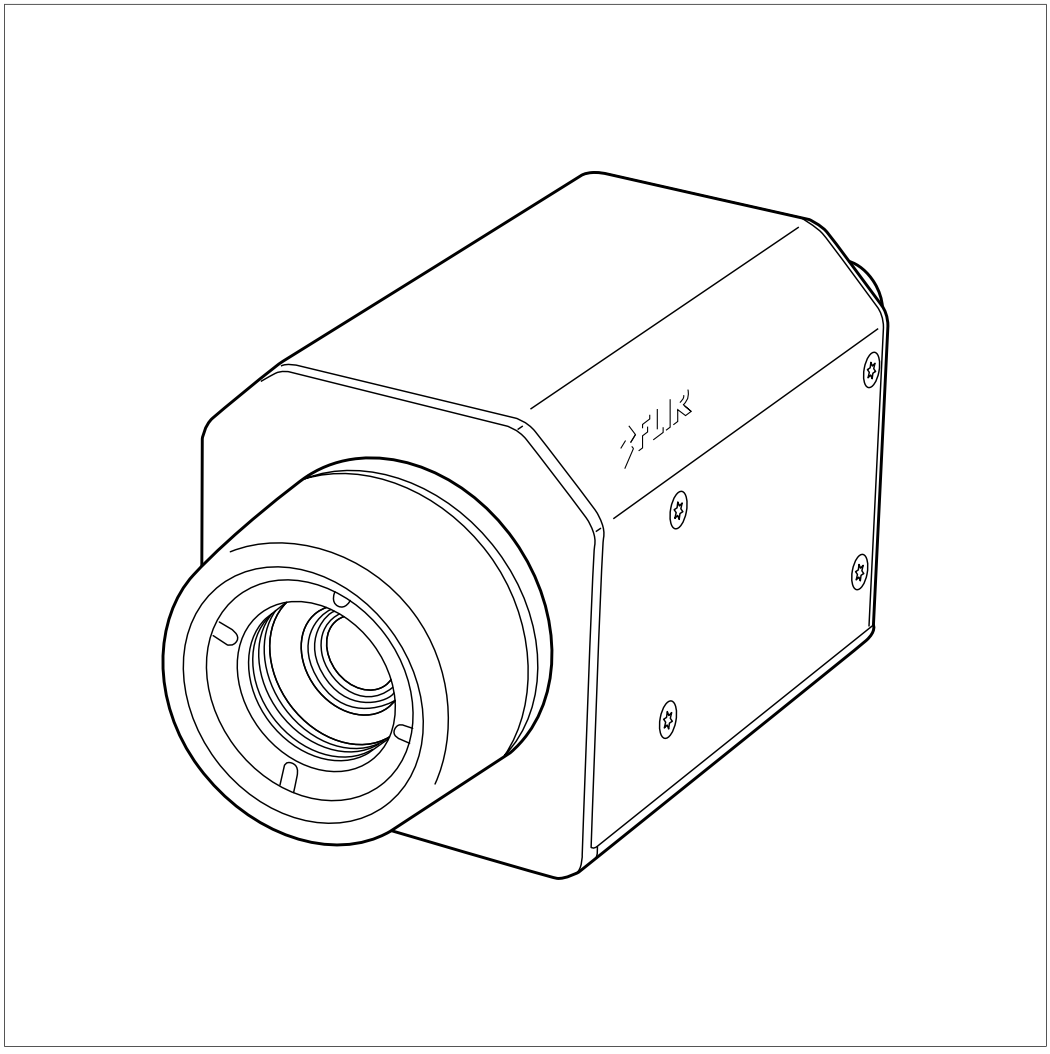
User's manual
FLIR Ax5 series



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。

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1 Legal disclaimer

1.1 Legal disclaimer

All products manufactured by FLIR Systems are warranted against defective materials and workmanship for a period of one (1) year from the delivery date of the original purchase, provided such products have been under normal storage, use and service, and in accordance with FLIR Systems instruction.

Products which are not manufactured by FLIR Systems but included in systems delivered by FLIR Systems to the original purchaser, carry the warranty, if any, of the particular supplier only. FLIR Systems has no responsibility whatsoever for such products.

The warranty extends only to the original purchaser and is not transferable. It is not applicable to any product which has been subjected to misuse, neglect, accident or abnormal conditions of operation. Expendable parts are excluded from the warranty.

In the case of a defect in a product covered by this warranty the product must not be further used in order to prevent additional damage. The purchaser shall promptly report any defect to FLIR Systems or this warranty will not apply.

FLIR Systems will, at its option, repair or replace any such defective product free of charge if, upon inspection, it proves to be defective in material or workmanship and provided that it is returned to FLIR Systems within the said one-year period.

FLIR Systems has no other obligation or liability for defects than those set forth above.

No other warranty is expressed or implied. FLIR Systems specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

FLIR Systems shall not be liable for any direct, indirect, special, incidental or consequential loss or damage, whether based on contract, tort or any other legal theory.

This warranty shall be governed by Swedish law.

Any dispute, controversy or claim arising out of or in connection with this warranty, shall be finally settled by arbitration in accordance with the Rules of the Arbitration Institute of the Stockholm Chamber of Commerce. The place of arbitration shall be Stockholm. The language to be used in the arbitral proceedings shall be English.

1.2 Usage statistics

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

1.3 Changes to registry

The registry entry HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Lsa \LmCompatibilityLevel will be automatically changed to level 2 if the FLIR Camera Monitor service detects a FLIR camera connected to the computer with a USB cable. The modification will only be executed if the camera device implements a remote network service that supports network logons.

1.4 U.S. Government Regulations

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

1.5 Copyright

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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.

1.6 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.

1.7 Patents

000439161; 000653423; 000726344; 000859020; 001707738; 001707746; 001707787; 001776519; 001954074; 002021543; 002021543-0002; 002058180; 002249953; 002531178; 002816785; 002816793; 011200326; 014347553; 057692; 061609; 07002405; 100414275; 101796816; 101796817; 101796818; 102334141; 1062100; 11063060001; 11517895; 1226865; 12300216; 12300224; 1285345; 1299699; 1325808; 1336775; 1391114; 1402918; 1404291; 1411581; 1415075; 1421497; 1458284; 1678485; 1732314; 17399650; 1880950; 1886650; 2007301511414; 2007303395047; 2008301285812; 2009301900619; 20100060357; 2010301761271; 2010301761303; 2010301761572; 2010305959313; 2011304423549; 2012304717443; 2012306207318; 2013302676195; 2015202354035; 2015304259171; 204465713; 204967995; 2106017; 2107799; 2115696; 2172004; 2315433; 2381417; 2794760001; 3006596; 3006597; 303330211; 4358936; 483782; 484155; 4889913; 4937897; 4995790001; 5177595; 540838; 579475; 584755; 599392; 60122153; 6020040116815; 602006006500.0; 6020080347796; 6020110003453; 615113; 615116; 664580; 664581; 665004; 665440; 67023029; 6707044; 677298; 68657; 69036179; 70022216; 70028915; 70028923; 70057990; 7034300; 710424; 7110035; 7154093; 7157705; 718801; 723605; 7237946; 7312822; 7332716; 7336823; 734803; 7544944; 7606484; 7634157; 7667198; 7809258; 7826736; 8018649; 8153971; 8212210; 8289372; 8340414; 8354639; 8384783; 8520970; 8565547; 8595689; 8599262; 8654239; 8680468; 8803093; 8823803; 8853631; 8933403; 9171361; 9191583; 9279728; 9280812; 9338352; 9423940; 9471970; 9595087; D549758.

1.8 EULA Terms

- You have acquired a device (“INFRARED CAMERA”) that includes software licensed by FLIR Systems AB from Microsoft Licensing, GP or its affiliates (“MS”). Those installed software products of MS origin, as well as associated media, printed materials, and “online” or electronic documentation (“SOFTWARE”) are protected by international intellectual property laws and treaties. The SOFTWARE is licensed, not sold. All rights reserved.
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- No Liability for Certain Damages. **EXCEPT AS PROHIBITED BY LAW, MS SHALL HAVE NO LIABILITY FOR ANY INDIRECT, SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES ARISING FROM OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THE SOFTWARE. THIS LIMITATION SHALL APPLY EVEN IF ANY REMEDY FAILS OF ITS ESSENTIAL PURPOSE. IN NO EVENT SHALL MS BE LIABLE FOR ANY AMOUNT IN EXCESS OF U.S. TWO HUNDRED FIFTY DOLLARS (U.S.$250.00).**
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2 Safety information

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

Applicability: FLIR Ax5.

Do not use screws that are too long. If you use screws that are too long, damage to the camera will occur. The maximum depth of the M3 holes is 4 mm (0.15 in.).

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 temperatures more than +50°C (+122°F), unless other information is specified in the user documentation or technical data. High temperatures can cause damage to the camera.

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.

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). If you disable the shutter for a longer time period, damage to the detector 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.

CAUTION

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

Do not use the pressurized air from the pneumatic air systems in a workshop when you remove dust from the detector. The air contains oil mist to lubricate the pneumatic tools and the pressure is too high. Damage to the detector can occur.

3 Notice to user

3.1 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, which is available on the calibration certificate or on the side of the camera.

3.2 Calibration

FLIR Systems recommends that you verify your calibration yearly. You can verify the calibration yourself or with the help of a FLIR Systems Partner. If preferred, FLIR Systems offers a calibration, adjustment, and general maintenance service.

3.3 Accuracy

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

3.4 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.

3.5 Training

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

3.6 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.

3.7 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.

3.8 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

The FLIR Ax5 cameras have features and functions that make them the natural choice for anyone who uses PC software to solve problems. Available resolutions include 80 × 64, 160 × 128, and 320 × 256 pixels.

Among their main features are GigE Vision and GenICam compliance, which makes them plug-and-play when used with software packages such as IMAQ Vision and Halcon.

Key features:

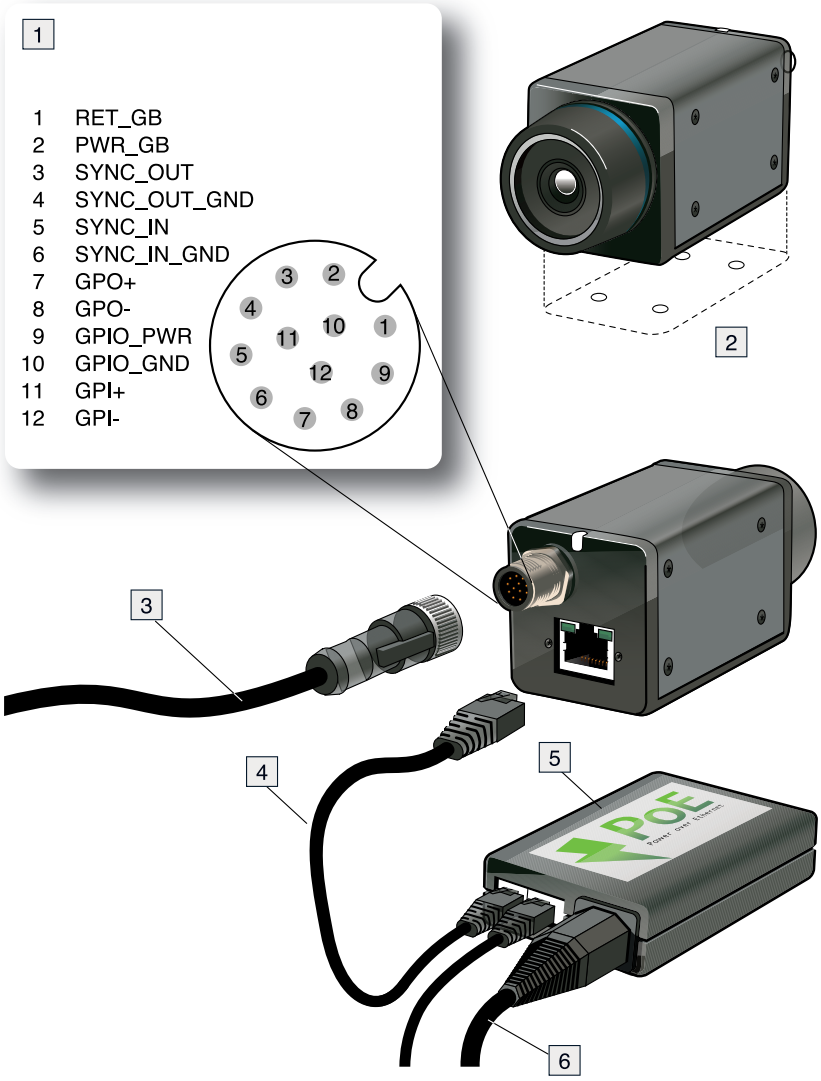
- Very affordable.
- Compact (40 × 43 × 106 mm/1.57 × 1.69 × 4.17 in.).
- GigE Vision and GenICam compliant.
- GigE Vision lockable connector.
- PoE (power over Ethernet).
- 8-bit monochrome image streaming.
- 14-bit radiometric image streaming.
- High frame rates (60 Hz).
- Synchronization between cameras possible.
- 1x+1x GPIO.
- Compliant with any software that supports GenICam, including National Instruments IMAQ Vision, Stemmers Common Vision Blox, and COGNEX Vision Pro.
- Lenses: 5°, 9°, 13°, 19°, and 25° (model-dependent).

Typical applications:

- Automation, thermal machine vision.
- Entry-level “high-speed” R&D.

6 System overview

6.1 Figure



6.2 Explanation

1. Pin configuration in M12 connector. For more information, see section 16.1 *M12 connector pin configuration*, page 78.
2. 4x M3 threaded holes.
3. Cable M12 pigtail or Cable M12 sync.
4. Ethernet cable CAT6, 2 m/6.6 ft.
5. PoE injector.
6. Cable kit mains.

7 Quick start guide

Follow this procedure:

1. Go to http://support.flir.com and download FLIR GEV Demo from the downloads section.
2. Install FLIR GEV Demo.
3. Connect the camera to power and to the computer, typically via a PoE injector connected to the Ethernet cable.
4. Start FLIR GEV Demo.
5. In FLIR GEV Demo, click the *Select/Connect* button.
6. In the GEV Device Selection window, identify the camera using the MAC address (printed on the camera). Select the camera in the list and click the *OK* button.
7. If the device is not visible, check the box “Show unreachable Network Devices” and then select the correct device and press "Set IP Address…”. Then assign the correct IP address to your device.
8. FLIR GEV Demo can now be used to set up and control the camera. Click the *Play* button to start the image stream.

8 List of accessories

Product name	Part number
Base support	T198349
Cable kit Mains (UK,EU,US)	T198348
Cable M12 Pigtail	T127605ACC
Cable M12 Sync	T127606ACC
Ethernet cable CAT6, 2 m/6.6 ft.	T951004ACC
FLIR IR Camera Player	DSW-10000
FLIR Tools	T198584
FLIR Tools+ (download card incl. license key)	T198583
Focus adjustment tool	T198342ACC
Gigabit PoE injector 16 W, with multi-plugs	T911183
Table stand kit	T198392
Transport case Ax5	T198594ACC

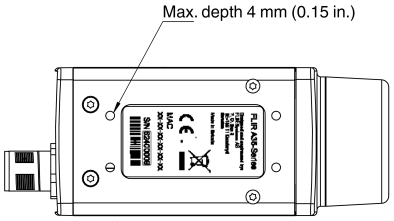
Note FLIR Systems reserves the right to discontinue models, parts or accessories, and other items, or to change specifications at any time without prior notice.

9 Mechanical installation

The camera unit has been designed to allow it to be mounted in any position. It has a mounting interface on the bottom with four metric M3 holes.

WARNING

Do not use screws that are too long. Using screws that are too long will damage the camera. The maximum depth of the M3 holes is 4 mm (0.15 in.).



Note 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 base support or a heat sink made of a material that has a high capacity to transfer heat, e.g., aluminum. FLIR Systems provides P/N T198349 (base support) for this purpose, but other base supports or heat sinks can be used.
The use of the base support is also strongly recommended in order to minimize temperature drift of the infrared detector in the camera.

If the camera unit is to be permanently mounted on the application site, certain steps have to be taken. The camera unit might need to be enclosed in a protective housing and, depending on the ambient conditions (e.g., temperature), the housing may need to be cooled by means of water or air. In very dusty conditions the installation might also need to have a stream of pressurized air directed at the lens, in order to prevent dust build-up.

When mounting the camera unit in harsh environments, every precaution should be taken when it comes to securing the unit. If the environment exposes the unit to severe vibrations, there may arise a need to secure the mounting screws by means of Loctite or another industrial brand of thread-locking liquid, as well as to dampen the vibrations by mounting the camera unit on a specially designed mounting base.

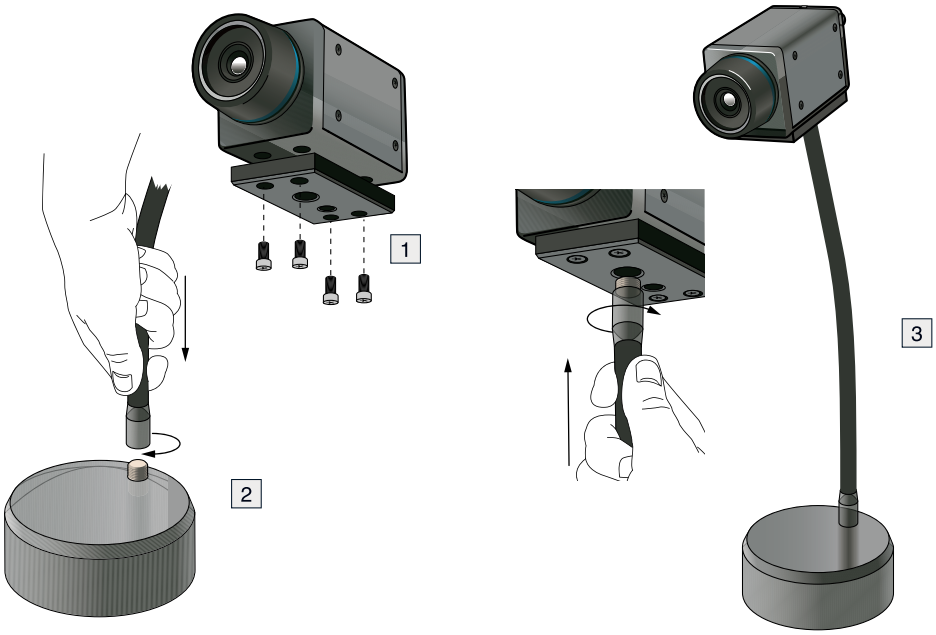
For further information regarding mounting recommendations and environmental enclosures, contact FLIR Systems.

The camera is typically powered using PoE (Power over Ethernet). A PoE injector and cable kit are available from FLIR Systems. See the part numbers below.

- T198348, Cable kit mains (UK, EU, US).
- T911112, PoE injector.
- T951004ACC, Ethernet cable CAT-6, 2 m/6.6 ft.

9.1 Table stand mounting

9.1.1 Figure



9.1.2 Explanation

1. Base support.
2. Table stand.
3. Gooseneck.

10 Focusing the camera

10.1 Focusing cameras with 5 to 19 mm lenses

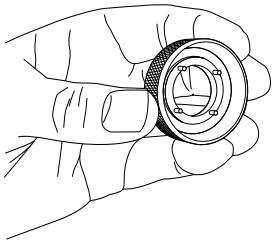
10.1.1 Necessary tools

Focus adjustment tool (included in the package for cameras with 5 to 19 mm lenses).

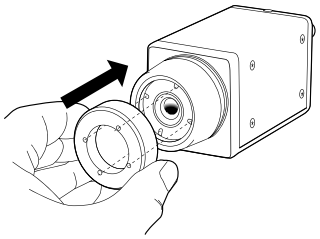
10.1.2 Procedure

Follow this procedure:

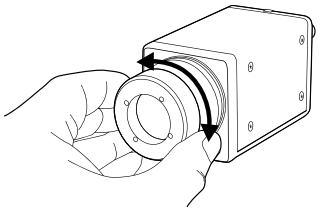
1. Note the four pegs on the inside of the focus adjustment tool.



2. Align the four pegs with the corresponding slots on the front of the lens, and push the focus adjustment tool into position.



3. Rotate the lens.



10.2 Focusing cameras with 25 to 100 mm lenses

⚠ CAUTION
Do not use the focus adjustment tool when focusing cameras with 25 to 100 mm lenses.

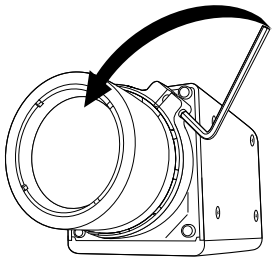
10.2.1 Necessary tools

Allen wrench, 1.5 mm.

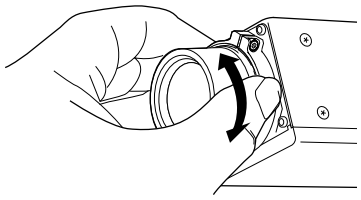
10.2.2 Procedure

Follow this procedure:

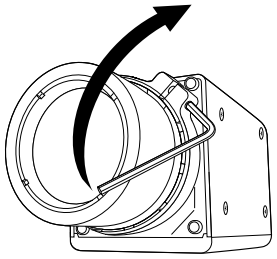
1. Unlock the clamp by loosening the Allen screw.



2. Focus the camera by rotating the lens.



3. Lock the clamp by tightening the Allen screw.



11 Downloads

The principal software used to configure and control the camera is FLIR GEV Demo 1.3.0. This software is based on the PleoraeBus SDK and the runtime Pleora GEVPlayer that comes with the SDK.

Downloads:

- http://support.flir.com/Ax5-software
- Link to download PureGEV SDK Sample (source code): http://support.flir.com/SwDownload/app/RssSWDownload.aspx?ID=133
- Link to download FLIR GEV Demo 1.3.0 (installer): http://support.flir.com/SwDownload/app/RssSWDownload.aspx?ID=155

The camera is compliant with the following standards. Additional software and documentation resources can be downloaded from these sites.

- GeniCAM: http:www.genicam.org
- Gigabit Ethernet: http://www.ieee802.org/3

12 About I/O, synchronization, and measurement

12.1 FLIR Ax5 General Purpose I/O

The FLIR Ax5 camera has one general-purpose input line and one output line that can be used in control applications.

Typical usage:

- The output line is asserted when an alarm condition is met.
- The input line is used to trigger an action, for example saving an image.

The output line GPO+ is controlled by the register *UserOutputValue*. Set this register to *True* to assert (level equal to GPIO_PWR) the GPO+ signal, and set to *False* to de-assert (level is equal to GPIO_GND).

You can monitor the input line by reading the *LineStatus* register on a regular basis. The *LineStatus* register will return*True* if the input level is asserted (level equal to GPIO_PWR voltage), and it will return*False* if the input line is de-asserted (level is equal to GPIO_ GND).

