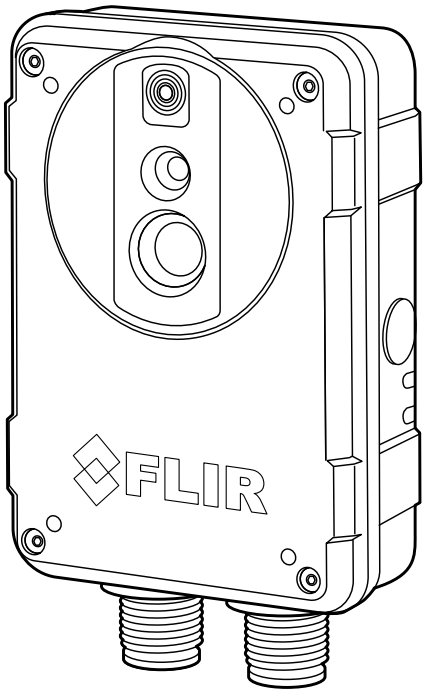
User's manual
FLIR AX series



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Table of contents

1 Disclaimers

1.1 Legal disclaimer

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

1.2 U.S. Government Regulations

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

1.3 Patents

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

https://www.flir.com/patentnotices

1.4 Quality assurance

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

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

1.5 Usage statistics

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

1.6 Copyright

1.7 EULA Terms

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1.8 EULA Terms

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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 AX series.

Do not use screws that are too long. The maximum depth of the holes in the camera is 4.5 mm (0.18″). Damage to the camera will occur if you use screws that are too long.

CAUTION

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

CAUTION

Do not use the camera in 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

Make sure that you are a minimum distance of 232 mm (10 in.) from the camera torch LED when you operate it. If you do not do this, injury to your eyes and skin can occur.

3 Notice to customer

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 AX series camera/sensor offers an affordable and accurate temperature measurement solution for anyone who needs to solve problems that require built-in “smartness” such as analysis, alarm functionality, and autonomous communication using standard protocols. The FLIR AX series camera/sensor also has all the necessary features and functions to build distributed single- or multi-camera solutions utilizing standard Ethernet hardware and software protocols.

The FLIR AX series camera/sensor also has built-in support to connect to industrial control equipment such as programmable logic controllers (PLCs), and allows the sharing of analysis and alarm results and simple control using the Ethernet/IP and Modbus TCP field bus protocols.

