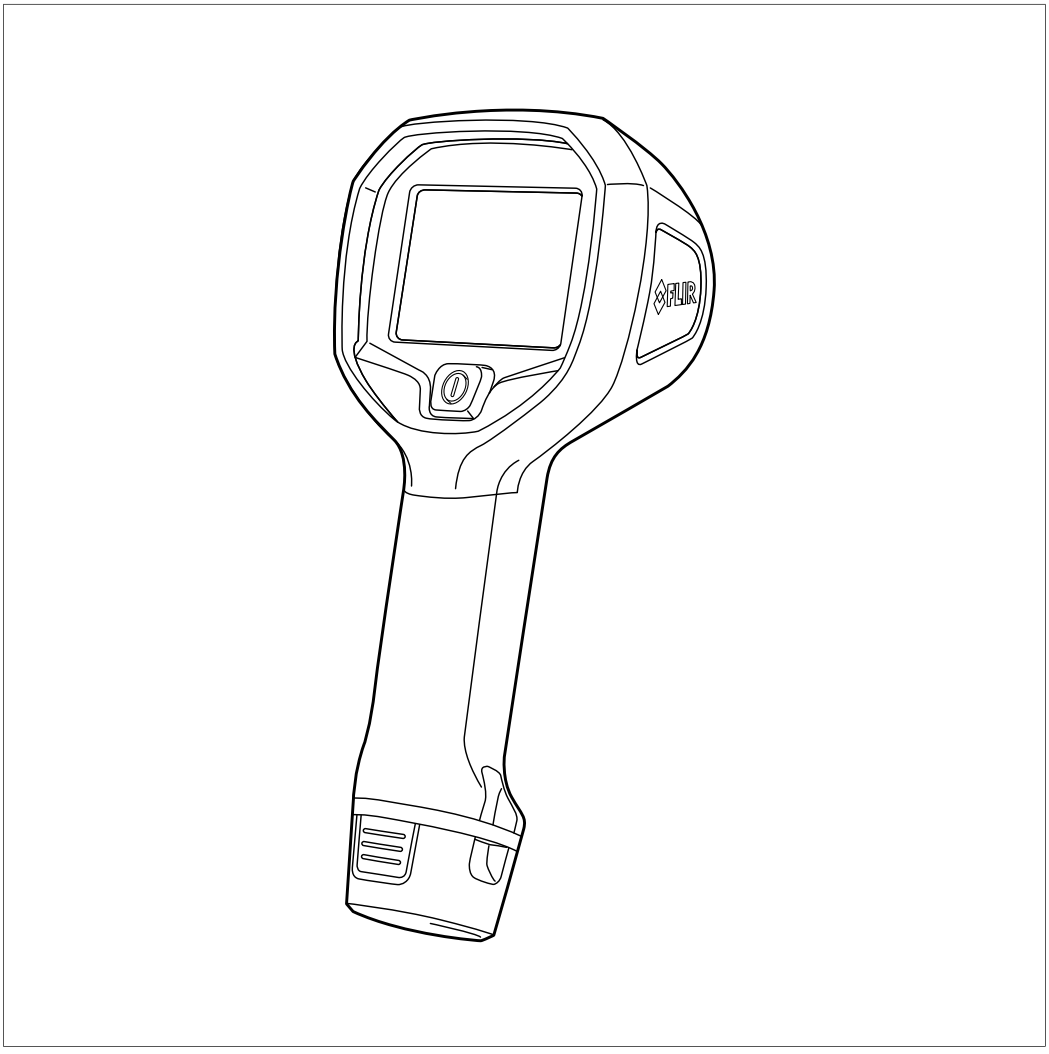
User's manual
FLIR Kx series



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。

Table of contents

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

2 Safety information

WARNING

Applicability: Cameras with one or more batteries.

Do not disassemble or do a modification to the battery. The battery contains safety and protection devices which, if damage occurs, can cause the battery to become hot, or cause an explosion or an ignition.

WARNING

Applicability: Cameras with one or more batteries.

If there is a leak from the battery and you get the fluid in your eyes, do not rub your eyes. Flush well with water and immediately get medical care. The battery fluid can cause injury to your eyes if you do not do this.

WARNING

Applicability: Cameras with one or more batteries.

Do not continue to charge the battery if it does not become charged in the specified charging time. If you continue to charge the battery, it can become hot and cause an explosion or ignition. Injury to persons can occur.

WARNING

Applicability: Cameras with one or more batteries.

Only use the correct equipment to remove the electrical power from the battery. If you do not use the correct equipment, you can decrease the performance or the life cycle of the battery. If you do not use the correct equipment, an incorrect flow of current to the battery can occur. This can cause the battery to become hot, or cause an explosion. Injury to persons can occur.

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.

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

Applicability: Cameras with one or more batteries.

Do not attach the batteries directly to a car's cigarette lighter socket, unless FLIR Systems supplies a specific adapter to connect the batteries to a cigarette lighter socket. Damage to the batteries can occur.

CAUTION

Applicability: Cameras with one or more batteries.

Do not connect the positive terminal and the negative terminal of the battery to each other with a metal object (such as wire). Damage to the batteries can occur.

CAUTION

Applicability: Cameras with one or more batteries.

Do not get water or salt water on the battery, or permit the battery to become wet. Damage to the batteries can occur.

CAUTION

Applicability: Cameras with one or more batteries.

Do not make holes in the battery with objects. Damage to the battery can occur.

CAUTION

Applicability: Cameras with one or more batteries.

Do not hit the battery with a hammer. Damage to the battery can occur.

CAUTION

Applicability: Cameras with one or more batteries.

Do not put your foot on the battery, hit it or cause shocks to it. Damage to the battery can occur.

CAUTION

Applicability: Cameras with one or more batteries.

Do not put the batteries in or near a fire, or into direct sunlight. When the battery becomes hot, the built-in safety equipment becomes energized and can stop the battery charging procedure. If the battery becomes hot, damage can occur to the safety equipment and this can cause more heat, damage or ignition of the battery.

CAUTION

Applicability: Cameras with one or more batteries.

Do not put the battery on a fire or increase the temperature of the battery with heat. Damage to the battery and injury to persons can occur.

CAUTION

Applicability: Cameras with one or more batteries.

Do not put the battery on or near fires, stoves, or other high-temperature locations. Damage to the battery and injury to persons can occur.

CAUTION

Applicability: Cameras with one or more batteries.

Do not solder directly onto the battery. Damage to the battery can occur.

CAUTION

Applicability: Cameras with one or more batteries.

Do not use the battery if, when you use, charge, or put the battery in storage, there is an unusual smell from the battery, the battery feels hot, changes color, changes shape, or is in an unusual condition. Speak with your sales office if one or more of these problems occurs. Damage to the battery and injury to persons can occur.

CAUTION

Applicability: Cameras with one or more batteries.

Only use a specified battery charger when you charge the battery. Damage to the battery can occur if you do not do this.

CAUTION

Applicability: Cameras with one or more batteries.

Only use a specified battery for the camera. Damage to the camera and the battery can occur if you do not do this.

CAUTION

Applicability: Cameras with one or more batteries.

The temperature range through which you can charge the battery is 0°C to +45°C (+32°F to +113°F). If you charge the battery at temperatures out of this range, it can cause the battery to become hot or to break. It can also decrease the performance or the life cycle of the battery.

CAUTION

Applicability: Cameras with one or more batteries.

The temperature range through which you can remove the electrical power from the battery is -15°C to +50°C (+5°F to +122°F), unless other information is specified in the user documentation or technical data. If you operate the battery out of this temperature range, it can decrease the performance or the life cycle of the battery.

CAUTION

Applicability: Cameras with one or more batteries.

When the battery is worn, apply insulation to the terminals with adhesive tape or equivalent materials before you discard it. Damage to the battery and injury to persons can occur if you do not do this.

CAUTION

Applicability: Cameras with one or more batteries.

Remove any water or moisture on the battery before you install it. Damage to the battery can occur if you do not do this.

CAUTION

Do not apply solvents or equivalent liquids to the camera, the cables, or other items. Damage to the battery and injury to persons can occur.

CAUTION

Be careful when you clean the infrared lens. The lens has an anti-reflective coating which is easily damaged. Damage to the infrared lens can occur.

