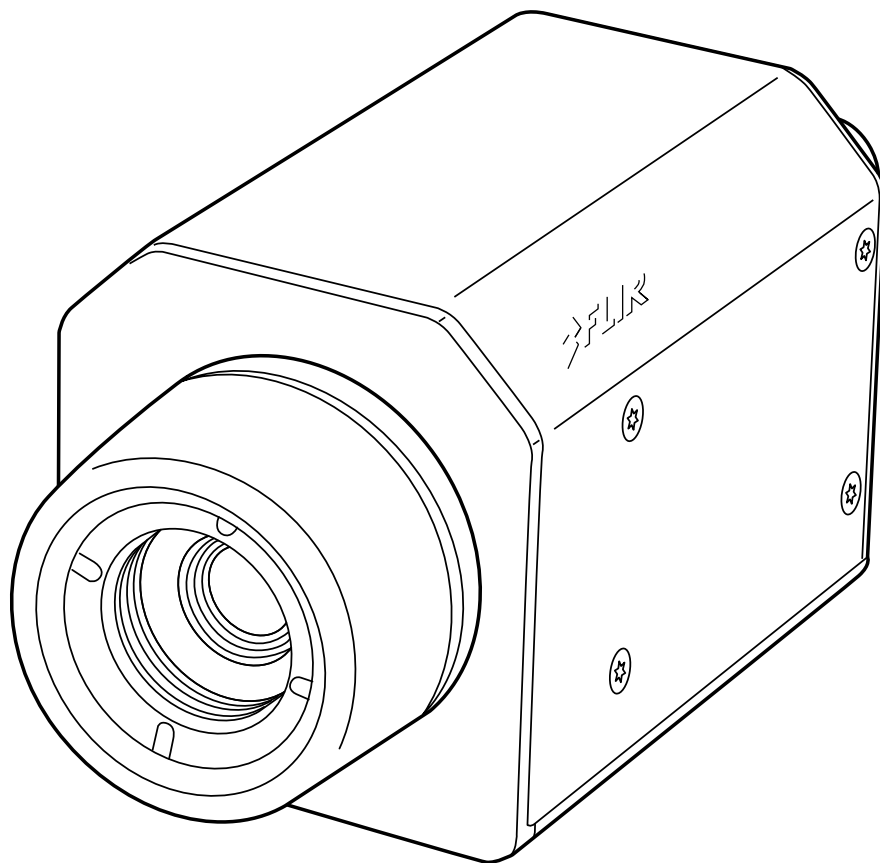


User's manual

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.

Viktig meddelelse

Før du betjener enheden, skal 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 renunciaciones 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 használatá 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, przestrożami 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.

重要注意事項

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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1.1 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 export-questions@flir.com.

1.5 Copyright

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language or computer language in any form or by any means, electronic, magnetic, optical, manual or otherwise, without the prior written permission of FLIR Systems.

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

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

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.
- IF YOU DO NOT AGREE TO THIS END USER LICENSE AGREEMENT ("EULA"), DO NOT USE THE DEVICE OR COPY THE SOFTWARE. INSTEAD, PROMPTLY CONTACT FLIR Systems AB FOR INSTRUCTIONS ON RETURN OF THE UNUSED DEVICE(S) FOR A REFUND. **ANY USE OF THE SOFTWARE, INCLUDING BUT NOT LIMITED TO USE ON THE DEVICE, WILL CONSTITUTE YOUR AGREEMENT TO THIS EULA (OR RATIFICATION OF ANY PREVIOUS CONSENT).**
- **GRANT OF SOFTWARE LICENSE.** This EULA grants you the following license:

-
- You may use the SOFTWARE only on the DEVICE.
 - **NOT FAULT TOLERANT.** THE SOFTWARE IS NOT FAULT TOLERANT. FLIR Systems AB HAS INDEPENDENTLY DETERMINED HOW TO USE THE SOFTWARE IN THE DEVICE, AND MS HAS RELIED UPON FLIR Systems AB TO CONDUCT SUFFICIENT TESTING TO DETERMINE THAT THE SOFTWARE IS SUITABLE FOR SUCH USE.
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 - **Limitations on Reverse Engineering, Decompilation, and Disassembly.** You may not reverse engineer, decompile, or disassemble the SOFTWARE, except and only to the extent that such activity is expressly permitted by applicable law notwithstanding this limitation.
 - **SOFTWARE TRANSFER ALLOWED BUT WITH RESTRICTIONS.** You may permanently transfer rights under this EULA only as part of a permanent sale or transfer of the Device, and only if the recipient agrees to this EULA. If the SOFTWARE is an upgrade, any transfer must also include all prior versions of the SOFTWARE.
 - **EXPORT RESTRICTIONS.** You acknowledge that SOFTWARE is subject to U.S. export jurisdiction. You agree to comply with all applicable international and national laws that apply to the SOFTWARE, including the U.S. Export Administration Regulations, as well as end-user, end-use and destination restrictions issued by U.S. and other governments. For additional information see <http://www.microsoft.com/exporting/>.

**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.

3.1 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.

4.1 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.



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.

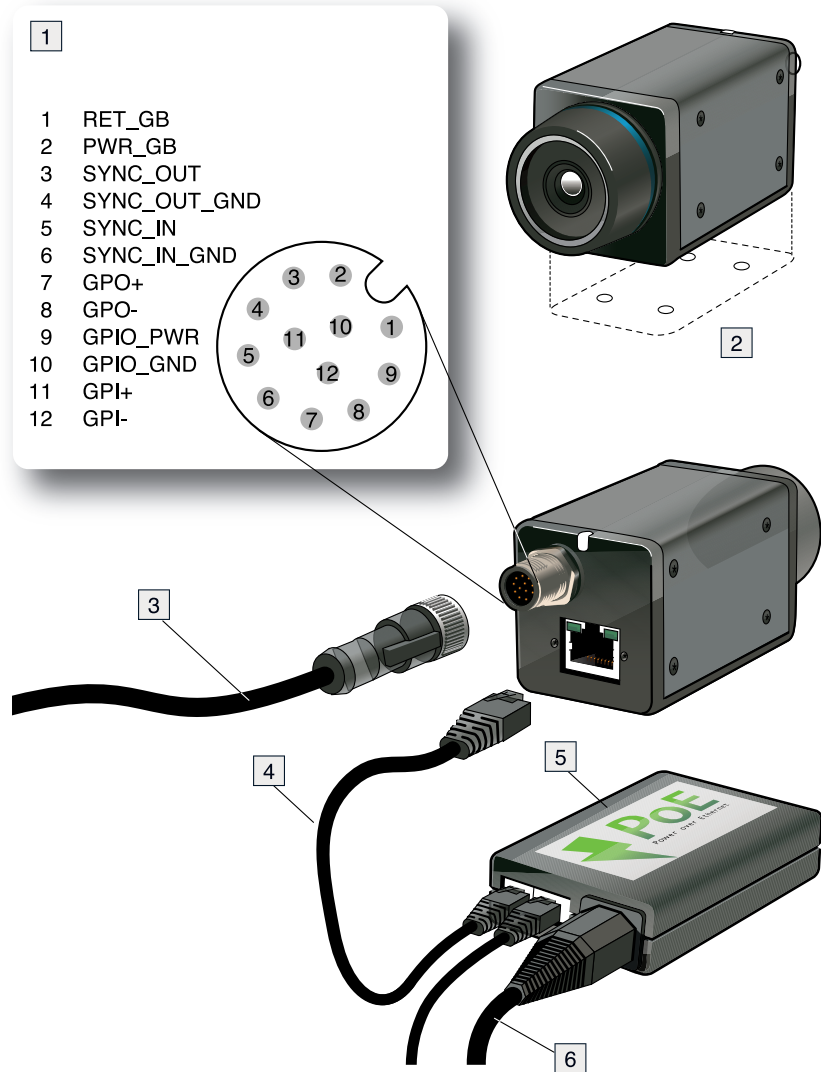
Key features:

- Very affordable.
- Compact ($40 \times 43 \times 106$ mm/ $1.57 \times 1.69 \times 4.17$ 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.

6.1 Figure



6.2 Explanation

1. Pin configuration in M12 connector. For more information, see section 15.1 *M12 connector pin configuration*, page 37.
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.

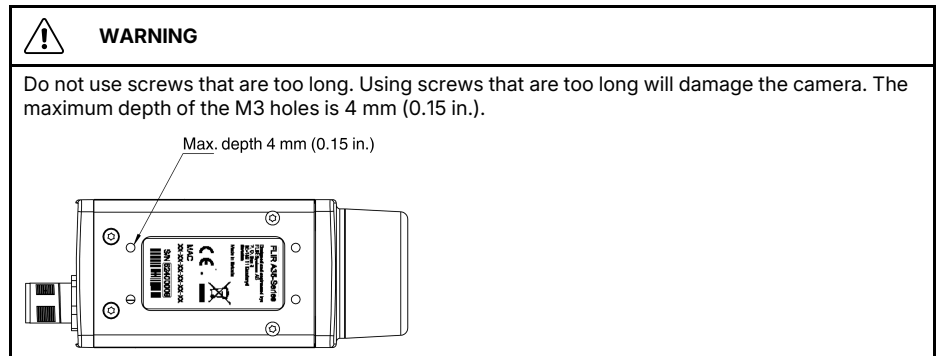
Follow this procedure:

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.

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.

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.



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.