Another option is to configure the camera to send a GigEVision event when the input line state is changed. In order to configure the camera for event transmission you need to modify the following registers:

PLC_Q7_Variable0	Enum	Set this register to PLC_I0 (enumeration value 2) to route the GPI signal
EventSelector	Enum	Set this register to PLC_Interrupt_FIFO0_Q7 (enumeration value 5)
EventNotification	Enum	Set this register to GigEVisionEvent (enumeration value 3)

To de-bounce the input signal you also might want to configure the *LineDebounceFactor* register. This register controls the width of the window during which spurious transitions from the input line are filtered out (in increments of ~480 ns). This register is 0 by default, which means that the de-bouncing is disabled. The maximum value for this register is 65535, which corresponds to a maximum holding time of ~31 ms.

The FLIR GEV Demo 1.3 sample illustrates how to setup the event transmission. C++ source code is available in PureGEV SDK Sample.

Applicable downloads:

- Link to download PureGEV SDK Sample (source code): http://support.flir.com/SwDownload/app/RssSWDownload.aspx?ID=133
- Link to download FLIR GEV Demo 1.3.0 (installer): http://support.flir.com/SwDownload/app/RssSWDownload.aspx?ID=155

12.2 FLIR Ax5 synchronization

The camera provides an external sync channel that can be used to synchronize the frame start between two cameras, one configured as the master and the other configured as the slave. It can also be used to synchronize the frame start of a camera with that of another product.

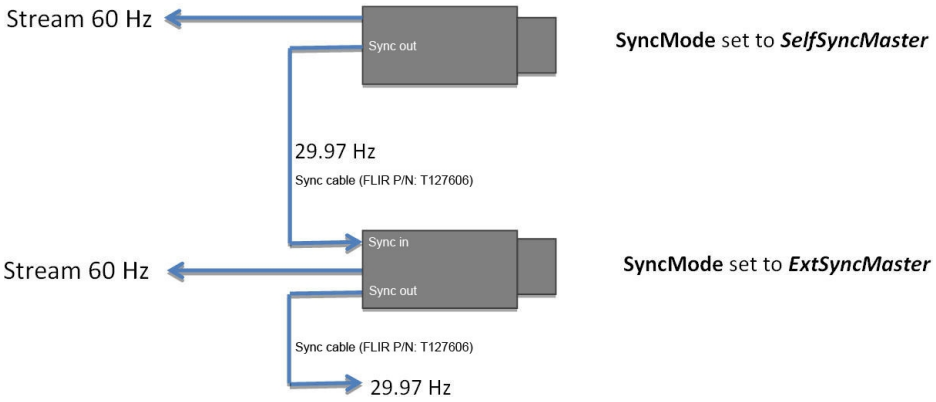


Figure 12.1 Master/slave synchronization between two FLIR Ax5 cameras (NTSC).

Note External synchronization can be applied but only by using an input signal with a frequency of 29.97 Hz (NTSC).

- The signal voltage (relative to digital GND) is 3.3 V.
- The pulse width (minimum) is 100 ns (will be extended to 1 µs).

Note that the synchronization mode is not persistent. The camera will always return to *SyncMode Disabled* after reset or power cycling.

For slow configurations (9 Hz), the output frame rate is a fraction of the sync pulse rate. Because there is ambiguity as to which received pulse triggers the frame timing, FLIR does not recommend using the external sync interface with a slow-configured camera.

Note The only difference between *ExtSyncMaster* and *SelfSyncSlave* mode is that the incoming sync signal is relayed to the SYNC_OUT port if set to *ExtSyncMaster*.

12.3 FLIR Ax5 measurement

The FLIR Ax5 camera has an option to output 14-bit digital video that is temperature linear.

Each count in the temperature-linear video corresponds to either 0.04 K or 0.4 K in 14-bit video, depending on the selected resolution.

Temperature-linear output is enabled or disabled with the feature register:

TemperatureLinearMode: On (1) or Off (0)

Temparture-linear resolution is determined with the feature register:

TemperatureLinearResolution: Low 0.4 K (0) or High 0.04 K (1)

If **TemperatureLinearMode** is On, the signal-to-temperature mapping is calculated using the equations

$$T_{[K]} = 0.04 \times S \text{ (for high resolution)}$$

$$T_{[K]} = 0.4 \times S \text{ (for low resolution)}$$

S corresponds to the 14-bit pixel value.

If the **TemperatureLinearMode** is Off, then the camera provides registers that can be used to convert signal values to temperature. For each measurement range (or gain mode) there is a set of register values that is used for this conversion.

The conversion from the corrected signal *S* to the temperature $T_{[K]}$ is performed using the external RBFO values for the selected lens and gain mode. The signal-to-temperature mapping is calculated using the equation

$$T_{[K]} = \frac{B}{\ln\left(\frac{R}{S-O} + F\right)}$$

ln(*x*) is the base-e logarithm of the *x* parameter, and *S* corresponds to the 14-bit pixel value.

Register name	Type
R	Integer
B	Float
F	Float
O	Float (handles only positive vales)
OInt	Integer (same as O but handles negative values)

Please note that these registers will be automatically updated when switching between the high gain mode and the low gain mode.

The FLIR GEV Demo sample illustrates how to use this conversion formula.

You also have the option to do your own one-point calibration by adjusting the offset value (register **OInt**) by pointing the camera at an accurately known temperature. Knowing the temperature, you can then calculate the offset value and update the **OInt** register.

$$OInt = S - \left(R \Big/ \left(\exp\left(B / T_{KNOWN}\right) - F\right)\right)$$

The FLIR GEV Demo sample illustrates how to perform this kind of calibration. Please note that you will need to save the current settings if you want the new offset value to be persistent. Use the command register **SensorSetDefaults** to set all current settings as power on defaults.

There are additional registers that also affect the temperature linear output. These registers are grouped together as Object Parameter registers. These registers only affect the transformation of detector signal values to temperature values when the camera is in temperature linear mode.

ReflectedTemperature: The estimated reflected background temperature for the target scene.

ObjectEmissivity: The target scene emissivity factor. The default value is 1.0.

WindowTransmission: The estimated transmission factor for the protective window. The default value is 1.0.

WindowTemperature: The external window temperature T_{win} (in kelvin).

AtmosphericTransmission: The estimated transmission factor for the atmosphere between the camera and the scene.

AtmosphericTemperature: The estimated temperature T_{atm} for the atmosphere between the camera and the scene.

The correction for scene parameters is extended to include the following parameters:

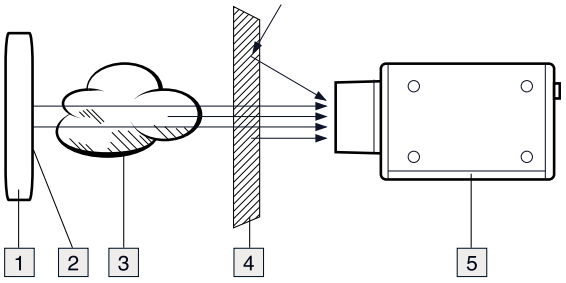


Figure 12.2 1: Scene, T_{scene}; 2: Reflected background temperature; 3: Atmosphere, T_{Atm}; 4: External window, T_{win}; 5: Infrared camera.

Note The default values for the object parameters are set to values that will have no impact on the conversion between detector signal values and corrected signal values.

13 Technical data

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13.1 Online field-of-view calculator

Please visit http://support.flir.com and click the photo of the camera series for field-of-view tables for all lens–camera combinations.

13.2 Note about technical data

FLIR Systems reserves the right to change specifications at any time without prior notice. Please check http://support.flir.com for latest changes.

13.3 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.

13.4 FLIR A35 f=9 mm with SC kit

P/N: 73309-0102
Rev.: 81605

General description
The FLIR A35 has features and functions that make it the natural choice for anyone who uses PC software to solve problems and for whom 320 × 256 pixel resolution is sufficient. Among its main features are GigE Vision and GenICam compliance, which makes it plug-and-play when used with software packages such as IMAQ Vision and Halcon.
Key features:
• Very affordable. • Compact (40 mm × 43 mm × 106 mm). • GigE Vision and GenICam compliant. • GigE Vision lockable connector. • PoE (power over Ethernet). • 8-bit 320 × 256 pixel images streamed at 60 Hz, signal linear. • 14-bit 320 × 256 pixel images streamed at 60 Hz, signal and temperature linear. • High frame rates (60 Hz). • Synchronization between cameras possible. • 1x+1x GPIO. • Compliant with any software that supports GenICam, including National Instruments IMAQ Vision, Stemmers Common Vision Blox, and COGNEX Vision Pro.
Typical applications:
• Automation and thermal machine vision. • Entry level “high-speed” R&D.

Imaging and optical data	
IR resolution	320 × 256 pixels
Thermal sensitivity/NETD	< 0.05°C @ +30°C (+86°F) / 50 mK
Field of view (FOV)	48° × 39°
Minimum focus distance	3.2 cm (1.6 in.)
Field of view (FOV) / minimum focus distance	48° × 39° / fixed focus
Focal length	9 mm (0.35 in.)
Spatial resolution (IFOV)	2.78 mrad
F-number	1.25
Image frequency	60 Hz
Focus	Fixed

Detector data	
Detector type	Focal plane array (FPA), uncooled VOX microbolometer
Spectral range	7.5–13 µm
Focal plane array (FPA) / spectral range	Uncooled VOX microbolometer / 7.5–13 µm
Detector pitch	25 µm
Detector time constant	Typical 12 ms

Measurement	
Object temperature range	• –25 to +135°C (–13 to 275°F) • –40 to +550°C (–40 to +1022°F)
Accuracy	±5°C (±9°F) or ±5% of reading

Measurement analysis	
Atmospheric transmission correction	Automatic, based on inputs for distance, atmospheric temperature and relative humidity
Optics transmission correction	Automatic, based on signals from internal sensors
Emissivity correction	Variable from 0.5 to 1.0
Reflected apparent temperature correction	Automatic, based on input of reflected temperature
External optics/windows correction	Automatic, based on input of optics/window transmission and temperature
Measurement corrections	Global object parameters

Ethernet	
Ethernet	Control and image
Ethernet, type	Gigabit Ethernet
Ethernet, standard	IEEE 802.3
Ethernet, connector type	RJ-45
Ethernet, communication	GigE Vision ver. 1.2 Client API GenICam compliant
Ethernet, image streaming	8-bit monochrome @ 60 Hz • Signal linear/ DDE • Automatic/ Manual • Flip H&V 14-bit 320 × 256 pixels @ 60 Hz • Signal linear/ DDE • Temperature linear GigE Vision and GenICam compatible
Ethernet, power	Power over Ethernet, PoE IEEE 802.3af class 0 Power
Ethernet, protocols	TCP, UDP, ICMP, IGMP, DHCP, GigEVision

Digital input/output	
Digital input, purpose	General purpose
Digital input	1× opto-isolated, “0” <1.2 VDC, “1” = 2–25 VDC.
Digital output, purpose	General purpose output to ext. device (programmatically set)
Digital output	1× opto-isolated, 2–40 VDC, max. 185 mA
Digital I/O, isolation voltage	500 VRMS
Digital I/O, supply voltage	2–40 VDC, max. 200 mA
Digital I/O, connector type	12-pole M12 connector (shared with Digital synchronization and External power)
Synchronization in, purpose	Frame synchronization in to control camera
Synchronization in	1×, non-isolated
Synchronization in, type	LVC Buffer @3.3V, “0” <0.8 V, “1”>2.0 V.
Synchronization out, purpose	Frame synchronization out to control another FLIR Ax5 camera
Synchronization out	1×, non-isolated
Synchronization out, type	LVC Buffer @ 3.3V,”0”=24 MA max, “1”= –24 mA max.
Digital synchronization, connector type	12-pole M12 connector (shared with Digital I/O and External power)

Power system	
External power operation	12/24 VDC, < 3.5 W nominal < 6.0 W absolute max.
External power, connector type	12-pole M12 connector (shared with Digital I/O and Digital Synchronization)
Voltage	Allowed range 10–30 VDC

Environmental data	
Operating temperature range	–15°C to +50°C (+5°F to +122°F) **NOTE** The operating temperature range assumes that the camera is mounted on the base support (included in the package) or a similar type of heatsink.
Storage temperature range	–40°C to +70°C (–40°F to +158°F)
Humidity (operating and storage)	IEC 60068-2-30/24 h 95% relative humidity +25°C to +40°C (+77°F to +104°F)
EMC	• EN 61000-6-2 (Immunity) • EN 61000-6-3 (Emission) • FCC 47 CFR Part 15 Class B (Emission)
Encapsulation	IP 40 (IEC 60529) with base support mounted
Shock	25 g (IEC 60068-2-27)
Vibration	2 g (IEC 60068-2-6)
Declaration of conformity	See: https://support.flir.com/resources/DoC

Physical data	
Weight	0.200 kg (0.44 lb.)
Camera size (L × W × H)	106 × 40 × 43 mm (4.2 × 1.6 × 1.7 in.)
Tripod mounting	1 × UNC ¼"-20 (with Base support accessory, included in the delivery box)
Base mounting	4 × M3 thread mounting holes (bottom)
Housing material	Magnesium and aluminum

Shipping information	
Packaging, type	Cardboard box
List of contents	• Hard transport case • Infrared camera with lens • Base support • Cable tie (2 ea.) • Ethernet cable CAT-6, 2m/6.6 ft (2 ea.) • FLIR Research Studio 1-Year Subscription (license only) • Focus adjustment tool • Gooseneck • Mains cable kit (UK,EU,US) • PoE Injector (power over Ethernet) • Printed documentation • Table stand
Packaging, weight	
Packaging, size	370 × 180 × 320 mm (14.6 × 7.1 × 12.6 in.)
EAN-13	7332558010570
UPC-12	845188011246
Country of origin	Sweden

Supplies & accessories:

- T951004ACC; Ethernet cable CAT6, 2 m/6.6 ft.
- T198349; Base support
- T198348; Cable kit Mains (UK,EU,US)
- T127605ACC; Cable M12 Pigtail
- T127606ACC; Cable M12 Sync
- T199698; Environmental housing for Ax5
- T199356; FLIR Ax5 accessory starter kit
- T911183; Gigabit PoE injector 16 W, with multi-plugs
- T198392; Table stand kit
- T198594ACC; Transport case Ax5
- T300243; FLIR Thermal Studio Pro, 1 Year Subscription
- T300083; FLIR Thermal Studio Pro, Perpetual license
- T300341; FLIR Thermal Studio Standard, 1 Year Subscription
- T300258; FLIR Thermal Studio Standard, Perpetual license
- T198584; FLIR Tools
- T198583; FLIR Tools+ (download card incl. license key)
- T199233; FLIR Atlas SDK for .NET
- T199234; FLIR Atlas SDK for MATLAB
- 4232535; FLIR Research Studio, Professional Edition - 1 Year Subscription (online activation)
- 4232556; FLIR Research Studio, Professional Edition - Perpetual License (online activation)
- 4232590; FLIR Research Studio, Professional Edition - Perpetual License (USB dongle)
- 4232557; FLIR Research Studio, Professional Edition - USB dongle only
- 4220499; FLIR Research Studio, Standard Edition - 1 Year Subscription (online activation)
- 4220500; FLIR Research Studio, Standard Edition - Perpetual License (online activation)
- 4220646; FLIR Research Studio, Standard Edition - Perpetual License (USB dongle)
- 24971-010; FLIR Research Studio, Standard Edition - USB dongle only
- 4232591; FLIR ResearchIR to Research Studio, Professional Edition - 1 Year License Upgrade

13.5 FLIR A35 FOV 69 (30 Hz, ver. 2017)

P/N: 83209-0102
Rev.: 81605

General description
The FLIR A35 has features and functions that make it the natural choice for anyone who uses PC software to solve problems and for whom 370 × 296 pixel resolution is sufficient. Among its main features are GigE Vision and GenICam compliance, which makes it plug-and-play when used with software packages such as IMAQ Vision and Halcon.
Key features:
• Very affordable. • Compact. • GigE Vision and GenICam compliant. • GigE Vision lockable connector. • PoE (power over Ethernet). • 8-bit 370 × 296 pixel images streamed at 30 Hz, signal linear. • 14-bit 370 × 296 pixel images streamed at 30 Hz, signal and temperature linear. • High frame rates (30 Hz). • Synchronization between cameras possible. • 1x+1x GPIO. • Compliant with any software that supports GenICam, including National Instruments IMAQ Vision, Stemmers Common Vision Blox, and COGNEX Vision Pro.
Typical applications:
• Automation and thermal machine vision. • Entry level “high-speed” R&D.

Imaging and optical data	
IR resolution	320 × 256 pixels
Thermal sensitivity/NETD	< 0.05°C @ +30°C (+86°F) / 50 mK
Field of view (FOV)	69° × 56°
Minimum focus distance	3.2 cm (1.6 in.)
Field of view (FOV) / minimum focus distance	
Focal length	9 mm (0.35 in.)
Spatial resolution (IFOV)	3.8 mrad
F-number	1.4
Image frequency	30 Hz
Focus	Fixed

Detector data	
Detector type	Focal plane array (FPA), uncooled VOX microbolometer
Spectral range	7.5–13 µm
Focal plane array (FPA) / spectral range	Uncooled VOX microbolometer / 7.5–13 µm
Detector pitch	34 µm
Detector time constant	Typical 12 ms

Measurement	
Object temperature range	• –25 to +135°C (–13 to 275°F) • –40 to +550°C (–40 to +1022°F)
Accuracy	±5°C (±9°F) or ±5% of reading

Measurement analysis	
Atmospheric transmission correction	Automatic, based on inputs for distance, atmospheric temperature and relative humidity
Optics transmission correction	Automatic, based on signals from internal sensors
Emissivity correction	Variable from 0.5 to 1.0
Reflected apparent temperature correction	Automatic, based on input of reflected temperature
External optics/windows correction	Automatic, based on input of optics/window transmission and temperature
Measurement corrections	Global object parameters

Ethernet	
Ethernet	Control and image
Ethernet, type	Gigabit Ethernet
Ethernet, standard	IEEE 802.3
Ethernet, connector type	RJ-45
Ethernet, communication	GigE Vision ver. 1.2 Client API GenICam compliant
Ethernet, image streaming	8-bit monochrome @ 30 Hz • Signal linear/ DDE • Automatic/ Manual • Flip H&V 14-bit 370 × 296 pixels @ 30 Hz • Signal linear/ DDE • Temperature linear GigE Vision and GenICam compatible
Ethernet, power	Power over Ethernet, PoE IEEE 802.3af class 0 Power
Ethernet, protocols	TCP, UDP, ICMP, IGMP, DHCP, GigEVision

Digital input/output	
Digital input, purpose	General purpose
Digital input	1× opto-isolated, “0” <1.2 VDC, “1” = 2–25 VDC.
Digital output, purpose	General purpose output to ext. device (programmatically set)
Digital output	1× opto-isolated, 2–40 VDC, max. 185 mA
Digital I/O, isolation voltage	500 VRMS
Digital I/O, supply voltage	2–40 VDC, max. 200 mA
Digital I/O, connector type	12-pole M12 connector (shared with Digital synchronization and External power)
Synchronization in, purpose	Frame synchronization in to control camera
Synchronization in	1×, non-isolated
Synchronization in, type	LVC Buffer @3.3V, “0” <0.8 V, “1”>2.0 V.
Synchronization out, purpose	Frame synchronization out to control another FLIR Ax5 camera
Synchronization out	1×, non-isolated
Synchronization out, type	LVC Buffer @ 3.3V,”0”=24 MA max, “1”= –24 mA max.
Digital synchronization, connector type	12-pole M12 connector (shared with Digital I/O and External power)

Power system	
External power operation	12/24 VDC, < 3.5 W nominal < 6.0 W absolute max.
External power, connector type	12-pole M12 connector (shared with Digital I/O and Digital Synchronization)
Voltage	Allowed range 10–30 VDC

Environmental data	
Operating temperature range	–15°C to +60°C (+5°F to +140°F) **NOTE** The operating temperature range assumes that the camera is mounted on the base support (included in the package) or a similar type of heatsink.
Storage temperature range	–40°C to +70°C (–40°F to +158°F)
Humidity (operating and storage)	IEC 60068-2-30/24 h 95% relative humidity +25°C to +40°C (+77°F to +104°F)
EMC	• EN 61000-6-2 (Immunity) • EN 61000-6-3 (Emission) • FCC 47 CFR Part 15 Class B (Emission)
Encapsulation	IP 40 (IEC 60529) with base support mounted
Shock	25 g (IEC 60068-2-27)
Vibration	2 g (IEC60068-2-6) and MIL-STD810G
Declaration of conformity	See: https://support.flir.com/resources/DoC

Physical data	
Camera size (L × W × H)	104.1 × 49.6 × 46.6 mm (4.1 × 1.9 × 1.8 in.)
Tripod mounting	1 × UNC ¼"-20 (with Base support accessory, included in the delivery box)
Base mounting	4 × M3 thread mounting holes (bottom)
Housing material	Magnesium and aluminum

Shipping information	
Packaging, type	Cardboard box
List of contents	• Infrared camera with lens • Base support • Focus adjustment tool • Printed documentation
EAN-13	7332558013106
UPC-12	845188014889
Country of origin	Sweden

Supplies & accessories:

- T951004ACC; Ethernet cable CAT6, 2 m/6.6 ft.
- T198349; Base support
- T198348; Cable kit Mains (UK,EU,US)
- T127605ACC; Cable M12 Pigtail
- T127606ACC; Cable M12 Sync
- T199698; Environmental housing for Ax5
- T199356; FLIR Ax5 accessory starter kit
- T198342ACC; Focus adjustment tool
- T911183; Gigabit PoE injector 16 W, with multi-plugs
- T198392; Table stand kit

- T198594ACC; Transport case Ax5
- T199722; ThermoVision EFD, max. 2 cameras
- T199724; ThermoVision EFD, max. 4 cameras
- T300243; FLIR Thermal Studio Pro, 1 Year Subscription
- T300083; FLIR Thermal Studio Pro, Perpetual license
- T300341; FLIR Thermal Studio Standard, 1 Year Subscription
- T300258; FLIR Thermal Studio Standard, Perpetual license
- T198584; FLIR Tools
- T198583; FLIR Tools+ (download card incl. license key)
- T199233; FLIR Atlas SDK for .NET
- T199234; FLIR Atlas SDK for MATLAB
- 4232535; FLIR Research Studio, Professional Edition - 1 Year Subscription (online activation)
- 4232556; FLIR Research Studio, Professional Edition - Perpetual License (online activation)
- 4232590; FLIR Research Studio, Professional Edition - Perpetual License (USB dongle)
- 4232557; FLIR Research Studio, Professional Edition - USB dongle only
- 4220499; FLIR Research Studio, Standard Edition - 1 Year Subscription (online activation)
- 4220500; FLIR Research Studio, Standard Edition - Perpetual License (online activation)
- 4220646; FLIR Research Studio, Standard Edition - Perpetual License (USB dongle)
- 24971-010; FLIR Research Studio, Standard Edition - USB dongle only
- 4232591; FLIR ResearchIR to Research Studio, Professional Edition - 1 Year License Upgrade

13.6 FLIR A35 FOV 45 (60 Hz, ver. 2017)

P/N: 83207-0102
Rev.: 81605

General description
The FLIR A35 has features and functions that make it the natural choice for anyone who uses PC software to solve problems and for whom 320 × 256 pixel resolution is sufficient. Among its main features are GigE Vision and GenICam compliance, which makes it plug-and-play when used with software packages such as IMAQ Vision and Halcon.
Key features:
• Very affordable. • Compact • GigE Vision and GenICam compliant. • GigE Vision lockable connector. • PoE (power over Ethernet). • 8-bit 320 × 256 pixel images streamed at 60 Hz, signal linear. • 14-bit 320 × 256 pixel images streamed at 60 Hz, signal and temperature linear. • High frame rates (60 Hz). • Synchronization between cameras possible. • 1x+1x GPIO. • Compliant with any software that supports GenICam, including National Instruments IMAQ Vision, Stemmers Common Vision Blox, and COGNEX Vision Pro.
Typical applications:
• Automation and thermal machine vision. • Entry level “high-speed” R&D.