CAUTION

Do not use too much force to clean the infrared lens. This can cause damage to the anti-reflective coating.

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.

CAUTION

Do not change the standard fire-fighting procedures when you use a FLIR K series camera. The FLIR K series camera is not a replacement technology.

CAUTION

Do not use the FLIR K series camera without the correct training. If the persons that operate the camera do not have the correct training, an incorrect analysis of the infrared images can occur. Thus, incorrect decisions during the firefighting can be made.

The training must include:

- How a thermal camera operates and its limits
- How to interpret an image
- How to work safely with the camera.

3 Notice to user

3.1 Online documentation

Our manuals are continuously updated and published online.

To access the FLIR Kx user manual and other product documentation, go to http://support.flir.com/resources/k4qd.

To access the manuals for our other products, as well as manuals for our discontinued products, go to https://support.flir.com/resources/app.

3.2 Register your camera

Register your camera to receive an extended warranty and other related benefits.

To register the camera, go to www.flir.com/register.

To access the registration form, you must log in to your FLIR account or sign up for a new account.

You will also need the serial number of your camera.

- A label with the serial number is available under the rubber cover at the top of the camera.

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

For training resources and courses, go to https://www.flir.com/support-center/training.

3.5 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.

3.6 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 Important information about FLIR Kx series service

- Contact the service department before shipping the camera. Many problems can be resolved on the phone—if so, the camera does not need to be shipped.
- The camera must be thoroughly cleaned, decontaminated and disinfected before shipping to our service department. No hazardous residues are allowed on cameras. Such residues include—but are not limited to—chemical fire-extinguishing compounds, radioactivity, biohazardous materials, and residues from chemical fires.
- FLIR Systems reserves the right to charge the full cost for the decontamination and disinfection of contaminated cameras that are shipped to our service department.

6 Introduction

Thank you for choosing a FLIR Kx series camera from FLIR Systems.

The FLIR Kx series is a robust and reliable infrared camera series designed to perform under extremely severe conditions. The FLIR Kx series camera has an intuitive interface with a design that makes it easy to control even with a gloved hand.

Main features:

- **Robust and reliable**. The FLIR Kx series is designed to meet tough operating conditions. It can withstand a drop from 2 m (6.5′) onto a concrete floor, is water resistant to IP67, and is fully operational up to 55°C (135°F).
- **Innovative**. The FLIR Kx series utilizes our patented technology MSX, where a thermal sensor is combined with a visual camera sensor to give detailed image information in many user situations.
- **Easy-to-use**. The FLIR Kx series is easily used in a gloved professional hand. An intuitive and simple user interface allows you to focus on the job. The FLIR Kx series can be controlled by just one large button on top of the unit.

7 Quick start guide

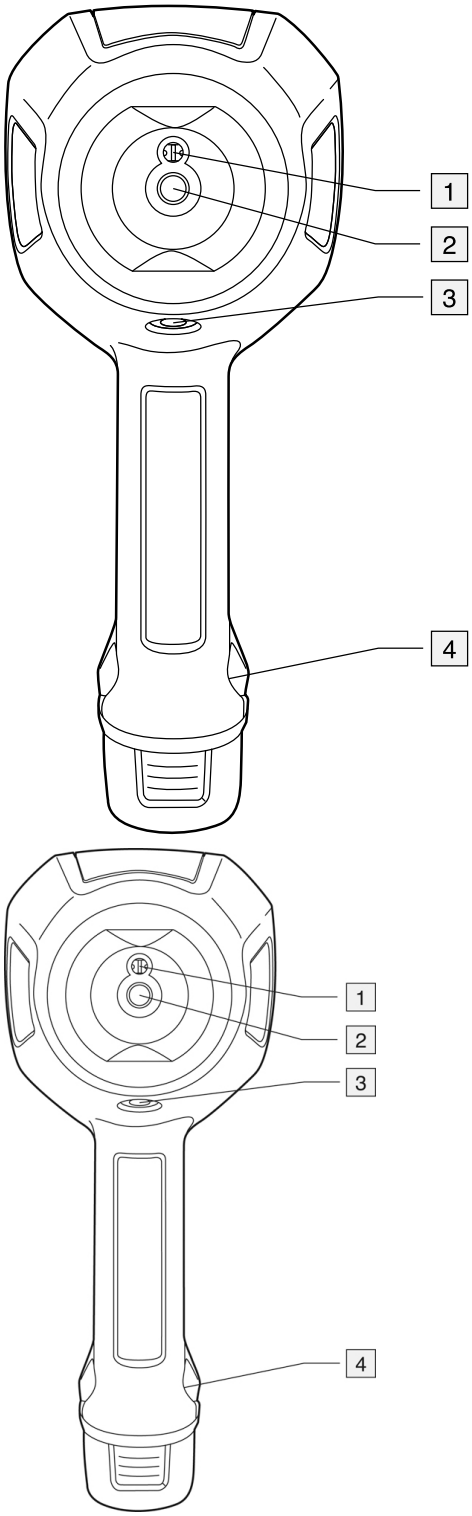
Follow this procedure:

1. Charge the battery. You can do this in three different ways:
   - Charge the battery using the FLIR stand-alone battery charger.
   - Charge the battery using the FLIR power supply.
   - Charge the battery using a USB cable connected to a computer.

     Note Charging the camera using a USB cable connected to a computer takes *considerably* longer than using the FLIR power supply or the FLIR stand-alone battery charger.
2. Push the on/off button to turn on the camera.
3. Aim the camera toward the object of interest.