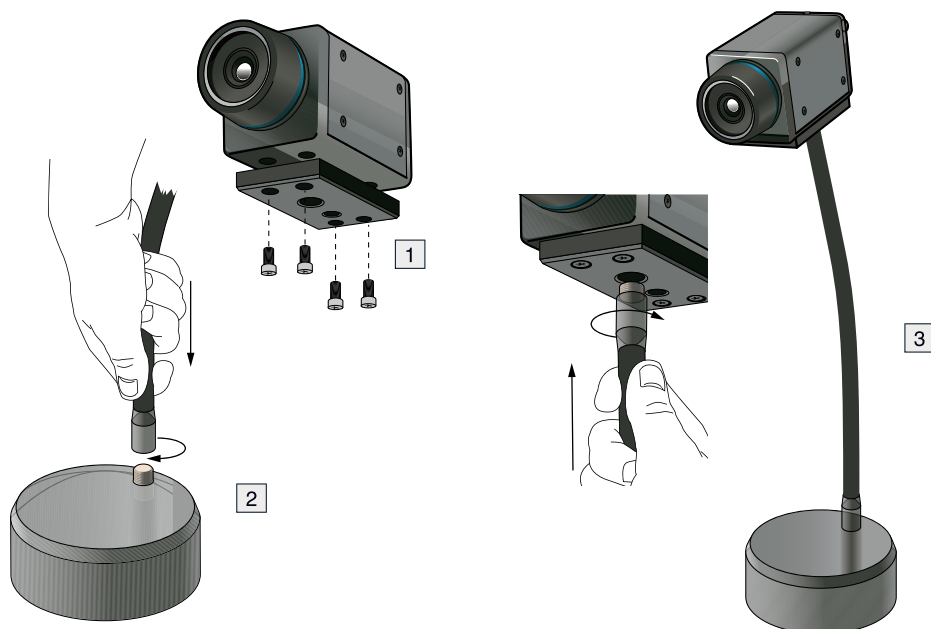
For further information regarding mounting recommendations and environmental enclosures, contact FLIR Systems.

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.

10.1 Focusing cameras with 5 to 19 mm lenses

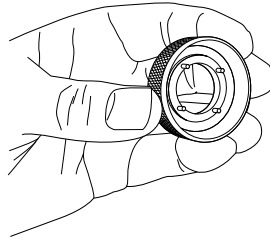
10.1.1 Necessary tools

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

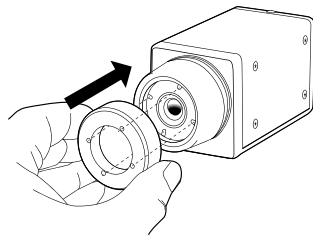
10.1.2 Procedure

Follow this procedure:

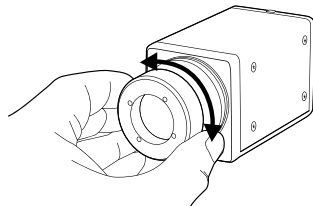
1. Note the four pegs on the inside of the focus adjustment tool.



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.

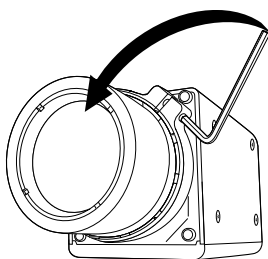
10.2.1 Necessary tools

Allen wrench, 1.5 mm.

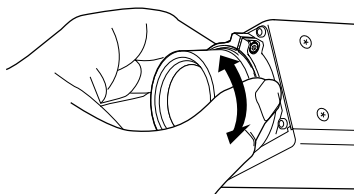
10.2.2 Procedure

Follow this procedure:

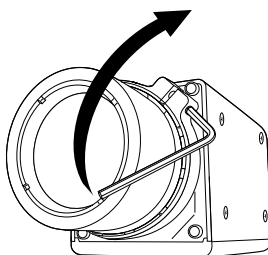
1. Unlock the clamp by loosening the Allen screw.



2. Focus the camera by rotating the lens.



3. Lock the clamp by tightening the Allen screw.



The principal software used to configure and control the camera is FLIR GEV Demo 1.3.0. This software is based on the PleoraBus 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>

12.1 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_Interupt_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.

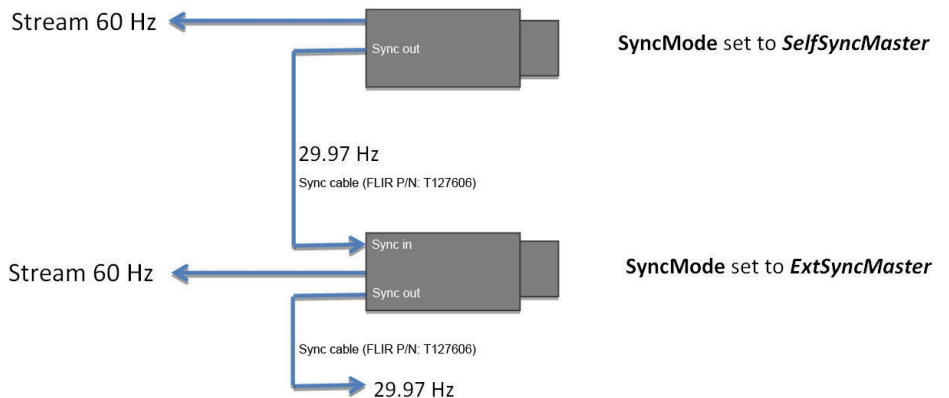


Figure 12.1 Master/slave synchronization between two FLIR Ax5 cameras (NTSC).

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 μ s).

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)

Temperature-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.

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

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:

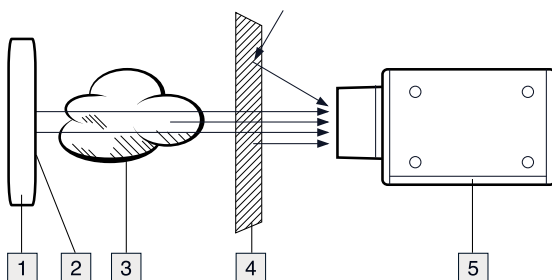


Figure 12.2 1: Scene, T_{scene} ; 2: Reflected background temperature; 3: Atmosphere, T_{Atm} ; 4: External window, T_{win} ; 5: Infrared camera.

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.

[See next page]

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

4x M3
Depth max 4 mm

Connector GP I/O
M12 12-pin

LED Power indicator

Connector Ethernet
RJ45

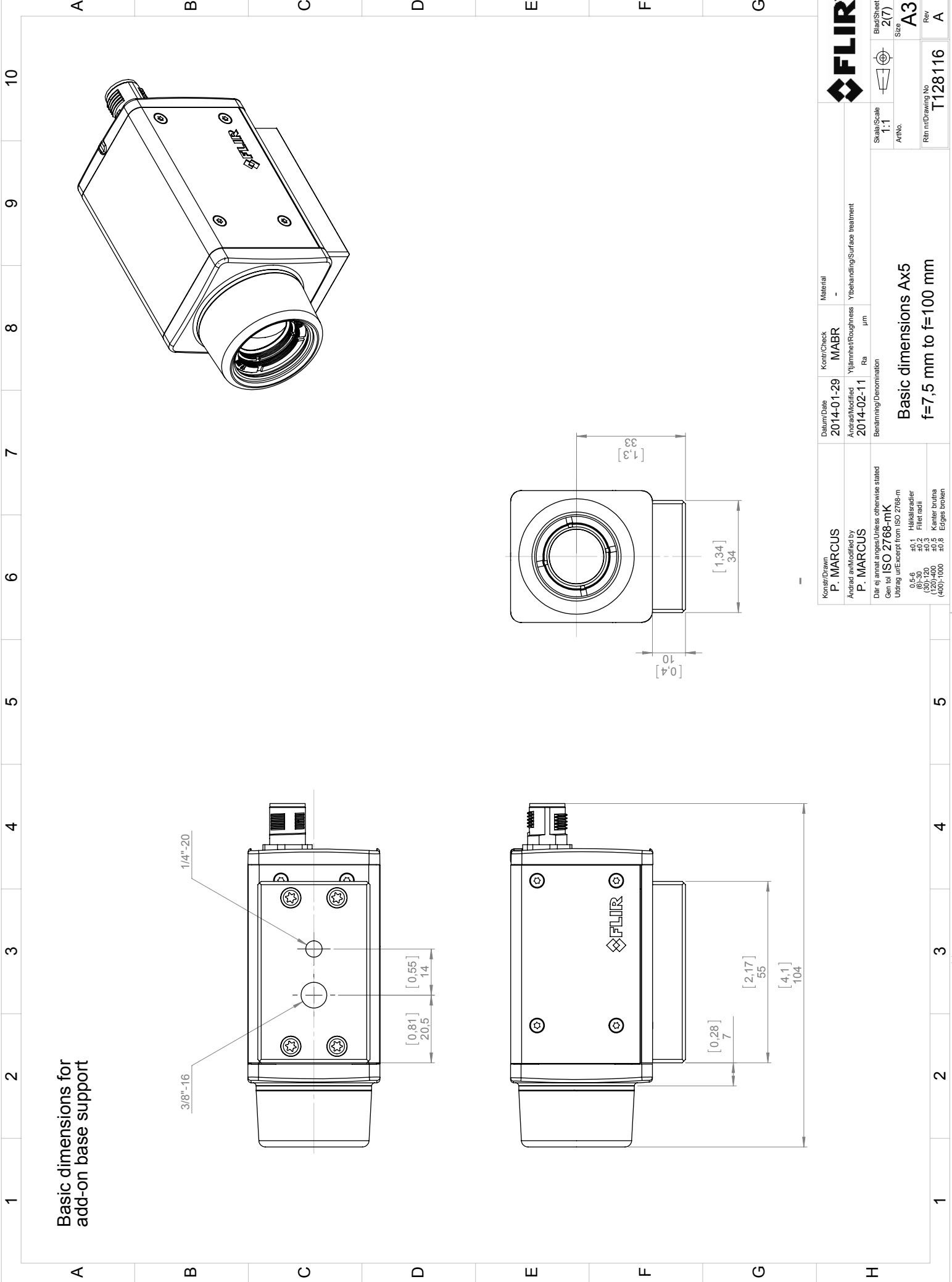
Basic dimensions Ax5
f=7,5 mm to f=100 mm