Imaging and optical data	
IR resolution	320 × 256 pixels
Thermal sensitivity/NETD	< 0.05°C @ +30°C (+86°F) / 50 mK
Field of view (FOV)	45° × 35°
Minimum focus distance	2.5 cm (0.98 in.)
Field of view (FOV) / minimum focus distance	48° × 39° / fixed focus
Focal length	7.5 mm (0.30 in.)
Spatial resolution (IFOV)	2.267 mrad
F-number	1.4
Image frequency	60 Hz
Focus	Fixed

Detector data	
Detector type	Focal plane array (FPA), uncooled VOX microbolometer
Spectral range	7.5–13 µm
Focal plane array (FPA) / spectral range	Uncooled VOX microbolometer / 7.5–13 µm
Detector pitch	17 µm
Detector time constant	Typical 12 ms

Measurement	
Object temperature range	• –25 to +100°C (–13 to 212°F) • –40 to +550°C (–40 to +1022°F)
Accuracy	±5°C (±9°F) or ±5% of reading

Measurement analysis	
Atmospheric transmission correction	Automatic, based on inputs for distance, atmospheric temperature and relative humidity
Optics transmission correction	Automatic, based on signals from internal sensors
Emissivity correction	Variable from 0.5 to 1.0
Reflected apparent temperature correction	Automatic, based on input of reflected temperature
External optics/windows correction	Automatic, based on input of optics/window transmission and temperature
Measurement corrections	Global object parameters

Ethernet	
Ethernet	Control and image
Ethernet, type	Gigabit Ethernet
Ethernet, standard	IEEE 802.3
Ethernet, connector type	RJ-45
Ethernet, communication	GigE Vision ver. 1.2 Client API GenICam compliant
Ethernet, image streaming	8-bit monochrome @ 60 Hz • Signal linear/ DDE • Automatic/ Manual • Flip H&V 14-bit 320 × 256 pixels @ 60 Hz • Signal linear/ DDE • Temperature linear GigE Vision and GenICam compatible
Ethernet, power	Power over Ethernet, PoE IEEE 802.3af class 0 Power
Ethernet, protocols	TCP, UDP, ICMP, IGMP, DHCP, GigEVision

Digital input/output	
Digital input, purpose	General purpose
Digital input	1× opto-isolated, “0” <1.2 VDC, “1” = 2–25 VDC.
Digital output, purpose	General purpose output to ext. device (programmatically set)
Digital output	1× opto-isolated, 2–40 VDC, max. 185 mA
Digital I/O, isolation voltage	500 VRMS
Digital I/O, supply voltage	2–40 VDC, max. 200 mA
Digital I/O, connector type	12-pole M12 connector (shared with Digital synchronization and External power)
Synchronization in, purpose	Frame synchronization in to control camera
Synchronization in	1×, non-isolated
Synchronization in, type	LVC Buffer @3.3V, “0” <0.8 V, “1”>2.0 V.
Synchronization out, purpose	Frame synchronization out to control another FLIR Ax5 camera
Synchronization out	1×, non-isolated
Synchronization out, type	LVC Buffer @ 3.3V,”0”=24 MA max, “1”= –24 mA max.
Digital synchronization, connector type	12-pole M12 connector (shared with Digital I/O and External power)

Power system	
External power operation	12/24 VDC, < 3.5 W nominal < 6.0 W absolute max.
External power, connector type	12-pole M12 connector (shared with Digital I/O and Digital Synchronization)
Voltage	Allowed range 10–30 VDC

Environmental data	
Operating temperature range	–15°C to +60°C (+5°F to +140°F) **NOTE** The operating temperature range assumes that the camera is mounted on the base support (included in the package) or a similar type of heatsink.
Storage temperature range	–40°C to +70°C (–40°F to +158°F)
Humidity (operating and storage)	IEC 60068-2-30/24 h 95% relative humidity +25°C to +40°C (+77°F to +104°F)
EMC	• EN 61000-6-2 (Immunity) • EN 61000-6-3 (Emission) • FCC 47 CFR Part 15 Class B (Emission)
Encapsulation	IP 40 (IEC 60529) with base support mounted
Shock	25 g (IEC 60068-2-27)
Vibration	2 g (IEC60068-2-6) and MIL-STD810G
Declaration of conformity	See: https://support.flir.com/resources/DoC

Physical data	
Camera size (L × W × H)	104.1 × 49.6 × 46.6 mm (4.1 × 1.9 × 1.8 in.)
Tripod mounting	1 × UNC ¼"-20 (with Base support accessory, included in the delivery box)
Base mounting	4 × M3 thread mounting holes (bottom)
Housing material	Magnesium and aluminum

Shipping information	
Packaging, type	Cardboard box
List of contents	• Infrared camera with lens • Base support • Focus adjustment tool • Printed documentation
EAN-13	7332558013120
UPC-12	845188014865
Country of origin	Sweden

Supplies & accessories:

- T951004ACC; Ethernet cable CAT6, 2 m/6.6 ft.
- T198349; Base support
- T198348; Cable kit Mains (UK,EU,US)
- T127605ACC; Cable M12 Pigtail
- T127606ACC; Cable M12 Sync
- T199698; Environmental housing for Ax5
- T199356; FLIR Ax5 accessory starter kit
- T198342ACC; Focus adjustment tool
- T911183; Gigabit PoE injector 16 W, with multi-plugs
- T198392; Table stand kit

- T198594ACC; Transport case Ax5
- T199722; ThermoVision EFD, max. 2 cameras
- T199724; ThermoVision EFD, max. 4 cameras
- T300243; FLIR Thermal Studio Pro, 1 Year Subscription
- T300083; FLIR Thermal Studio Pro, Perpetual license
- T300341; FLIR Thermal Studio Standard, 1 Year Subscription
- T300258; FLIR Thermal Studio Standard, Perpetual license
- T198584; FLIR Tools
- T198583; FLIR Tools+ (download card incl. license key)
- T199233; FLIR Atlas SDK for .NET
- T199234; FLIR Atlas SDK for MATLAB
- 4232535; FLIR Research Studio, Professional Edition - 1 Year Subscription (online activation)
- 4232556; FLIR Research Studio, Professional Edition - Perpetual License (online activation)
- 4232590; FLIR Research Studio, Professional Edition - Perpetual License (USB dongle)
- 4232557; FLIR Research Studio, Professional Edition - USB dongle only
- 4220499; FLIR Research Studio, Standard Edition - 1 Year Subscription (online activation)
- 4220500; FLIR Research Studio, Standard Edition - Perpetual License (online activation)
- 4220646; FLIR Research Studio, Standard Edition - Perpetual License (USB dongle)
- 24971-010; FLIR Research Studio, Standard Edition - USB dongle only
- 4232591; FLIR ResearchIR to Research Studio, Professional Edition - 1 Year License Upgrade

13.7 FLIR A35 FOV 25 (60 Hz, ver. 2017)

P/N: 83213-0102
Rev.: 81605

General description
The FLIR A35 has features and functions that make it the natural choice for anyone who uses PC software to solve problems and for whom 320 × 256 pixel resolution is sufficient. Among its main features are GigE Vision and GenICam compliance, which makes it plug-and-play when used with software packages such as IMAQ Vision and Halcon.
Key features:
• Very affordable. • Compact. • GigE Vision and GenICam compliant. • GigE Vision lockable connector. • PoE (power over Ethernet). • 8-bit 320 × 256 pixel images streamed at 60 Hz, signal linear. • 14-bit 320 × 256 pixel images streamed at 60 Hz, signal and temperature linear. • High frame rates (60 Hz). • Synchronization between cameras possible. • 1x+1x GPIO. • Compliant with any software that supports GenICam, including National Instruments IMAQ Vision, Stemmers Common Vision Blox, and COGNEX Vision Pro.
Typical applications:
• Automation and thermal machine vision. • Entry level “high-speed” R&D.

Imaging and optical data	
IR resolution	320 × 256 pixels
Thermal sensitivity/NETD	< 0.05°C @ +30°C (+86°F) / 50 mK
Field of view (FOV)	25° × 19°
Minimum focus distance	7.6 cm (3.0 in.)
Field of view (FOV) / minimum focus distance	25° × 19° / fixed focus
Focal length	13 mm (0.51 in.)
Spatial resolution (IFOV)	1.308 mrad
F-number	1.25
Image frequency	60 Hz
Focus	Fixed

Detector data	
Detector type	Focal plane array (FPA), uncooled VOX microbolometer
Spectral range	7.5–13 µm
Focal plane array (FPA) / spectral range	Uncooled VOX microbolometer / 7.5–13 µm
Detector pitch	17 µm
Detector time constant	Typical 12 ms

Measurement	
Object temperature range	• –25 to +100°C (–13 to 212°F) • –40 to +550°C (–40 to +1022°F)
Accuracy	±5°C (±9°F) or ±5% of reading

Measurement analysis	
Atmospheric transmission correction	Automatic, based on inputs for distance, atmospheric temperature and relative humidity
Optics transmission correction	Automatic, based on signals from internal sensors
Emissivity correction	Variable from 0.5 to 1.0
Reflected apparent temperature correction	Automatic, based on input of reflected temperature
External optics/windows correction	Automatic, based on input of optics/window transmission and temperature
Measurement corrections	Global object parameters

Ethernet	
Ethernet	Control and image
Ethernet, type	Gigabit Ethernet
Ethernet, standard	IEEE 802.3
Ethernet, connector type	RJ-45
Ethernet, communication	GigE Vision ver. 1.2 Client API GenICam compliant
Ethernet, image streaming	8-bit monochrome @ 60 Hz • Signal linear/ DDE • Automatic/ Manual • Flip H&V 14-bit 320 × 256 pixels @ 60 Hz • Signal linear/ DDE • Temperature linear GigE Vision and GenICam compatible
Ethernet, power	Power over Ethernet, PoE IEEE 802.3af class 0 Power
Ethernet, protocols	TCP, UDP, ICMP, IGMP, DHCP, GigEVision

Digital input/output	
Digital input, purpose	General purpose
Digital input	1× opto-isolated, “0” <1.2 VDC, “1” = 2–25 VDC.
Digital output, purpose	General purpose output to ext. device (programmatically set)
Digital output	1× opto-isolated, 2–40 VDC, max. 185 mA
Digital I/O, isolation voltage	500 VRMS
Digital I/O, supply voltage	2–40 VDC, max. 200 mA
Digital I/O, connector type	12-pole M12 connector (shared with Digital synchronization and External power)
Synchronization in, purpose	Frame synchronization in to control camera
Synchronization in	1×, non-isolated
Synchronization in, type	LVC Buffer @3.3V, “0” <0.8 V, “1”>2.0 V.
Synchronization out, purpose	Frame synchronization out to control another FLIR Ax5 camera
Synchronization out	1×, non-isolated
Synchronization out, type	LVC Buffer @ 3.3V,”0”=24 MA max, “1”= –24 mA max.
Digital synchronization, connector type	12-pole M12 connector (shared with Digital I/O and External power)

Power system	
External power operation	12/24 VDC, < 3.5 W nominal < 6.0 W absolute max.
External power, connector type	12-pole M12 connector (shared with Digital I/O and Digital Synchronization)
Voltage	Allowed range 10–30 VDC

Environmental data	
Operating temperature range	–15°C to +60°C (+5°F to +140°F) **NOTE** The operating temperature range assumes that the camera is mounted on the base support (included in the package) or a similar type of heatsink.
Storage temperature range	–40°C to +70°C (–40°F to +158°F)
Humidity (operating and storage)	IEC 60068-2-30/24 h 95% relative humidity +25°C to +40°C (+77°F to +104°F)
EMC	• EN 61000-6-2 (Immunity) • EN 61000-6-3 (Emission) • FCC 47 CFR Part 15 Class B (Emission)
Encapsulation	IP 40 (IEC 60529) with base support mounted
Shock	25 g (IEC 60068-2-27)
Vibration	2 g (IEC60068-2-6) and MIL-STD810G
Declaration of conformity	See: https://support.flir.com/resources/DoC

Physical data	
Camera size (L × W × H)	104.1 × 49.6 × 46.6 mm (4.1 × 1.9 × 1.8 in.)
Tripod mounting	1 × UNC ¼"-20 (with Base support accessory, included in the delivery box)
Base mounting	4 × M3 thread mounting holes (bottom)
Housing material	Magnesium and aluminum

Shipping information	
Packaging, type	Cardboard box
List of contents	• Infrared camera with lens • Base support • Focus adjustment tool • Printed documentation
EAN-13	7332558013090
UPC-12	845188014858
Country of origin	Sweden

Supplies & accessories:

- T951004ACC; Ethernet cable CAT6, 2 m/6.6 ft.
- T198349; Base support
- T198348; Cable kit Mains (UK,EU,US)
- T127605ACC; Cable M12 Pigtail
- T127606ACC; Cable M12 Sync
- T199698; Environmental housing for Ax5
- T199356; FLIR Ax5 accessory starter kit
- T198342ACC; Focus adjustment tool
- T911183; Gigabit PoE injector 16 W, with multi-plugs
- T198392; Table stand kit

- T198594ACC; Transport case Ax5
- T199722; ThermoVision EFD, max. 2 cameras
- T199724; ThermoVision EFD, max. 4 cameras
- T300243; FLIR Thermal Studio Pro, 1 Year Subscription
- T300083; FLIR Thermal Studio Pro, Perpetual license
- T300341; FLIR Thermal Studio Standard, 1 Year Subscription
- T300258; FLIR Thermal Studio Standard, Perpetual license
- T198584; FLIR Tools
- T198583; FLIR Tools+ (download card incl. license key)
- T199233; FLIR Atlas SDK for .NET
- T199234; FLIR Atlas SDK for MATLAB
- 4232535; FLIR Research Studio, Professional Edition - 1 Year Subscription (online activation)
- 4232556; FLIR Research Studio, Professional Edition - Perpetual License (online activation)
- 4232590; FLIR Research Studio, Professional Edition - Perpetual License (USB dongle)
- 4232557; FLIR Research Studio, Professional Edition - USB dongle only
- 4220499; FLIR Research Studio, Standard Edition - 1 Year Subscription (online activation)
- 4220500; FLIR Research Studio, Standard Edition - Perpetual License (online activation)
- 4220646; FLIR Research Studio, Standard Edition - Perpetual License (USB dongle)
- 24971-010; FLIR Research Studio, Standard Edition - USB dongle only
- 4232591; FLIR ResearchIR to Research Studio, Professional Edition - 1 Year License Upgrade

13.8 FLIR A35 FOV 13 (60 Hz, ver. 2017)

P/N: 83225-0101
Rev.: 81605

General description
The FLIR A35 has features and functions that make it the natural choice for anyone who uses PC software to solve problems and for whom 320 × 256 pixel resolution is sufficient. Among its main features are GigE Vision and GenICam compliance, which makes it plug-and-play when used with software packages such as IMAQ Vision and Halcon.
Key features:
• Very affordable. • Compact • GigE Vision and GenICam compliant. • GigE Vision lockable connector. • PoE (power over Ethernet). • 8-bit 320 × 256 pixel images streamed at 60 Hz, signal linear. • 14-bit 320 × 256 pixel images streamed at 60 Hz, signal and temperature linear. • High frame rates (60 Hz). • Synchronization between cameras possible. • 1x+1x GPIO. • Compliant with any software that supports GenICam, including National Instruments IMAQ Vision, Stemmers Common Vision Blox, and COGNEX Vision Pro.
Typical applications:
• Automation and thermal machine vision. • Entry level “high-speed” R&D.

Imaging and optical data	
IR resolution	320 × 256 pixels
Thermal sensitivity/NETD	< 0.05°C @ +30°C (+86°F) / 50 mK
Field of view (FOV)	13° × 10°
Minimum focus distance	30 cm (12 in.)
Field of view (FOV) / minimum focus distance	
Focal length	25 mm (0.98 in.)
Spatial resolution (IFOV)	0.680 mrad
F-number	1.1
Image frequency	60 Hz
Focus	Fixed

Detector data	
Detector type	Focal plane array (FPA), uncooled VOX microbolometer
Spectral range	7.5–13 µm
Focal plane array (FPA) / spectral range	Uncooled VOX microbolometer / 7.5–13 µm
Detector pitch	17 µm
Detector time constant	Typical 12 ms

Measurement	
Object temperature range	• –25 to +100°C (–13 to 212°F) • –40 to +550°C (–40 to +1022°F)
Accuracy	±5°C (±9°F) or ±5% of reading

Measurement analysis	
Atmospheric transmission correction	Automatic, based on inputs for distance, atmospheric temperature and relative humidity
Optics transmission correction	Automatic, based on signals from internal sensors
Emissivity correction	Variable from 0.5 to 1.0
Reflected apparent temperature correction	Automatic, based on input of reflected temperature
External optics/windows correction	Automatic, based on input of optics/window transmission and temperature
Measurement corrections	Global object parameters

Ethernet	
Ethernet	Control and image
Ethernet, type	Gigabit Ethernet
Ethernet, standard	IEEE 802.3
Ethernet, connector type	RJ-45
Ethernet, communication	GigE Vision ver. 1.2 Client API GenICam compliant
Ethernet, image streaming	8-bit monochrome @ 60 Hz • Signal linear/ DDE • Automatic/ Manual • Flip H&V 14-bit 320 × 256 pixels @ 60 Hz • Signal linear/ DDE • Temperature linear GigE Vision and GenICam compatible
Ethernet, power	Power over Ethernet, PoE IEEE 802.3af class 0 Power
Ethernet, protocols	TCP, UDP, ICMP, IGMP, DHCP, GigEVision

Digital input/output	
Digital input, purpose	General purpose
Digital input	1× opto-isolated, “0” <1.2 VDC, “1” = 2–25 VDC.
Digital output, purpose	General purpose output to ext. device (programmatically set)
Digital output	1× opto-isolated, 2–40 VDC, max. 185 mA
Digital I/O, isolation voltage	500 VRMS
Digital I/O, supply voltage	2–40 VDC, max. 200 mA
Digital I/O, connector type	12-pole M12 connector (shared with Digital synchronization and External power)
Synchronization in, purpose	Frame synchronization in to control camera
Synchronization in	1×, non-isolated
Synchronization in, type	LVC Buffer @3.3V, “0” <0.8 V, “1”>2.0 V.
Synchronization out, purpose	Frame synchronization out to control another FLIR Ax5 camera
Synchronization out	1×, non-isolated
Synchronization out, type	LVC Buffer @ 3.3V,”0”=24 MA max, “1”= –24 mA max.
Digital synchronization, connector type	12-pole M12 connector (shared with Digital I/O and External power)

Power system	
External power operation	12/24 VDC, < 3.5 W nominal < 6.0 W absolute max.
External power, connector type	12-pole M12 connector (shared with Digital I/O and Digital Synchronization)
Voltage	Allowed range 10–30 VDC

Environmental data	
Operating temperature range	–15°C to +60°C (+5°F to +140°F) **NOTE** The operating temperature range assumes that the camera is mounted on the base support (included in the package) or a similar type of heatsink.
Storage temperature range	–40°C to +70°C (–40°F to +158°F)
Humidity (operating and storage)	IEC 60068-2-30/24 h 95% relative humidity +25°C to +40°C (+77°F to +104°F)
EMC	• EN 61000-6-2 (Immunity) • EN 61000-6-3 (Emission) • FCC 47 CFR Part 15 Class B (Emission)
Encapsulation	IP 40 (IEC 60529) with base support mounted
Shock	25 g (IEC 60068-2-27)
Vibration	2 g (IEC60068-2-6) and MIL-STD810G
Declaration of conformity	See: https://support.flir.com/resources/DoC

Physical data	
Camera size (L × W × H)	107.8 × 49.6 × 46.6 mm (4.2 × 1.9 × 1.8 in.)
Tripod mounting	1 × UNC ¼"-20 (with Base support accessory, included in the delivery box)
Base mounting	4 × M3 thread mounting holes (bottom)
Housing material	Magnesium and aluminum

Shipping information	
Packaging, type	Cardboard box
List of contents	• Infrared camera with lens • Base support • Printed documentation
EAN-13	7332558013113
UPC-12	845188014872
Country of origin	Sweden

Supplies & accessories:

- T951004ACC; Ethernet cable CAT6, 2 m/6.6 ft.
- T198349; Base support
- T198348; Cable kit Mains (UK,EU,US)
- T127605ACC; Cable M12 Pigtail
- T127606ACC; Cable M12 Sync
- T199698; Environmental housing for Ax5
- T199356; FLIR Ax5 accessory starter kit
- T198342ACC; Focus adjustment tool
- T911183; Gigabit PoE injector 16 W, with multi-plugs
- T198392; Table stand kit
- T198594ACC; Transport case Ax5

- T199722; ThermoVision EFD, max. 2 cameras
- T199724; ThermoVision EFD, max. 4 cameras
- T300243; FLIR Thermal Studio Pro, 1 Year Subscription
- T300083; FLIR Thermal Studio Pro, Perpetual license
- T300341; FLIR Thermal Studio Standard, 1 Year Subscription
- T300258; FLIR Thermal Studio Standard, Perpetual license
- T198584; FLIR Tools
- T198583; FLIR Tools+ (download card incl. license key)
- T199233; FLIR Atlas SDK for .NET
- T199234; FLIR Atlas SDK for MATLAB
- 4232535; FLIR Research Studio, Professional Edition - 1 Year Subscription (online activation)
- 4232556; FLIR Research Studio, Professional Edition - Perpetual License (online activation)
- 4232590; FLIR Research Studio, Professional Edition - Perpetual License (USB dongle)
- 4232557; FLIR Research Studio, Professional Edition - USB dongle only
- 4220499; FLIR Research Studio, Standard Edition - 1 Year Subscription (online activation)
- 4220500; FLIR Research Studio, Standard Edition - Perpetual License (online activation)
- 4220646; FLIR Research Studio, Standard Edition - Perpetual License (USB dongle)
- 24971-010; FLIR Research Studio, Standard Edition - USB dongle only
- 4232591; FLIR ResearchIR to Research Studio, Professional Edition - 1 Year License Upgrade

13.9 FLIR A65 f=13 mm with SC kit (30 Hz)

P/N: 73413-0102
Rev.: 81605

General description
The FLIR A65 has features and functions that make it the natural choice for anyone who uses PC software to solve problems and for whom 640 × 512 pixel resolution is sufficient. Among its main features are GigE Vision and GenICam compliance, which makes it plug-and-play when used with software packages such as IMAQ Vision and Halcon.
Key features:
• Very affordable. • Compact (40 mm × 43 mm × 106 mm). • GigE Vision and GenICam compliant. • GigE Vision lockable connector. • PoE (power over Ethernet). • 8-bit 640 × 512 pixel images streamed at 30 Hz, signal linear • 14-bit 640 × 512 pixel images streamed at 30 Hz, signal and temperature linear • Synchronization between cameras possible. • 1x+1x GPIO. • Compliant with any software that supports GenICam, including National Instruments IMAQ Vision, Stemmers Common Vision Blox, and COGNEX Vision Pro.
Typical applications:
• Automation and thermal machine vision. • Entry level “high-speed” R&D.