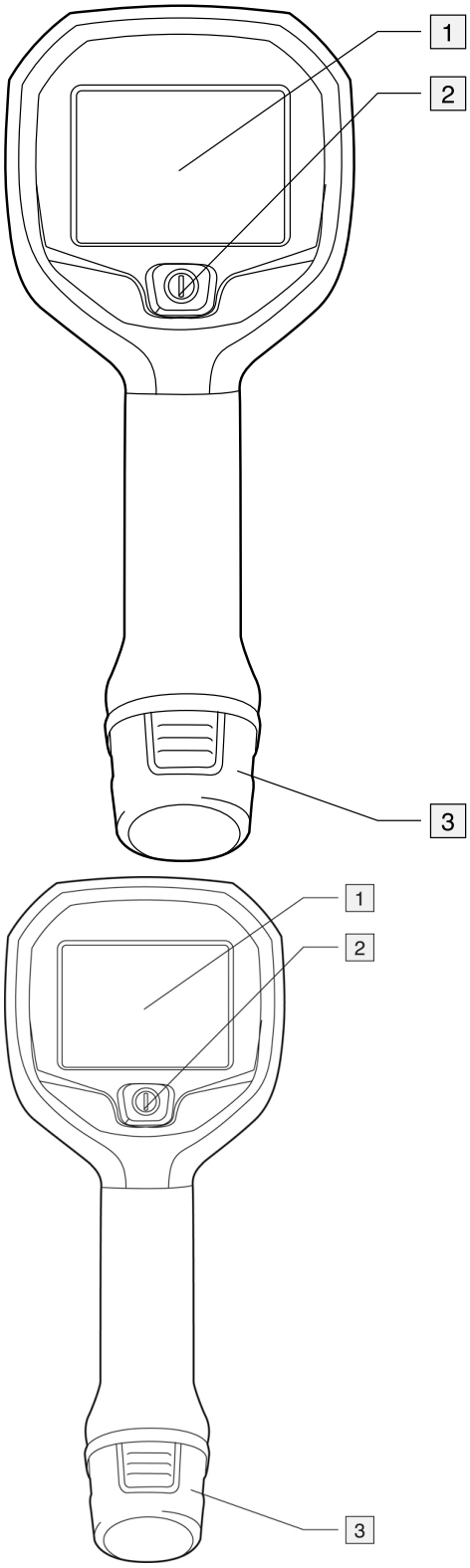
8 Camera parts

8.1 View from the front



1. Digital camera lens.
2. Infrared lens.
3. Tripod mount.
4. Attachment point for lanyard strap.

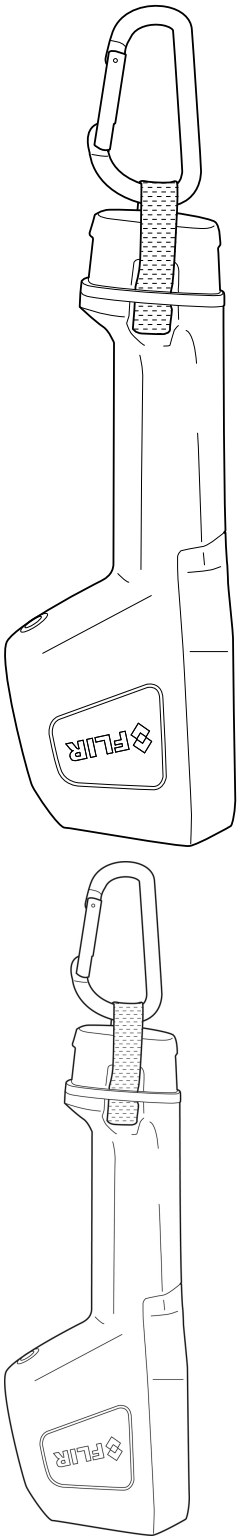
8.2 View from the rear



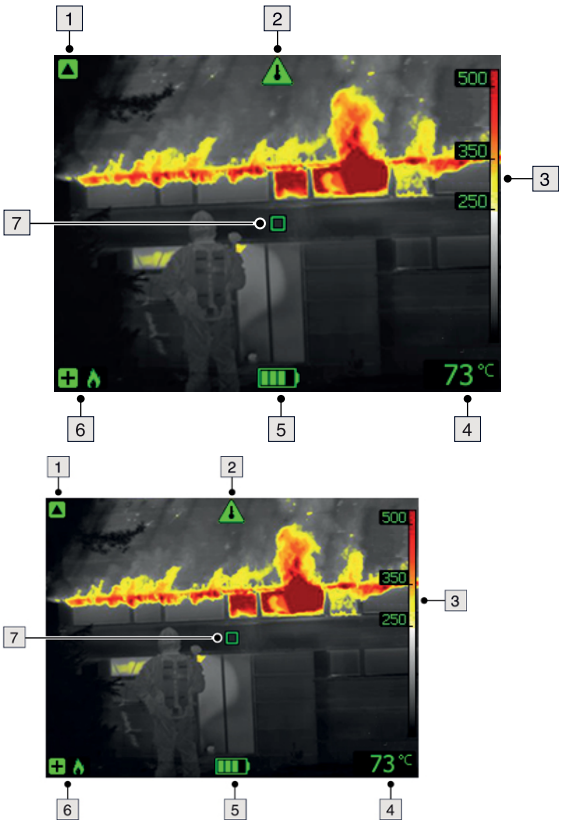
1. Camera screen.

2. On/off button. This button has three functions:
    - Push the on/off button to turn on the camera.
    - Push and hold the on/off button for more than 3 seconds but less than 10 seconds to put the camera into standby mode. The camera then automatically turns off after 6 hours.
    - Push and hold the on/off button for more than 10 seconds to turn off the camera.
3. Battery.

8.3 Lanyard strap



9 Screen elements



1. Low-sensitivity range indicator.
2. Overheating indicator. The indicator provides a visual warning to the user that the thermal imager is about to shut down due to internal overheating.
3. Temperature scale.
4. Digital readout of the temperature at the position of the spotmeter.
5. Battery status indicator.
6. Camera mode indicator (e.g. *fire mode*).
7. Spotmeter.

Note The icons are displayed in green or blue, depending on the selected camera mode.

- The green icon color indicates that the camera is in a mode where it automatically switches between the high-sensitivity range and the low-sensitivity range, depending on the temperature of objects in the field of view.
- The blue icon color indicates that the camera is in a mode where the temperature range is locked to the high-sensitivity range.

10 Operation

10.1 Charging the battery

10.1.1 Charging the battery using the FLIR power supply

Follow this procedure:

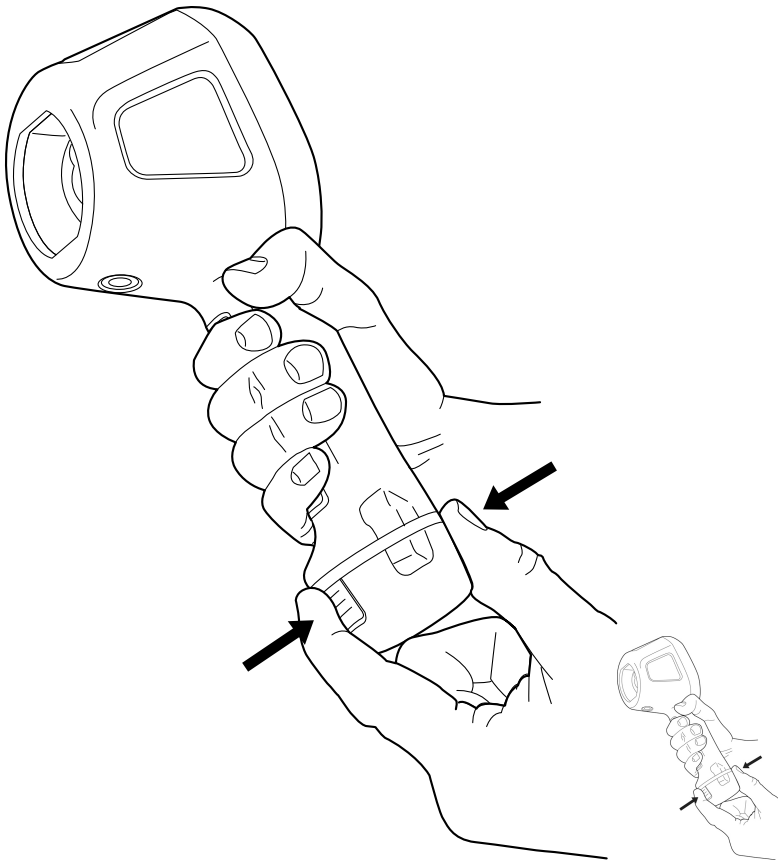
1. Connect the power supply to a wall outlet.
2. Connect the power supply cable to the USB connector on the camera. To access the USB connector, see section 10.3 *Accessing the connector bay*, page 17.

Note The charging time for a fully depleted battery is 2 hours.

10.1.2 Charging the battery using the FLIR stand-alone battery charger.

Follow this procedure:

1. Connect the stand-alone battery charger to a wall outlet.
2. Remove the battery from the camera.



3. Put the battery into the stand-alone battery charger.

Note

- The charging time for a fully depleted battery is 2 hours.
- The battery is being charged when the blue LED is flashing.
- The battery is fully charged when the blue LED is continuous.

10.1.3 Charging the battery using a USB cable

Follow this procedure:

1. Connect the camera to a computer using a USB cable. To access the USB connector, see section 10.3 *Accessing the connector bay*, page 17.

Note

- To charge the camera, the computer must be turned on.
- Charging the camera using a USB cable connected to a computer takes *considerably* longer than using the FLIR power supply or the FLIR stand-alone battery charger.

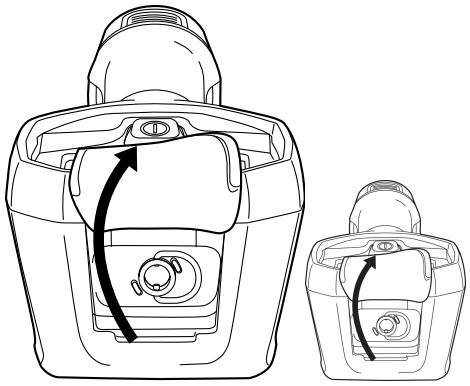
10.2 Turning on and turning off the camera

- Push the on/off button to turn on the camera.
- Push and hold the on/off button for more than 3 seconds but less than 10 seconds to put the camera into standby mode. The camera then automatically turns off after 6 hours.
- Push and hold the on/off button for more than 10 seconds to turn off the camera.

