapshot and save the image. The image can later be viewed and managed on the *Library* tab. Up to 100 images can be saved.

To take a snapshot, follow this procedure:

1. On the toolbar and in the *View modes* section, click *Snapshot*.
2. The *Notification* text *Snapshot stored* is temporarily displayed under the live image.

10.4.13 Pausing the live image stream

To pause or freeze the live image stream, follow this procedure:

1. On the toolbar and in the *View modes* section, click *Freeze*.
2. To resume the live image stream, click *Unfreeze*.

10.4.14 Hiding the overlay graphics

To hide all overlay graphics in the live image, follow this procedure:

1. On the toolbar and in the *View modes* section, click *Hide overlay*.

2. To show any hidden overlay graphics, click *Show overlay*.

10.4.15 Camera presets

It is possible to save the current camera setup. The zipped file with the presets is saved to disk in your Downloads folder. It can later on be uploaded and applied.

10.4.15.1 Saving a preset

To save the current camera setup, follow this procedure:

1. In the *Active measurements* section, click *Save preset*.

10.4.15.2 Loading a preset

To load a saved preset file, follow this procedure:

1. In the *Active measurements* section, click *Load preset*. The standard Windows Open dialog box appears.
2. Browse to the Downloads folder (or to the folder where you have stored the preset files).
3. Select the file, and then click *Open*. This loads and applies the presets.

10.5 Administration tab

Note The *Administration* tab is only available for the *admin* role.

Under the *Administration* tab you can manage:

- Firewall
- SSL certificates
- Services
- Web protocols
- User management
- Regional settings
- Network settings
- System and firmware

10.5.1 Firewall

Use the settings on the *Firewall* page to configure how the functions and services of the camera are allowed to be accessed.

Note The services also need to be enabled which is done on the *Services* page.

10.5.2 SSL certificates

A network client program that is setup to communicate with or control the camera remotely must be approved first, which is done on the *SSL certificates* page. The client uploads a certificate which is then shown in the *Certificates* list, and then the camera administrator can approve the client. Approved clients can be revoked later on.

Temporarily enable the *Auto approve* functionality while setting up the network clients. However, it is recommended to disable *Auto approve* when all setup is completed.

10.5.3 Services

Use the *Services* page to enable and disable the services of the camera.

Note The services also need to be allowed to be accessed which is done on the *Firewall* page.

10.5.4 Web protocols

Use the *Web protocols* page to configure which web protocol to use when accessing the camera; *http* or *https*.

10.5.5 User management

Use the *User management* page to enable and disable user roles, and to change passwords.

Note The *viewer* and *user* roles are disabled by default.

10.5.6 Regional settings

Use the *Regional settings* page to set *Date and time*.

Date and time can be set in four ways:

1. Get date and time from an *SNTP Server* (Simple Network Time Protocol):
   Select the *Enable* check box, and then type the IP address of the SNTP Server in the *Server address* box.
2. Set date and time manually:
   Select the correct *Time zone* in the list, and then type date and time information in the *Year*, *Month*, *Day*, *Hour*, *Minute*, and *Second* boxes.
3. Get date and time from your internet browser:
   Click *Read from browser*.
4. Get date and time from your camera:
   Click *Read from camera*.

10.5.7 Network settings

Use the *Network settings* page to manage the network setup and to select the streaming bit rate.

Note When altering the network settings, the address of the camera might change. Make sure your settings are correct before saving them or the camera might not be reachable afterwards. If this occurs, you can use FLIR IP Config to locate the camera again or reset the camera to its default settings.

10.5.7.1 Ethernet setup

Follow this procedure:

1. In the navigation pane, click *Network settings*.
2. Select one of the following:
   - To automatically obtain an IP address for the camera, click *Obtain IP address automatically (DHCP)*.
   - To manually set an IP address for the camera, click *Manual configuration*, and then type valid network information in the *IP*, *Subnet mask*, and *Gateway* boxes.
3. Click *Apply*.

10.5.7.2 Wireless

The *Wireless* connection can be set to *Off*, *Server mode*, or *Client mode*.

In *Server mode*, you configure the camera itself to act as a wireless server allowing other devices to connect, such as mobile phones or tablets. This is useful in situations where no other network exists. In *Client mode* you connect the camera to an existing network.

To let the camera act as a wireless server, follow this procedure:

1. In the navigation pane, click *Network settings*.
2. Click *Server mode*.
3. Type a *Network name* and a *Password* for accessing the network.
4. Click *Share network*.
   The camera will now act as a “hotspot” that computers or tablets (with high resolution) can connect to. When a wireless connection has been established, the camera will be available at the IP address 192.168.16.1.

To connect the camera to an existing network, follow this procedure:

1. In the navigation pane, click *Network settings*.
2. Click *Client mode*.
3. Click *Scan networks*.
4. Select one of the *Available networks* in the list, and then click *Connect*.
5. Type the *Password* for accessing the network, and then click *Connect*.

10.5.7.3 Streaming bit rate

Follow this procedure:

1. In the navigation pane, click *Network settings*.
2. In the *Streaming bit rate* list, select one of the available bit rates.
3. Click *Apply*.

10.5.8 System and firmware

The *System and firmware* page displays *System version*, *Software details*, and *Hardware details* of the camera. In the *System* section, you can restart the camera, reset the camera to factory settings, or upgrade the camera firmware.

10.5.8.1 Restart camera

Follow this procedure:

1. In the navigation pane, click *System and firmware*.
2. In the *System* section, click *Restart camera*. This displays a dialog box.
3. In the dialog box, click *OK*. The camera will restart.

10.5.8.2 Reset camera to factory settings

A factory reset will affect all camera settings, including regional settings. Saved images will not be affected.

Follow this procedure:

1. In the navigation pane, click *System and firmware*.
2. In the *System* section, click *Reset to factory settings*. This displays a dialog box.
3. In the dialog box, click *OK*. The camera will restart.

10.5.8.3 Upgrade camera firmware

Follow this procedure:

1. In the navigation pane, click *System and firmware*.
2. In the *System* section, click *Upgrade firmware*. This displays a dialog box.
3. Click *Select file*. The standard Windows Open dialog box appears.
4. Browse to the location of the firmware file, select the file, and then click *Open*.
5. Click *Upgrade firmware*.
6. When the upgrade is completed, restart the camera.