Konstruktör/Drawn	2014-01-29	Kontroll/Check	Material
P. MARCUS	2014-01-29	MABR	-
Ändrad av/Modified by	Ändrad/Modified	Ytfinish/Roughness	Ytbehandling/Surface treatment
P. MARCUS	2014-02-11	Ra	µm
Benämning/Denomination			

Skala/Scale	1:1
Bladdetalj	17
Size	A3

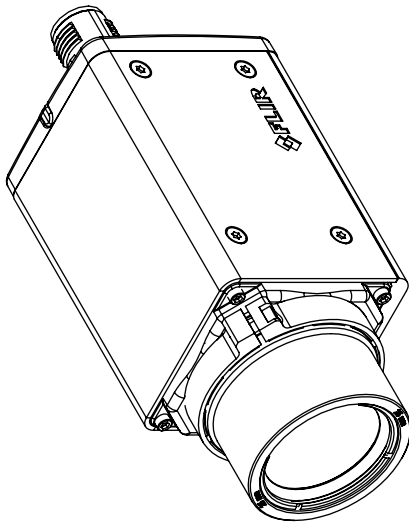
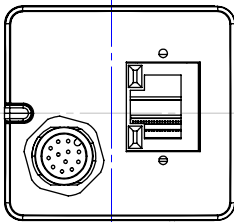
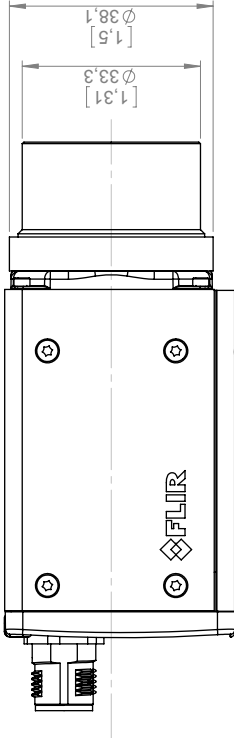
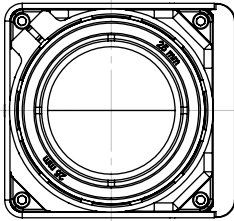
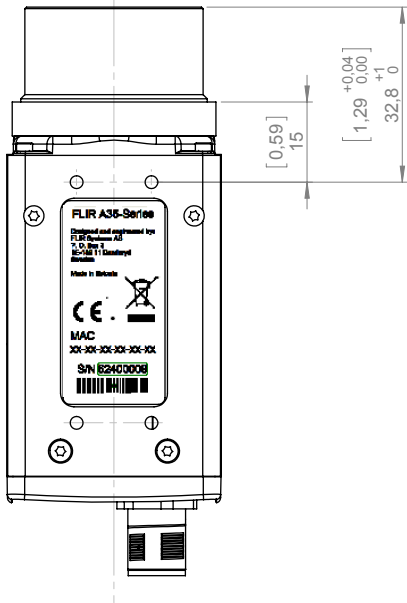
Ritning/Drawing No.	T128116
Rev	A



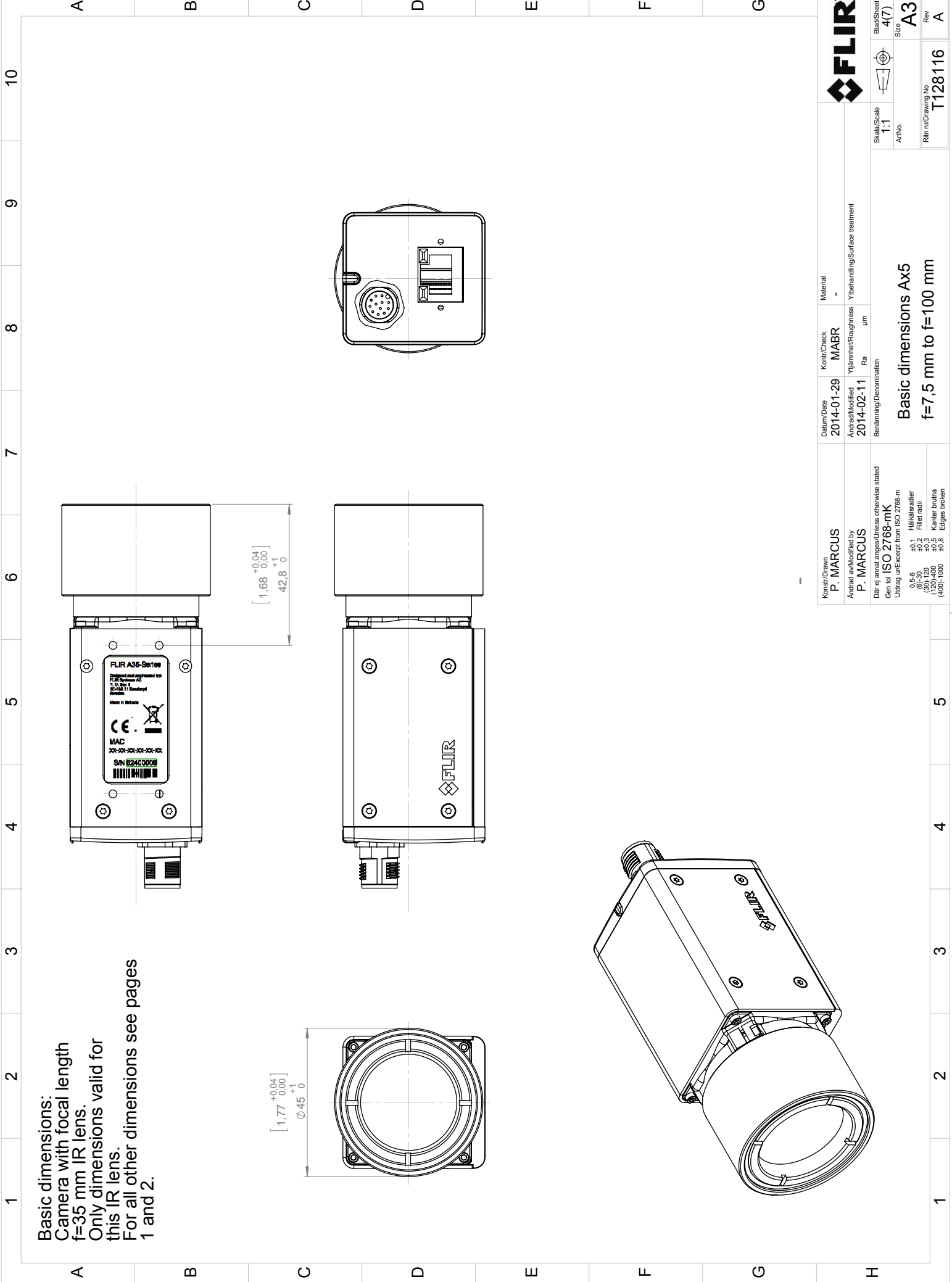
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Konstr/Drawn P. MARCUS		Datum/Date 2014-01-29	Kontr/Check MABR	Material -
Ändrad av/Modified by P. MARCUS		Ändrad/Modified 2014-02-11	Ytlämne/Roughness Ra	Ytbehandling/Surface treatment µm
Där ej annat anges/Unless otherwise stated Gen töl ISO 2768-mK Utmått ut/Excerpt from ISO 2768-m		Benämning/Denomination Basic dimensions Ax5 f=7,5 mm to f=100 mm		
0,5-6 ±0,1 Hållarsradier (6)-30 ±0,2 Fillet radii (120)-400 ±0,5 Kanter brutna (400)-1000 ±0,8 Edges broken		Scale/Scale 1:1		
		Blad/Sheet 2(7)		
		Rev A		
		T128116		

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.