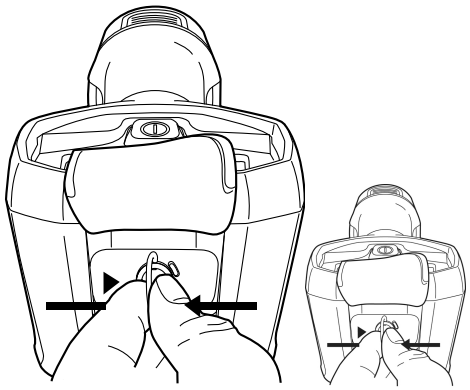
10.3 Accessing the connector bay

Follow this procedure:

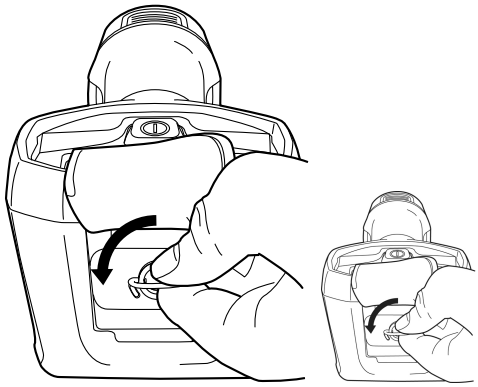
1. Fold up the rubber cover at the top of the camera.



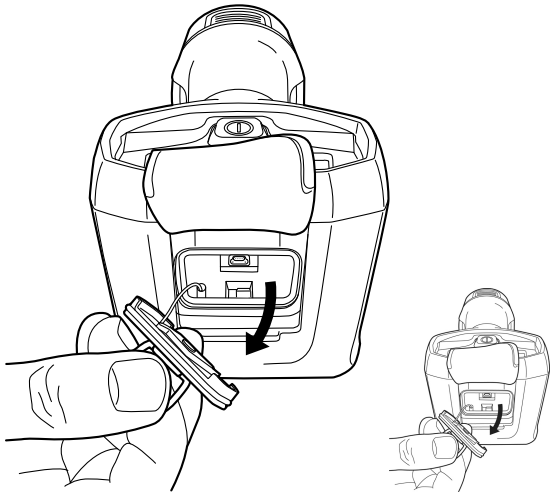
2. Hold the metal ring firmly.



3. Turn the ring about 90° counter-clockwise.



4. Pull out the plastic insert.



⚠ CAUTION
The plastic insert has an O-ring seal. Do not damage the O-ring seal.

10.4 Changing temperature unit

The camera displays temperatures in °C or °F. You change the temperature unit with a switch, located in the connector bay.

Follow this procedure:

1. To access the temperature unit switch, see section 10.3 *Accessing the connector bay*, page 17.
2. Set the temperature unit switch to the desired position.

10.5 Configuring the camera

The FLIR K-series camera configurator is a Windows application used to configure the camera.

10.5.1 Installation

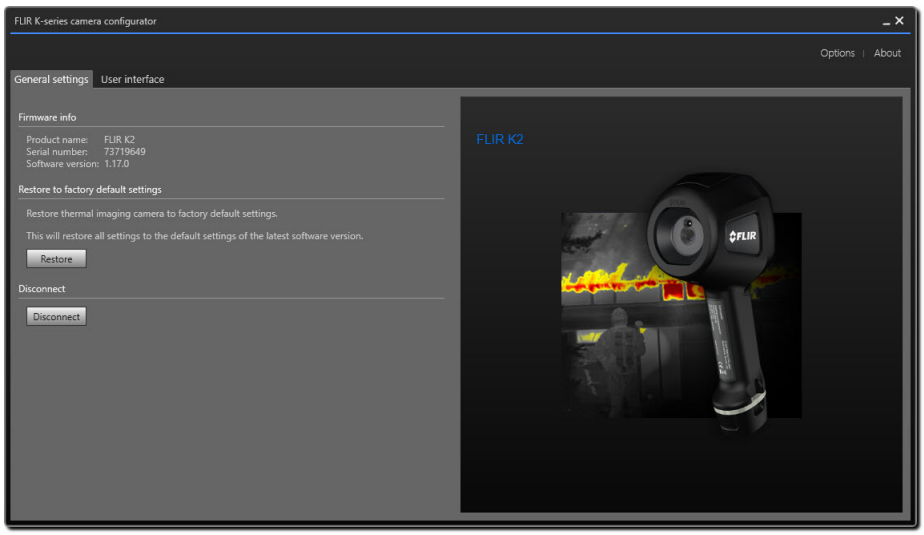
1. Go to https://support.flir.com. Find the software download area and search for FLIR K-series camera configurator.
2. Download the FLIR K-series camera configurator installer package.

3. Start the installation by double-clicking the executable installer file.
4. Follow the instructions in the setup wizard.

10.5.2 Configure the camera

1. Connect the camera to the computer, using the USB cable.
2. Turn on the camera.
3. Run the FLIR K-series camera configurator application.
4. The application automatically connects to the camera and displays the available settings.
5. To change the language, click *Options* on the top menu.

10.5.3 The *General settings* tab

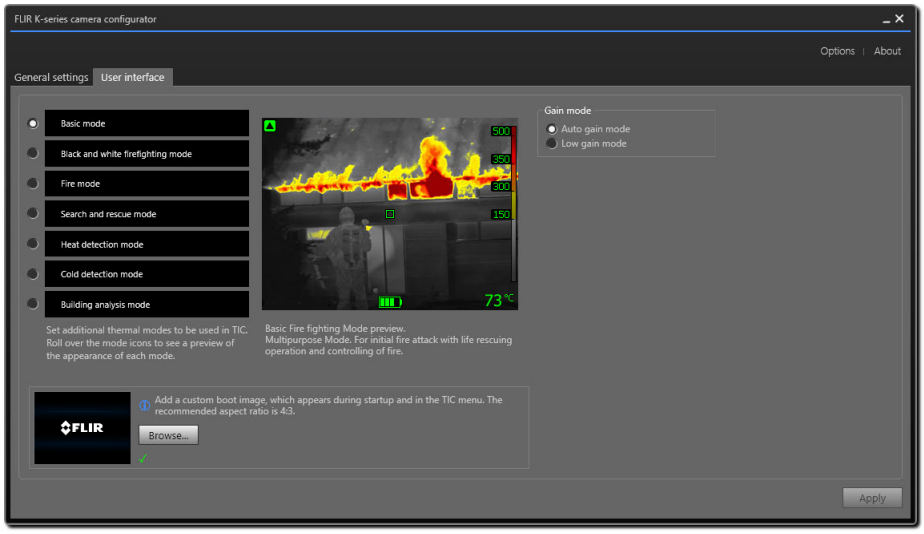


Restore to factory default area: To restore all camera settings to the factory defaults, click *Restore*.

Firmware info area: Displays the current version of the camera firmware. To check if a newer version of the camera firmware is available, go to https://support.flir.com, then find the software download area and search for your camera model.

Disconnect area: To disconnect the camera from the application, click *Disconnect*. To re-connect, turn off the camera and then turn it on again. The application will automatically connect to the camera.

10.5.4 The *User interface* tab



Camera modes area: To define which camera modes to enable in the camera, select the camera mode. For more information on each camera mode, see section 10.5.5.2 *Explanation of the different camera modes*, page 21.

Gain mode area:

- *Auto gain mode*: Select to make the camera automatically switch between the high-sensitivity range and the low-sensitivity range, depending on the scene temperature. The temperature level at which the camera switches between the two modes is +150° C (+302°F).
- *Low gain mode*: Select to make the camera work in the low-sensitivity range only. This has the advantage that the camera does not perform a non-uniformity correction when an object with a temperature higher than +150°C (+302°F) enters the scene. However, the disadvantage is lower sensitivity and a higher level of signal noise.

Add custom boot image area: To specify your own unique image to appear during start-up, click *Browse*, and navigate to the image file. This is useful for, for example, identifying your fire department's cameras. By incorporating your fire department's logo, and a unique identity number in the image, you can keep track of your cameras.

To download any setting changes to the camera, click *Apply*.

10.5.5 Camera modes

10.5.5.1 General

The FLIR Kx series features seven different camera modes:

1. Basic mode.
2. Black and white firefighting mode.
3. Fire mode.
4. Search and rescue mode.
5. Heat detection mode.
6. Cold detection mode.
7. Building analysis mode.

Each mode is optimized for a certain type of firefighting application. The modes also differ in the following ways:

- Modes with green icons (1–3 in the list): The camera switches between the high-sensitivity range (–20 to +150°C (–4 to +302°F)) and the low-sensitivity range (0 to +500° C (+32 to +932°F)) automatically when an object with a temperature above 150°C (302°F), covering more than 2% of the image, enters the field of view of the camera.