Imaging and optical data	
IR resolution	640 × 512 pixels
Thermal sensitivity/NETD	< 0.05°C @ +30°C (+86°F) / 50 mK
Field of view (FOV)	45° × 37°
Minimum focus distance	7.6 cm (3.0 in.)
Field of view (FOV) / minimum focus distance	45° × 37° / fixed focus
Focal length	13 mm (0.5 in.)
Spatial resolution (IFOV)	1.31 mrad
F-number	1.25
Image frequency	30 Hz
Focus	Fixed

Detector data	
Detector type	Focal plane array (FPA), uncooled VOX microbolometer
Spectral range	7.5–13 µm
Focal plane array (FPA) / spectral range	Uncooled VOX microbolometer / 7.5–13 µm
Detector pitch	17 µm
Detector time constant	Typical 12 ms

Measurement	
Object temperature range	• –25 to +135°C (–13 to 275°F) • –40 to +550°C (–40 to +1022°F)
Accuracy	±5°C (±9°F) or ±5% of reading

Measurement analysis	
Atmospheric transmission correction	Automatic, based on inputs for distance, atmospheric temperature and relative humidity
Optics transmission correction	Automatic, based on signals from internal sensors
Emissivity correction	Variable from 0.5 to 1.0
Reflected apparent temperature correction	Automatic, based on input of reflected temperature
External optics/windows correction	Automatic, based on input of optics/window transmission and temperature
Measurement corrections	Global object parameters

Ethernet	
Ethernet	Control and image
Ethernet, type	Gigabit Ethernet
Ethernet, standard	IEEE 802.3
Ethernet, connector type	RJ-45
Ethernet, communication	GigE Vision ver. 1.2 Client API GenICam compliant
Ethernet, image streaming	8-bit monochrome @ 30 Hz • Signal linear/ DDE • Automatic/ Manual • Flip H&V 14-bit 640 × 512 pixels @ 30 Hz • Signal linear/ DDE • Temperature linear GigE Vision and GenICam compatible
Ethernet, power	Power over Ethernet, PoE IEEE 802.3af class 0 Power
Ethernet, protocols	TCP, UDP, ICMP, IGMP, DHCP, GigEVision

Digital input/output	
Digital input, purpose	General purpose
Digital input	1× opto-isolated, “0” <1.2 VDC, “1” = 2–25 VDC.
Digital output, purpose	General purpose output to ext. device (programmatically set)
Digital output	1× opto-isolated, 2–40 VDC, max. 185 mA
Digital I/O, isolation voltage	500 VRMS
Digital I/O, supply voltage	2–40 VDC, max. 200 mA
Digital I/O, connector type	12-pole M12 connector (shared with Digital synchronization and External power)
Synchronization in, purpose	Frame synchronization in to control camera
Synchronization in	1×, non-isolated
Synchronization in, type	LVC Buffer @3.3V, “0” <0.8 V, “1”>2.0 V.
Synchronization out, purpose	Frame synchronization out to control another FLIR Ax5 camera
Synchronization out	1×, non-isolated
Synchronization out, type	LVC Buffer @ 3.3V,”0”=24 MA max, “1”= –24 mA max.
Digital synchronization, connector type	12-pole M12 connector (shared with Digital I/O and External power)

Power system	
External power operation	12/24 VDC, < 3.5 W nominal < 6.0 W absolute max.
External power, connector type	12-pole M12 connector (shared with Digital I/O and Digital Synchronization)
Voltage	Allowed range 10–30 VDC

Environmental data	
Operating temperature range	–15°C to +50°C (+5°F to +122°F) **NOTE** The operating temperature range assumes that the camera is mounted on the base support (included in the package) or a similar type of heatsink.
Storage temperature range	–40°C to +70°C (–40°F to +158°F)
Humidity (operating and storage)	IEC 60068-2-30/24 h 95% relative humidity +25°C to +40°C (+77°F to +104°F)
EMC	• EN 61000-6-2 (Immunity) • EN 61000-6-3 (Emission) • FCC 47 CFR Part 15 Class B (Emission)
Encapsulation	IP 40 (IEC 60529) with base support mounted
Shock	25 g (IEC 60068-2-27)
Vibration	2 g (IEC 60068-2-6)
Declaration of conformity	See: https://support.flir.com/resources/DoC

Physical data	
Weight	0.200 kg (0.44 lb.)
Camera size (L × W × H)	106 × 40 × 43 mm (4.2 × 1.6 × 1.7 in.)
Tripod mounting	1 × UNC ¼"-20 (with Base support accessory, included in the delivery box)
Base mounting	4 × M3 thread mounting holes (bottom)
Housing material	Magnesium and aluminum

Shipping information	
Packaging, type	Cardboard box
List of contents	• Hard transport case • Infrared camera with lens • Base support • Cable tie (2 ea.) • Ethernet cable CAT-6, 2m/6.6 ft (2 ea.) • FLIR Research Studio 1-Year Subscription (license only) • Focus adjustment tool • Gooseneck • Mains cable kit (UK,EU,US) • PoE Injector (power over Ethernet) • Printed documentation • Table stand
Packaging, weight	
Packaging, size	295 × 200 × 105 mm (11.6 × 7.9 × 4.1 in.)
EAN-13	7332558011829
UPC-12	845188012915
Country of origin	Estonia

Supplies & accessories:

- T951004ACC; Ethernet cable CAT6, 2 m/6.6 ft.
- T198349; Base support
- T198348; Cable kit Mains (UK,EU,US)
- T127605ACC; Cable M12 Pigtail
- T127606ACC; Cable M12 Sync
- T199698; Environmental housing for Ax5
- T199356; FLIR Ax5 accessory starter kit
- T198342ACC; Focus adjustment tool
- T911183; Gigabit PoE injector 16 W, with multi-plugs
- T198392; Table stand kit
- T198594ACC; Transport case Ax5
- T300243; FLIR Thermal Studio Pro, 1 Year Subscription
- T300083; FLIR Thermal Studio Pro, Perpetual license
- T300341; FLIR Thermal Studio Standard, 1 Year Subscription
- T300258; FLIR Thermal Studio Standard, Perpetual license
- T198584; FLIR Tools
- T198583; FLIR Tools+ (download card incl. license key)
- T199233; FLIR Atlas SDK for .NET
- T199234; FLIR Atlas SDK for MATLAB
- 4232535; FLIR Research Studio, Professional Edition - 1 Year Subscription (online activation)
- 4232556; FLIR Research Studio, Professional Edition - Perpetual License (online activation)
- 4232590; FLIR Research Studio, Professional Edition - Perpetual License (USB dongle)
- 4232557; FLIR Research Studio, Professional Edition - USB dongle only
- 4220499; FLIR Research Studio, Standard Edition - 1 Year Subscription (online activation)
- 4220500; FLIR Research Studio, Standard Edition - Perpetual License (online activation)
- 4220646; FLIR Research Studio, Standard Edition - Perpetual License (USB dongle)
- 24971-010; FLIR Research Studio, Standard Edition - USB dongle only
- 4232591; FLIR ResearchIR to Research Studio, Professional Edition - 1 Year License Upgrade

13.10 FLIR A65 f=13 mm with SC kit (7.5 Hz)

P/N: 73513-0102
Rev.: 81605

General description
The FLIR A65 has features and functions that make it the natural choice for anyone who uses PC software to solve problems and for whom 640 × 512 pixel resolution is sufficient. Among its main features are GigE Vision and GenICam compliance, which makes it plug-and-play when used with software packages such as IMAQ Vision and Halcon.
Key features:
• Very affordable. • Compact (40 mm × 43 mm × 106 mm). • GigE Vision and GenICam compliant. • GigE Vision lockable connector. • PoE (power over Ethernet). • 8-bit 640 × 512 pixel images streamed at 7.5 Hz, signal linear • 14-bit 640 × 512 pixel images streamed at 7.5 Hz, signal and temperature linear • Synchronization between cameras possible. • 1x+1x GPIO. • Compliant with any software that supports GenICam, including National Instruments IMAQ Vision, Stemmers Common Vision Blox, and COGNEX Vision Pro.
Typical applications:
• Automation and thermal machine vision. • Entry level “high-speed” R&D.

Imaging and optical data	
IR resolution	640 × 512 pixels
Thermal sensitivity/NETD	< 0.05°C @ +30°C (+86°F) / 50 mK
Field of view (FOV)	45° × 37°
Minimum focus distance	7.6 cm (3.0 in.)
Field of view (FOV) / minimum focus distance	45° × 37° / fixed focus
Focal length	13 mm (0.5 in.)
Spatial resolution (IFOV)	1.31 mrad
F-number	1.25
Image frequency	7.5 Hz
Focus	Fixed

Detector data	
Detector type	Focal plane array (FPA), uncooled VOX microbolometer
Spectral range	7.5–13 µm
Focal plane array (FPA) / spectral range	Uncooled VOX microbolometer / 7.5–13 µm
Detector pitch	17 µm
Detector time constant	Typical 12 ms

Measurement	
Object temperature range	• –25 to +135°C (–13 to 275°F) • –40 to +550°C (–40 to +1022°F)
Accuracy	±5°C (±9°F) or ±5% of reading

Measurement analysis	
Atmospheric transmission correction	Automatic, based on inputs for distance, atmospheric temperature and relative humidity
Optics transmission correction	Automatic, based on signals from internal sensors
Emissivity correction	Variable from 0.5 to 1.0
Reflected apparent temperature correction	Automatic, based on input of reflected temperature
External optics/windows correction	Automatic, based on input of optics/window transmission and temperature
Measurement corrections	Global object parameters

Ethernet	
Ethernet	Control and image
Ethernet, type	Gigabit Ethernet
Ethernet, standard	IEEE 802.3
Ethernet, connector type	RJ-45
Ethernet, communication	GigE Vision ver. 1.2 Client API GenICam compliant
Ethernet, image streaming	8-bit monochrome @ 7.5 Hz • Signal linear/ DDE • Automatic/ Manual • Flip H&V 14-bit 640 × 512 pixels @ 7.5 Hz • Signal linear/ DDE • Temperature linear GigE Vision and GenICam compatible
Ethernet, power	Power over Ethernet, PoE IEEE 802.3af class 0 Power
Ethernet, protocols	TCP, UDP, ICMP, IGMP, DHCP, GigEVision

Digital input/output	
Digital input, purpose	General purpose
Digital input	1× opto-isolated, “0” <1.2 VDC, “1” = 2–25 VDC.
Digital output, purpose	General purpose output to ext. device (programmatically set)
Digital output	1× opto-isolated, 2–40 VDC, max. 185 mA
Digital I/O, isolation voltage	500 VRMS
Digital I/O, supply voltage	2–40 VDC, max. 200 mA
Digital I/O, connector type	12-pole M12 connector (shared with Digital synchronization and External power)
Synchronization in, purpose	Frame synchronization in to control camera
Synchronization in	1×, non-isolated
Synchronization in, type	LVC Buffer @3.3V, “0” <0.8 V, “1”>2.0 V.
Synchronization out, purpose	Frame synchronization out to control another FLIR Ax5 camera
Synchronization out	1×, non-isolated
Synchronization out, type	LVC Buffer @ 3.3V,”0”=24 MA max, “1”= –24 mA max.
Digital synchronization, connector type	12-pole M12 connector (shared with Digital I/O and External power)

Power system	
External power operation	12/24 VDC, < 3.5 W nominal < 6.0 W absolute max.
External power, connector type	12-pole M12 connector (shared with Digital I/O and Digital Synchronization)
Voltage	Allowed range 10–30 VDC

Environmental data	
Operating temperature range	–15°C to +50°C (+5°F to +122°F) **NOTE** The operating temperature range assumes that the camera is mounted on the base support (included in the package) or a similar type of heatsink.
Storage temperature range	–40°C to +70°C (–40°F to +158°F)
Humidity (operating and storage)	IEC 60068-2-30/24 h 95% relative humidity +25°C to +40°C (+77°F to +104°F)
EMC	• EN 61000-6-2 (Immunity) • EN 61000-6-3 (Emission) • FCC 47 CFR Part 15 Class B (Emission)
Encapsulation	IP 40 (IEC 60529) with base support mounted
Shock	25 g (IEC 60068-2-27)
Vibration	2 g (IEC 60068-2-6)
Declaration of conformity	See: https://support.flir.com/resources/DoC

Physical data	
Weight	0.200 kg (0.44 lb.)
Camera size (L × W × H)	106 × 40 × 43 mm (4.2 × 1.6 × 1.7 in.)
Tripod mounting	1 × UNC ¼"-20 (with Base support accessory, included in the delivery box)
Base mounting	4 × M3 thread mounting holes (bottom)
Housing material	Magnesium and aluminum

Shipping information	
Packaging, type	Cardboard box
List of contents	• Hard transport case • Infrared camera with lens • Base support • Cable tie (2 ea.) • Ethernet cable CAT-6, 2m/6.6 ft (2 ea.) • FLIR Research Studio 1-Year Subscription (license only) • Focus adjustment tool • Gooseneck • Mains cable kit (UK,EU,US) • PoE Injector (power over Ethernet) • Printed documentation • Table stand
Packaging, weight	5.3 kg (11.7 lb.)
Packaging, size	370 × 180 × 320 mm (14.6 × 7.1 × 12.6 in.)
EAN-13	7332558010624
UPC-12	845188011291
Country of origin	Sweden

Supplies & accessories:

- T951004ACC; Ethernet cable CAT6, 2 m/6.6 ft.
- T198349; Base support
- T198348; Cable kit Mains (UK,EU,US)
- T127605ACC; Cable M12 Pigtail
- T127606ACC; Cable M12 Sync
- T199698; Environmental housing for Ax5
- T199356; FLIR Ax5 accessory starter kit
- T911183; Gigabit PoE injector 16 W, with multi-plugs
- T198392; Table stand kit
- T198594ACC; Transport case Ax5
- T300243; FLIR Thermal Studio Pro, 1 Year Subscription
- T300083; FLIR Thermal Studio Pro, Perpetual license
- T300341; FLIR Thermal Studio Standard, 1 Year Subscription
- T300258; FLIR Thermal Studio Standard, Perpetual license
- T198584; FLIR Tools
- T198583; FLIR Tools+ (download card incl. license key)
- T199233; FLIR Atlas SDK for .NET
- T199234; FLIR Atlas SDK for MATLAB
- 4232535; FLIR Research Studio, Professional Edition - 1 Year Subscription (online activation)
- 4232556; FLIR Research Studio, Professional Edition - Perpetual License (online activation)
- 4232590; FLIR Research Studio, Professional Edition - Perpetual License (USB dongle)
- 4232557; FLIR Research Studio, Professional Edition - USB dongle only
- 4220499; FLIR Research Studio, Standard Edition - 1 Year Subscription (online activation)
- 4220500; FLIR Research Studio, Standard Edition - Perpetual License (online activation)
- 4220646; FLIR Research Studio, Standard Edition - Perpetual License (USB dongle)
- 24971-010; FLIR Research Studio, Standard Edition - USB dongle only
- 4232591; FLIR ResearchIR to Research Studio, Professional Edition - 1 Year License Upgrade

13.11 FLIR A65 FOV 90 (30 Hz, ver. 2016)

P/N: 75007-0101
Rev.: 81605

General description
The FLIR A65 has features and functions that make it the natural choice for anyone who uses PC software to solve problems and for whom 640 × 512 pixel resolution is sufficient. Among its main features are GigE Vision and GenICam compliance, which makes it plug-and-play when used with software packages such as IMAQ Vision and Halcon.
Key features:
• Very affordable. • Compact. • GigE Vision and GenICam compliant. • GigE Vision lockable connector. • PoE (power over Ethernet). • 8-bit 640 × 512 pixel images streamed at 30 Hz, signal linear • 14-bit 640 × 512 pixel images streamed at 30 Hz, signal and temperature linear • Synchronization between cameras possible. • 1x+1x GPIO. • Compliant with any software that supports GenICam, including National Instruments IMAQ Vision, Stemmers Common Vision Blox, and COGNEX Vision Pro.
Typical applications:
• Automation and thermal machine vision. • Entry level “high-speed” R&D.

Imaging and optical data	
IR resolution	640 × 512 pixels
Thermal sensitivity/NETD	< 0.05°C @ +30°C (+86°F) / 50 mK
Field of view (FOV)	90° × 69°
Minimum focus distance	2.5 cm (0.98 in.)
Field of view (FOV) / minimum focus distance	
Focal length	7.5 mm (0.30 in.)
Spatial resolution (IFOV)	2.27 mrad
F-number	1.4
Image frequency	30 Hz
Focus	Fixed

Detector data	
Detector type	Focal plane array (FPA), uncooled VOX microbolometer
Spectral range	7.5–13 µm
Focal plane array (FPA) / spectral range	Uncooled VOX microbolometer / 7.5–13 µm
Detector pitch	17 µm
Detector time constant	Typical 12 ms

Measurement	
Object temperature range	• –25 to +135°C (–13 to 275°F) • –40 to +550°C (–40 to +1022°F)
Accuracy	±5°C (±9°F) or ±5% of reading

Measurement analysis	
Atmospheric transmission correction	Automatic, based on inputs for distance, atmospheric temperature and relative humidity
Optics transmission correction	Automatic, based on signals from internal sensors
Emissivity correction	Variable from 0.5 to 1.0
Reflected apparent temperature correction	Automatic, based on input of reflected temperature
External optics/windows correction	Automatic, based on input of optics/window transmission and temperature
Measurement corrections	Global object parameters

Ethernet	
Ethernet	Control and image
Ethernet, type	Gigabit Ethernet
Ethernet, standard	IEEE 802.3
Ethernet, connector type	RJ-45
Ethernet, communication	GigE Vision ver. 1.2 Client API GenICam compliant
Ethernet, image streaming	8-bit monochrome @ 30 Hz • Signal linear/ DDE • Automatic/ Manual • Flip H&V 14-bit 640 × 512 pixels @ 30 Hz • Signal linear/ DDE • Temperature linear GigE Vision and GenICam compatible
Ethernet, power	Power over Ethernet, PoE IEEE 802.3af class 0 Power
Ethernet, protocols	TCP, UDP, ICMP, IGMP, DHCP, GigEVision

Digital input/output	
Digital input, purpose	General purpose
Digital input	1× opto-isolated, “0” <1.2 VDC, “1” = 2–25 VDC.
Digital output, purpose	General purpose output to ext. device (programmatically set)
Digital output	1× opto-isolated, 2–40 VDC, max. 185 mA
Digital I/O, isolation voltage	500 VRMS
Digital I/O, supply voltage	2–40 VDC, max. 200 mA
Digital I/O, connector type	12-pole M12 connector (shared with Digital synchronization and External power)
Synchronization in, purpose	Frame synchronization in to control camera
Synchronization in	1×, non-isolated
Synchronization in, type	LVC Buffer @3.3V, “0” <0.8 V, “1”>2.0 V.
Synchronization out, purpose	Frame synchronization out to control another FLIR Ax5 camera
Synchronization out	1×, non-isolated
Synchronization out, type	LVC Buffer @ 3.3V,”0”=24 MA max, “1”= –24 mA max.
Digital synchronization, connector type	12-pole M12 connector (shared with Digital I/O and External power)

Power system	
External power operation	12/24 VDC, < 3.5 W nominal < 6.0 W absolute max.
External power, connector type	12-pole M12 connector (shared with Digital I/O and Digital Synchronization)
Voltage	Allowed range 10–30 VDC

Environmental data	
Operating temperature range	–15°C to +60°C (+5°F to +140°F) **NOTE** The operating temperature range assumes that the camera is mounted on the base support (included in the package) or a similar type of heatsink.
Storage temperature range	–40°C to +70°C (–40°F to +158°F)
Humidity (operating and storage)	IEC 60068-2-30/24 h 95% relative humidity +25°C to +40°C (+77°F to +104°F)
EMC	• EN 61000-6-2 (Immunity) • EN 61000-6-3 (Emission) • FCC 47 CFR Part 15 Class B (Emission)
Encapsulation	IP 40 (IEC 60529) with base support mounted
Shock	25 g (IEC 60068-2-27)
Vibration	2 g (IEC60068-2-6) and MIL-STD810G
Declaration of conformity	See: https://support.flir.com/resources/DoC

Physical data	
Camera size (L × W × H)	104.1 × 49.6 × 46.6 mm (4.1 × 1.9 × 1.8 in.)
Tripod mounting	1 × UNC ¼"-20 (with Base support accessory, included in the delivery box)
Base mounting	4 × M3 thread mounting holes (bottom)
Housing material	Magnesium and aluminum

Shipping information	
Packaging, type	Cardboard box
List of contents	• Infrared camera with lens • Base support • Focus adjustment tool • Printed documentation
EAN-13	7332558011621
UPC-12	845188012571
Country of origin	Sweden

Supplies & accessories:

- T951004ACC; Ethernet cable CAT6, 2 m/6.6 ft.
- T198349; Base support
- T198348; Cable kit Mains (UK,EU,US)
- T127605ACC; Cable M12 Pigtail
- T127606ACC; Cable M12 Sync
- T199356; FLIR Ax5 accessory starter kit
- T198342ACC; Focus adjustment tool
- T911183; Gigabit PoE injector 16 W, with multi-plugs
- T198392; Table stand kit
- T198594ACC; Transport case Ax5

- T199722; ThermoVision EFD, max. 2 cameras
- T199724; ThermoVision EFD, max. 4 cameras
- T300243; FLIR Thermal Studio Pro, 1 Year Subscription
- T300083; FLIR Thermal Studio Pro, Perpetual license
- T300341; FLIR Thermal Studio Standard, 1 Year Subscription
- T300258; FLIR Thermal Studio Standard, Perpetual license
- T198584; FLIR Tools
- T198583; FLIR Tools+ (download card incl. license key)
- T199233; FLIR Atlas SDK for .NET
- T199234; FLIR Atlas SDK for MATLAB
- 4232535; FLIR Research Studio, Professional Edition - 1 Year Subscription (online activation)
- 4232556; FLIR Research Studio, Professional Edition - Perpetual License (online activation)
- 4232590; FLIR Research Studio, Professional Edition - Perpetual License (USB dongle)
- 4232557; FLIR Research Studio, Professional Edition - USB dongle only
- 4220499; FLIR Research Studio, Standard Edition - 1 Year Subscription (online activation)
- 4220500; FLIR Research Studio, Standard Edition - Perpetual License (online activation)
- 4220646; FLIR Research Studio, Standard Edition - Perpetual License (USB dongle)
- 24971-010; FLIR Research Studio, Standard Edition - USB dongle only
- 4232591; FLIR ResearchIR to Research Studio, Professional Edition - 1 Year License Upgrade

13.12 FLIR A65 FOV 45 (30 Hz, ver. 2016)

P/N: 75013-0101
Rev.: 81605

General description
The FLIR A65 has features and functions that make it the natural choice for anyone who uses PC software to solve problems and for whom 640 × 512 pixel resolution is sufficient. Among its main features are GigE Vision and GenICam compliance, which makes it plug-and-play when used with software packages such as IMAQ Vision and Halcon.
Key features:
• Very affordable. • Compact • GigE Vision and GenICam compliant. • GigE Vision lockable connector. • PoE (power over Ethernet). • 8-bit 640 × 512 pixel images streamed at 30 Hz, signal linear • 14-bit 640 × 512 pixel images streamed at 30 Hz, signal and temperature linear • Synchronization between cameras possible. • 1x+1x GPIO. • Compliant with any software that supports GenICam, including National Instruments IMAQ Vision, Stemmers Common Vision Blox, and COGNEX Vision Pro.
Typical applications:
• Automation and thermal machine vision. • Entry level “high-speed” R&D.