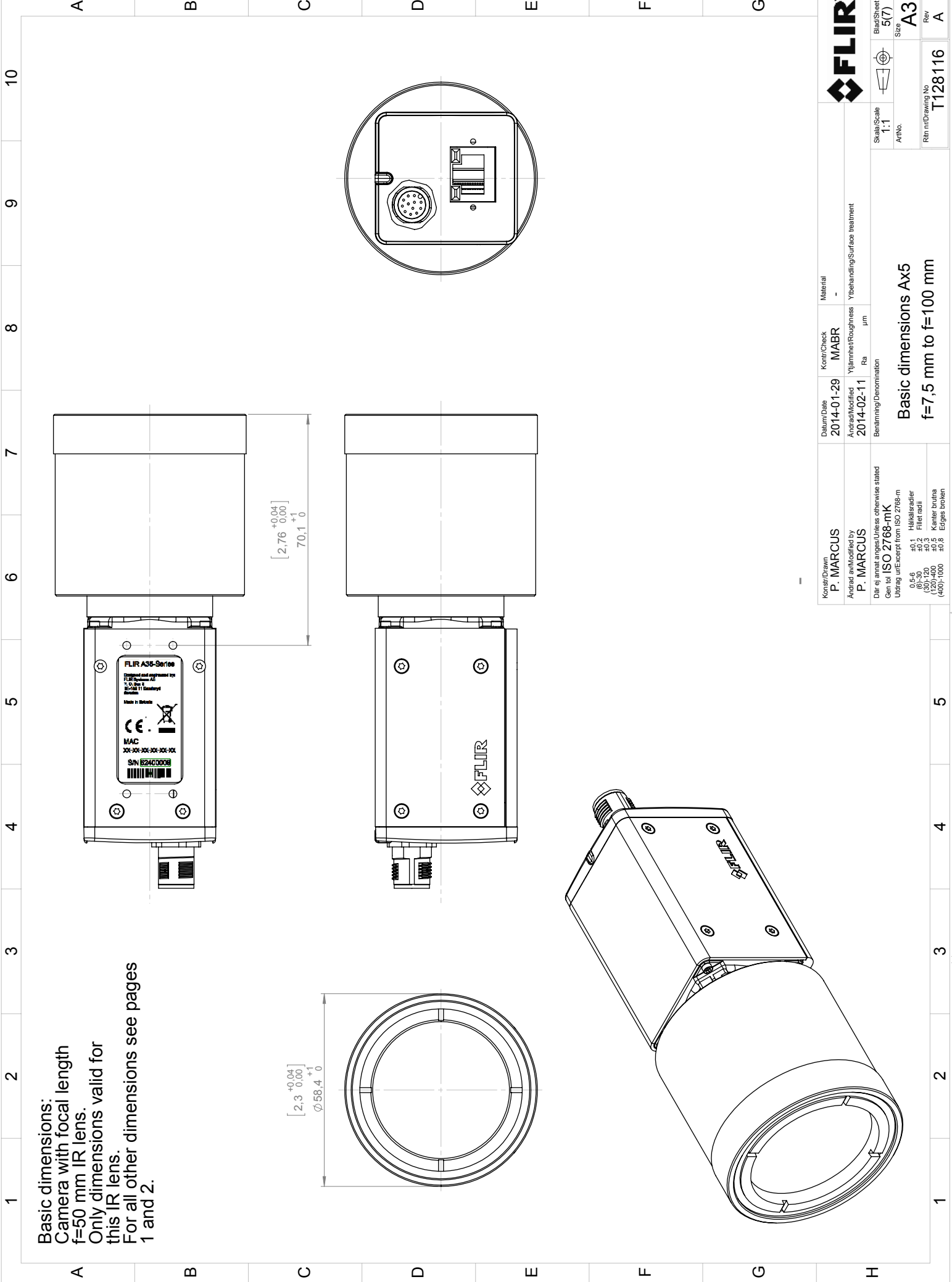
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Ändrad av/Modified by P. MARCUS		Ändrad/Modified 2014-02-11	Ytämne/Roughness Ra	Ytbehandling/Surface treatment µm	A3	
Där ej annat anges/Unless otherwise stated Utdrag ur/Excerpt from ISO 2768-m		Benämning/Denomination Basic dimensions Ax5 f=7.5 mm to f=100 mm		Scale/Scale 1:1		Blad/Sheet 3(7)
0.5-6 ±0.1 Hållarsradier (6)-30 ±0.2 Fillet radii (120)-400 ±0.5 Kanter brutna (400)-1000 ±0.8 Edges broken		Rev A		Ritning/Drawing No T128116		Size



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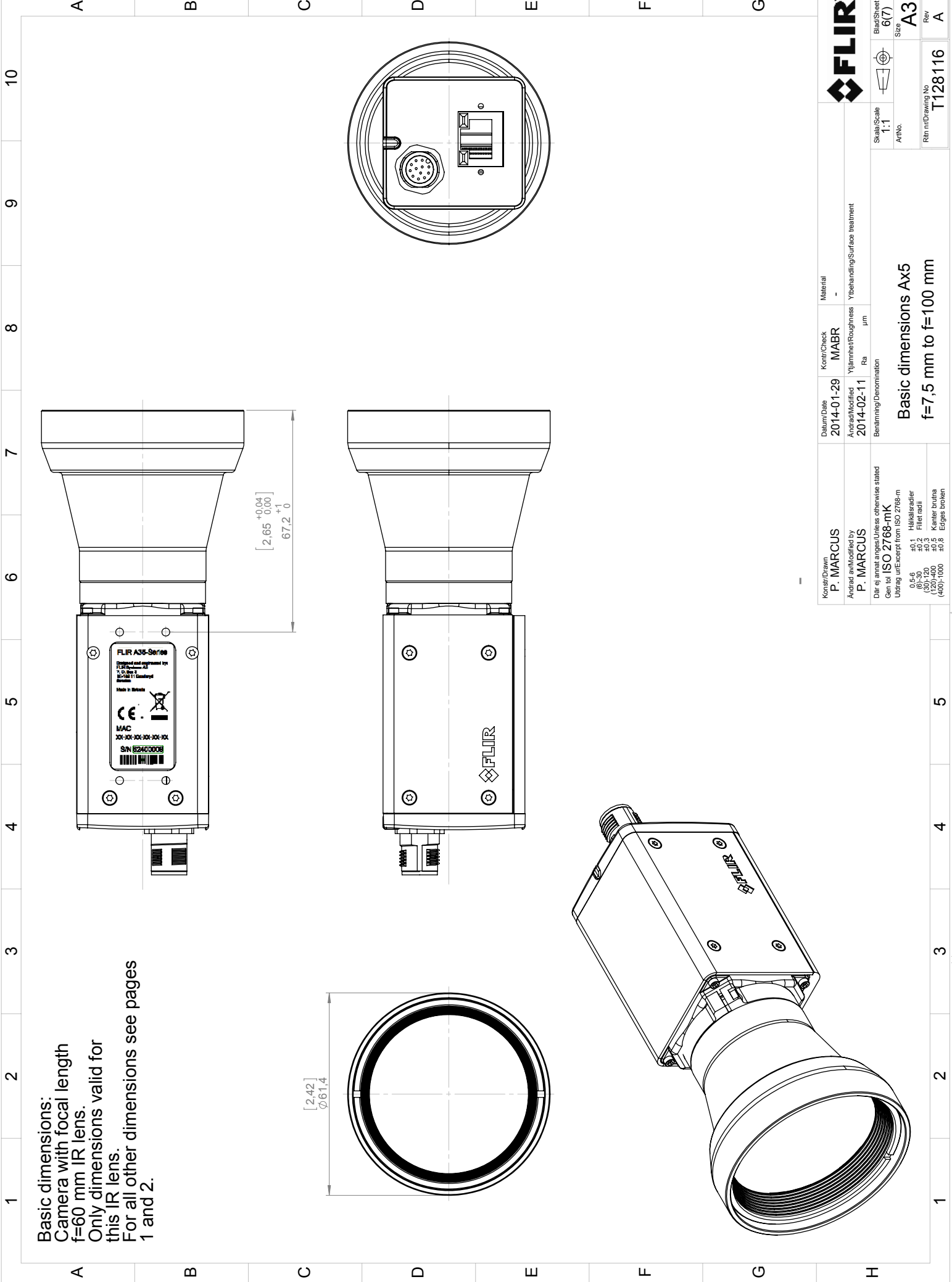
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Ändrad av/Modified by		Ändrad/Modified		Ytämne/Roughness		Ytbehandling/Surface treatment	
P. MARCUS		2014-02-11		Ra		µm	
Där ej annat anges/Unless otherwise stated		Benämning/Denomination					
Gen töl ISO 2768-mK							
Utdrag ur/Excerpt from ISO 2768-m							
0,5-6							
±0,1							
(6,3)-30							
±0,3							
(120)-400							
±0,5							
(400)-1000							
±0,8							
</							



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Konstr/Drawn P. MARCUS		Datum/Date 2014-01-29	Kontroll/Check MABR	Material -
Ändrad av/Modified by P. MARCUS		Ändrad/Modified 2014-02-11	Ytjämnhet/Roughness Ra	Ytbehandling/Surface treatment µm
Där ej annat anges/Unless otherwise stated Utdrag ur/Excerpt from ISO 2768-m		Benämning/Denomination Basic dimensions Ax5 f=7,5 mm to f=100 mm		
0,5-6 6,3-30 30-120 120-400 400-1000		±0,1 ±0,1 ±0,2 ±0,5 ±0,8		
		Höjlsradier Fillet radii Kantlar brutna Edges broken		
		Skala/Scale 1:1		
		Blad/Sheet 5(7)		
		Rev A		
		Ritning/Drawing No T128116		





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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	Ytämne/Roughness Ra	Ytbehandling/Surface treatment µm
Där ej annat anges/Unless otherwise stated Utdrag ur/Excerpt from ISO 2768-m		Benämning/Denomination Basic dimensions Ax5 f=7,5 mm to f=100 mm		
Gen tol ISO 2768-mK		Scale/Scale 1:1		
0,5-6 ±0,1 Hållarsradier (6)-30 ±0,2 Fillet radii (120)-400 ±0,5 Kanter brutna (400)-1000 ±0,8 Edges broken		Blad/Sheet 6(7)		
		A/Nr. T128116		
		Rev A		



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.