- Modes with blue icons (4–7 in the list): The temperature range is locked to the high-sensitivity range (–20 to +150°C (–4 to +302°F)). This is useful if you need to maintain the best possible image for objects with a temperature below 150°C (302°F), even if there are objects with a temperature above 150°C (302°F) in the field of view of the camera.

10.5.5.2 Explanation of the different camera modes

10.5.5.2.1 Basic mode

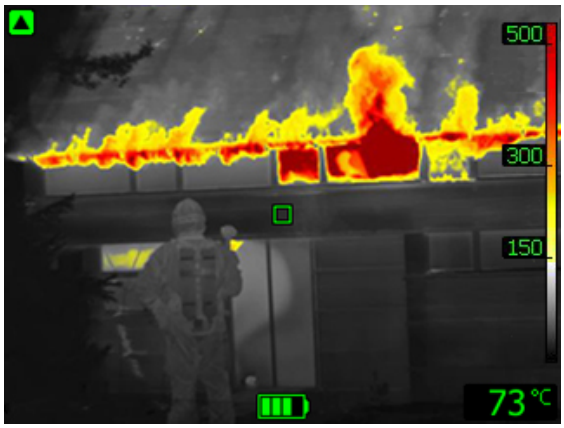


Figure 10.1 Basic mode.

The Basic mode is the default mode of the camera. It is a multipurpose mode for the initial fire attack with life rescuing operation and control of the fire. The camera automatically switches between the high-sensitivity range and the low-sensitivity range, to maintain an optimal infrared image while at the same time maintaining a safe and consistent heat colorization of the fire scene.

- Automatic range.
- Colorization of heat: +150 to +500°C (+302 to +932°F).
- High-sensitivity range: –20 to +150°C (–4 to +302°F).
- Low-sensitivity range: 0 to +500°C (+32 to +932°F).

10.5.5.2.2 Black and white firefighting mode

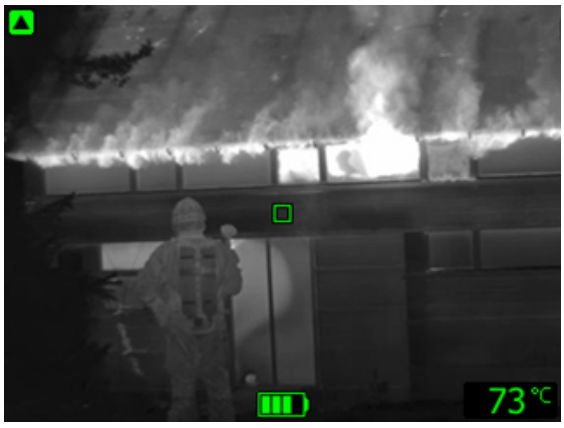


Figure 10.2 Black and white firefighting mode.

The *black and white firefighting mode* is a standardized firefighting mode based on the Basic mode. It is a multipurpose mode for the initial fire intervention that includes life rescuing operations and control of the fire. It is specifically designed for fire services that do not want to use the heat colorization feature.

The camera automatically switches between the high-sensitivity range and the low-sensitivity range, to maintain an optimal infrared image.

- Automatic range.
- High-sensitivity range: –20 to +150°C (–4 to +302°F).
- Low-sensitivity range: 0 to +500°C (+32 to +932°F).

10.5.5.2.3 Fire mode

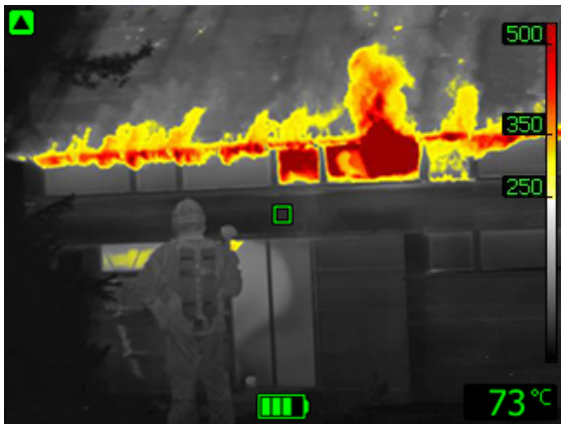


Figure 10.3 Fire mode.

The *fire mode* is similar to the Basic mode, but with a higher-temperature starting point for the heat colorization. It is suitable for fire scenes with higher background temperatures, where there are already a lot of open flames and a high background temperature. The camera automatically switches between the high-sensitivity range and the low-sensitivity range, to maintain an optimal infrared image while at the same time maintaining a safe and consistent heat colorization.

- Automatic range.
- Colorization of heat: +250 to +500°C (+ 482 to +932°F).
- High-sensitivity range: –20 to +150°C (–4 to +302°F).
- Low-sensitivity range: 0 to +500°C (+32 to +932°F).

10.5.5.2.4 Search and rescue mode

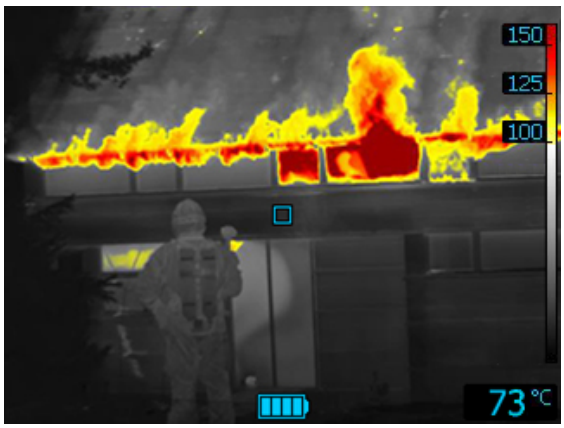


Figure 10.4 Search and rescue mode.

The *search and rescue mode* is optimized for maintaining high contrast in the infrared image while searching for people in landscapes, buildings, or traffic accident scenes.

- High-sensitivity range only.
- Colorization of heat: +100 to +150°C (+212 to +302°F).
- High-sensitivity range: –20 to +150°C (–4 to +302°F).

10.5.5.2.5 Heat detection mode

Figure 10.5 Heat detection mode.

The *heat detection mode* is optimized for searching hotspots during overhaul after the fire is out—typically to ensure that there is no remaining hidden fire. This mode can also be used to find thermal patterns (e.g., signs of people in car seats after accidents), to ensure that everyone has been found. This mode can also be used to search for people in water and open landscapes.

- High-sensitivity range only.
- Colorization of heat: the 20% highest temperatures in the scene.
- High-sensitivity range: –20 to +150°C (–4 to +302°F).

10.5.5.2.6 Cold detection mode

Figure 10.6 Cold detection mode.

The *cold detection mode* is optimized for searching coldspots—typically to find drafts and air flows.

- High-sensitivity range only.
- Colorization of cold: the 20% lowest temperatures in the scene.
- High-sensitivity range: –20 to +150°C (–4 to +302°F).

10.5.5.2.7 Building analysis mode

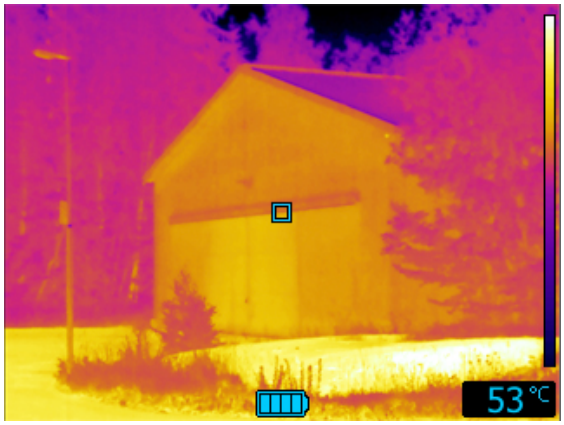


Figure 10.7 Building analysis mode.

The *building analysis mode* is suitable for the analysis of buildings and the detection of building-related anomalies. The thermal image can provide information on structural, mechanical, plumbing, and electrical constructions as well as an indication of moisture, wetness, and air infiltration.