Imaging and optical data	
IR resolution	640 × 512 pixels
Thermal sensitivity/NETD	< 0.05°C @ +30°C (+86°F) / 50 mK
Field of view (FOV)	45° × 37°
Minimum focus distance	7.6 cm (3.0 in.)
Field of view (FOV) / minimum focus distance	45° × 37° / fixed focus
Focal length	13 mm (0.5 in.)
Spatial resolution (IFOV)	1.31 mrad
F-number	1.25
Image frequency	30 Hz
Focus	Fixed

Detector data	
Detector type	Focal plane array (FPA), uncooled VOX microbolometer
Spectral range	7.5–13 µm
Focal plane array (FPA) / spectral range	Uncooled VOX microbolometer / 7.5–13 µm
Detector pitch	17 µm
Detector time constant	Typical 12 ms

Measurement	
Object temperature range	• –25 to +135°C (–13 to 275°F) • –40 to +550°C (–40 to +1022°F)
Accuracy	±5°C (±9°F) or ±5% of reading

Measurement analysis	
Atmospheric transmission correction	Automatic, based on inputs for distance, atmospheric temperature and relative humidity
Optics transmission correction	Automatic, based on signals from internal sensors
Emissivity correction	Variable from 0.5 to 1.0
Reflected apparent temperature correction	Automatic, based on input of reflected temperature
External optics/windows correction	Automatic, based on input of optics/window transmission and temperature
Measurement corrections	Global object parameters

Ethernet	
Ethernet	Control and image
Ethernet, type	Gigabit Ethernet
Ethernet, standard	IEEE 802.3
Ethernet, connector type	RJ-45
Ethernet, communication	GigE Vision ver. 1.2 Client API GenICam compliant
Ethernet, image streaming	8-bit monochrome @ 30 Hz • Signal linear/ DDE • Automatic/ Manual • Flip H&V 14-bit 640 × 512 pixels @ 30 Hz • Signal linear/ DDE • Temperature linear GigE Vision and GenICam compatible
Ethernet, power	Power over Ethernet, PoE IEEE 802.3af class 0 Power
Ethernet, protocols	TCP, UDP, ICMP, IGMP, DHCP, GigEVision

Digital input/output	
Digital input, purpose	General purpose
Digital input	1× opto-isolated, “0” <1.2 VDC, “1” = 2–25 VDC.
Digital output, purpose	General purpose output to ext. device (programmatically set)
Digital output	1× opto-isolated, 2–40 VDC, max. 185 mA
Digital I/O, isolation voltage	500 VRMS
Digital I/O, supply voltage	2–40 VDC, max. 200 mA
Digital I/O, connector type	12-pole M12 connector (shared with Digital synchronization and External power)
Synchronization in, purpose	Frame synchronization in to control camera
Synchronization in	1×, non-isolated
Synchronization in, type	LVC Buffer @3.3V, “0” <0.8 V, “1”>2.0 V.
Synchronization out, purpose	Frame synchronization out to control another FLIR Ax5 camera
Synchronization out	1×, non-isolated
Synchronization out, type	LVC Buffer @ 3.3V,”0”=24 MA max, “1”= –24 mA max.
Digital synchronization, connector type	12-pole M12 connector (shared with Digital I/O and External power)

Power system	
External power operation	12/24 VDC, < 3.5 W nominal < 6.0 W absolute max.
External power, connector type	12-pole M12 connector (shared with Digital I/O and Digital Synchronization)
Voltage	Allowed range 10–30 VDC

Environmental data	
Operating temperature range	–15°C to +60°C (+5°F to +140°F) **NOTE** The operating temperature range assumes that the camera is mounted on the base support (included in the package) or a similar type of heatsink.
Storage temperature range	–40°C to +70°C (–40°F to +158°F)
Humidity (operating and storage)	IEC 60068-2-30/24 h 95% relative humidity +25°C to +40°C (+77°F to +104°F)
EMC	• EN 61000-6-2 (Immunity) • EN 61000-6-3 (Emission) • FCC 47 CFR Part 15 Class B (Emission)
Encapsulation	IP 40 (IEC 60529) with base support mounted
Shock	25 g (IEC 60068-2-27)
Vibration	2 g (IEC60068-2-6) and MIL-STD810G
Declaration of conformity	See: https://support.flir.com/resources/DoC

Physical data	
Camera size (L × W × H)	104.1 × 49.6 × 46.6 mm (4.1 × 1.9 × 1.8 in.)
Tripod mounting	1 × UNC ¼"-20 (with Base support accessory, included in the delivery box)
Base mounting	4 × M3 thread mounting holes (bottom)
Housing material	Magnesium and aluminum

Shipping information	
Packaging, type	Cardboard box
List of contents	• Infrared camera with lens • Base support • Focus adjustment tool • Printed documentation
EAN-13	7332558011102
UPC-12	845188011970
Country of origin	Sweden

Supplies & accessories:

- T951004ACC; Ethernet cable CAT6, 2 m/6.6 ft.
- T198349; Base support
- T198348; Cable kit Mains (UK,EU,US)
- T127605ACC; Cable M12 Pigtail
- T127606ACC; Cable M12 Sync
- T199698; Environmental housing for Ax5
- T199356; FLIR Ax5 accessory starter kit
- T198342ACC; Focus adjustment tool
- T911183; Gigabit PoE injector 16 W, with multi-plugs
- T198392; Table stand kit

- T198594ACC; Transport case Ax5
- T199722; ThermoVision EFD, max. 2 cameras
- T199724; ThermoVision EFD, max. 4 cameras
- T300243; FLIR Thermal Studio Pro, 1 Year Subscription
- T300083; FLIR Thermal Studio Pro, Perpetual license
- T300341; FLIR Thermal Studio Standard, 1 Year Subscription
- T300258; FLIR Thermal Studio Standard, Perpetual license
- T198584; FLIR Tools
- T198583; FLIR Tools+ (download card incl. license key)
- T199233; FLIR Atlas SDK for .NET
- T199234; FLIR Atlas SDK for MATLAB
- 4232535; FLIR Research Studio, Professional Edition - 1 Year Subscription (online activation)
- 4232556; FLIR Research Studio, Professional Edition - Perpetual License (online activation)
- 4232590; FLIR Research Studio, Professional Edition - Perpetual License (USB dongle)
- 4232557; FLIR Research Studio, Professional Edition - USB dongle only
- 4220499; FLIR Research Studio, Standard Edition - 1 Year Subscription (online activation)
- 4220500; FLIR Research Studio, Standard Edition - Perpetual License (online activation)
- 4220646; FLIR Research Studio, Standard Edition - Perpetual License (USB dongle)
- 24971-010; FLIR Research Studio, Standard Edition - USB dongle only
- 4232591; FLIR ResearchIR to Research Studio, Professional Edition - 1 Year License Upgrade

13.13 FLIR A65 FOV 25 (30 Hz, ver. 2016)

P/N: 75025-0101
Rev.: 81605

General description
The FLIR A65 has features and functions that make it the natural choice for anyone who uses PC software to solve problems and for whom 640 × 512 pixel resolution is sufficient. Among its main features are GigE Vision and GenICam compliance, which makes it plug-and-play when used with software packages such as IMAQ Vision and Halcon.
Key features:
• Very affordable. • Compact. • GigE Vision and GenICam compliant. • GigE Vision lockable connector. • PoE (power over Ethernet). • 8-bit 640 × 512 pixel images streamed at 30 Hz, signal linear • 14-bit 640 × 512 pixel images streamed at 30 Hz, signal and temperature linear • Synchronization between cameras possible. • 1x+1x GPIO. • Compliant with any software that supports GenICam, including National Instruments IMAQ Vision, Stemmers Common Vision Blox, and COGNEX Vision Pro.
Typical applications:
• Automation and thermal machine vision. • Entry level “high-speed” R&D.

Imaging and optical data	
IR resolution	640 × 512 pixels
Thermal sensitivity/NETD	< 0.05°C @ +30°C (+86°F) / 50 mK
Field of view (FOV)	25° × 20°
Minimum focus distance	30 cm (12 in.)
Field of view (FOV) / minimum focus distance	25° × 20° / fixed focus
Focal length	25 mm (0.98 in.)
Spatial resolution (IFOV)	0.68 mrad
F-number	1.25
Image frequency	30 Hz
Focus	Fixed

Detector data	
Detector type	Focal plane array (FPA), uncooled VOX microbolometer
Spectral range	7.5–13 µm
Focal plane array (FPA) / spectral range	Uncooled VOX microbolometer / 7.5–13 µm
Detector pitch	17 µm
Detector time constant	Typical 12 ms

Measurement	
Object temperature range	• –25 to +135°C (–13 to 275°F) • –40 to +550°C (–40 to +1022°F)
Accuracy	±5°C (±9°F) or ±5% of reading

Measurement analysis	
Atmospheric transmission correction	Automatic, based on inputs for distance, atmospheric temperature and relative humidity
Optics transmission correction	Automatic, based on signals from internal sensors
Emissivity correction	Variable from 0.5 to 1.0
Reflected apparent temperature correction	Automatic, based on input of reflected temperature
External optics/windows correction	Automatic, based on input of optics/window transmission and temperature
Measurement corrections	Global object parameters

Ethernet	
Ethernet	Control and image
Ethernet, type	Gigabit Ethernet
Ethernet, standard	IEEE 802.3
Ethernet, connector type	RJ-45
Ethernet, communication	GigE Vision ver. 1.2 Client API GenICam compliant
Ethernet, image streaming	8-bit monochrome @ 30 Hz • Signal linear/ DDE • Automatic/ Manual • Flip H&V 14-bit 640 × 512 pixels @ 30 Hz • Signal linear/ DDE • Temperature linear GigE Vision and GenICam compatible
Ethernet, power	Power over Ethernet, PoE IEEE 802.3af class 0 Power
Ethernet, protocols	TCP, UDP, ICMP, IGMP, DHCP, GigEVision

Digital input/output	
Digital input, purpose	General purpose
Digital input	1× opto-isolated, “0” <1.2 VDC, “1” = 2–25 VDC.
Digital output, purpose	General purpose output to ext. device (programmatically set)
Digital output	1× opto-isolated, 2–40 VDC, max. 185 mA
Digital I/O, isolation voltage	500 VRMS
Digital I/O, supply voltage	2–40 VDC, max. 200 mA
Digital I/O, connector type	12-pole M12 connector (shared with Digital synchronization and External power)
Synchronization in, purpose	Frame synchronization in to control camera
Synchronization in	1×, non-isolated
Synchronization in, type	LVC Buffer @3.3V, “0” <0.8 V, “1”>2.0 V.
Synchronization out, purpose	Frame synchronization out to control another FLIR Ax5 camera
Synchronization out	1×, non-isolated
Synchronization out, type	LVC Buffer @ 3.3V,”0”=24 MA max, “1”= –24 mA max.
Digital synchronization, connector type	12-pole M12 connector (shared with Digital I/O and External power)

Power system	
External power operation	12/24 VDC, < 3.5 W nominal < 6.0 W absolute max.
External power, connector type	12-pole M12 connector (shared with Digital I/O and Digital Synchronization)
Voltage	Allowed range 10–30 VDC

Environmental data	
Operating temperature range	–15°C to +60°C (+5°F to +140°F) **NOTE** The operating temperature range assumes that the camera is mounted on the base support (included in the package) or a similar type of heatsink.
Storage temperature range	–40°C to +70°C (–40°F to +158°F)
Humidity (operating and storage)	IEC 60068-2-30/24 h 95% relative humidity +25°C to +40°C (+77°F to +104°F)
EMC	• EN 61000-6-2 (Immunity) • EN 61000-6-3 (Emission) • FCC 47 CFR Part 15 Class B (Emission)
Encapsulation	IP 40 (IEC 60529) with base support mounted
Shock	25 g (IEC 60068-2-27)
Vibration	2 g (IEC60068-2-6) and MIL-STD810G
Declaration of conformity	See: https://support.flir.com/resources/DoC

Physical data	
Camera size (L × W × H)	107.8 × 49.6 × 46.6 mm (4.2 × 1.9 × 1.8 in.)
Tripod mounting	1 × UNC ¼"-20 (with Base support accessory, included in the delivery box)
Base mounting	4 × M3 thread mounting holes (bottom)
Housing material	Magnesium and aluminum

Shipping information	
Packaging, type	Cardboard box
List of contents	• Infrared camera with lens • Base support • Printed documentation
EAN-13	7332558011119
UPC-12	845188011987
Country of origin	Sweden

Supplies & accessories:

- T951004ACC; Ethernet cable CAT6, 2 m/6.6 ft.
- T198349; Base support
- T198348; Cable kit Mains (UK,EU,US)
- T127605ACC; Cable M12 Pigtail
- T127606ACC; Cable M12 Sync
- T199698; Environmental housing for Ax5
- T199356; FLIR Ax5 accessory starter kit
- T198342ACC; Focus adjustment tool
- T911183; Gigabit PoE injector 16 W, with multi-plugs
- T198392; Table stand kit
- T198594ACC; Transport case Ax5

- T199722; ThermoVision EFD, max. 2 cameras
- T199724; ThermoVision EFD, max. 4 cameras
- T300243; FLIR Thermal Studio Pro, 1 Year Subscription
- T300083; FLIR Thermal Studio Pro, Perpetual license
- T300341; FLIR Thermal Studio Standard, 1 Year Subscription
- T300258; FLIR Thermal Studio Standard, Perpetual license
- T198584; FLIR Tools
- T198583; FLIR Tools+ (download card incl. license key)
- T199233; FLIR Atlas SDK for .NET
- T199234; FLIR Atlas SDK for MATLAB
- 4232535; FLIR Research Studio, Professional Edition - 1 Year Subscription (online activation)
- 4232556; FLIR Research Studio, Professional Edition - Perpetual License (online activation)
- 4232590; FLIR Research Studio, Professional Edition - Perpetual License (USB dongle)
- 4232557; FLIR Research Studio, Professional Edition - USB dongle only
- 4220499; FLIR Research Studio, Standard Edition - 1 Year Subscription (online activation)
- 4220500; FLIR Research Studio, Standard Edition - Perpetual License (online activation)
- 4220646; FLIR Research Studio, Standard Edition - Perpetual License (USB dongle)
- 24971-010; FLIR Research Studio, Standard Edition - USB dongle only
- 4232591; FLIR ResearchIR to Research Studio, Professional Edition - 1 Year License Upgrade

14 Mechanical drawings

[See next page]

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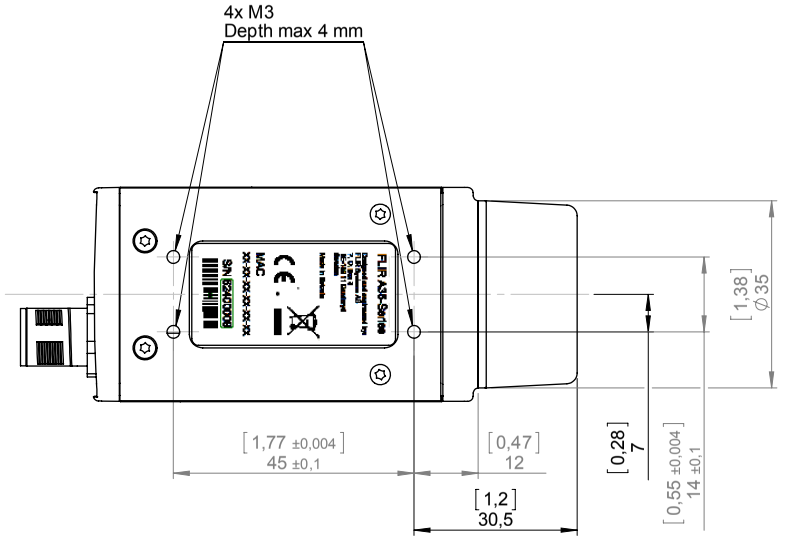
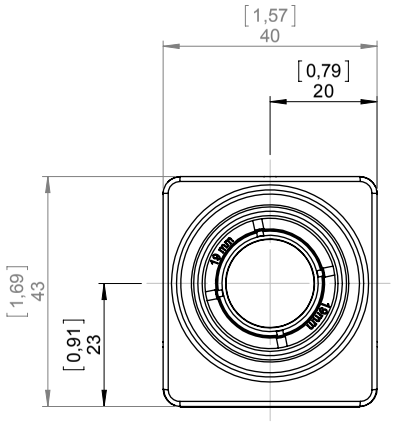
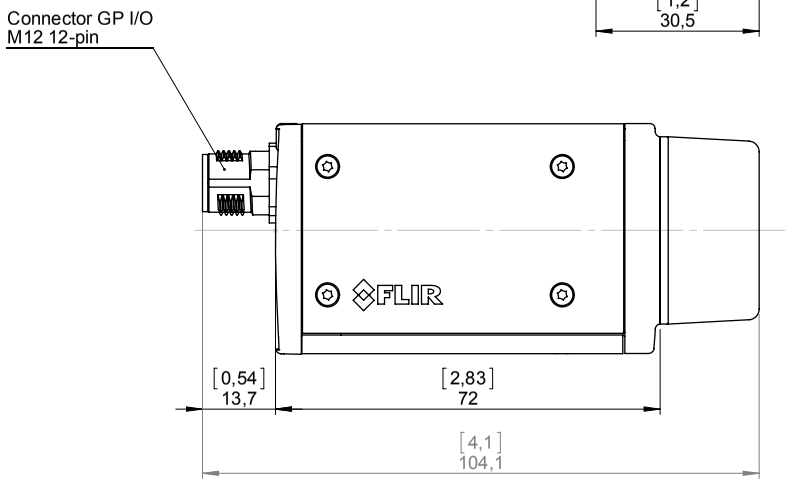
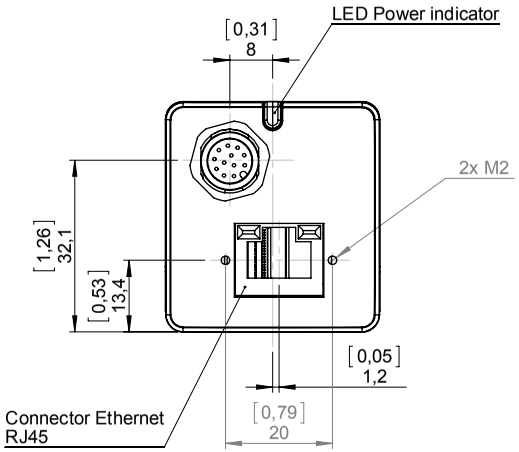
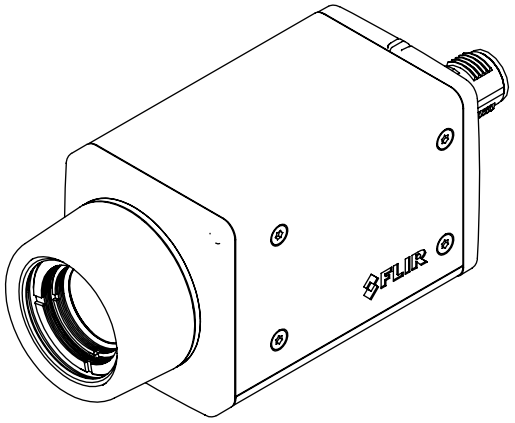
# Basic dimensions for cameras with focal length:
f= 7,5 mm
f= 9 mm
f=13 mm
f=19 mm











Konstr/Drawn: P. MARCUS	Datum/Date: 2014-01-29	Kontr/Check: MABR	Material: -
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2014-02-11	Ytjämnhet/Roughness: Ra µm	Ytbehandling/Surface treatment

Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

0,5-6	±0,1	Hålkälsradier
(6)-30	±0,2	Fillet radii
(30)-120	±0,3	
(120)-400	±0,5	Kanter brutna
(400)-1000	±0,8	Edges broken

Benämning/Denomination

Basic dimensions Ax5
f=7,5 mm to f=100 mm

Skala/Scale: 1:1	Blad/Sheet: 1(7)
ArtNo.	Size: A3
Ritn nr/Drawing No: T128116	Rev: A