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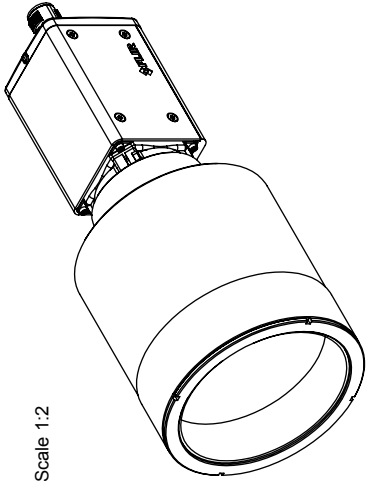
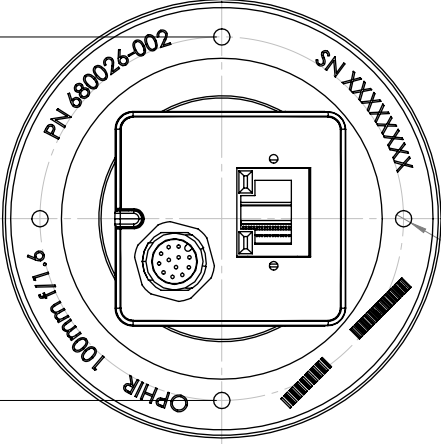
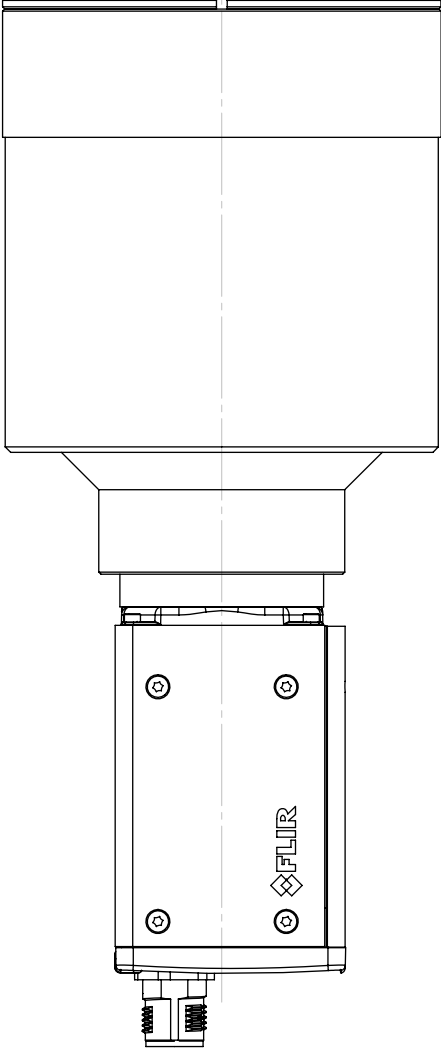
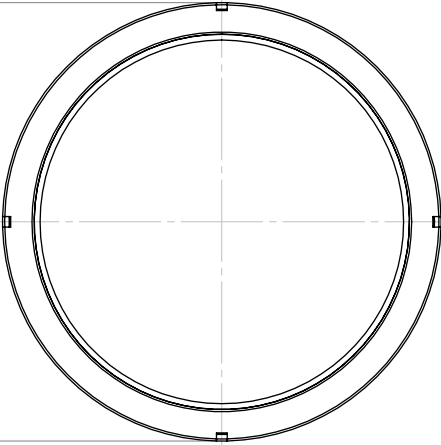


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[4,8 ^{+0,04} _{0,00}]
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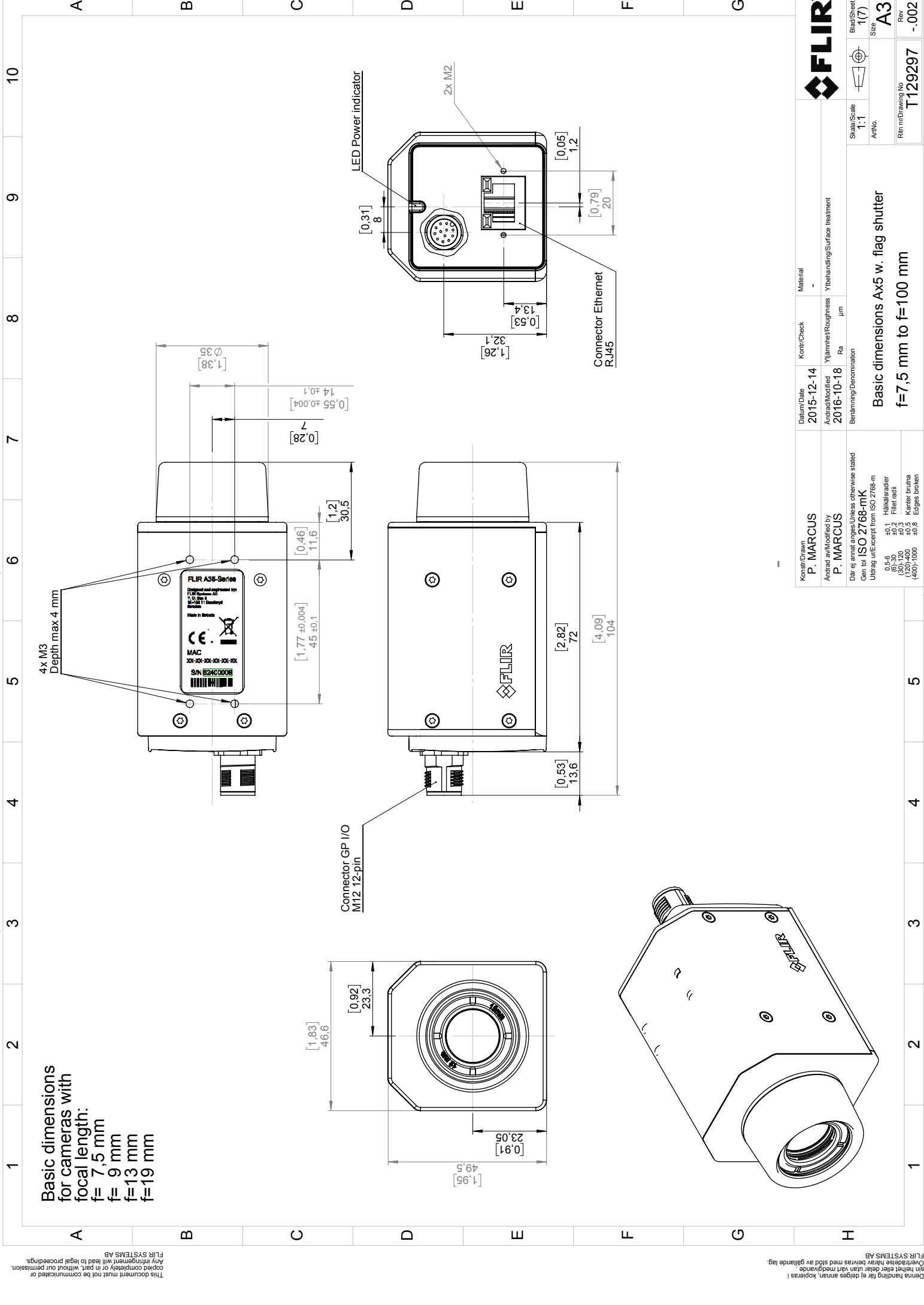
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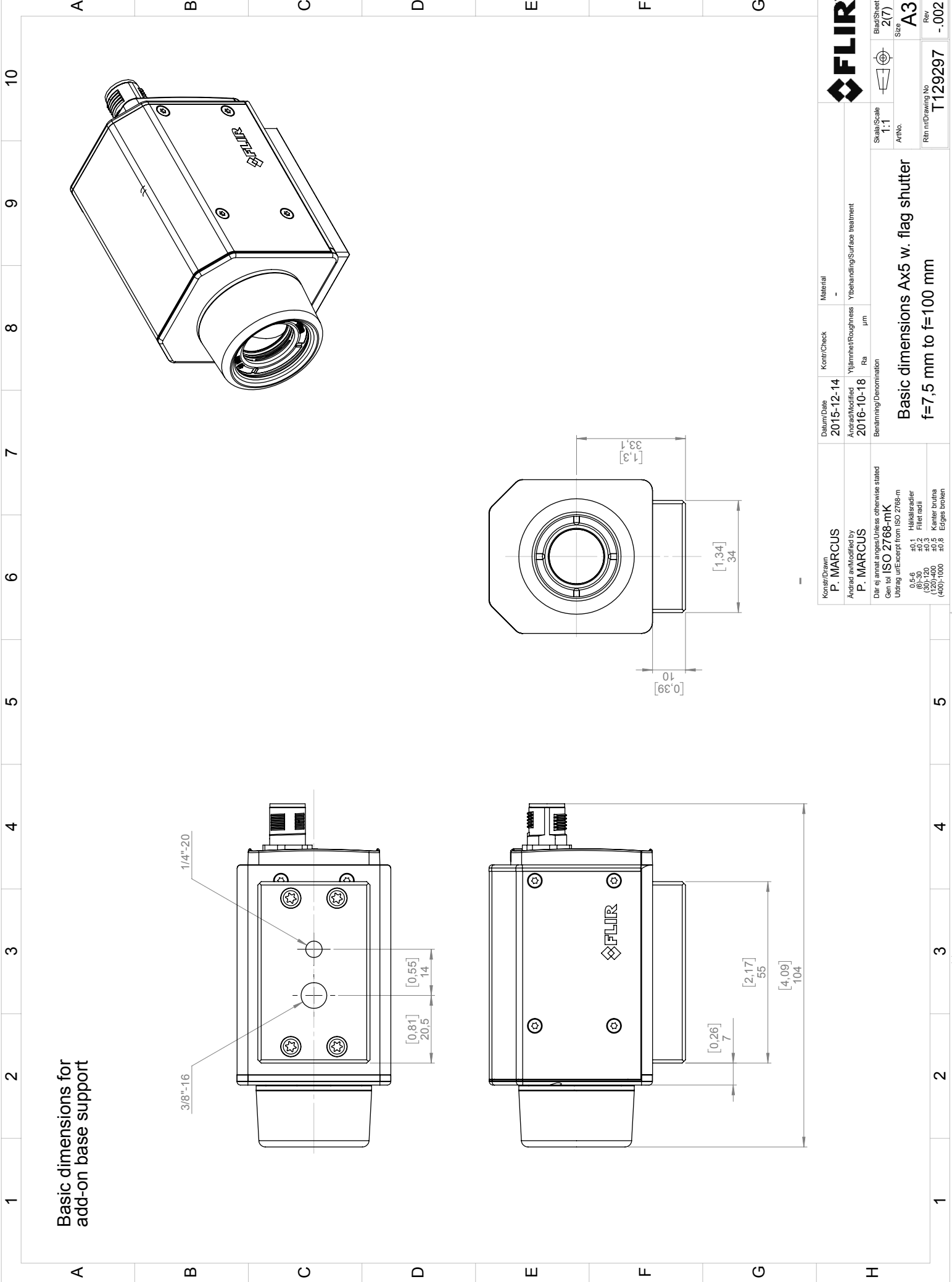
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Scale 1:2