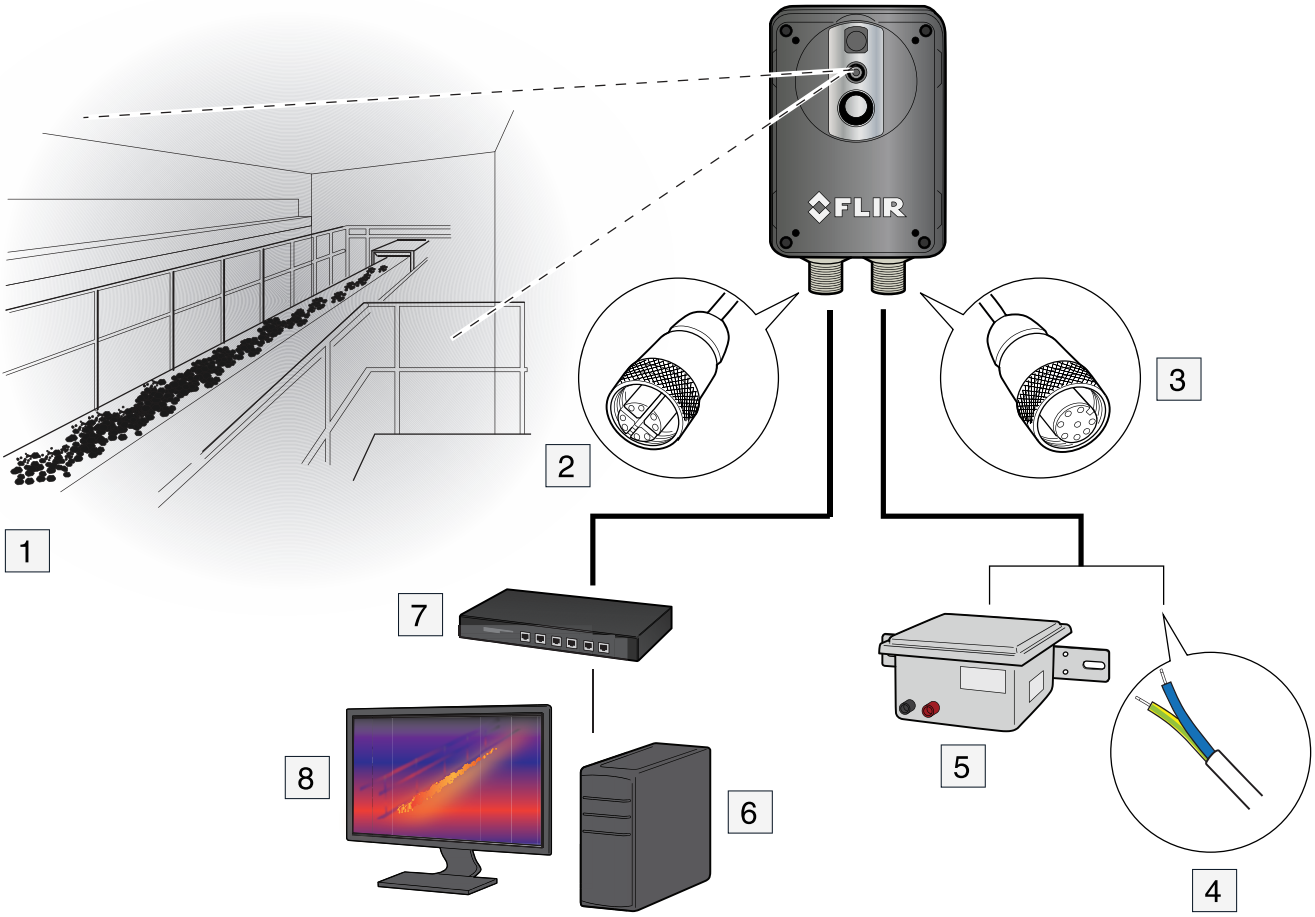
Key features:

- Support for the EthernetIP field bus protocol (analyze, alarm, and simple camera control).
- Support for the Modbus TCP field bus protocol (analyze, alarm, and simple camera control).
- Built-in analysis functionality.
- Alarm functionality, as a function of analysis and more.
- Built-in web server for control and setup.
- MJPEG/MPEG4/H.264 image streaming.
- PoE (Power over Ethernet).
- General-purpose I/O.
- 100 Mbps Ethernet (100 m cable).
- On alarm: file sending (FTP) or e-mail (SMTP) of analysis results or images.