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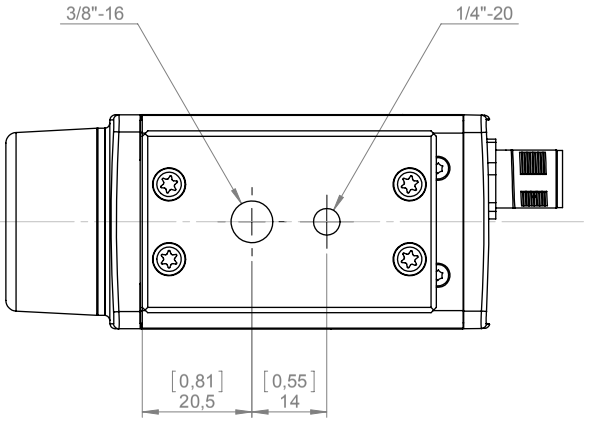
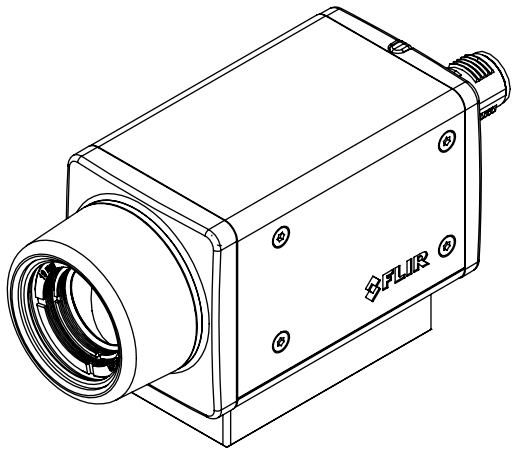
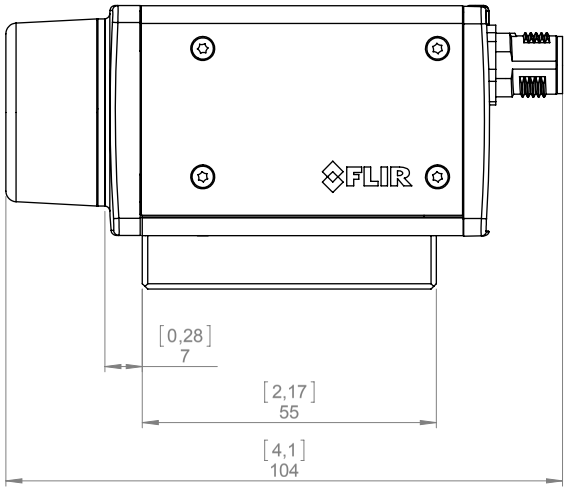
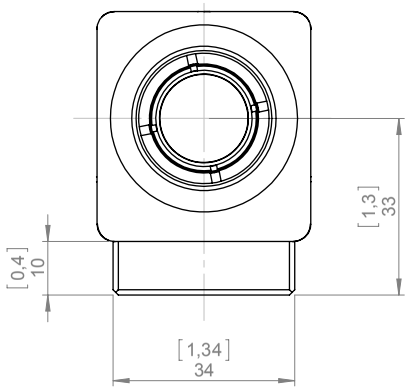
Basic dimensions for add-on base support









Konstr/Drawn: P. MARCUS	Datum/Date: 2014-01-29	Kontr/Check: MABR	Material: -
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2014-02-11	Ytjämnhet/Roughness: Ra µm	Ytbehandling/Surface treatment

Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

0,5-6	±0,1	Hålkälsradier
(6)-30	±0,2	Fillet radii
(30)-120	±0,3	
(120)-400	±0,5	Kanter brutna
(400)-1000	±0,8	Edges broken

Benämning/Denomination

Basic dimensions Ax5
f=7,5 mm to f=100 mm

Skala/Scale 1:1	Blad/Sheet 2(7)
ArtNo.	Size A3
Ritn nr/Drawing No T128116	Rev A

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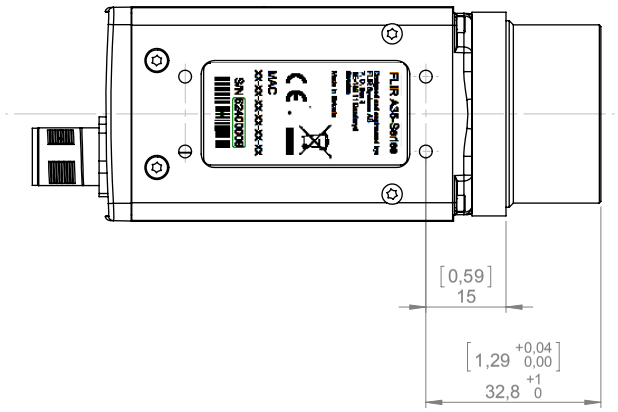
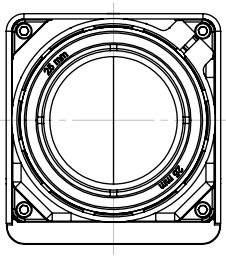
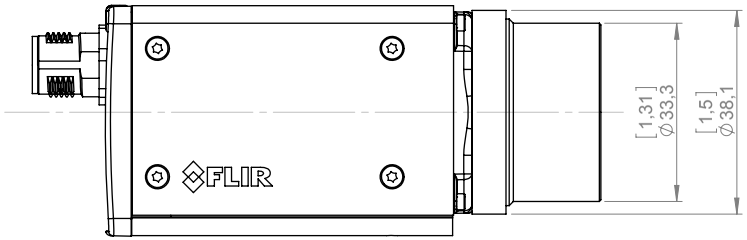
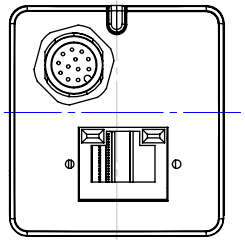
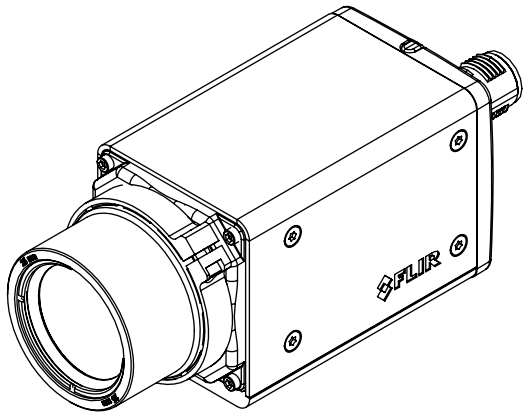
Basic dimensions:
Camera with focal length f=25 mm IR lens.
Only dimensions valid for this IR lens.
For all other dimensions see pages 1 and 2.











Konstr/Drawn: P. MARCUS	Datum/Date: 2014-01-29	Kontr/Check: MABR	Material: -
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2014-02-11	Ytjämnhet/Roughness: Ra µm	Ytbehandling/Surface treatment

Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

0,5-6	±0,1	Hålkälsradier
(6)-30	±0,2	Fillet radii
(30)-120	±0,3	
(120)-400	±0,5	Kanter brutna
(400)-1000	±0,8	Edges broken

Benämning/Denomination

Basic dimensions Ax5
f=7,5 mm to f=100 mm

Skala/Scale 1:1	Blad/Sheet 3(7)
ArtNo.	Size A3
Ritn nr/Drawing No T128116	Rev A

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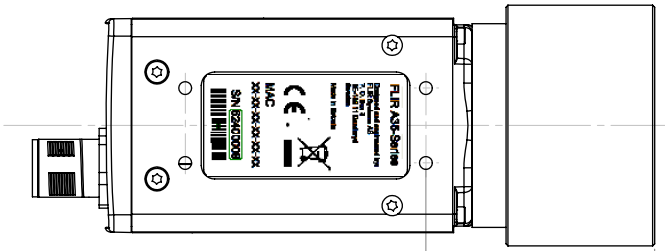
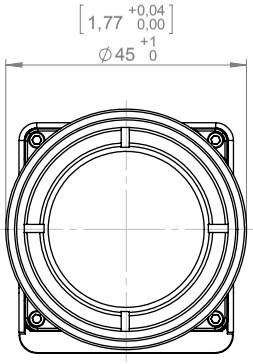
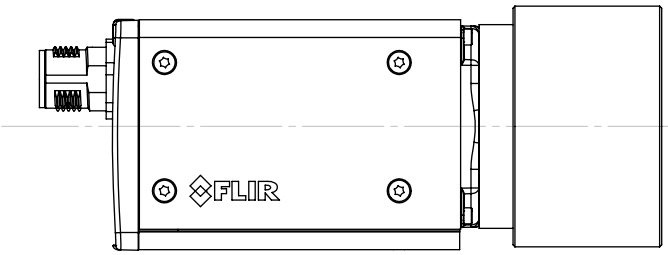
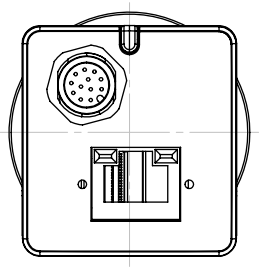
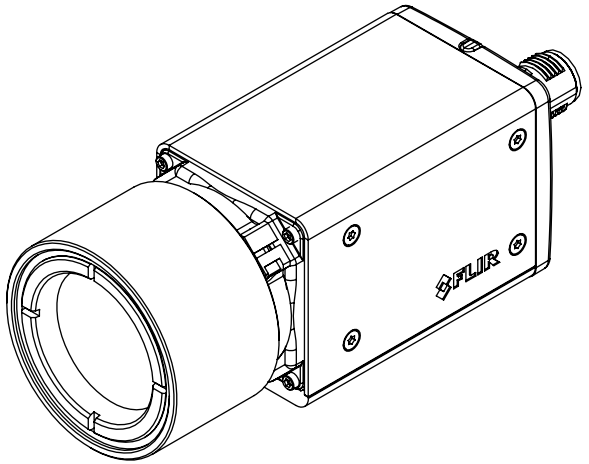
Basic dimensions:
Camera with focal length f=35 mm IR lens.
Only dimensions valid for this IR lens.
For all other dimensions see pages 1 and 2.











Konstr/Drawn: P. MARCUS	Datum/Date: 2014-01-29	Kontr/Check: MABR	Material: -
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2014-02-11	Ytjämnhet/Roughness: Ra µm	Ytbehandling/Surface treatment

Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

0,5-6	±0,1	Hålkälsradier
(6)-30	±0,2	Fillet radii
(30)-120	±0,3	
(120)-400	±0,5	Kanter brutna
(400)-1000	±0,8	Edges broken

Benämning/Denomination

Basic dimensions Ax5
f=7,5 mm to f=100 mm

Skala/Scale 1:1	Blad/Sheet 4(7)
ArtNo.	Size A3
Ritn nr/Drawing No T128116	Rev A

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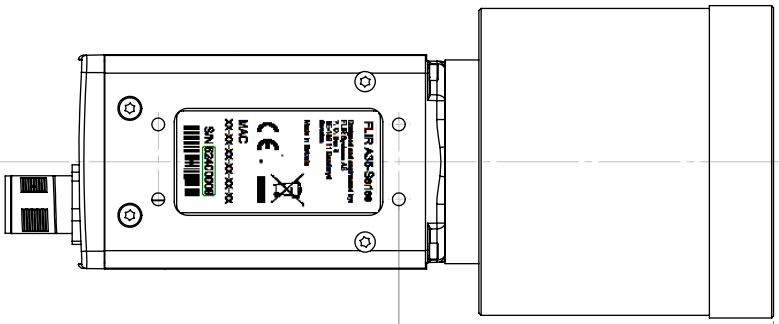
Basic dimensions:
Camera with focal length
f=50 mm IR lens.
Only dimensions valid for
this IR lens.
For all other dimensions see pages
1 and 2.



$[2{,}76\ ^{+0{,}04}_{0{,}00}]$
$70{,}1\ ^{+1}_{0}$

$[2{,}3\ ^{+0{,}04}_{0{,}00}]$
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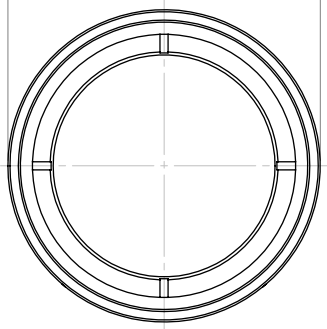

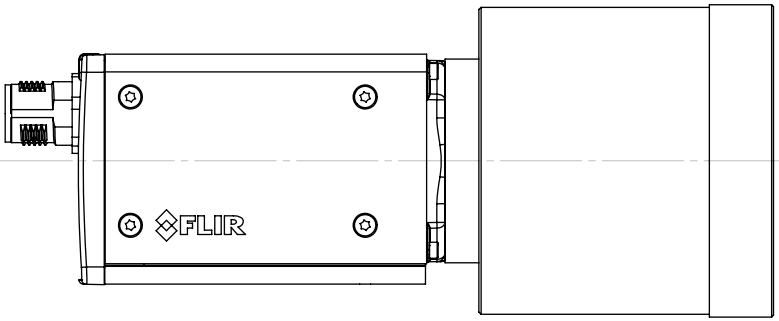

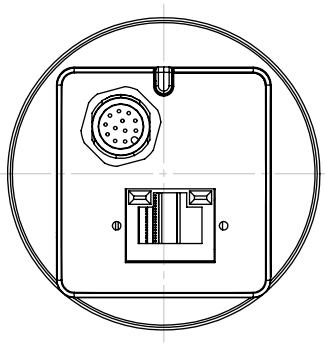

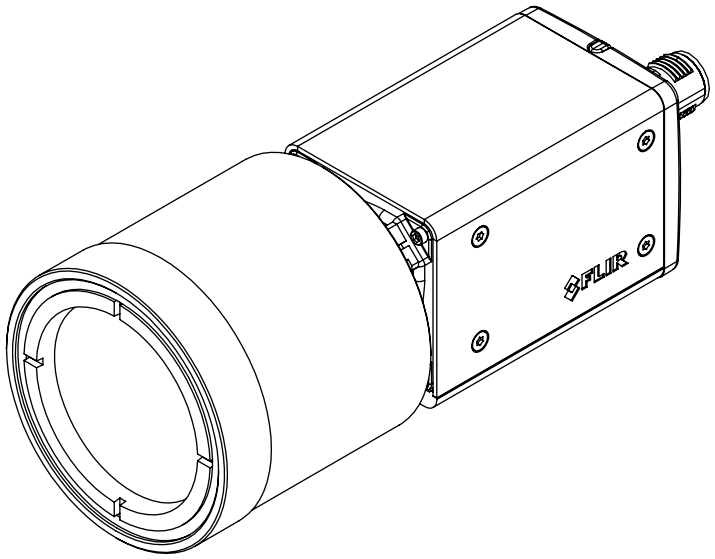

Konstr/Drawn: P. MARCUS	Datum/Date: 2014-01-29	Kontr/Check: MABR	Material: -
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2014-02-11	Ytjämnhet/Roughness: Ra µm	Ytbehandling/Surface treatment

Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

0,5-6	±0,1	Hålkälsradier
(6)-30	±0,2	Fillet radii
(30)-120	±0,3	
(120)-400	±0,5	Kanter brutna
(400)-1000	±0,8	Edges broken

Benämning/Denomination

Basic dimensions Ax5
f=7,5 mm to f=100 mm

Skala/Scale: 1:1	Blad/Sheet: 5(7)
ArtNo.	Size: A3
Ritn nr/Drawing No: T128116	Rev: A

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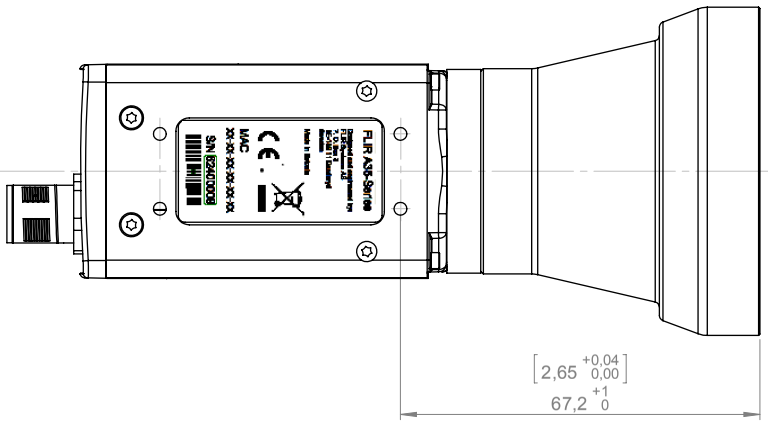
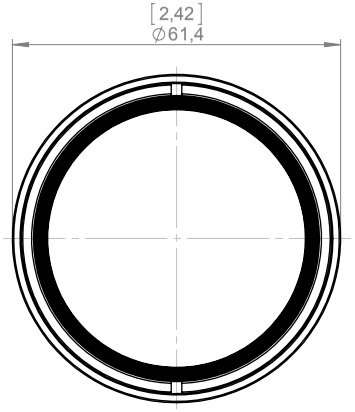
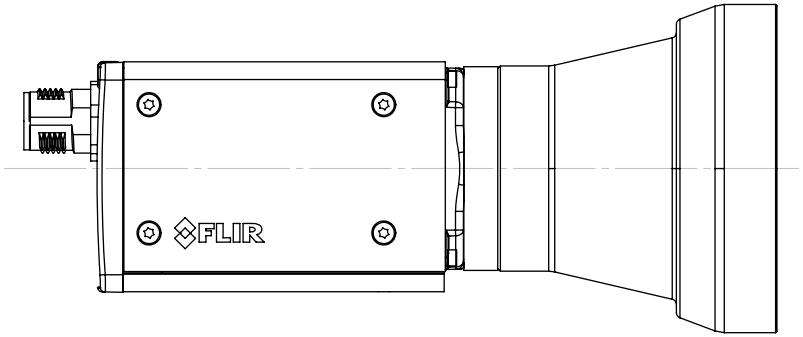
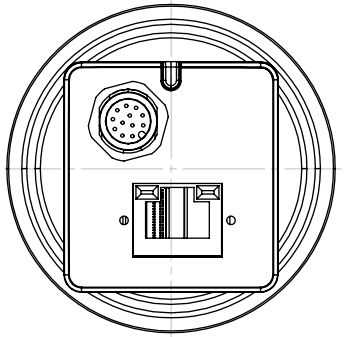
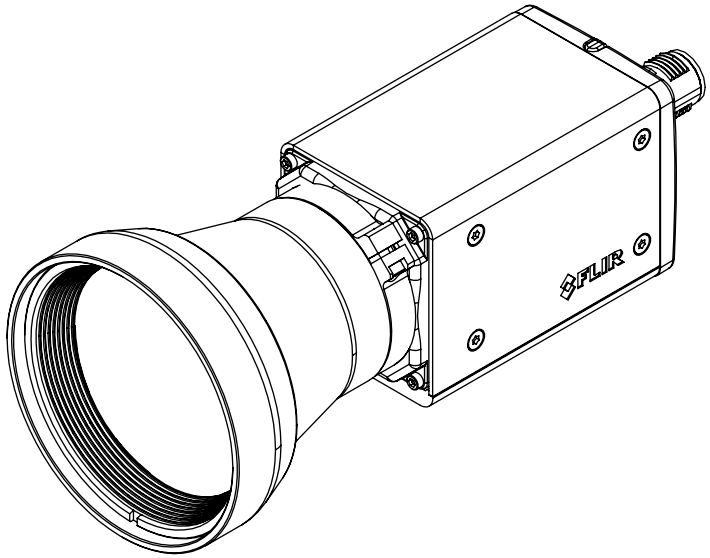
Basic dimensions:
Camera with focal length
f=60 mm IR lens.
Only dimensions valid for
this IR lens.
For all other dimensions see pages
1 and 2.











Konstr/Drawn: P. MARCUS	Datum/Date: 2014-01-29	Kontr/Check: MABR	Material: -
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2014-02-11	Ytjämnhet/Roughness Ra µm	Ytbehandling/Surface treatment

Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

0,5-6	±0,1	Hålkälsradier
(6)-30	±0,2	Fillet radii
(30)-120	±0,3	
(120)-400	±0,5	Kanter brutna
(400)-1000	±0,8	Edges broken

Benämning/Denomination

Basic dimensions Ax5
f=7,5 mm to f=100 mm

Skala/Scale 1:1	Blad/Sheet 6(7)
ArtNo.	Size A3
Ritn nr/Drawing No T128116	Rev A

Denna handling får ej delges annan, kopieras i sin helhet eller delar utan vårt medgivande. Överträdelse härav beivras med stöd av gällande lag.
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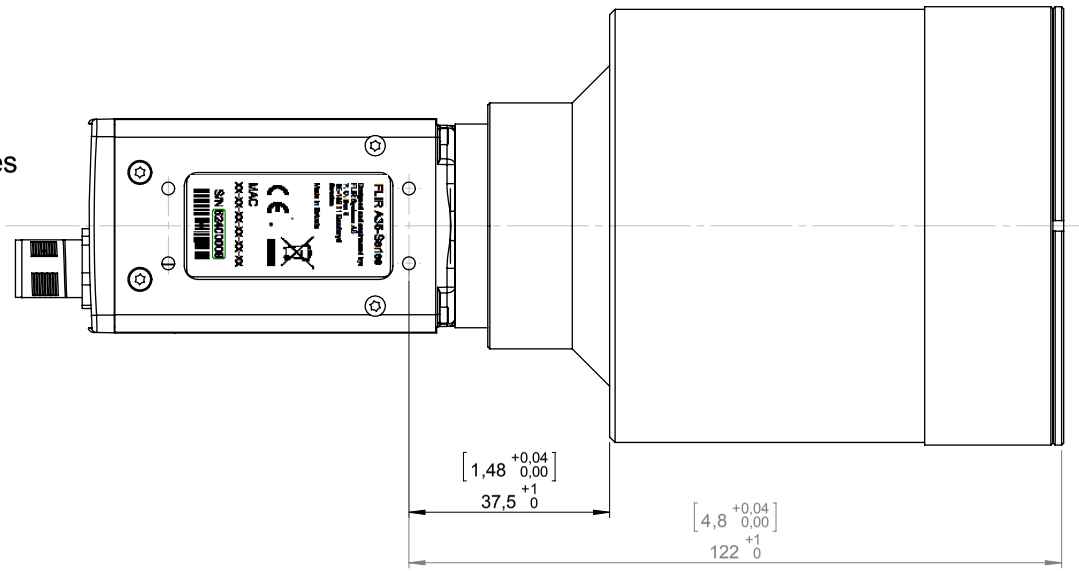
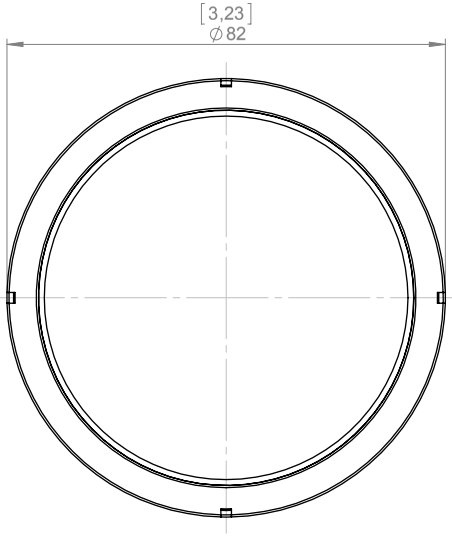
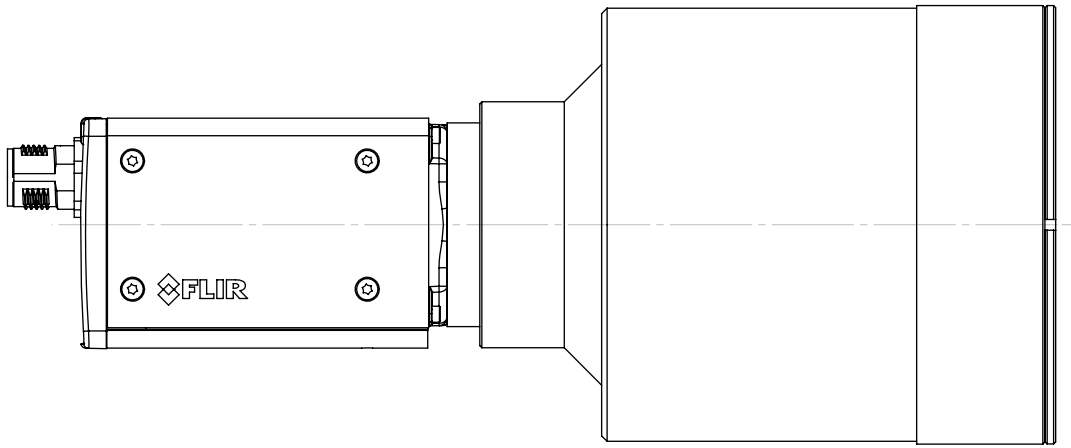
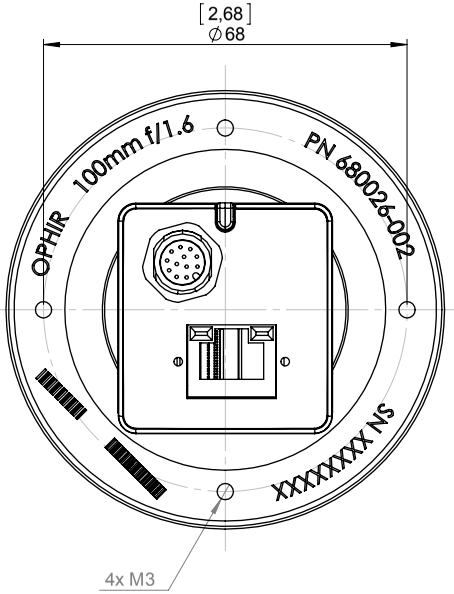
FLIR SYSTEMS AB

Basic dimensions:
Camera with focal length
f=100 mm IR lens.
Only dimensions valid for
this IR lens.
For all other dimensions see pages
1 and 2.