In this mode, the camera uses an iron color palette to display the different temperatures, where black, blue, and purple are for the coldest areas, followed by red, orange, and yellow for the mid-range and going to white for the hottest parts. The temperature scale is automatically adjusted to the thermal content of the image.

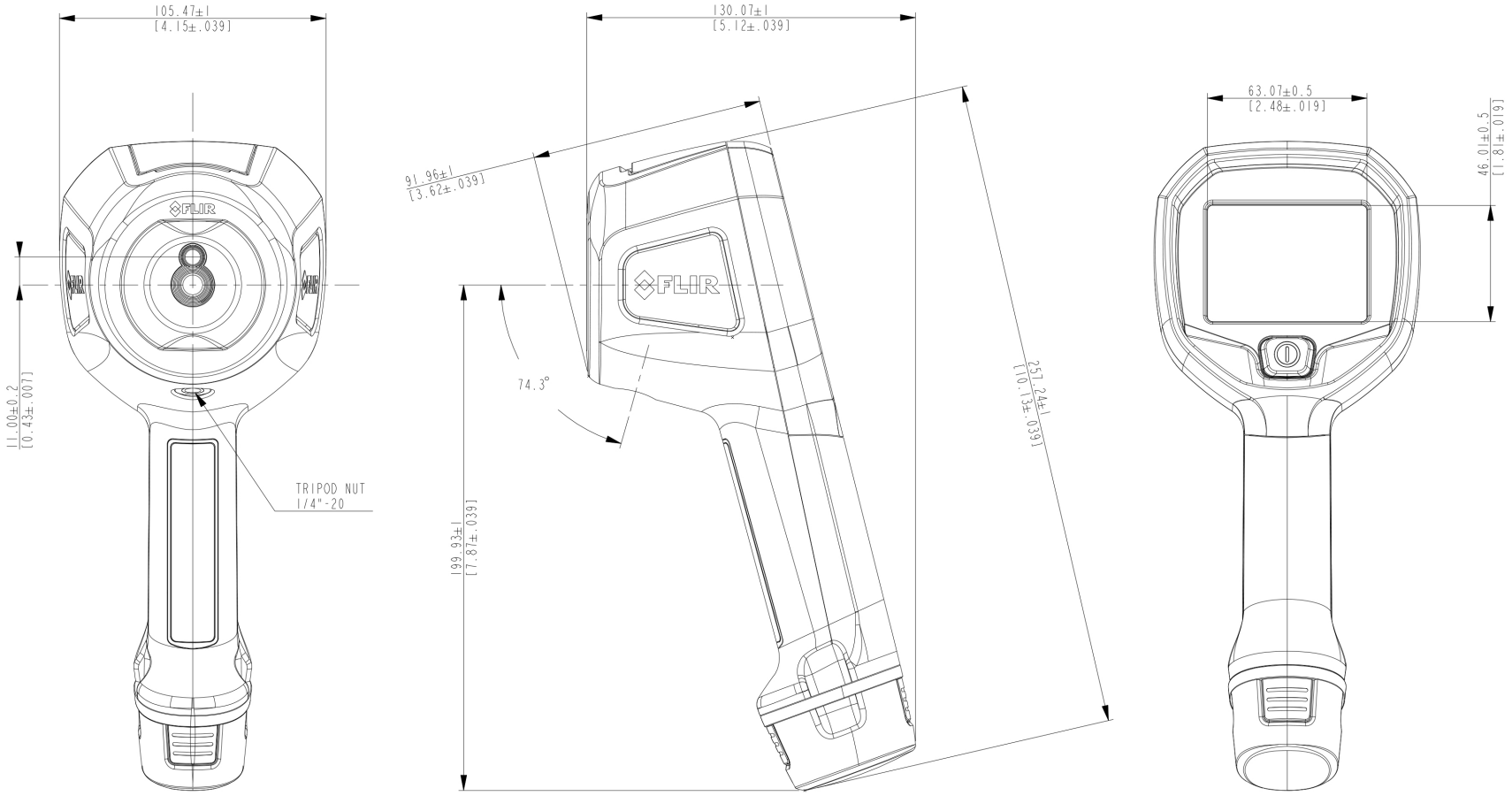
10.6 Updating the camera

To take advantage of the latest FLIR camera firmware, it is important that you keep your camera updated.

For information on how to update your camera, go to http://support.flir.com.

11 Mechanical drawings

[See next page]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[4.15±.039]
FLIR
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1/4"-20
11.00±0.2
[.433±.008]
130.07±1
[5.12±.039]
91.96±1
[3.62±.039]
74.3°
199.93±1
[7.87±.039]
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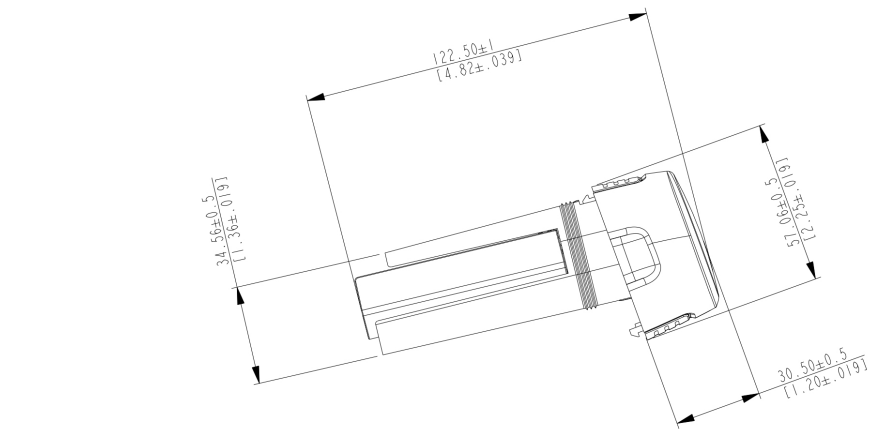
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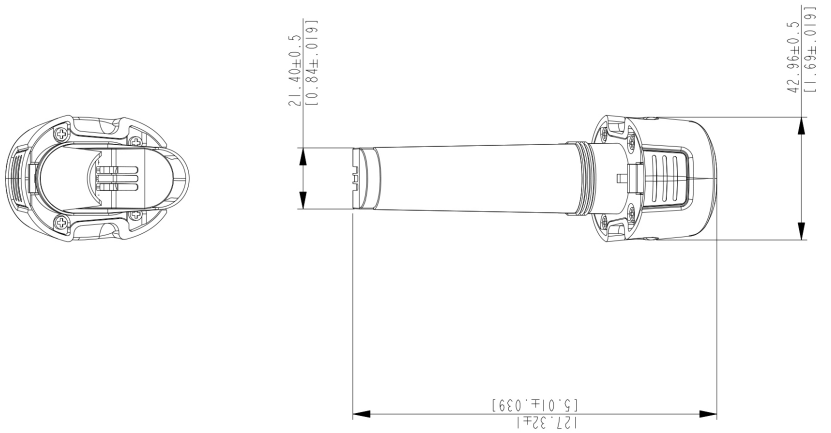
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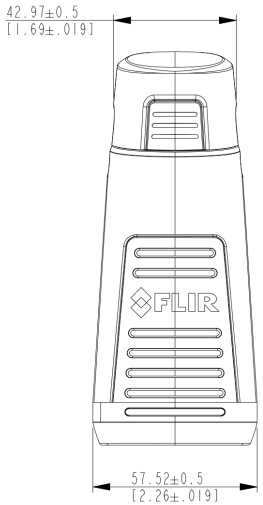
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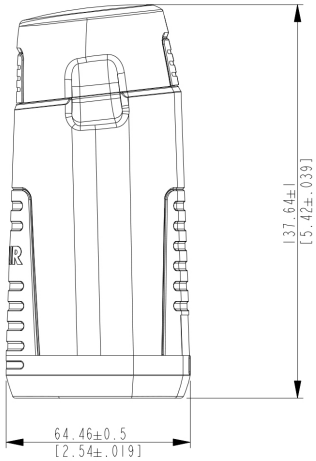
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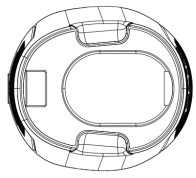