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Där ej annat anges/Unless otherwise stated		Benämning/Denomination		Skala/Scale 1:1		Blad/Sheet 7(7)
Utdrag ur/Excerpt from ISO 2768-m		Gen tol ISO 2768-mK		Art.No.	Size A3	
0,5-6 ±0,1 Höjlsradier		0,5-6 ±0,1 Höjlsradier		Basic dimensions Ax5 f=7,5 mm to f=100 mm		
6,3-30 ±0,2 Fillet radii		6,3-30 ±0,2 Fillet radii				
(120)-400 ±0,5 Kantler brutna		(120)-400 ±0,5 Kantler brutna				
(400)-1000 ±0,8 Edges broken		(400)-1000 ±0,8 Edges broken		Rit nr/Drawing No T128116	Rev A	

[illegible][illegible]

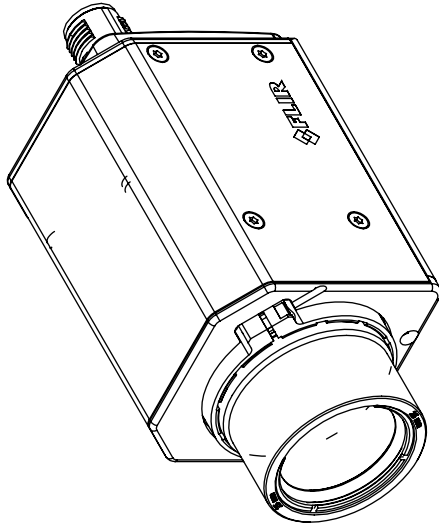
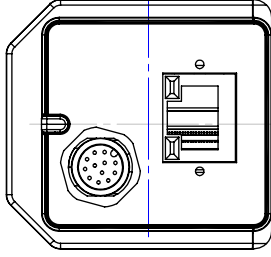
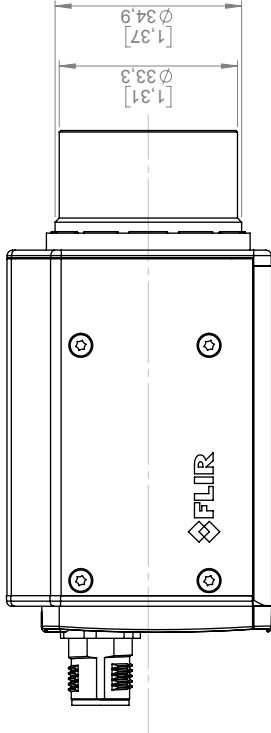
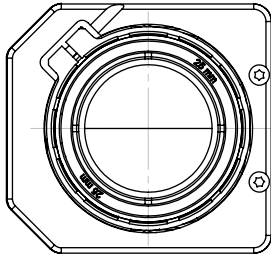
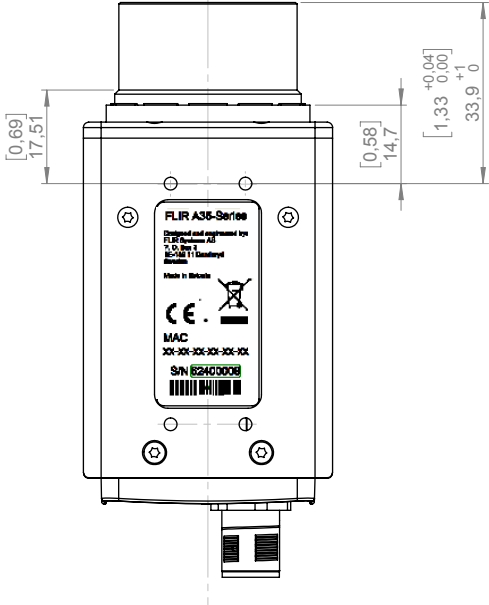


Basic dimensions for
add-on base support

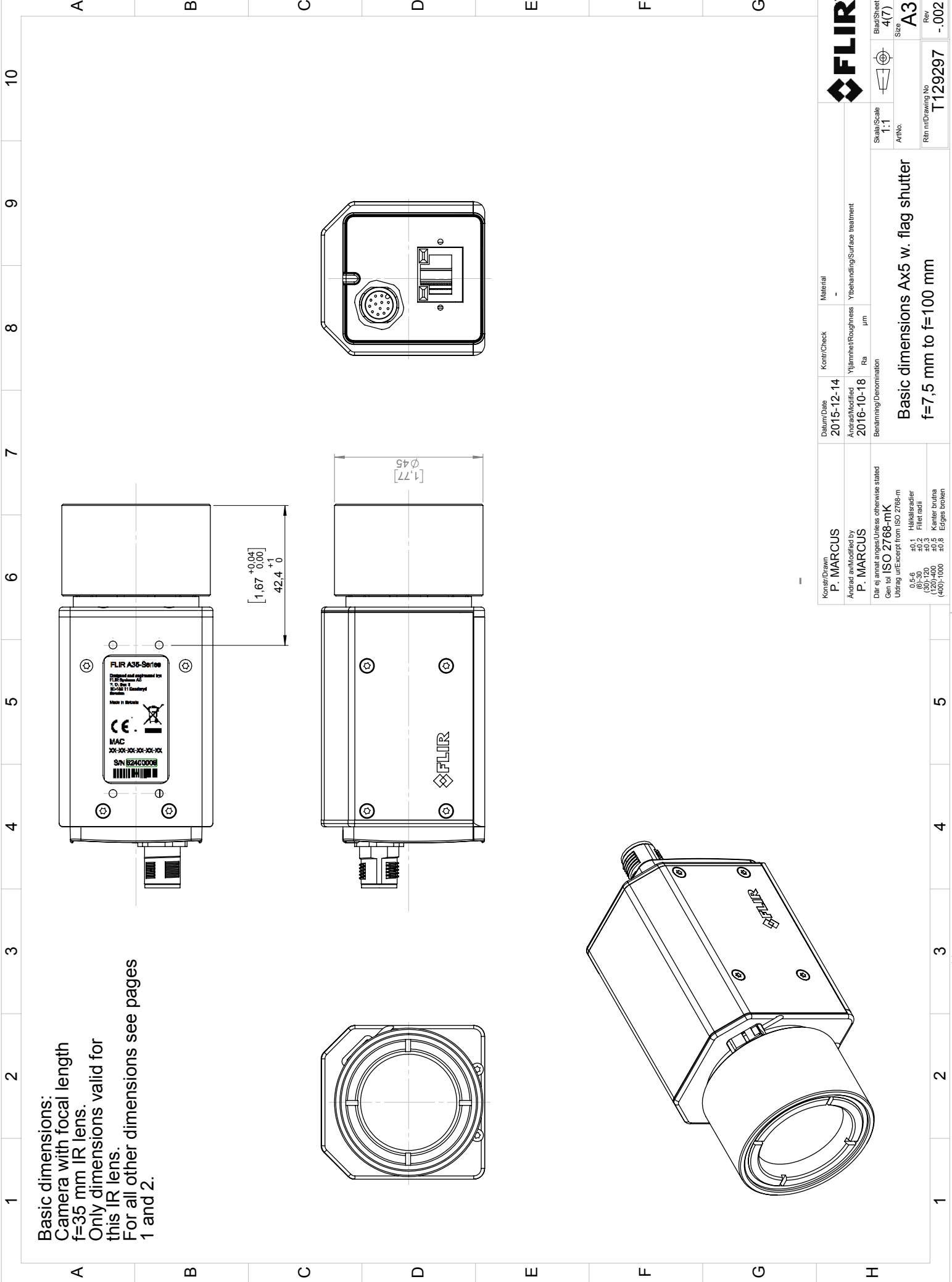
		Blad/Sheet 2(7)		Size A3		Rev -	
Scale/Scale 1:1		ArNo.		Rin nr/Drawing No T129297			

Konstr/Drawn P. MARCUS		Datum/Date 2015-12-14		Kontr/Check -		Material -	
Ändrad av/Modified by P. MARCUS		Ändrad/Modified 2016-10-18		Ytlämhu/Roughness Ra		Ytbehandling/Surface treatment µm	
Där ej annat anges/Unless otherwise stated Gen töl ISO 2768-mK Utmått ut/Excerpt from ISO 2768-m		Benämning/Denomination Basic dimensions Ax5 w. flag shutter f=7,5 mm to f=100 mm					
0.5-6 ±0.1 Hållstrådi (6)-30 ±0.2 Fillet radii (120)-400 ±0.5 Kantstrådi (400)-1000 ±0.8 Edges broken							

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.