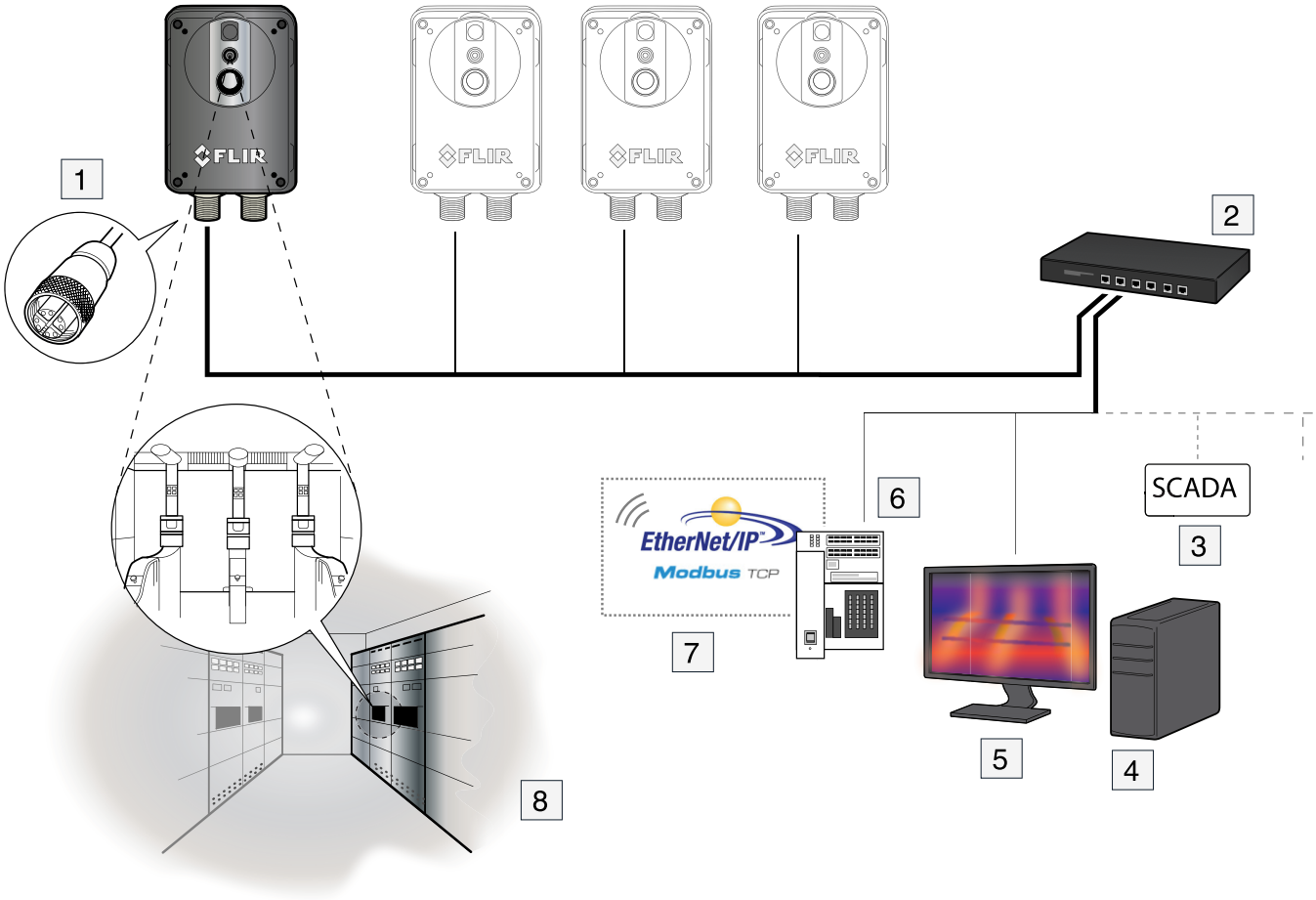
Typical applications:

- Electrical and mechanical condition-monitoring applications where temperature or temperature trends can be an indication of a potential risk of failure.
- Simple process control applications.

6 Typical system overviews



1. Coal mine conveyor belt.
2. Ethernet connector M12, X-coded.
3. Power–I/O connector M12, A-coded.
4. Digital output to a PLC.
5. Separate DIN rail power supply for galvanic isolation (10.8–30 V DC).
6. PC for the set up of the camera using the built-in web server.
7. PoE switch.
8. Infrared image on a monitor.



1. Ethernet connector M12, X-coded.
2. PoE switch.
3. Supervisory control and data acquisition.
4. PC for the setup of the camera using the built-in web server.
5. Infrared image on a monitor.
6. PLC.
7. Readout and analysis of data from the camera using built-in measurement functions.
8. Electrical cabinets with circuit breakers.

7 Quick start guide

Follow this procedure:

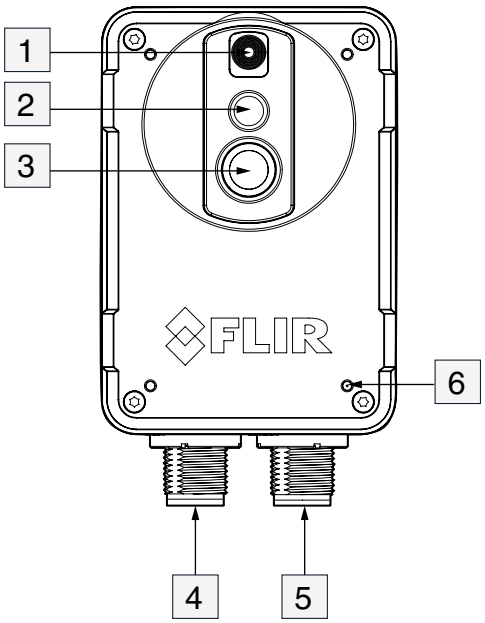
1. Mount the camera.