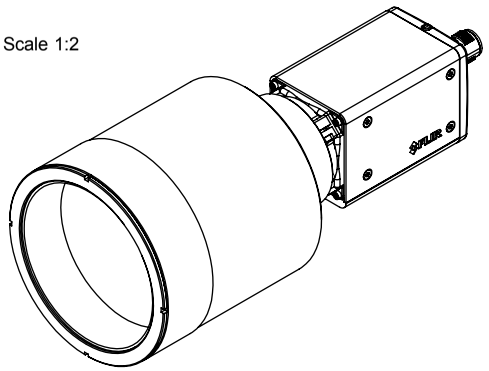








Scale 1:2



Konstr/Drawn: P. MARCUS	Datum/Date: 2014-01-29	Kontr/Check: MABR	Material: -
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2014-02-11	Ytjämnhet/Roughness Ra µm	Ytbehandling/Surface treatment

Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

0,5-6	±0,1	Hålkälsradier
(6)-30	±0,2	Fillet radii
(30)-120	±0,3	
(120)-400	±0,5	Kanter brutna
(400)-1000	±0,8	Edges broken

Benämning/Denomination

Basic dimensions Ax5
f=7,5 mm to f=100 mm

Skala/Scale 1:1	Blad/Sheet 7(7)
ArtNo.	Size A3
Ritn nr/Drawing No T128116	Rev A

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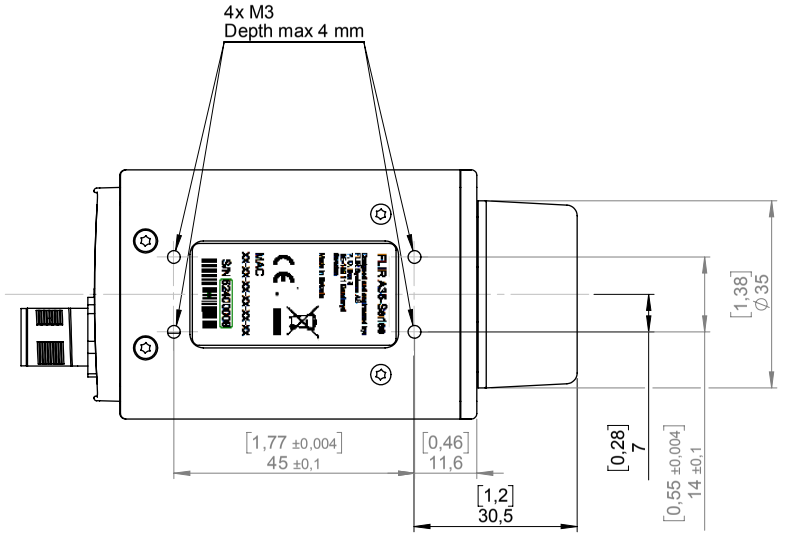
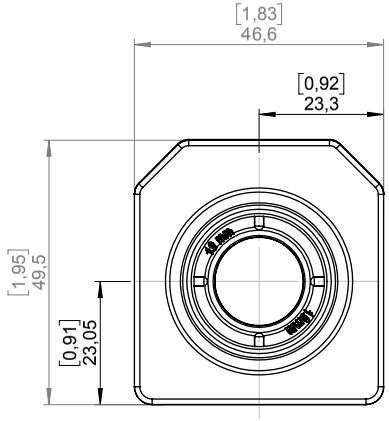
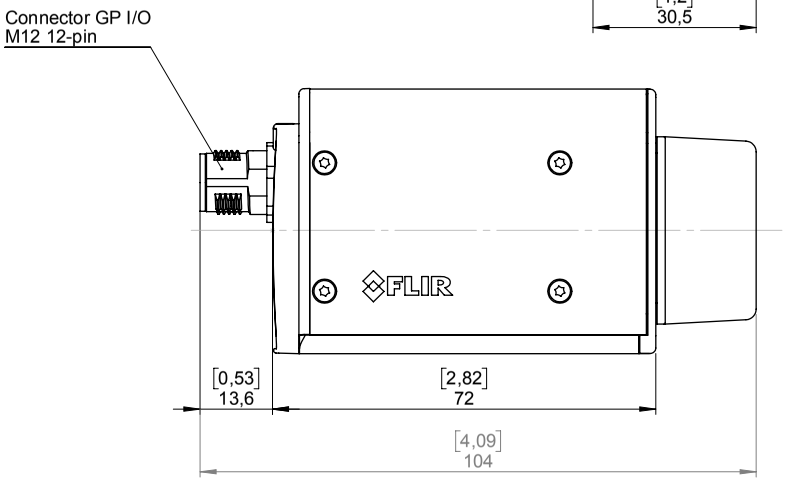
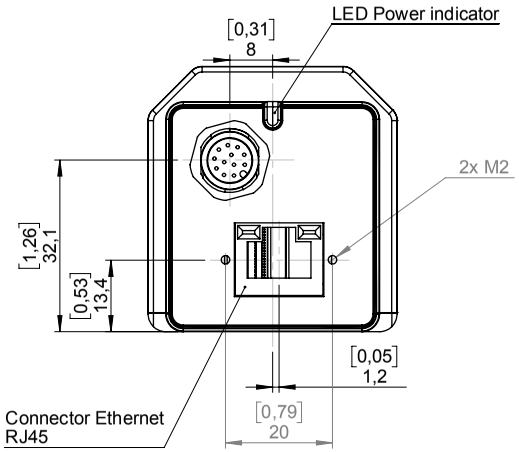
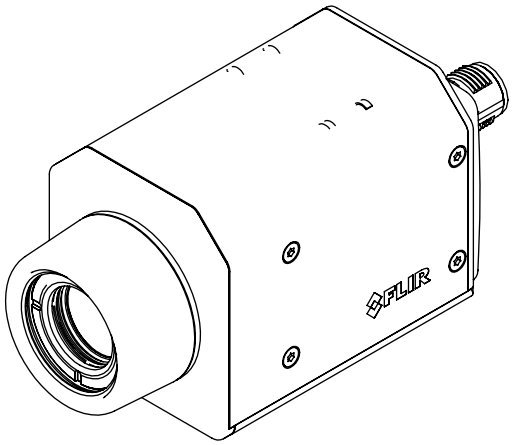
# Basic dimensions for cameras with focal length:
f= 7,5 mm
f= 9 mm
f=13 mm
f=19 mm











Konstr/Drawn: P. MARCUS	Datum/Date: 2015-12-14	Kontr/Check:	Material: -
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2016-10-18	Ytjämnhet/Roughness: Ra µm	Ytbehandling/Surface treatment
Där ej annat anges/Unless otherwise stated: Gen tol ISO 2768-mK; Utdrag ur/Excerpt from ISO 2768-m	Benämning/Denomination: Basic dimensions Ax5 w. flag shutter; f=7,5 mm to f=100 mm	Skala/Scale: 1:1	Blad/Sheet: 1(7)
0,5-6 ±0,1 Hålkälsradier; (6)-30 ±0,2 Fillet radii; (30)-120 ±0,3; (120)-400 ±0,5 Kanter brutna; (400)-1000 ±0,8 Edges broken		ArtNo.	Size: A3
		Ritn nr/Drawing No: T129297	Rev: -.002

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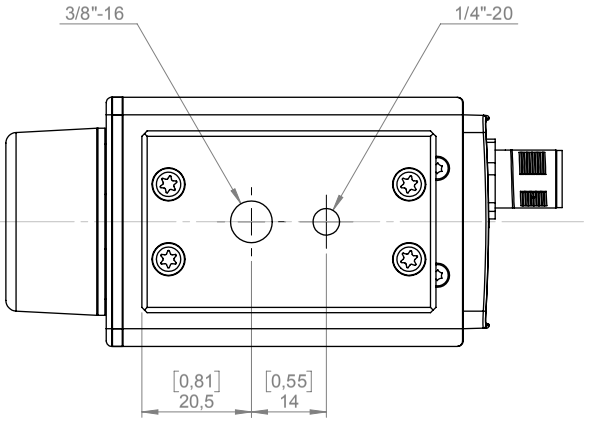
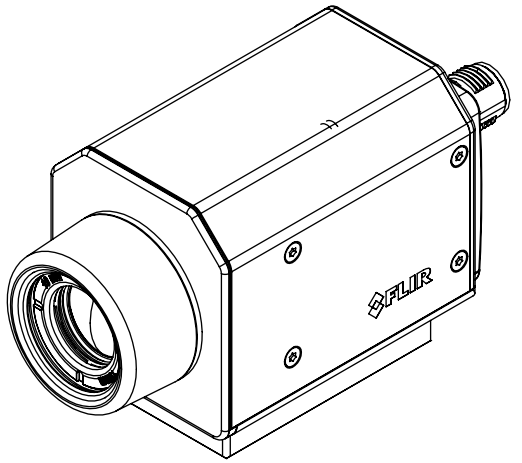
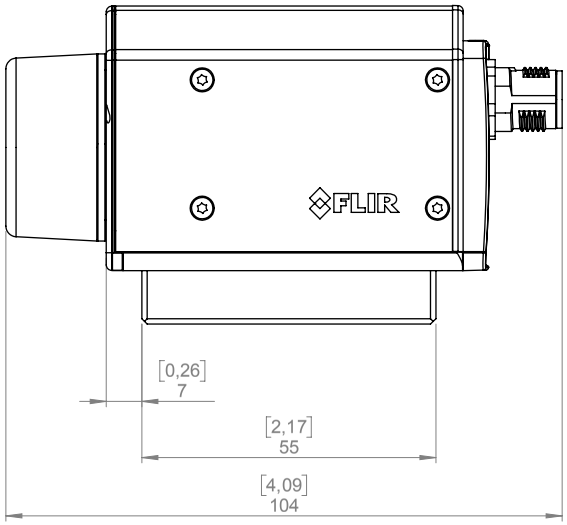
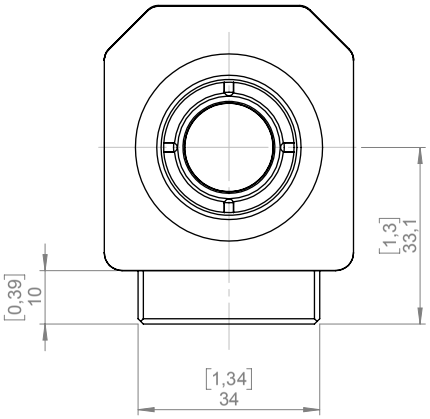
Basic dimensions for add-on base support









Konstr/Drawn: P. MARCUS	Datum/Date: 2015-12-14	Kontr/Check:	Material: -
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2016-10-18	Ytjämnhet/Roughness Ra µm	Ytbehandling/Surface treatment

Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

0,5-6	±0,1	Hålkälsradier
(6)-30	±0,2	Fillet radii
(30)-120	±0,3	
(120)-400	±0,5	Kanter brutna
(400)-1000	±0,8	Edges broken

Benämning/Denomination

Basic dimensions Ax5 w. flag shutter f=7,5 mm to f=100 mm

Skala/Scale 1:1	Blad/Sheet 2(7)
ArtNo.	Size A3
Ritn nr/Drawing No T129297	Rev -.002

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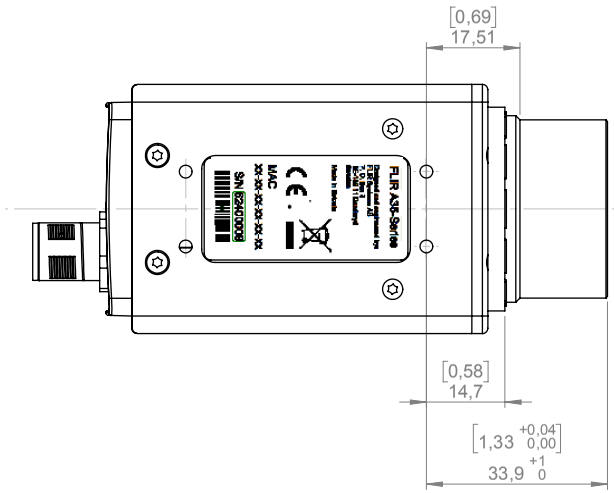
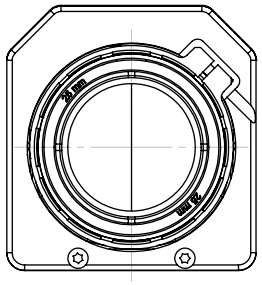
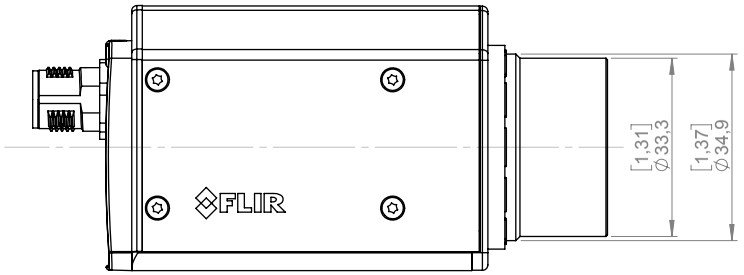
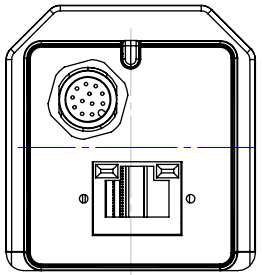
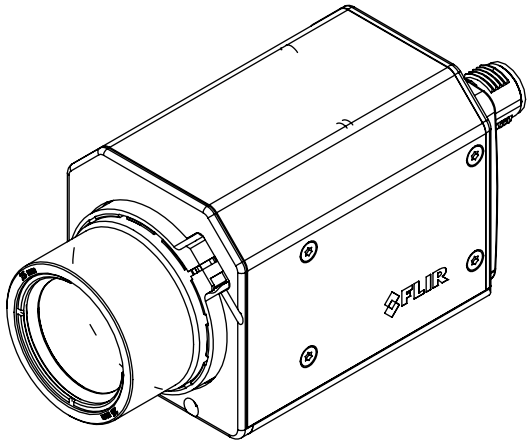
Basic dimensions:
Camera with focal length
f=25 mm IR lens.
Only dimensions valid for
this IR lens.
For all other dimensions see pages
1 and 2.











Konstr/Drawn: P. MARCUS	Datum/Date: 2015-12-14	Kontr/Check:	Material: -
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2016-10-18	Ytjämnhet/Roughness Ra µm	Ytbehandling/Surface treatment

Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

0,5-6	±0,1	Hålkälsradier
(6)-30	±0,2	Fillet radii
(30)-120	±0,3	
(120)-400	±0,5	Kanter brutna
(400)-1000	±0,8	Edges broken

Benämning/Denomination

Basic dimensions Ax5 w. flag shutter
f=7,5 mm to f=100 mm

Skala/Scale 1:1	Blad/Sheet 3(7)
ArtNo.	Size A3
Ritn nr/Drawing No T129297	Rev -.002

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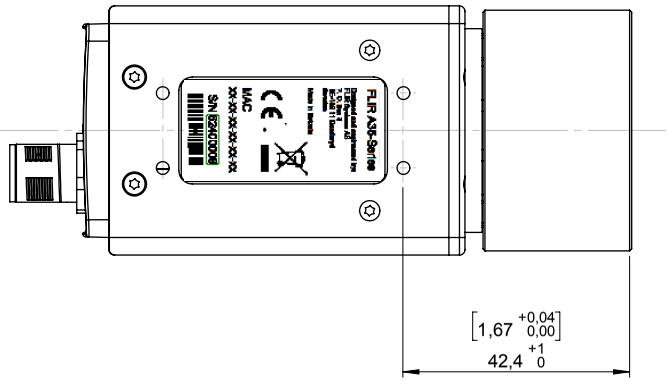
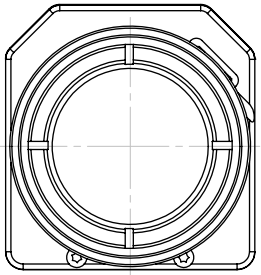
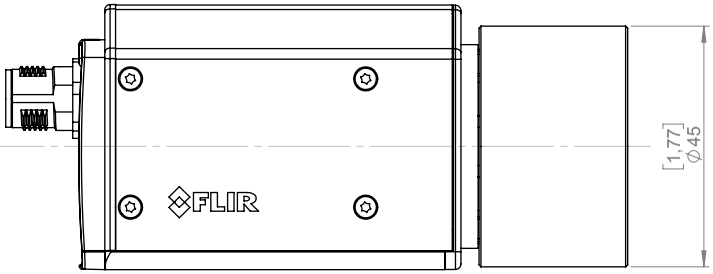
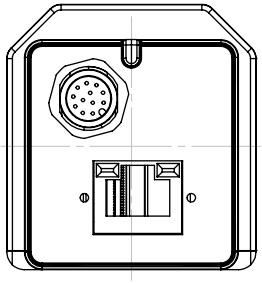
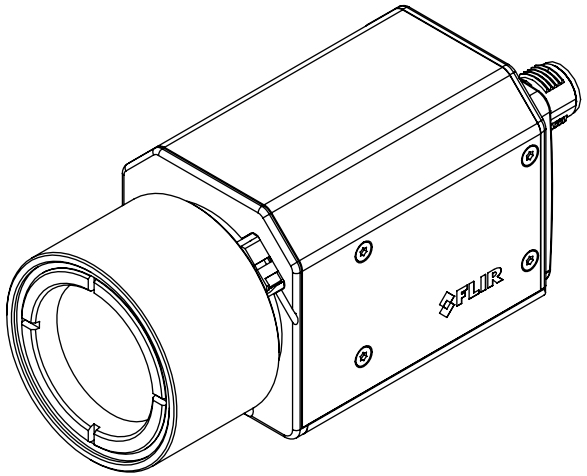
Basic dimensions:
Camera with focal length
f=35 mm IR lens.
Only dimensions valid for
this IR lens.
For all other dimensions see pages
1 and 2.











Konstr/Drawn: P. MARCUS	Datum/Date: 2015-12-14	Kontr/Check:	Material: -
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2016-10-18	Ytjämnhet/Roughness Ra µm	Ytbehandling/Surface treatment

Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

0,5-6	±0,1	Hålkälsradier
(6)-30	±0,2	Fillet radii
(30)-120	±0,3	
(120)-400	±0,5	Kanter brutna
(400)-1000	±0,8	Edges broken

Benämning/Denomination

Basic dimensions Ax5 w. flag shutter
f=7,5 mm to f=100 mm

Skala/Scale 1:1	Blad/Sheet 4(7)
ArtNo.	Size A3
Ritn nr/Drawing No T129297	Rev -.002

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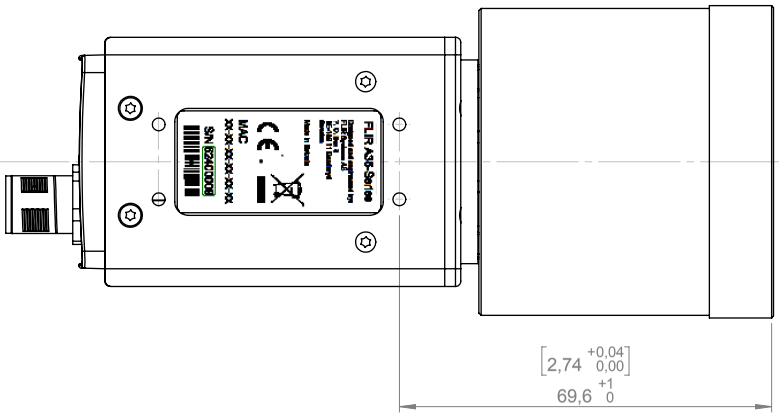
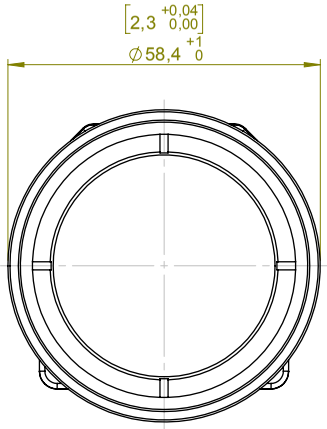
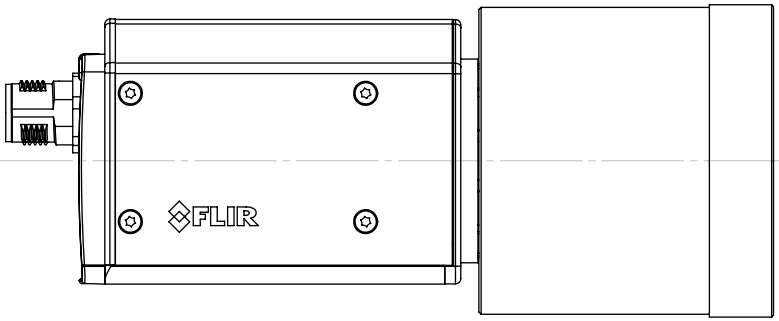
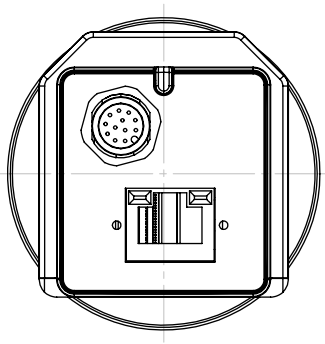
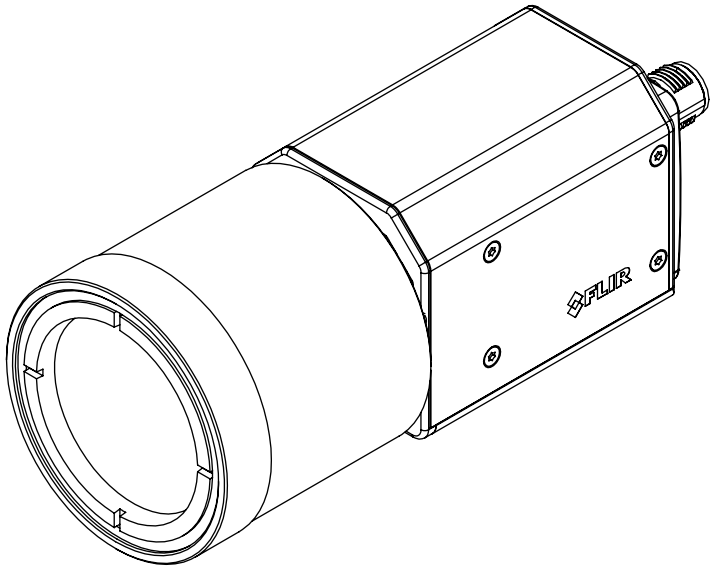
Basic dimensions:
Camera with focal length
f=50 mm IR lens.
Only dimensions valid for
this IR lens.
For all other dimensions see pages
1 and 2.