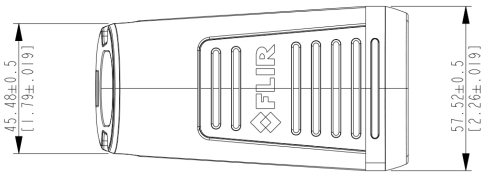
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FLIR
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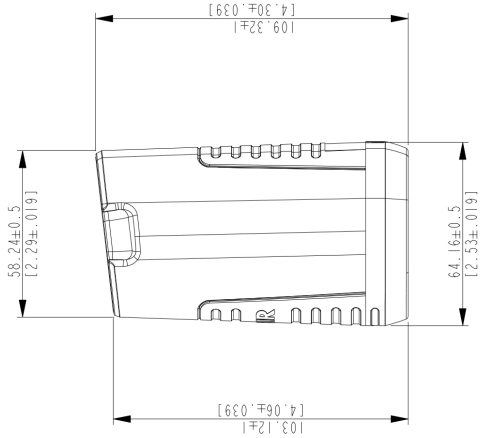
[2.26±.019]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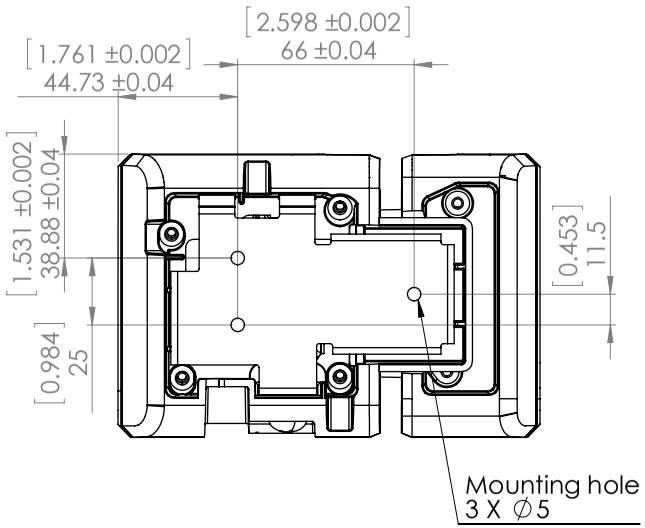

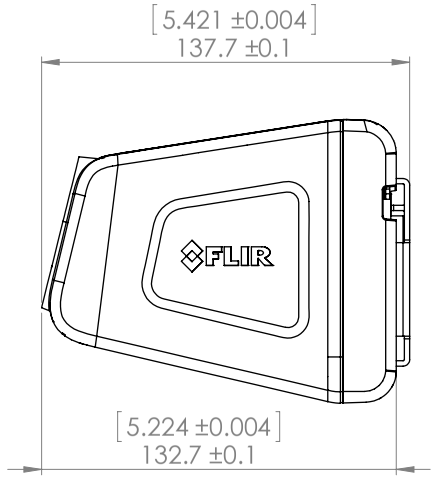

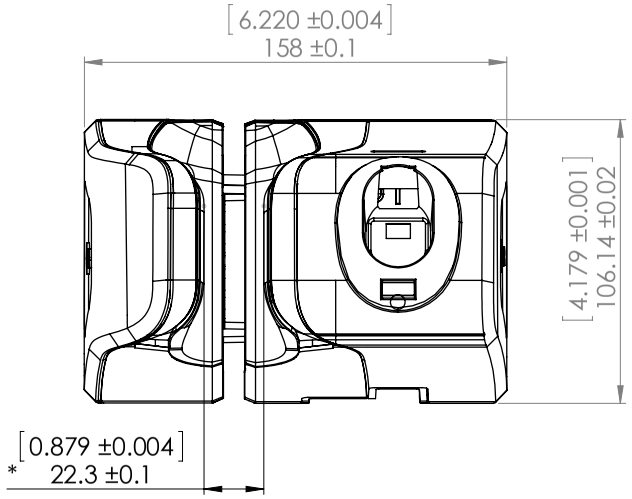

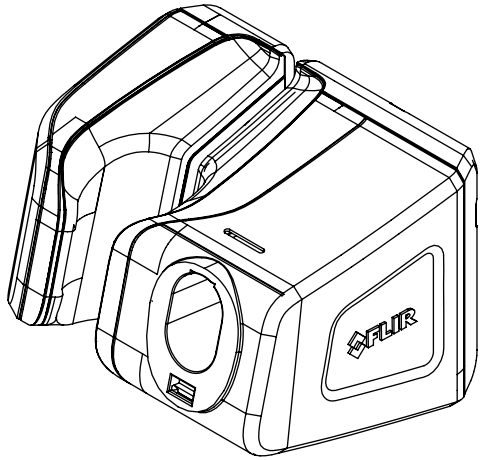

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Part Finishing: Refer Drawing		Document Responsibility / approved: Eugene	Date yy/mm/dd: 29/03/2017 / Rev: PA 1
Tolerances:		Product Name: K2 Truck Charger	
CAD Reference: Solidworks 2011		Document No.: KT 106 0271	Sheet: SHEET 1 (1)
Scale 1: 2	Units [inch] mm / Size A3		

K-ONE

12 Declaration of conformity

The full text of the Declaration of conformity is available at the following internet address: http://support.flir.com/resources/k4qd.

13 Cleaning, decontamination and disinfection

13.1 Cleaning

13.1.1 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.

13.1.2 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.

13.2 Decontamination and disinfection

- The camera must be thoroughly cleaned, decontaminated and disinfected before shipping to our service department. No hazardous residues are allowed on cameras. Such residues include—but are not limited to—chemical fire-extinguishing compounds, radioactivity, biohazardous materials, and residues from chemical fires.

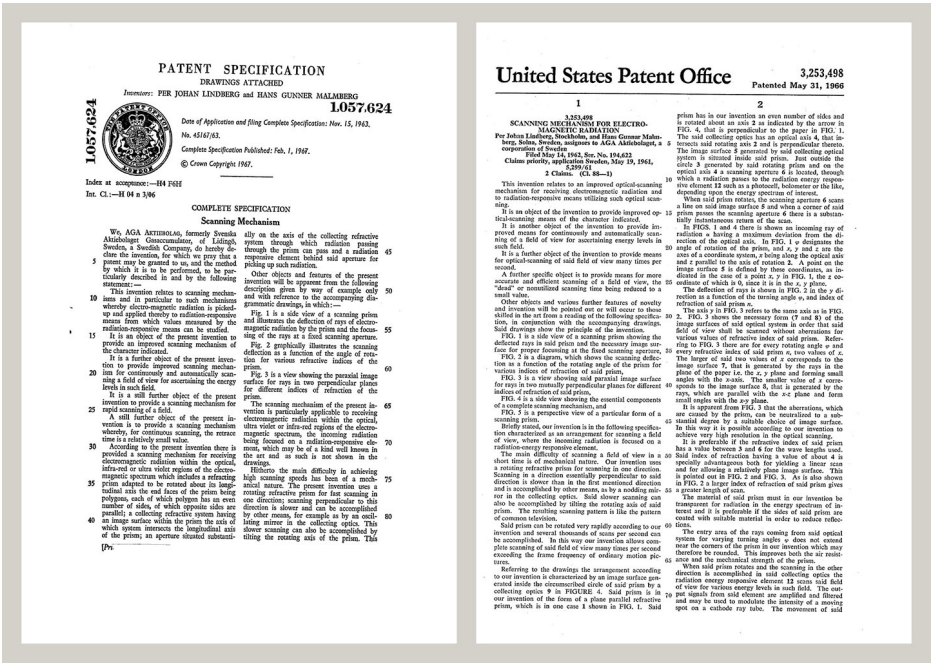
- FLIR Systems reserves the right to charge the full cost for the decontamination and disinfection of contaminated cameras that are shipped to our service department.

14 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)



PATENT SPECIFICATION

DRAWINGS ATTACHED

Inventors: PER JOHAN LINDBERG and HANS GUNNER MALMBERG

1057.624

Date of Application and filing Complete Specification: Nov. 15, 1963.

No. 45167/63.

Complete Specification Published: Feb. 1, 1967.