> **CAUTION**
>
> The camera should be mounted on a cooling bracket or heat sink unless the rear side of the camera is mounted against a material with a high capacity to transfer heat, e.g., aluminum. Damage to the camera can occur if you do not do this.

2. Download FLIR IP Config from http://tinyurl.com/o5wudd7.
3. Install FLIR IP Config.
4. Connect the camera to power, either via a PoE injector connected to the Ethernet cable or via the power–I/O connector (10.8–30 V DC).
5. Connect the camera to the network, using the Ethernet connector.
6. Start FLIR IP Config.
7. In the main window, identify the camera and double-click it to open the camera user web.
8. Log in using the username *admin* and the password *admin*. (You can change these credentials later.)

You have now accessed the FLIR AX series user web and can set up and control the camera.

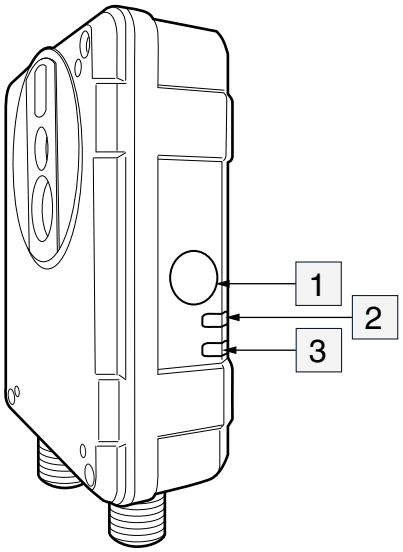
8 Camera parts



1. LED lamp.

⚠ CAUTION
Make sure that you are a minimum distance of 232 mm (10 in.) from the camera torch LED when you operate it. If you do not do this, injury to your eyes and skin can occur.

2. Visual camera.
3. Infrared sensor.
4. Ethernet connector, M12, X-coded.
   Due to the small form factor of the camera, the M12 connector of the FLIR AX is not according to standard conventions. For a compatible cable, the official M12 cable from FLIR should be used.
5. Power—I/O connector, M12, A-coded.
6. Mounting holes.
   See section 9 *Mechanical installation*, page 12 and section 17 *Mechanical drawings* for more information.



1. Factory reset button.

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

   See section 23 *Indicator LEDs and factory reset button*, page 77.

2. Ethernet communication indicator LED (green).
   See section 23 *Indicator LEDs and factory reset button*, page 77.

3. Power/error indicator LED (blue/red).
   See section 23 *Indicator LEDs and factory reset button*, page 77.

9 Mechanical installation

The camera unit has been designed to allow it to be mounted in any position. It has mounting interfaces on the front and back. For drilling templates, see section18 *Drilling templates*, page 65.

WARNING

Do not use screws that are too long. The maximum depth of the holes in the camera is 4.5 mm (0.18″). Damage to the camera will occur if you use screws that are too long.

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

A cooling bracket that has two tripod threads—one on the bottom and the other on the back—is available. This cooling bracket has a hole pattern that is compatible with third-party pan/tilt heads, e.g., the PTU-AB series from Allison Park Group, Inc.:

http://www.apgvision.com/ptuab-series-p-108.html

For further information regarding mounting recommendations, contact FLIR Systems.

10 Verifying camera operation

Prior to installing the camera, use a bench test to verify camera operation and to configure the camera for the local network. The camera is configured from a web browser.