10.6 Settings tab

Note The *Settings* tab is only available for the *admin* and *user* roles.

Under the *Settings* tab you can manage:

- General settings
- Alarm recipients
- Scheduler

10.6.1 General settings

The *General settings* page displays *Product* information, *Camera ID*, *IP6x settings*, and the possibility to *Test Digital Input/Output* functionality.

10.6.1.1 Camera ID

Type the preferred camera ID in the *Device label* box. Select the *Display in status bar* check box to show the camera ID on the active tab of the web browser and in the upper part of saved images.

10.6.1.2 IP6x settings

Use the *IP6x settings* if your camera is IP66 rated. This can be the case when the camera is delivered in an environmental housing or a pan & tilt, or if an IP hood has been attached to the camera.

- *Enable IP6x*
  When this setting is enabled, the two LED lamps at the front of the camera are disabled.
- *Disable manual focus ring*
  When this setting is enabled, it is impossible to use the manual focus ring of the camera. This is to prevent focus from changing due to, e.g., shock or vibrations.
- *External compensation*
  When this setting is enabled, compensation for the extra window (of the environmental housing, pan & tilt, or IP hood) in front of the infrared lens will be made. If needed, also change the *External temperature*.

10.6.1.3 Test Digital Input/Output

Use the test buttons to the test the electrical interfaces of the camera and the communication with them. These tests are useful when you set up the interfaces.

Click *Test (5s)*. A successful test is indicated by a green “dot” for 5 seconds.

10.6.2 Alarm recipients

Use the *Alarm recipients* page to configure alarm notifications. Notifications can be sent by e-mail or to a folder on an FTP server.

To configure delivery by e-mail, follow this procedure:

1. In the navigation pane, click *Alarm recipients*.
2. In the *Alarm recipient e-mail* box, type the e-mail address of the recipient.
3. In the *Mail server setup* box, type the IP address of the sending mail server.
4. If the sending mail server requires a login (mail server authentication), select the *Authentication required* check box, and then type the credentials in the *User* and *Password* boxes.
5. Click *Apply*.

To configure delivery to FTP, follow this procedure:

1. In the navigation pane, click *Alarm recipients*.
2. In the *FTP Server IP address* box, type the IP address of the FTP server.
3. In the *Folder* box, type the path to the folder where you want to save the notifications. This can be useful if you have multiple cameras connected to the same FTP server.
4. In the *User* and *Password* boxes, type the credentials for FTP access.
5. Click *Apply*.

10.6.3 Scheduler

Use the *Scheduler* page to configure what actions to run, and when to run them. The result of an action can be sent by e-mail or to a folder on an FTP server.

Available actions are:

- *E-mail image*
  Send the image with overlay graphics.
- *Save image on FTP*
  Send the image with overlay graphics to an FTP server.

To schedule actions, follow this procedure:

1. In the navigation pane, click *Scheduler*.
2. Click the check boxes to select which *Scheduled actions* to use.
3. In the schedule, click the *Active* check box for the days that the action will run:
   - To run the action once a day at a certain time, also click *Once* and then set an *Action Time*.
   - To run the action several times a day, also click *Repeat* and then set a time *Interval*, a *Start action* time, and an *End action* time.
4. Click *Apply*.

To configure delivery to FTP, follow this procedure:

1. In the *FTP Server* box, type the IP address of the FTP server.
2. In the *FTP User* and *FTP Password* boxes, type the credentials for the FTP access.
3. Click *Apply*.

To configure delivery by e-mail, follow this procedure:

1. In the *Recipient e-mail* box, type the e-mail address of the recipient.
2. In the *Mail server* box, type the IP address of the sending mail server.
3. In the *Sender e-mail* box, type the e-mail address of the sender.
4. If the sending mail server requires a login (mail server authentication), select the *Authenticate mail* check box, and then type the credentials in the *User* and *Password* boxes.
5. Click *Apply*.

10.7 *Library* tab

Note The *Library* tab is only available for the *admin* and *user* roles.

Under the *Library* tab you can view and manage saved images and videos from alarms and snapshots. When downloading multiple images or videos, a pop-up window will appear. Make sure it is not blocked by your internet browser.

10.7.1 Managing images

To view and manage image files, follow this procedure:

1. In the navigation pane, click *Images*.
2. To display a preview of an image, click the thumbnail of the image.
   As an alternative, click the image file name, and then click *Preview*.
3. To download an image, click the image file name, and then click *Download*.
4. To delete one or more images, click the image file name(s), and then click *Delete*.

10.7.2 Managing videos

To manage video files, follow this procedure:

1. In the navigation pane, click *Videos*.
2. To download a video, click the video file name, and then click *Download*.
3. To delete one or more videos, click the video file name(s), and then click *Delete*.

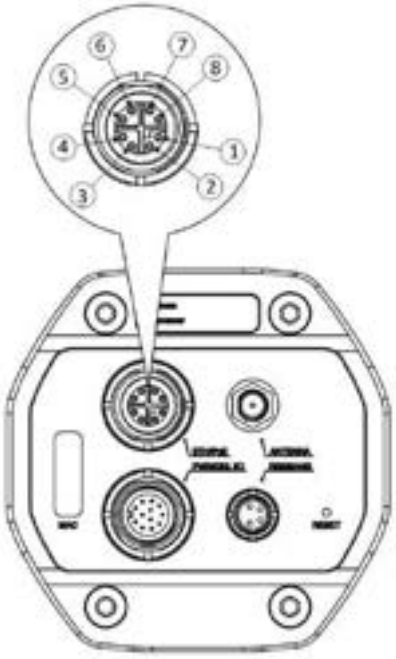
10.7.3 Managing logs

The alarms can be logged to file. To manage log files, follow this procedure:

1. In the navigation pane, click *Logs*.
2. To enable logging of alarms, click the *Logging enabled* check box.
3. To download the generated logs as a zipped file, click *Download log*.
4. To delete the generated logs, click *Clean log*.