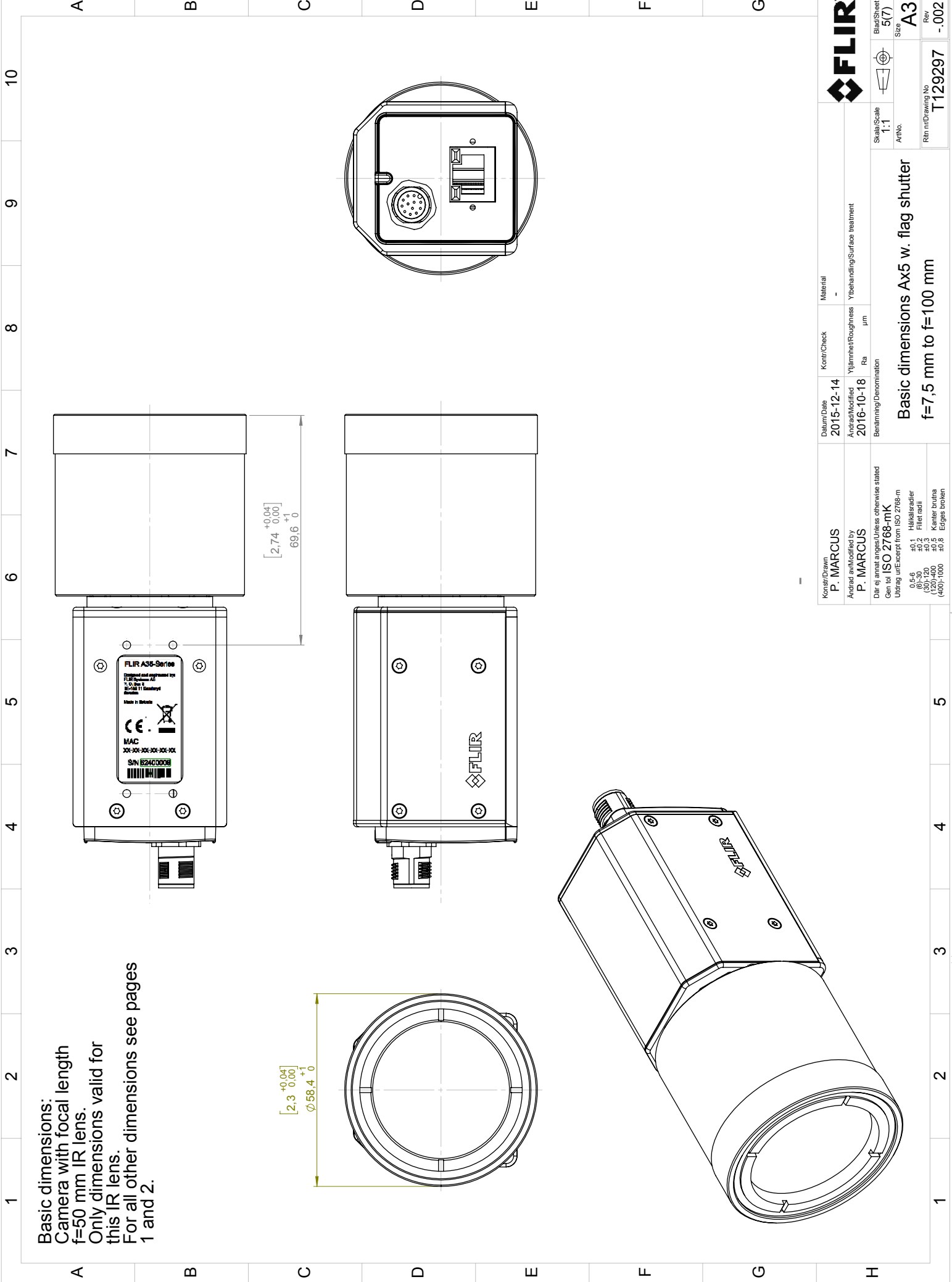


Konstr/Drawn P. MARCUS	Datum/Date 2015-12-14	Kontr/Check -	Material -
Ändrad av/Modified by P. MARCUS	Ändrad/Modified 2016-10-18	Ytlämnhet/Roughness Ra	Ytbehandling/Surface treatment µm
Benämning/Denomination Basic dimensions Ax5 w. flag shutter f=7,5 mm to f=100 mm			
Gen töl ISO 2768-mK Utmätg utExcerpt from ISO 2768-m 0,5-6 ±0,1 Hållkårsradier (60)-30 ±0,2 Fillet radii (120)-400 ±0,5 Kanter brutna (400)-1000 ±0,8 Edges broken			
Scale/Scale 1:1	Blad/Sheet 3(7)	Size A3	Rev -
ArtNo. T129297	Rev -	Rev -	Rev -



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	Kontroll/Check -	Material -
Ändrad av/Modified by P. MARCUS		Ändrad/Modified 2016-10-18		Ytjämnhet/Roughness Ra		Ytbehandling/Surface treatment µm
Där ej annat anges/Unless otherwise stated Gen töl 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 4(7)
0.5-6 ±0.1 Hållkålsradier (6)-30 ±0.2 Fillet radii (120)-400 ±0.5 Kanter brutna (400)-1000 ±0.8 Edges broken		Rev -002		A3		
		T129297		Ritning/Drawing No.		

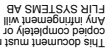
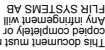
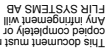
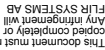
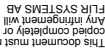


Basic dimensions:
Camera with focal length
f=50 mm IR lens.
Only dimensions valid for
this IR lens.
For all other dimensions see pages
1 and 2.

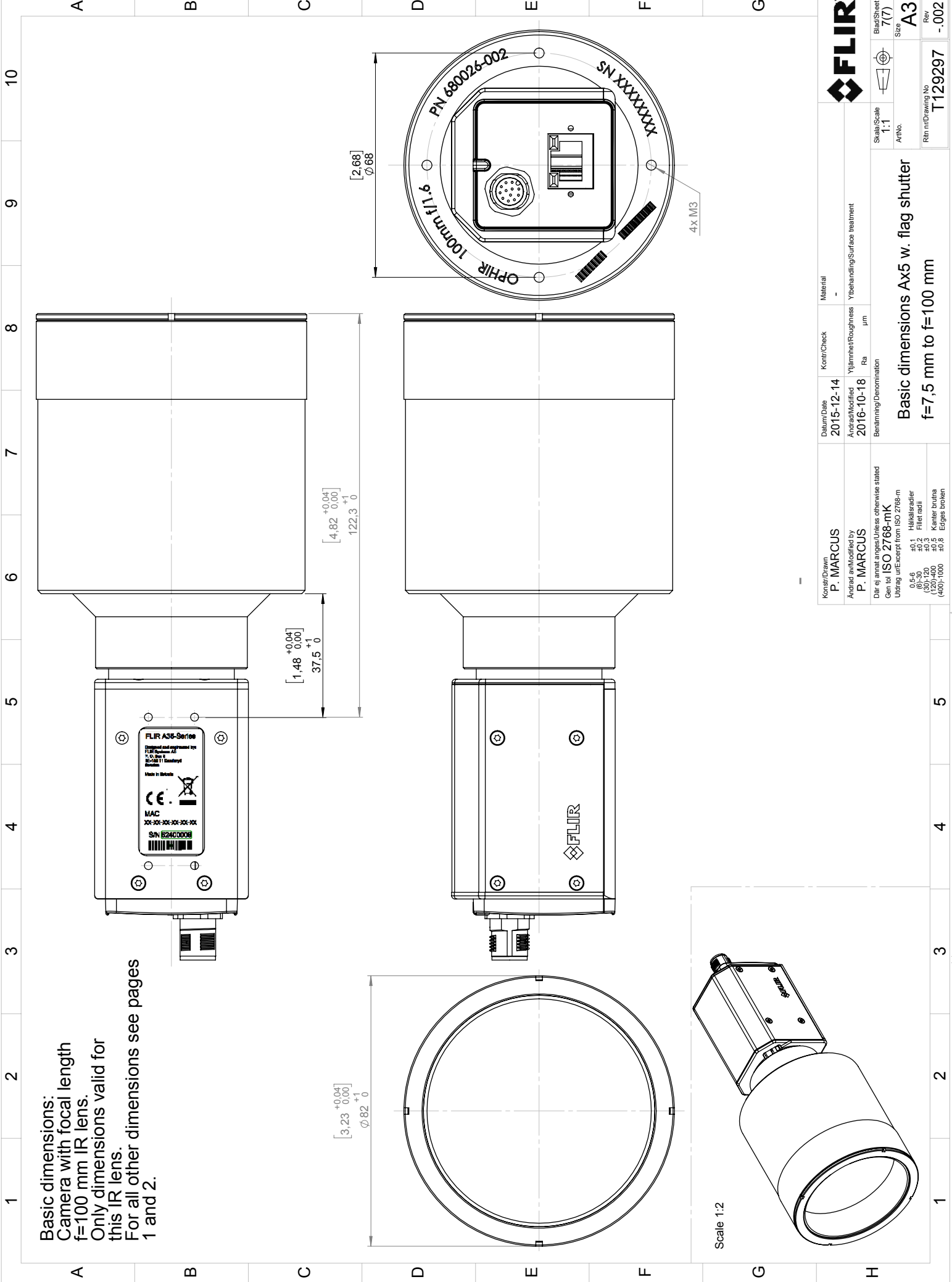
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Konstr/Drawn P. MARCUS		Datum/Date 2015-12-14	Kontroll/Check -	Material -	
Ändrad av/Modified by P. MARCUS		Ändrad/Modified 2016-10-18	Ytjämnhet/Roughness Ra	Ytbehandling/Surface treatment	
Där ej annat anges/Unless otherwise stated Gen töl ISO 2768-mK		Benämning/Denomination Basic dimensions Ax5 w. flag shutter f=7,5 mm to f=100 mm			
Utmärkning/Marking 0,5-6 60-120 120-400 400-1000		Höjlsradier ±0,1 ±0,2 ±0,5 ±0,8			
		Kantlar broken Edges broken			
		Skala/Scale 1:1			
		Artno. T129297			
		Blad/Sheet 5(7)			
		Size A3			
		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.