10.1 Connecting the camera to power

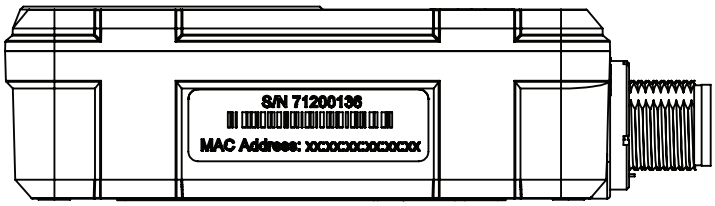
To power the camera, use one of the alternatives below:

- Connect the camera to a 10.8–30 V DC power supply using the A-coded M12 connector and cable P/N T128391ACC.
- Connect the camera to a PoE unit using the X-coded M12 connector and cable P/N T128390ACC.
  Due to the small form factor of the camera, the M12 connector of the FLIR AX is not according to standard conventions. For a compatible cable, the official M12 cable from FLIR should be used.

See section 21 *Pin configurations*, page 73 for pin configurations.

10.2 Connecting the camera to the network

The camera is set up on an existing network, and an IP address is assigned from the DHCP server. The MAC address can be found on a label on the side of the camera. See the figure below.



To detect the camera system on the network, use the FLIR IP Config software. You can download FLIR IP Config from the following link:

http://tinyurl.com/o5wudd7

Note The FLIR IP Config version must be 1.9 or later.

To access the latest FLIR IP Config user manual, go to https://support.flir.com/resources/wkqz/.

11 Network-related information

11.1 Troubleshooting bad connectivity

11.1.1 Finding the camera IP address

The camera IP address can be found using FLIR IP Config, which can be downloaded at http://tinyurl.com/o5wudd7.

Note The FLIR IP Config version must be 1.9 or later.

11.1.2 If you have problems connecting to the camera

Put the camera and the client on the same IP network. This ensures that there are no routing issues. Consult someone with IP knowledge if needed. The aim is for the camera to have an address of, e.g., 192.168.0.10/24 and the client an address of, e.g., 192.168.0.20/24. The /24 notation means that it is a class C network where the first three groups are fixed.

11.1.3 Environment

- Make sure the camera gets the correct voltage and power. If you suspect glitches or peaks, test the camera in a controlled environment.
- If you suspect complex and strong electromagnetic fields, test the camera in a controlled office environment.

11.1.4 Network performance issues—basic test

1. Ping the camera from the command line interface on the client. Ping with 300 packets (use the –n flag) and check that no packets are lost and that the delay (RTT) has only minor variations. The RTT should be a maximum of 10–20 ms in a small network.
2. Use managed switches so that you can check the link speed and lost packets on the camera and client ports.
3. Be careful with Wi-Fi connections and video streams. Wi-Fi can operate faultlessly, but it can also introduce a high PER (packet error rate) as well as delay and jitter.
4. Check for symptoms of lost packets: see http://tinyurl.com/nmdx3dg for more information.

11.1.5 Network performance issues—complex test

Use a monitoring (sometimes called a mirrored or SPAN) port on the Ethernet switch. Use the Wireshark software to check the RTP (Real-time Transport Protocol) stream between the camera and the client. Record for a couple of minutes and use the RTP tools that are built in. Note that mirrored ports are not available on all switches. You need a managed switch for this functionality.

11.2 Network detection

FLIR AX series cameras announce themselves on a network using mDNS (multicast Domain Name System) service records. This is also known as the Bonjour service discovery protocol. The FLIR-specific service it announces is the FLIR Resource Protocol on TCP port 22136.

- Service type: _flir-ircam._tcp
- Service port: 22136

The associated text records are:

- ID=NCAM
- bsp=N1
- GID=Gen_A
- SI=FFF_RTSP
- SIV=1.0.0
- CI=RTREE

- CIV=1.0.0

Additional services that are announced are SSH (Secure Shell) and SFTP (Secure Shell File Transfer Protocol):

- Service type: _ssh._tcp
- Service port: 22
- Service type: _sftp-ssh._tcp
- Service port: 22

11.3 Unicast and multicast

FLIR AX series cameras support both unicast and multicast streams.

A maximum of three unicast streams (using UDP) are supported. Note that the stream shown on the user web page counts as a unicast stream.

Streaming using TCP is supported for unicast streams. TCP streaming uses port 554.

Multicast streams use the fixed multicast address 224.2.0.1. At least 16 clients can share the multicast stream.