11 Pin configurations

11.1 Ethernet connector and cable



Pin	Configuration
1	DA+
2	DA-
3	DB+
4	DB-
5	DD+
6	DD-
7	DC-
8	DC+

Figure 11.1 Female X-coded M12 Ethernet connector

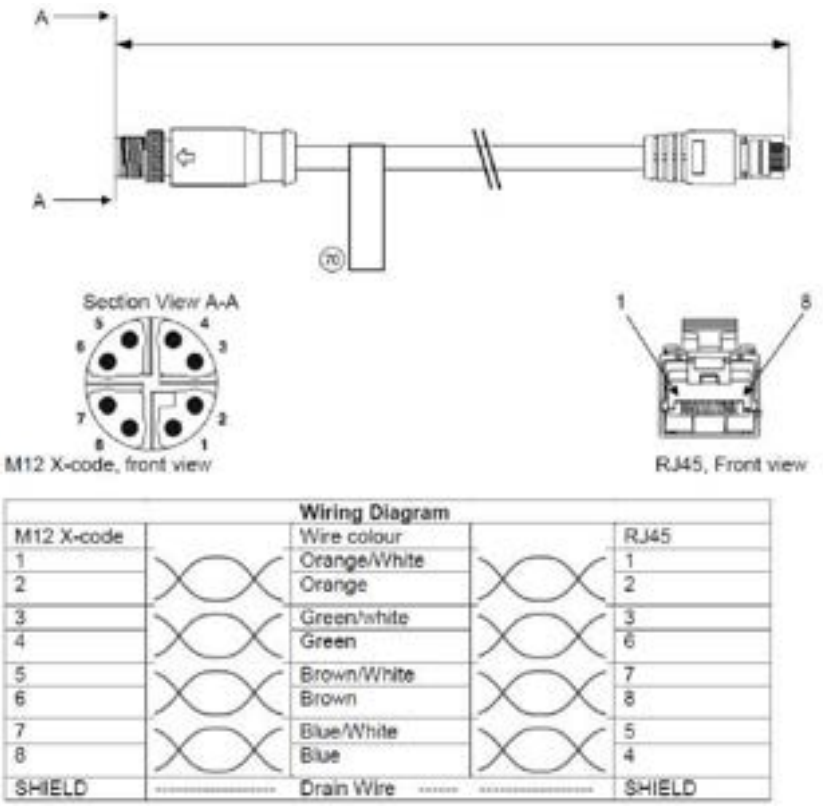
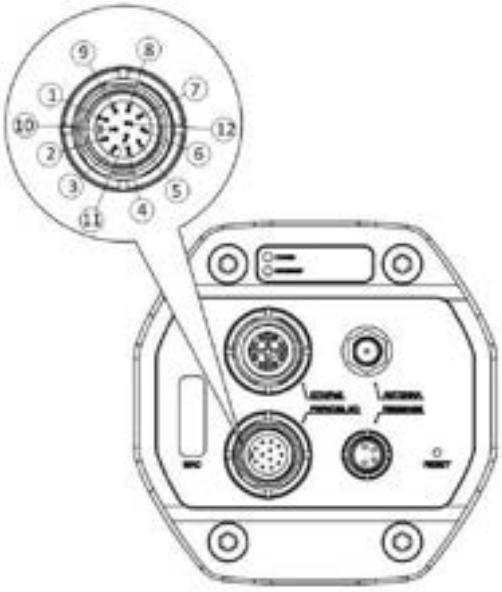


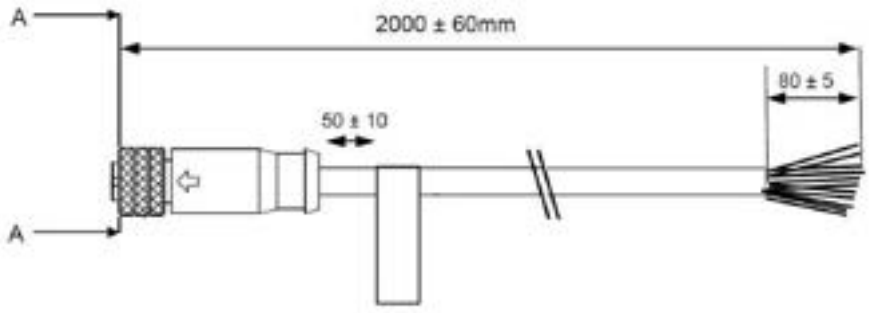
Figure 11.2 Ethernet cable M12 to RJ45

11.2 Power/Digital I/O connector and cable



Pin	Configuration
1	EXTPWR_RTN
2	EXTPWR_IN
3	FAULT_A
4	FAULT_B
5	DIGOUT1A
6	DIGOUT1B
7	DIGOUT2A
8	DIGOUT2B
9	DIGIN1
10	DIGIN2
11	Not Connected
12	DIGIN_RTN

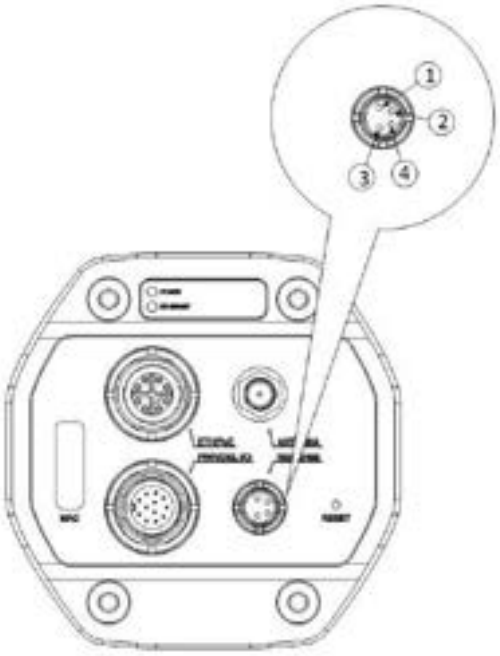
Figure 11.3 Male A-coded M12 Power/Digital I/O connector



Section A—A	Wire colour
1	Black
2	Red
3	Green
4	Purple
5	Yellow
6	Pink
7	Orange
8	Brown
9	White
10	Grey
11	Light blue
12	Blue