		Konstr/Drawn		Datum/Date		Kontroll/Check		Material	
P. MARCUS		2015-12-14		Ytämhet/Roughness		Ytbehandling/Surface treatment		-	
Ändrad/Modified by		2016-10-18		Ra		Ra		-	
P. MARCUS		Benämning/Denomination		Benämning/Denomination		Benämning/Denomination		-	
Gen tid ISO 2768-mK		Gen tid ISO 2768-mK		Gen tid ISO 2768-mK		Gen tid ISO 2768-mK		Gen tid ISO 2768-mK	
Utmätning/Measurement		Utmätning/Measurement		Utmätning/Measurement		Utmätning/Measurement		Utmätning/Measurement	
0.5-6		0.5-6		0.5-6		0.5-6		0.5-6	
(63)-30		(63)-30		(63)-30		(63)-30		(63)-30	
40.2		40.2		40.2		40.2		40.2	
120-400		120-400		120-400		120-400		120-400	
40.5		40.5		40.5		40.5		40.5	
(400)-1000		(400)-1000		(400)-1000		(400)-1000		(400)-1000	
±0.8		±0.8		±0.8		±0.8		±0.8	
Kantlar brutna		Kantlar brutna		Kantlar brutna		Kantlar brutna		Kantlar brutna	
Edges broken		Edges broken		Edges broken		Edges broken		Edges broken	

Basic dimensions Ax5 w. flag shutter
f=7.5 mm to f=100 mm

Blad/Sheet	7(7)
Size	A3
Rev	Rev
Scale/Scale	1:1
ArtNo.	T129297
Rin nr/Drawing No	T129297

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

15.1 M12 connector pin configuration

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

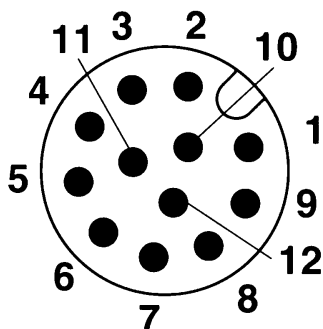


Figure 15.1 Pin assignment M12 male connector: 12 positions, male side view.

Table 15.1 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 Output 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.

15.2 Pig-tail end of cable

1 RET_GB		BLACK
2 PWR_GB		BROWN
3 SYNC_OUT		BLACK
4 SYNC_OUT_GND		RED
5 SYNC_IN		BLACK
6 SYNC_IN_GND		ORANGE
7 GPO+		BLACK
8 GPO-		YELLOW
9 GPIO_PWR		BLACK
10 GPIO_GND		GREEN
11 GPI+		BLACK
12 GPI-		BLUE

Figure 15.2 Mapping table, signal type to cable color.

15.3 SYNC input/output schematics

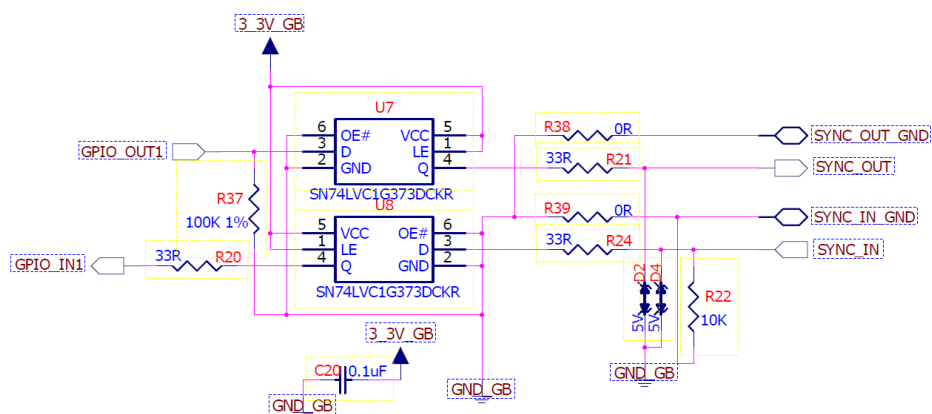


Figure 15.3 Schematics of SYNC input and output.

The schematic diagram illustrates a 24VDC relay module with two relays (U4 and U6) and two LEDs (D3 and D5). The module is powered by a 24VDC input (GPI+) and a 5V regulator (U1). The 5V regulator is connected to the 5V pin of the relays and the anode of the LEDs. The 24VDC input is connected to the coil of the relays and the cathode of the LEDs. The module includes two relays (U4 and U6) and two LEDs (D3 and D5). The relays are controlled by GPIO_IN0 and GPIO_OUT0. The LEDs are controlled by GPIO_PWR and GPIO_GND. The module also includes a 5V regulator (U1) and a 24VDC input (GPI+). The 5V regulator is connected to the 5V pin of the relays and the anode of the LEDs. The 24VDC input is connected to the coil of the relays and the cathode of the LEDs. The module includes two relays (U4 and U6) and two LEDs (D3 and D5). The relays are controlled by GPIO_IN0 and GPIO_OUT0. The LEDs are controlled by GPIO_PWR and GPIO_GND. The module also includes a 5V regulator (U1) and a 24VDC input (GPI+). The 5V regulator is connected to the 5V pin of the relays and the anode of the LEDs. The 24VDC input is connected to the coil of the relays and the cathode of the LEDs.

Figure 15.4 Schematics of GP input and output.

16.1 Camera housing, cables, and other items

Use one of these liquids:

- Warm water
- A weak detergent solution

Equipment:

- A soft cloth

Follow this procedure:

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



CAUTION

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

16.2 Infrared lens

Use one of these liquids:

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

Equipment:

- Cotton wool



CAUTION

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

Follow this procedure:

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



WARNING

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



CAUTION

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

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

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

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

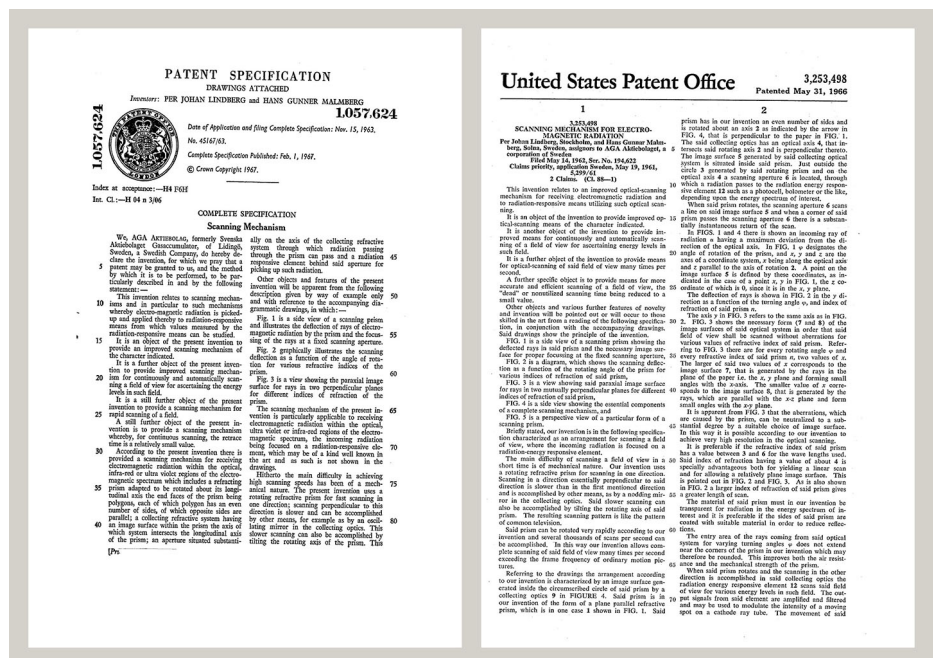


Figure 17.1 Patent documents from the early 1960s

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.

17.1 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.

17.2 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.

17.3 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

www.flir.com

Customer support

support.flir.com

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