Konstr/Drawn: P. MARCUS	Datum/Date: 2015-12-14	Kontr/Check:	Material: -
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2016-10-18	Ytjämnhet/Roughness Ra µm	Ytbehandling/Surface treatment

Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

0,5-6	±0,1	Hålkälsradier
(6)-30	±0,2	Fillet radii
(30)-120	±0,3	
(120)-400	±0,5	Kanter brutna
(400)-1000	±0,8	Edges broken

Benämning/Denomination

Basic dimensions Ax5 w. flag shutter
f=7,5 mm to f=100 mm

Skala/Scale 1:1	Blad/Sheet 5(7)
ArtNo.	Size A3
Ritn nr/Drawing No T129297	Rev -.002

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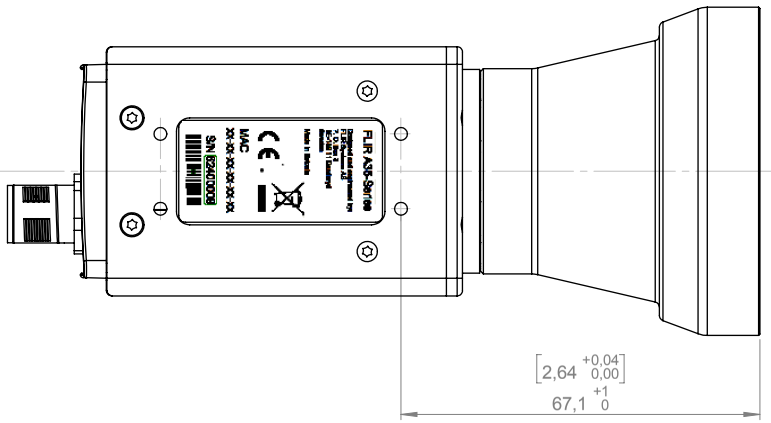
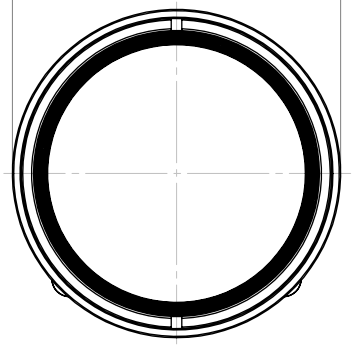
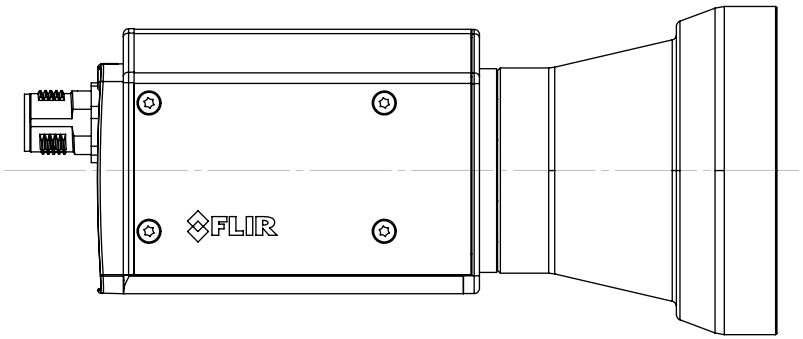
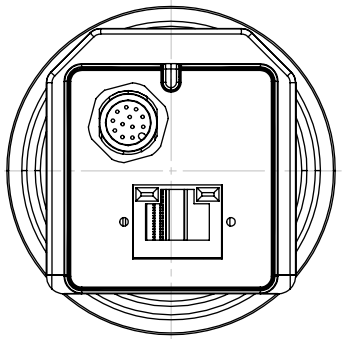
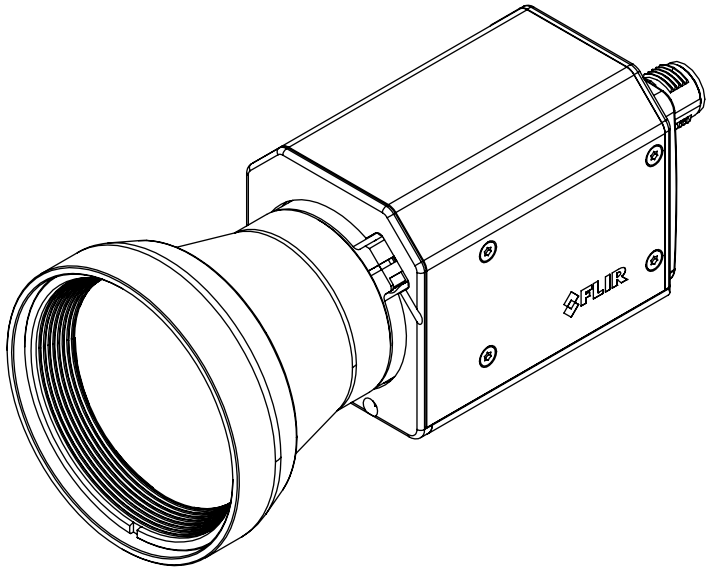
Basic dimensions:
Camera with focal length
f=60 mm IR lens.
Only dimensions valid for
this IR lens.
For all other dimensions see pages
1 and 2.











Konstr/Drawn: P. MARCUS	Datum/Date: 2015-12-14	Kontr/Check:	Material: -
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2016-10-18	Ytjämnhet/Roughness Ra µm	Ytbehandling/Surface treatment

Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

0,5-6	±0,1	Hålkälsradier
(6)-30	±0,2	Fillet radii
(30)-120	±0,3	
(120)-400	±0,5	Kanter brutna
(400)-1000	±0,8	Edges broken

Benämning/Denomination

Basic dimensions Ax5 w. flag shutter
f=7,5 mm to f=100 mm

Skala/Scale 1:1	Blad/Sheet 6(7)
ArtNo.	Size A3
Ritn nr/Drawing No T129297	Rev -.002

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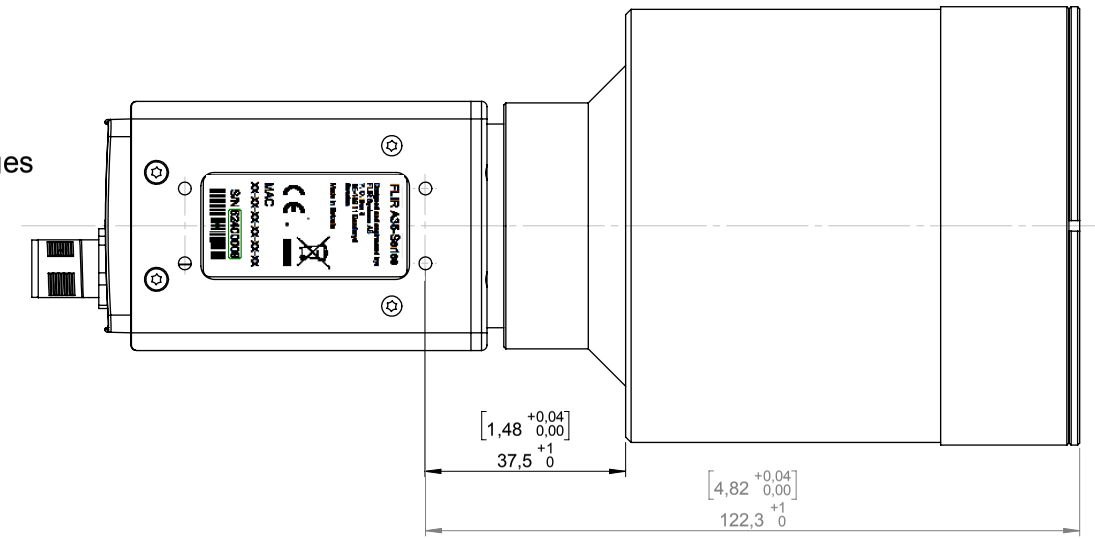
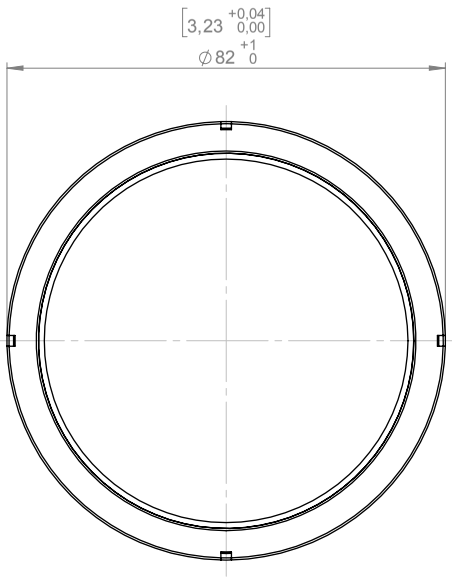
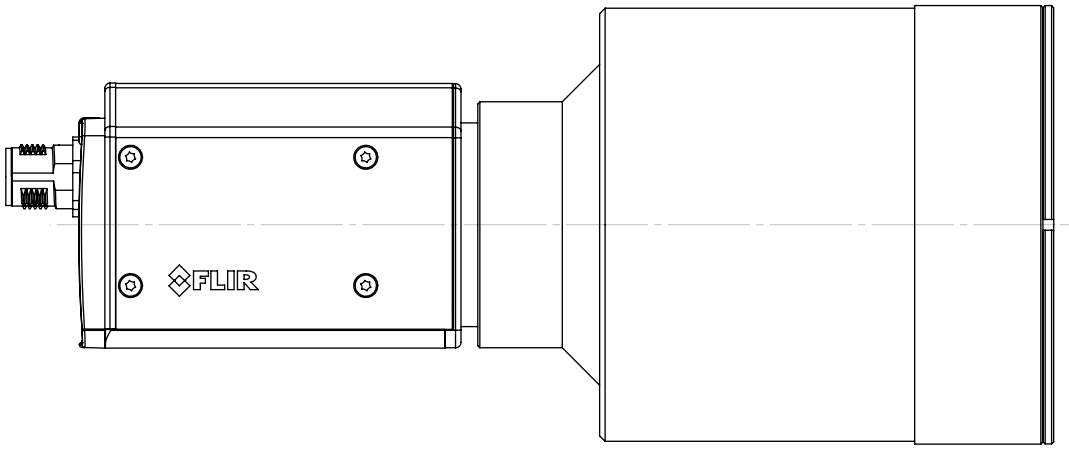
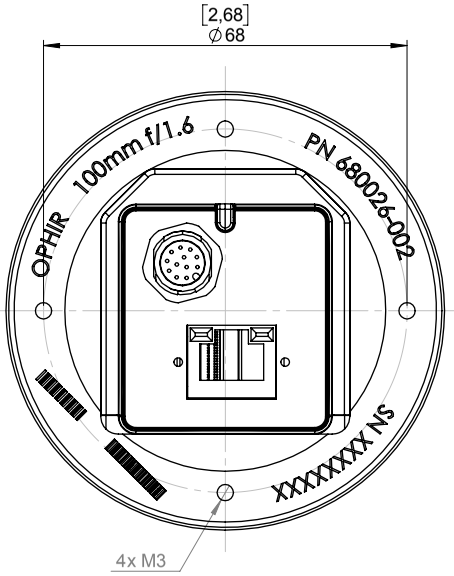
Basic dimensions:
Camera with focal length
f=100 mm IR lens.
Only dimensions valid for
this IR lens.
For all other dimensions see pages
1 and 2.

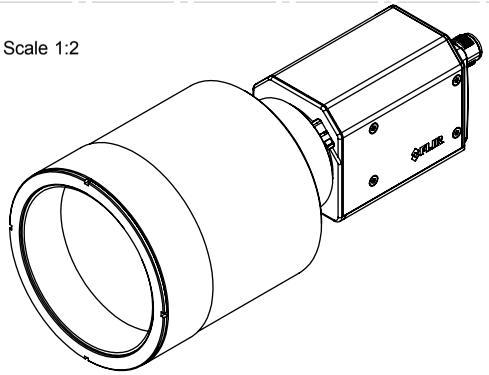








Scale 1:2



Konstr/Drawn: P. MARCUS	Datum/Date: 2015-12-14	Kontr/Check:	Material: -
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2016-10-18	Ytjämnhet/Roughness Ra µm	Ytbehandling/Surface treatment

Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

0,5-6	±0,1	Hålkälsradier
(6)-30	±0,2	Fillet radii
(30)-120	±0,3	
(120)-400	±0,5	Kanter brutna
(400)-1000	±0,8	Edges broken

Benämning/Denomination

Basic dimensions Ax5 w. flag shutter
f=7,5 mm to f=100 mm

Skala/Scale 1:1	Blad/Sheet 7(7)
ArtNo.	Size A3
Ritn nr/Drawing No T129297	Rev -.002

Denna handling får ej delges annan, kopieras i sin helhet eller delar utan vårt medgivande. Överträdelse härav beivras med stöd av gällande lag.
FLIR SYSTEMS AB

15 CE Declaration of conformity

The full text of the Declaration of conformity is available at the following internet address: https://support.flir.com/resources/p6fr.

16 Pin configurations and schematics

16.1 M12 connector pin configuration

This section specifies the pin configuration for the M12 connector at the rear of the camera.

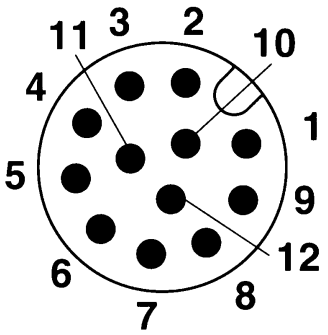


Figure 16.1 Pin assignment M12 male connector: 12 positions, male side view.

Table 16.1 Mapping table, pin to signal

Pin	Signal	Explanation
1	RET_GB	Camera PWR –
2	PWR_GB	Camera PWR +
3	SYNC_OUT	LVC Buffer @ 3.3 V, ”0” = 24 MA max, “1” = –24 mA max.
4	SYNC_OUT_GND	= RET_GB = Camera PWR –
5	SYNC_IN	LVC Buffer @ 3.3 V, “0” < 0.8 V, “1” > 2.0 V
6	SYNC_IN_GND	= RET_GB = Camera PWR –
7	GPO+	1 × opto-isolated, 2–40 VDC, max. 185 mA
8	GPO–	= GP Input return
9	GPIO_PWR	GP Output PWR. 2–40 VDC, max. 200 mA
10	GPIO_GND	GP Ouput PWR return
11	GPI+	1 × opto-isolated, “0” < 2, “1” = 2–40 VDC
12	GPI-	GP Input return

Cables for the M12 connector are available from FLIR Systems. See the part numbers below.

- T127605, Cable M12 pigtail.
- T127606, Cable M12 sync.

16.2 Pig-tail end of cable

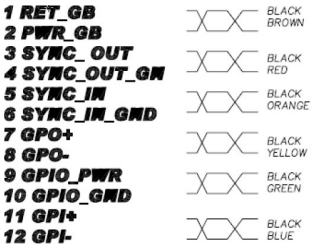


Figure 16.2 Mapping table, signal type to cable color.

16.3 SYNC input/output schematics

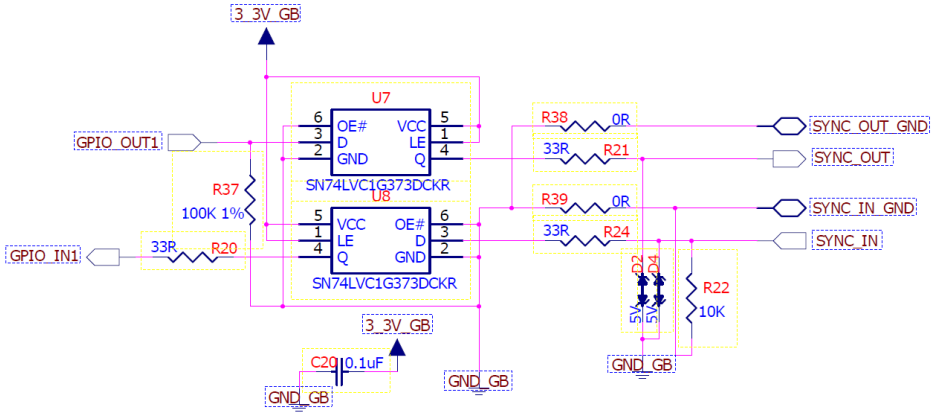


Figure 16.3 Schematics of SYNC input and output.

16.4 GP input/output schematics

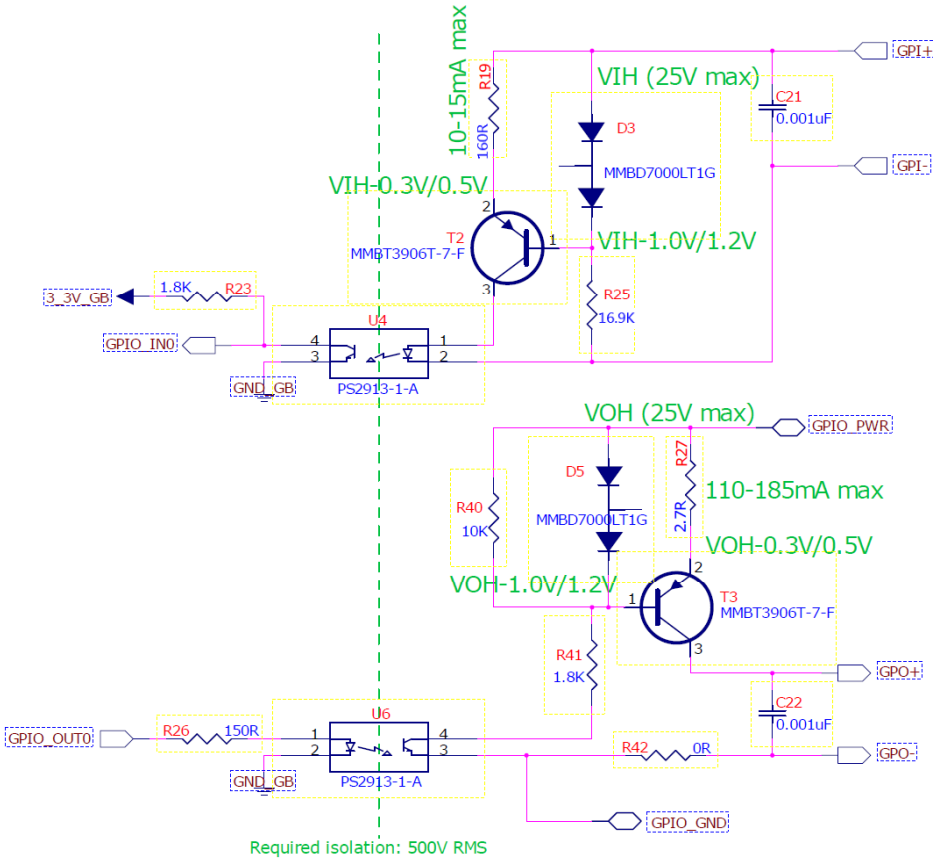


Figure 16.4 Schematics of GP input and output.

17 Cleaning the camera

17.1 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.

17.2 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

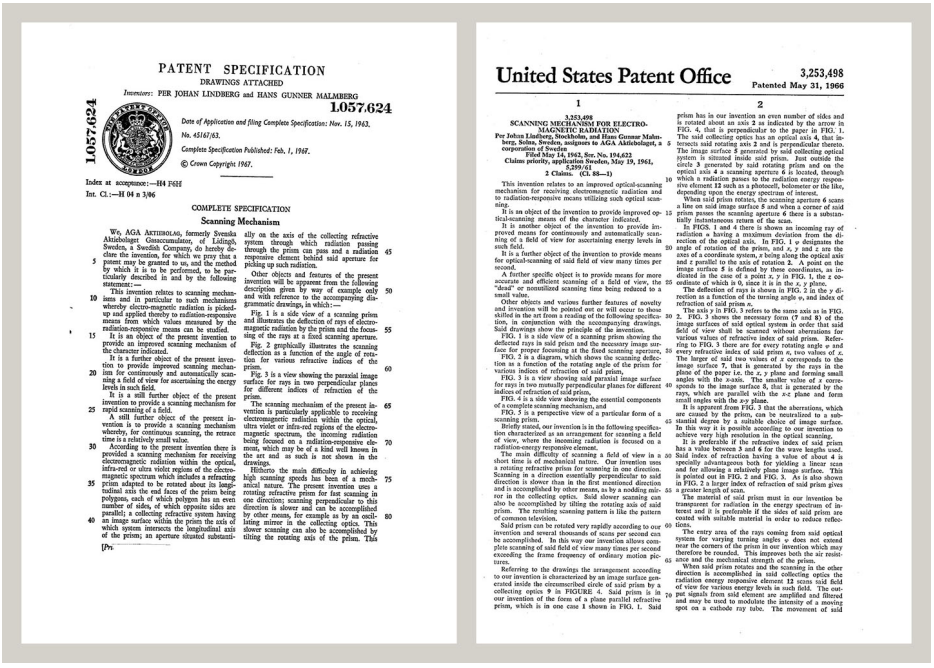
- Be careful when you clean the infrared lens. The lens has a delicate anti-reflective coating.
- Do not clean the infrared lens too vigorously. This can damage the anti-reflective coating.

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)



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 focused 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

1 2

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 so 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 (7 and 8) 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 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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Publ. No.: T559770
Release: AL
Commit: 81723
Head: 81723
Language: en-US
Modified: 2021-12-06
Formatted: 2021-12-06