Figure 11.4 Cable M12 to pigtail

11.3 RS232/RS485 connector



Pin	Configuration
1	RS232_TXD alt RS485A
2	RS232_RXD alt RS485B
3	Chassie GND
4	Not Connected

Figure 11.5 Male A-coded M8 RS232/RS485 connector

12 Software supporting FLIR GF77a series cameras

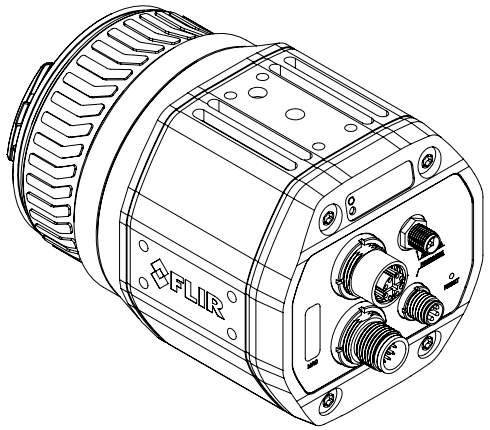
The following table explains which software supports FLIR GF77a series cameras:

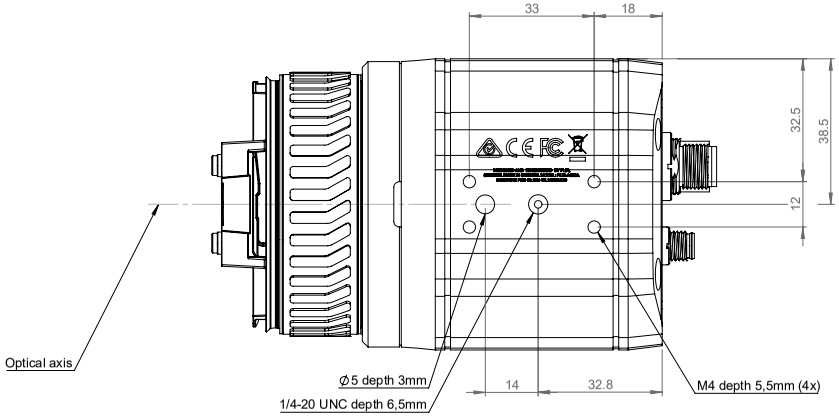
Software	Support	Comment
FLIR IP Config **Note** Use FLIR IP Config version 3.2 or higher.	Yes	• Detecting FLIR GF77a series cameras on the network. • Assigning IP addresses. • Accessing the built-in camera web interface.
Camera web interface	Yes	Camera configuration
FLIR IR Monitor	No	—
EthernetIP & Modbus TCP	No	—
FLIR Spinnaker SDK	Yes	—
FLIR Spinnaker GEV Demo	Yes	—
Pleora Ebus SDK	Yes	Requires license from Pleora.
FLIR GEV Demo	No	—
ONVIF-S compliant software	Yes	Live video (RTSP) supported with ONVIF-S

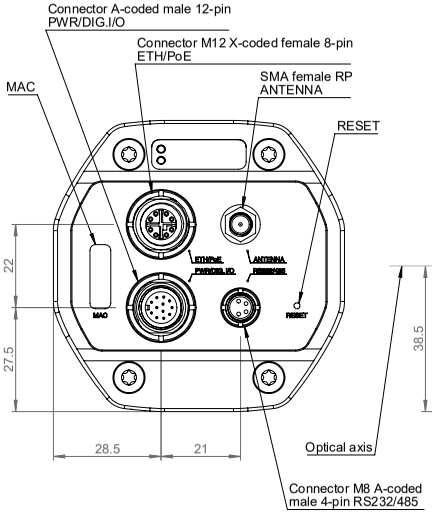
13 Mechanical drawings

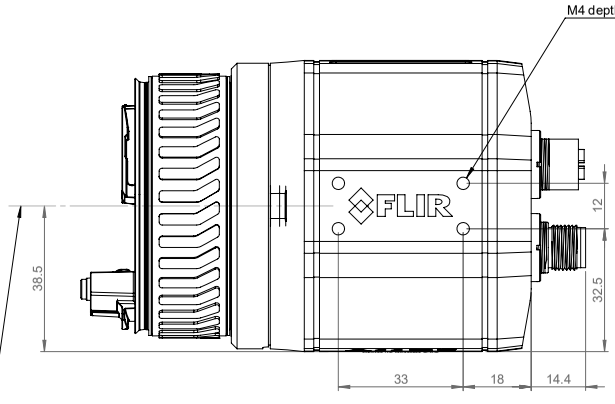
[See next page.]