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Index at acceptance:—H04 F6H

Int. Cl.:—H 04 n 3/06

COMPLETE SPECIFICATION

Scanning Mechanism

We, AGA AKTIEBOLAG, formerly Svenska Aktiebolaget Gasaccumulator, of Lidingö, Sweden, a Swedish Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to scanning mechanisms and in particular to such mechanisms whereby electro-magnetic radiation is picked-up and applied thereby to radiation-responsive means from which values measured by the radiation-responsive means can be studied.

It is an object of the present invention to provide an improved scanning mechanism of the character indicated.

It is a further object of the present invention to provide improved scanning mechanism for continuously and automatically scanning a field of view for ascertaining the energy levels in such field.

It is a still further object of the present invention to provide a scanning mechanism for rapid scanning of a field.

A still further object of the present invention is to provide a scanning mechanism whereby, for continuous scanning, the retrace time is a relatively small value.

According to the present invention there is provided a scanning mechanism for receiving electromagnetic radiation within the optical, infra-red or ultra violet regions of the electromagnetic spectrum which includes a refracting prism adapted to be rotated about its longitudinal axis the end faces of the prism being polygons, each of which polygon has an even number of sides, of which opposite sides are parallel; a collecting refractive system having an image surface within the prism the axis of which system intersects the longitudinal axis of the prism; an aperture situated substantially on the axis of the collecting refractive system through which radiation passing through the prism can pass and a radiation responsive element behind said aperture for picking up such radiation.

Other objects and features of the present invention will be apparent from the following description given by way of example only and with reference to the accompanying diagrammatic drawings, in which:—

Fig. 1 is a side view of a scanning prism and illustrates the deflection of rays of electromagnetic radiation by the prism and the focussing of the rays at a fixed scanning aperture.

Fig. 2 graphically illustrates the scanning deflection as a function of the angle of rotation for various refractive indices of the prism.

Fig. 3 is a view showing the parasial image surface for rays in two perpendicular planes for different indices of refraction of the prism.

The scanning mechanism of the present invention is particularly applicable to receiving electromagnetic radiation within the optical, ultra violet or infra-red regions of the electromagnetic spectrum, the incoming radiation being focussed on a radiation-responsive element, which may be of a kind well known in the art and as such is not shown in the drawings.

Hitherto the main difficulty in achieving high scanning speeds has been of a mechanical nature. The present invention uses a rotating refractive prism for fast scanning in one direction; scanning perpendicular to this direction is slower and can be accomplished by other means, for example as by an oscillating mirror in the collecting optics. This slower scanning can also be accomplished by tilting the rotating axis of the prism. This

[Pro

United States Patent Office 3,253,498 Patented May 31, 1966

3,253,498

SCANNING MECHANISM FOR ELECTRO-MAGNETIC RADIATION

Per Johan Lindberg, Stockholm, and Hans Gunnar Malmberg, Solna, Sweden, assignors to AGA Aktiebolaget, a corporation of Sweden

Filed May 14, 1962, Ser. No. 194,622

Claim priority, application Sweden, May 19, 1961, 5,239/61

2 Claims. (Cl. 88—1)

This invention relates to an improved optical-scanning mechanism for receiving electromagnetic radiation and to radiation-responsive means utilizing such optical scanning.

It is an object of the invention to provide improved optical-scanning means of the character indicated.

It is another object of the invention to provide improved means for continuously and automatically scanning of a field of view for ascertaining energy levels in such field.

It is a further object of the invention to provide means for optical-scanning of said field of view many times per second.

A further specific object is to provide means for more accurate and efficient scanning of a field of view, the "dead" or nonutilized scanning time being reduced to a small value.

Other objects and various further features of novelty and invention will be pointed out or will occur to those skilled in the art from a reading of the following specification, in conjunction with the accompanying drawings. Said drawings show the principle of the invention.

FIG. 1 is a side view of a scanning prism showing the deflected rays in said prism and the necessary image surface for proper focussing at the fixed scanning aperture.

FIG. 2 is a diagram, which shows the scanning deflection as a function of the rotating angle of the prism for various indices of refraction of said prism.

FIG. 3 is a view showing said parasial image surface for rays in two mutually perpendicular planes for different indices of refraction of said prism.

FIG. 4 is a side view showing the essential components of a complete scanning mechanism, and

FIG. 5 is a perspective view of a particular form of a scanning prism.

Briefly stated, our invention is in the following specification characterized as an arrangement for scanning a field of view, where the incoming radiation is focused on a radiation-energy responsive element.

The main difficulty of scanning a field of view in a short time is of mechanical nature. Our invention uses a rotating refractive prism for scanning in one direction. Scanning in a direction essentially perpendicular to said direction is slower than in the first mentioned direction and is accomplished by other means, as by a nodding mirror in the collecting optics. Said slower scanning can also be accomplished by tilting the rotating axis of said prism. The resulting scanning pattern is like the pattern of common television.

Said prism can be rotated very rapidly according to our invention and several thousands of scans per second can be accomplished. In this way our invention allows complete scanning of said field of view many times per second exceeding the frame frequency of ordinary motion pictures.

Referring to the drawings the arrangement according to our invention is characterized by an image surface generated inside the circumscribed circle of said prism by a collecting optics 9 in FIGURE 4. Said prism is in our invention of the form of a plane parallel refractive prism, which is in one case 4 shown in FIG. 1. Said prism has in our invention an even number of sides and is rotated about an axis 2 as indicated by the arrow in FIG. 4, that is perpendicular to the paper in FIG. 1. The said collecting optics has an optical axis 4, that intersects said rotating axis 2 and is perpendicular thereto. The image surface 5 generated by said collecting optical system is situated inside said prism. Just outside the circle 3 generated by said rotating prism and on the optical axis 4 a scanning aperture 6 is located, through which a radiation passes to the radiation energy responsive element 12 such as a photocell, bolometer or the like, depending upon the energy spectrum of interest.

When said prism rotates, the scanning aperture 6 scans a line on said image surface 5 and when a corner of said prism passes the scanning aperture 6 there is a substantially instantaneous return of the scan.

In FIGS. 1 and 4 there is shown an incoming ray of radiation a having a maximum deviation from the direction of the optical axis. In FIG. 1 φ designates the angle of rotation of the prism, and x, y and z are the axes of a coordinate system, x being along the optical axis and z parallel to the axis of rotation 2. A point on the image surface 5 is defined by those coordinates, as indicated in the case of a point x, y in FIG. 1, the z coordinate of which is 0, since it is in the x, y plane.

The deflection of rays is shown in FIG. 2 in the y direction as a function of the turning angle φ, and index of refraction of said prism n.

The axis y in FIG. 3 refers to the same axis as in FIG. 2. FIG. 3 shows the necessary form (Y and R) of the image surfaces of said optical system in order that said field of view shall be scanned without aberrations for various values of refractive index of said prism. Referring to FIG. 3 there are for every rotating angle φ and every refractive index of said prism n, two values of x. The larger of said two values of x corresponds to the image surface 7, that is generated by the rays in the plane of the paper i.e. the x, y plane and forming small angles with the x-axis. The smaller value of x corresponds to the image surface 8, that is generated by the rays, which are parallel with the x-z plane and form small angles with the x-y plane.

It is apparent from FIG. 3 that the aberrations, which are caused by the prism, can be neutralized to a substantial degree by a suitable choice of image surface. In this way it is possible according to our invention to achieve very high resolution in the optical scanning.

It is preferable if the refractive index of said prism has a value between 3 and 6 for the wave lengths used. Said index of refraction having a value of about 4 is specially advantageous both for yielding a linear scan and for allowing a relatively plane image surface. This is pointed out in FIG. 2 and FIG. 3. As is also shown in FIG. 2 a larger index of refraction of said prism gives a greater length of scan.

The material of said prism must in our invention be transparent for radiation in the energy spectrum of interest and it is preferable if the sides of said prism are coated with suitable material in order to reduce reflections.

The entry area of the rays coming from said optical system for varying turning angles φ does not extend near the corners of the prism in our invention which may therefore be rounded. This improves both the air resistance and the mechanical strength of the prism.

When said prism rotates and the scanning in the other direction is accomplished in said collecting optics the radiation energy responsive element 12 scans said field of view for various energy levels in such field. The output signals from said element are amplified and filtered and may be used to modulate the intensity of a moving spot on a cathode ray tube. The movement of said

Figure 14.1 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.

14.1 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.

14.2 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.

14.3 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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