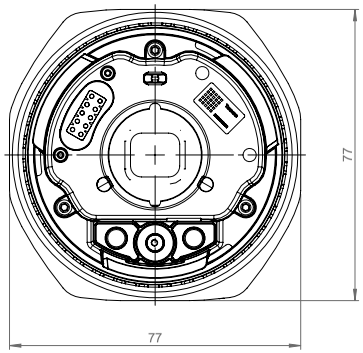
Default

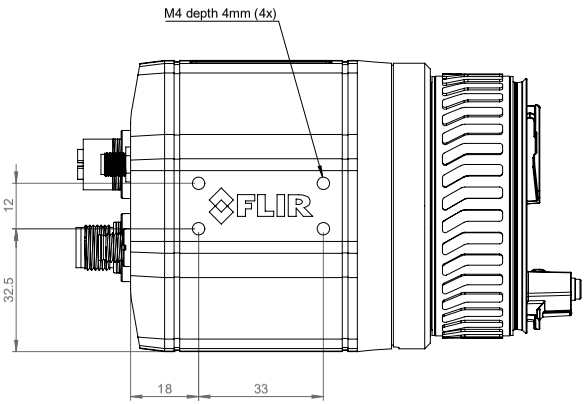


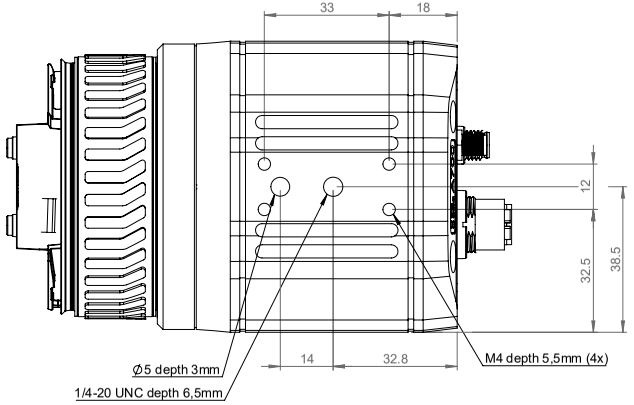












Modified	Check	Drawn by
2020-01-10	-	R&D Instruments

Denomination

Basic dimension Axxx/GF7xa

Size	Sheet
A2	1(3)
Scale	
1:1	
Drawing No.	Rev
T130771	A

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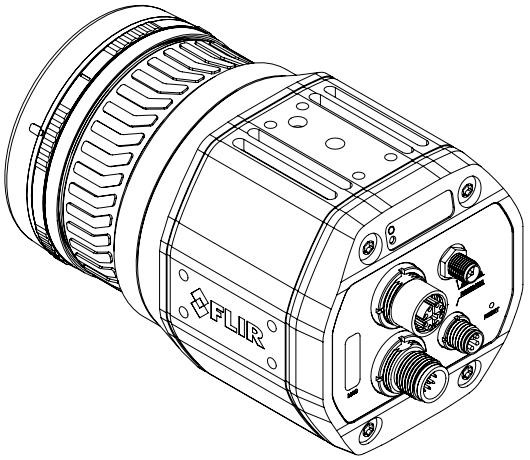
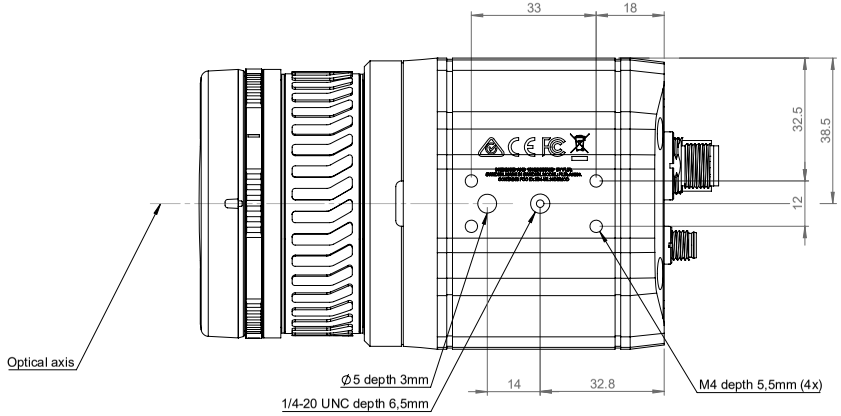
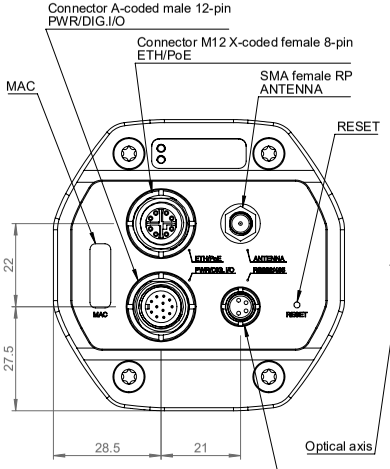
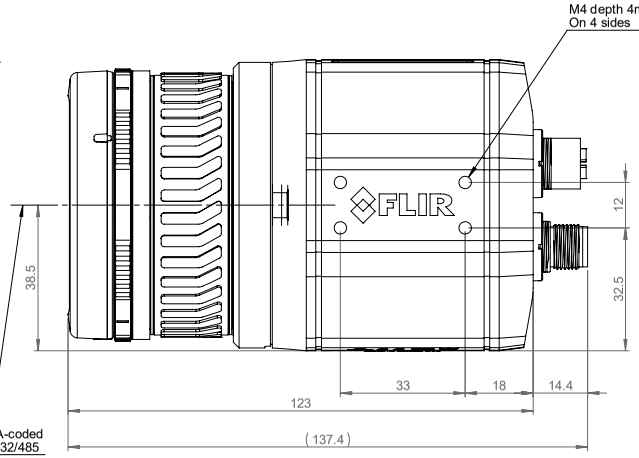
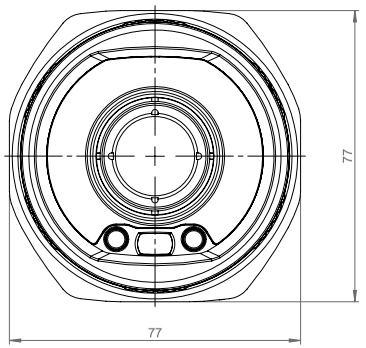
Incl. STD Lenses & Macro

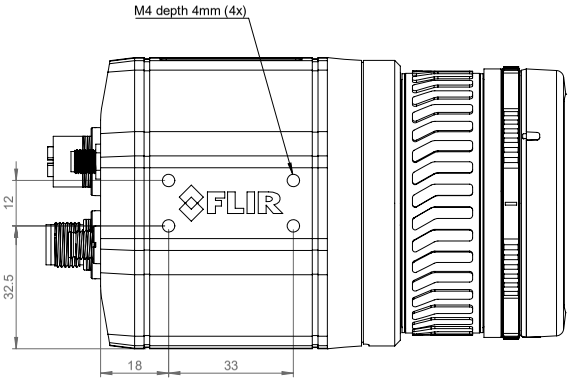


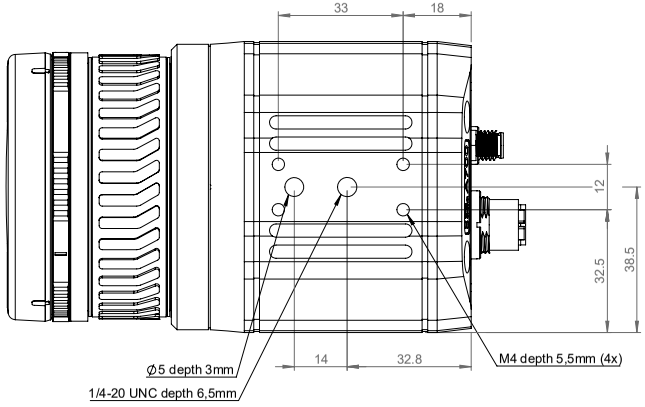












Basic dimensions for cameras with focal length:
f= 10mm
f= 17mm
f= 29mm

Macro WD=18mm

Modified	Check	Drawn by
2020-01-10	-	R&D Instruments

Denomination

Basic dimension Axxx/GF7xa

Size A2 | Scale 1:1 | Sheet 2(3)

Drawing No. T130771 | Rev A

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14 EU Declaration of conformity

[See next page]

June 22, 2020 Täby, Sweden AQ320379

CE Declaration of Conformity – EU Declaration of Conformity

Product: FLIR A4XX-, A5XX, A7XX-series and GF7Xa
Name and address of the manufacturer:
FLIR Systems AB
PO Box 7376
SE-187 15 Täby, Sweden

This declaration of conformity is issued under the sole responsibility of the manufacturer.
The object of the declaration: FLIR A4XX-, A5XX, A7XX-series and GF7Xa (Product Model Name FLIR-A8590).
The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

Directives:

Directive	2012/19/EU	Waste electrical and electric equipment
Directive	2011/65/EU	RoHS and 2015/830/EU (Phtalates)
Directive	2014/53/EU	Radio Equipment Directive (RED)

Standards:

Emission:	EN 55032:2015	Electromagnetic compability multimedia
Immunity:	EN 55035:2017	Electromagnetic Compability Multimedia
	ETSI EN 301489-1 v2.2.1	ERM – EMC for radio equipment
	ETSI EN 301489-17 v3.2.0	ERM – EMC Wideband data
Radio:	ETSI EN 300 328 v2.1.1	Harmonized EN covering essential requirements of the R&TTE Directive
	ETSI EN 301 893 v.2.1.1	5GHz WLAN
Safety:	IEC 62368-1:2014 (2nd Edition) + Cor.1:2015 + Cor.2: 2015 and EN62368-1:2014 + AC: 2015 + A11: 2017 + AC: 2017 Video, information and communication tech	
RoHS	EN 50581:2012	Technical documentation

FLIR Systems AB
Quality Assurance

Lea Dabiri
Quality Manager

15 Indicator LEDs and factory reset button

For location of the indicator LEDs and the factory reset button, see Figure 6.1 *View from the rear*, page 8.

15.1 Power/error indicator LED and factory reset button

Note Do not hold down the factory reset button when connecting the camera to power.

Factory reset button depression time period	Indicator LED status	Explanation
> 1 second	A continuous red light	When the factory reset button is released: • A factory reset is executed. • The main camera application is restarted. • The indicator LED status resumes the status it had before the button was depressed.
> 4 seconds	A flashing red light	When the factory reset button is released: • A factory reset is executed. • The main camera application is restarted. • The camera's IP settings are reset to the factory defaults (DHCP assigned). • The indicator LED status resumes the status it had before the button was depressed.
> 10 seconds	A rapidly flashing red light	When the factory reset button is released: • A factory reset is executed. • The camera's IP settings are reset to the factory defaults (DHCP assigned). • All added users are deleted. • All passwords are deleted. • The camera is restarted.

15.2 Power/error indicator LED and power modes

Indicator LED status	Explanation
Flashing blue light	Normal operation.
Steady pink light	Camera is booting up.
Steady red light	Camera malfunction.

15.3 Wired Ethernet connection

Note Wireless network activity is not reflected by the indicator LEDs.

Indicator LED status	Explanation
A flashing green light	The camera is connected to a network and the network activity is indicated.
No light (i.e., it is switched off).	The camera is not connected to any network.

16 Cleaning the camera

16.1 Camera housing, cables, and other items

Use one of these liquids:

- Warm water
- A weak detergent solution

Equipment:

- A soft cloth

Follow this procedure:

1. Soak the cloth in the liquid.
2. Twist the cloth to remove excess liquid.
3. Clean the part with the cloth.

CAUTION

Do not apply solvents or similar liquids to the camera, the cables, or other items. This can cause damage.

16.2 Infrared lens

Use one of these liquids:

- A commercial lens cleaning liquid with more than 30% isopropyl alcohol.
- 96% ethyl alcohol (C_2H_5OH).

Equipment:

- Cotton wool

CAUTION

If you use a lens cleaning cloth it must be dry. Do not use a lens cleaning cloth with the liquids that are listed above. These liquids can cause material on the lens cleaning cloth to become loose. This material can have an unwanted effect on the surface of the lens.

Follow this procedure:

1. Soak the cotton wool in the liquid.
2. Twist the cotton wool to remove excess liquid.
3. Clean the lens one time only and discard the cotton wool.

WARNING

Make sure that you read all applicable MSDS (Material Safety Data Sheets) and warning labels on containers before you use a liquid: the liquids can be dangerous.

CAUTION

- Be careful when you clean the infrared lens. The lens has a delicate anti-reflective coating.
- Do not clean the infrared lens too vigorously. This can damage the anti-reflective coating.

17 About calibration

17.1 Introduction

Calibration of a thermal camera is a prerequisite for temperature measurement. The calibration provides the relationship between the input signal and the physical quantity that the user wants to measure. However, despite its widespread and frequent use, the term “calibration” is often misunderstood and misused. Local and national differences as well as translation-related issues create additional confusion.

Unclear terminology can lead to difficulties in communication and erroneous translations, and subsequently to incorrect measurements due to misunderstandings and, in the worst case, even to lawsuits.

17.2 Definition—what is calibration?

The International Bureau of Weights and Measures[2] defines *calibration*[3] in the following way:

an operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication.

The calibration itself may be expressed in different formats: this can be a statement, calibration function, calibration diagram[4], calibration curve[5], or calibration table.

Often, the first step alone in the above definition is perceived and referred to as being “calibration.” However, this is not (always) sufficient.

Considering the calibration procedure of a thermal camera, the first step establishes the relation between emitted radiation (the quantity value) and the electrical output signal (the indication). This first step of the calibration procedure consists of obtaining a homogeneous (or uniform) response when the camera is placed in front of an extended source of radiation.

As we know the temperature of the reference source emitting the radiation, in the second step the obtained output signal (the indication) can be related to the reference source’s temperature (measurement result). The second step includes drift measurement and compensation.

To be correct, calibration of a thermal camera is, strictly, not expressed through temperature. Thermal cameras are sensitive to infrared radiation: therefore, at first you obtain a radiance correspondence, then a relationship between radiance and temperature. For bolometer cameras used by non-R&D customers, radiance is not expressed: only the temperature is provided.

17.3 Camera calibration at FLIR Systems

Without calibration, an infrared camera would not be able to measure either radiance or temperature. At FLIR Systems, the calibration of uncooled microbolometer cameras with a measurement capability is carried out during both production and service. Cooled cameras with photon detectors are often calibrated by the user with special software. With this type of software, in theory, common handheld uncooled thermal cameras could be calibrated by the user too. However, as this software is not suitable for reporting

2. http://www.bipm.org/en/about-us/ [Retrieved 2017-01-31.]
3. http://jcgm.bipm.org/vim/en/2.39.html [Retrieved 2017-01-31.]
4. http://jcgm.bipm.org/vim/en/4.30.html [Retrieved 2017-01-31.]
5. http://jcgm.bipm.org/vim/en/4.31.html [Retrieved 2017-01-31.]

purposes, most users do not have it. Non-measuring devices that are used for imaging only do not need temperature calibration. Sometimes this is also reflected in camera terminology when talking about infrared or thermal imaging cameras compared with thermography cameras, where the latter are the measuring devices.

The calibration information, no matter if the calibration is done by FLIR Systems or the user, is stored in calibration curves, which are expressed by mathematical functions. As radiation intensity changes with both temperature and the distance between the object and the camera, different curves are generated for different temperature ranges and exchangeable lenses.

17.4 The differences between a calibration performed by a user and that performed directly at FLIR Systems

First, the reference sources that FLIR Systems uses are themselves calibrated and traceable. This means, at each FLIR Systems site performing calibration, that the sources are controlled by an independent national authority. The camera calibration certificate is confirmation of this. It is proof that not only has the calibration been performed by FLIR Systems but that it has also been carried out using calibrated references. Some users own or have access to accredited reference sources, but they are very few in number.

Second, there is a technical difference. When performing a user calibration, the result is often (but not always) not drift compensated. This means that the values do not take into account a possible change in the camera's output when the camera's internal temperature varies. This yields a larger uncertainty. Drift compensation uses data obtained in climate-controlled chambers. All FLIR Systems cameras are drift compensated when they are first delivered to the customer and when they are recalibrated by FLIR Systems service departments.

17.5 Calibration, verification and adjustment

A common misconception is to confuse *calibration* with *verification* or *adjustment*. Indeed, calibration is a prerequisite for *verification*, which provides confirmation that specified requirements are met. Verification provides objective evidence that a given item fulfills specified requirements. To obtain the verification, defined temperatures (emitted radiation) of calibrated and traceable reference sources are measured. The measurement results, including the deviation, are noted in a table. The verification certificate states that these measurement results meet specified requirements. Sometimes, companies or organizations offer and market this verification certificate as a "calibration certificate."

Proper verification—and by extension calibration and/or recalibration—can only be achieved when a validated protocol is respected. The process is more than placing the camera in front of blackbodies and checking if the camera output (as temperature, for instance) corresponds to the original calibration table. It is often forgotten that a camera is not sensitive to temperature but to radiation. Furthermore, a camera is an *imaging* system, not just a single sensor. Consequently, if the optical configuration allowing the camera to "collect" radiance is poor or misaligned, then the "verification" (or calibration or recalibration) is worthless.

For instance, one has to ensure that the distance between the blackbody and the camera as well as the diameter of the blackbody cavity are chosen so as to reduce stray radiation and the size-of-source effect.

To summarize: a validated protocol must comply with the physical laws for *radiance*, and not only those for temperature.

Calibration is also a prerequisite for *adjustment*, which is the set of operations carried out on a measuring system such that the system provides prescribed indications corresponding to given values of quantities to be measured, typically obtained from measurement standards. Simplified, adjustment is a manipulation that results in instruments that measure correctly within their specifications. In everyday language, the term “calibration” is widely used instead of “adjustment” for measuring devices.

17.6 Non-uniformity correction

When the thermal camera displays ”Calibrating…” it is adjusting for the deviation in response of each individual detector element (pixel). In thermography, this is called a ”non-uniformity correction” (NUC). It is an offset update, and the gain remains unchanged.

The European standard EN 16714-3, Non-destructive Testing—Thermographic Testing —Part 3: Terms and Definitions, defines an NUC as “Image correction carried out by the camera software to compensate for different sensitivities of detector elements and other optical and geometrical disturbances.”

During the NUC (the offset update), a shutter (internal flag) is placed in the optical path, and all the detector elements are exposed to the same amount of radiation originating from the shutter. Therefore, in an ideal situation, they should all give the same output signal. However, each individual element has its own response, so the output is not uniform. This deviation from the ideal result is calculated and used to mathematically perform an image correction, which is essentially a correction of the displayed radiation signal. Some cameras do not have an internal flag. In this case, the offset update must be performed manually using special software and an external uniform source of radiation.

An NUC is performed, for example, at start-up, when changing a measurement range, or when the environment temperature changes. Some cameras also allow the user to trigger it manually. This is useful when you have to perform a critical measurement with as little image disturbance as possible.

17.7 Thermal image adjustment (thermal tuning)

Some people use the term “image calibration” when adjusting the thermal contrast and brightness in the image to enhance specific details. During this operation, the temperature interval is set in such a way that all available colors are used to show only (or mainly) the temperatures in the region of interest. The correct term for this manipulation is “thermal image adjustment” or “thermal tuning”, or, in some languages, “thermal image optimization.” You must be in manual mode to undertake this, otherwise the camera will set the lower and upper limits of the displayed temperature interval automatically to the coldest and hottest temperatures in the scene.

18 About FLIR Systems

FLIR Systems was established in 1978 to pioneer the development of high-performance infrared imaging systems, and is the world leader in the design, manufacture, and marketing of thermal imaging systems for a wide variety of commercial, industrial, and government applications. Today, FLIR Systems embraces five major companies with outstanding achievements in infrared technology since 1958—the Swedish AGEMA Infrared Systems (formerly AGA Infrared Systems), the three United States companies Indigo Systems, FSI, and Inframetrics, and the French company Cedip.

Since 2007, FLIR Systems has acquired several companies with world-leading expertise:

- NEOS (2019)
- Endeavor Robotics (2019)
- Aeryon Labs (2019)
- Seapilot (2018)
- Acyclica (2018)
- Prox Dynamics (2016)
- Point Grey Research (2016)
- DVTEL (2015)
- DigitalOptics micro-optics business (2013)
- MARSS (2013)
- Traficon (2012)
- Aerius Photonics (2011)
- TackTick Marine Digital Instruments (2011)
- ICx Technologies (2010)
- Raymarine (2010)
- Directed Perception (2009)
- OmniTech Partners (2009)
- Salvador Imaging (2009)
- Ifara Tecnologías (2008)
- Extech Instruments (2007)

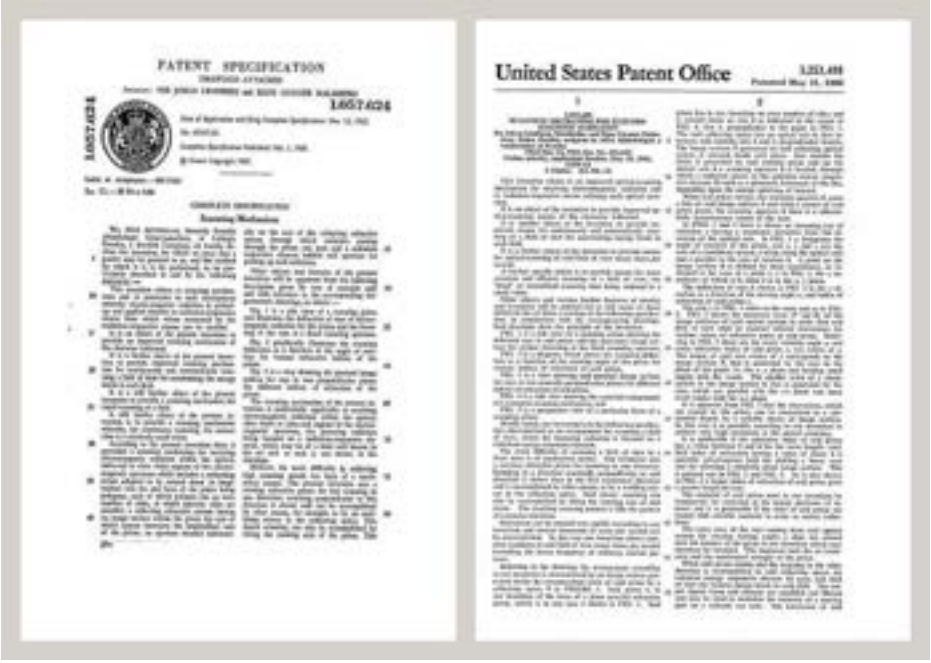

Figure 18.1 Patent documents from the early 1960s

FLIR Systems has three manufacturing plants in the United States (Portland, OR, Boston, MA, Santa Barbara, CA) and one in Sweden (Stockholm). Since 2007 there is also a manufacturing plant in Tallinn, Estonia. Direct sales offices in Belgium, Brazil, China,

France, Germany, Great Britain, Hong Kong, Italy, Japan, Korea, Sweden, and the USA —together with a worldwide network of agents and distributors—support our international customer base.

FLIR Systems is at the forefront of innovation in the infrared camera industry. We anticipate market demand by constantly improving our existing cameras and developing new ones. The company has set milestones in product design and development such as the introduction of the first battery-operated portable camera for industrial inspections, and the first uncooled infrared camera, to mention just two innovations.

1969: Thermovision Model 661. The camera weighed approximately 25 kg (55 lb.), the oscilloscope 20 kg (44 lb.), and the tripod 15 kg (33 lb.). The operator also needed a 220 VAC generator set, and a 10 L (2.6 US gallon) jar with liquid nitrogen. To the left of the oscilloscope the Polaroid attachment (6 kg (13 lb.)) can be seen.

2015: FLIR One, an accessory to iPhone and Android mobile phones. Weight: 36 g (1.3 oz.).

FLIR Systems manufactures all vital mechanical and electronic components of the camera systems itself. From detector design and manufacturing, to lenses and system electronics, to final testing and calibration, all production steps are carried out and supervised by our own engineers. The in-depth expertise of these infrared specialists ensures the accuracy and reliability of all vital components that are assembled into your infrared camera.

18.1 More than just an infrared camera

At FLIR Systems we recognize that our job is to go beyond just producing the best infrared camera systems. We are committed to enabling all users of our infrared camera systems to work more productively by providing them with the most powerful camera–software combination. Especially tailored software for predictive maintenance, R & D, and process monitoring is developed in-house. Most software is available in a wide variety of languages.

We support all our infrared cameras with a wide variety of accessories to adapt your equipment to the most demanding infrared applications.

18.2 Sharing our knowledge

Although our cameras are designed to be very user-friendly, there is a lot more to thermography than just knowing how to handle a camera. Therefore, FLIR Systems has founded the Infrared Training Center (ITC), a separate business unit, that provides certified training courses. Attending one of the ITC courses will give you a truly hands-on learning experience.

The staff of the ITC are also there to provide you with any application support you may need in putting infrared theory into practice.

18.3 Supporting our customers

FLIR Systems operates a worldwide service network to keep your camera running at all times. If you discover a problem with your camera, local service centers have all the equipment and expertise to solve it within the shortest possible time. Therefore, there is no need to send your camera to the other side of the world or to talk to someone who does not speak your language.

Website
http://www.flir.com

Customer support
http://support.flir.com

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