11.4 Image streams

The following URLs can be used to establish streaming sessions with FLIR AX series cameras:

- rtsp://<ip>/avc
- rtsp://<ip>/mpeg4
- rtsp://<ip>/mjpg

- avc = H264 encoding with overlay graphics
- mpeg4 = MPEG4 encoding with overlay graphics
- mjpg = Motion JPEG encoding with overlay graphics

If you do not want an overlay in the image stream, use the following URLs:

- rtsp://<ip-address>/avc?overlay=off
- rtsp://<ip-address>/mpeg4?overlay=off
- rtsp://<ip-address>/mjpg?overlay=off

The stream resolution is 640 × 480. The bitrate is set to 3 Mbit/s (default), which means that the compression factor will vary according to the color palette chosen and the scene contents.

The infrared detector has a resolution of 80 × 60, which means that the infrared image contents will be upsampled to 640 × 480.

A radiometric uncompressed 16-bit stream is not available.

12 Camera web server interface

12.1 Supported browsers

The camera web interface has been developed for and tested on Google Chrome 24 and later. Browsers supporting the latest specification (RFC 6455) of the WebSocket protocol should theoretically work, but have not been fully tested.

Other browsers supporting the WebSocket protocol include the following:

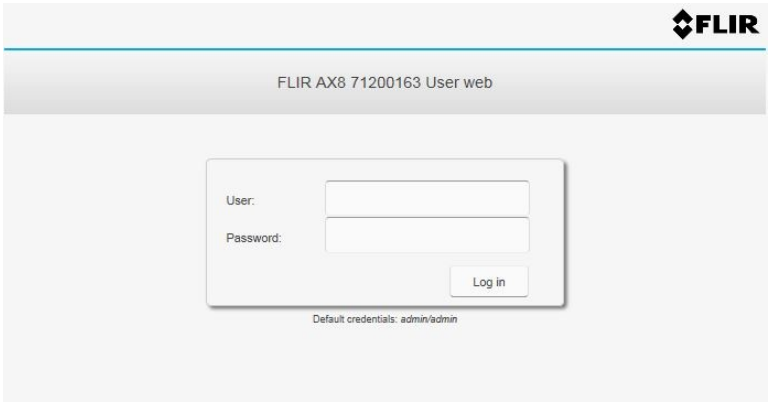
- Microsoft Internet Explorer 11 and later.
- Mozilla Firefox 30 and later.

12.2 Login

The FLIR IP Config scans for cameras automatically. You can identify your camera by the MAC address printed on a label on the side of the camera. Another way to connect is to enter the IP address of your camera into the address bar of a web browser.

To log in to the camera web server interface, follow this procedure:

1. Double-click on the camera in FLIR IP Config. This displays the login view.



2. When logging in for the first time, use the following user login credentials, depending on the type of user:

   User: admin, *Password:* admin

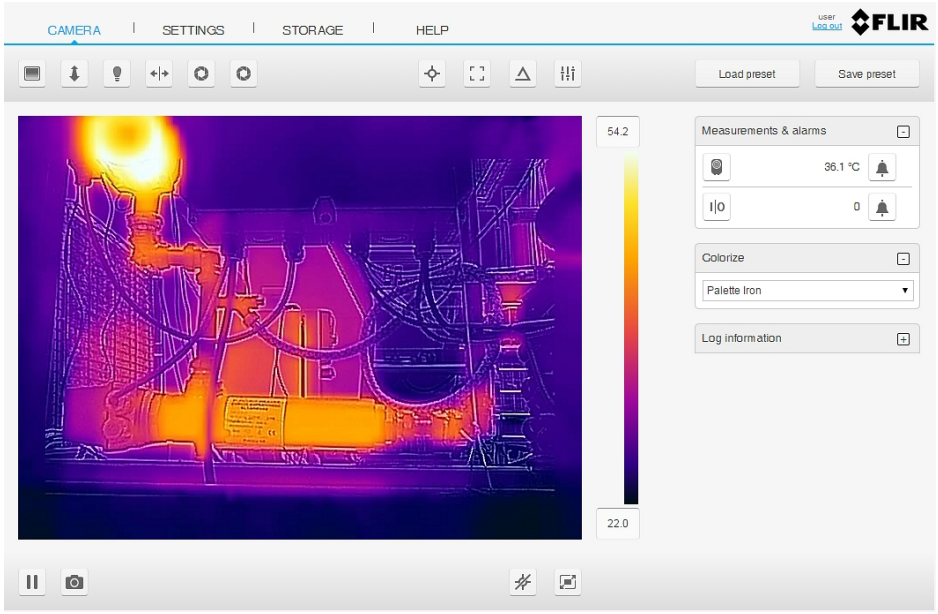
   User: user, *Password:* user

   User: viewer, *Password:* viewer

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

12.3 *Camera* tab

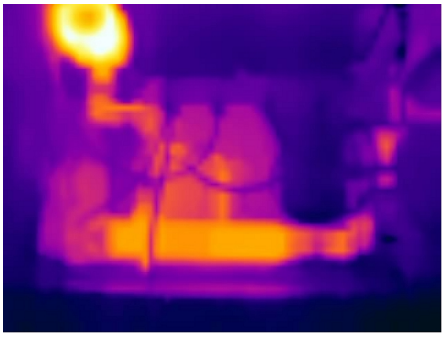
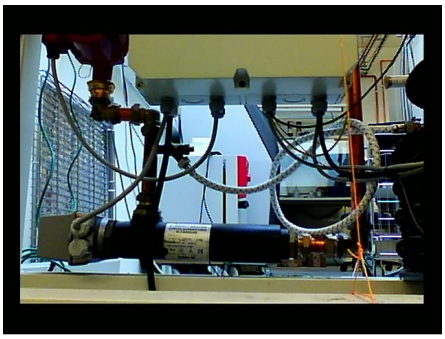
The *Camera* tab is the default tab after logging in. Under the *Camera* tab it is possible to view the video stream from the camera, make measurements, set alarms, take snapshots, calibrate the camera, manage image settings, etc.



12.3.1 Working with image modes

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

The camera supports the following image modes:

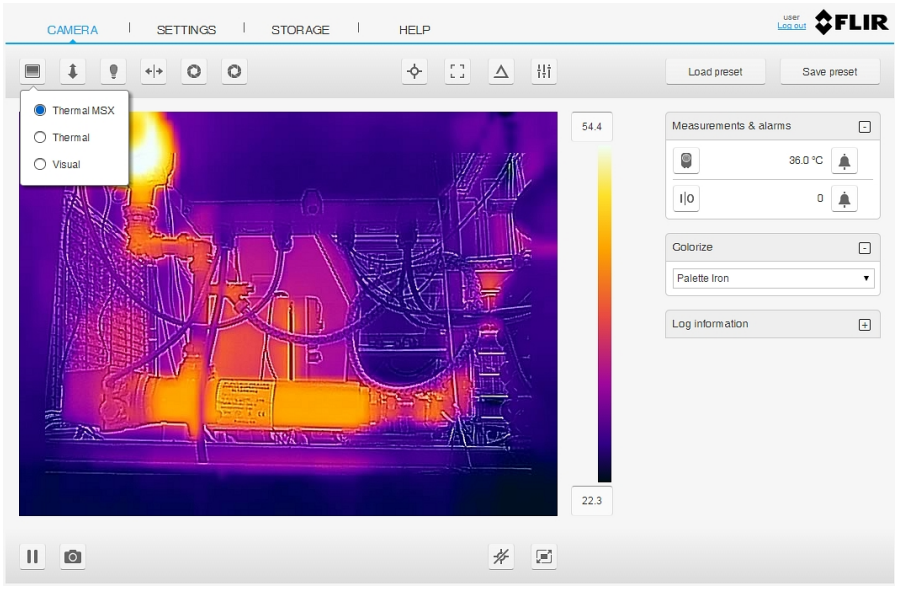
Image mode	Image
Thermal MSX Multi Spectral Dynamic Imaging—the camera displays infrared images where the edges of the objects are enhanced with visual image details.	
Thermal A full infrared image is displayed.	
Visual The visual image captured by the digital camera is displayed.	

To display a good fusion image (*Thermal MSX* mode), the camera must make adjustments to compensate for the small difference in position between the digital camera lens and the infrared lens. To adjust the image accurately, the camera requires the alignment distance (i.e., the distance to the object).

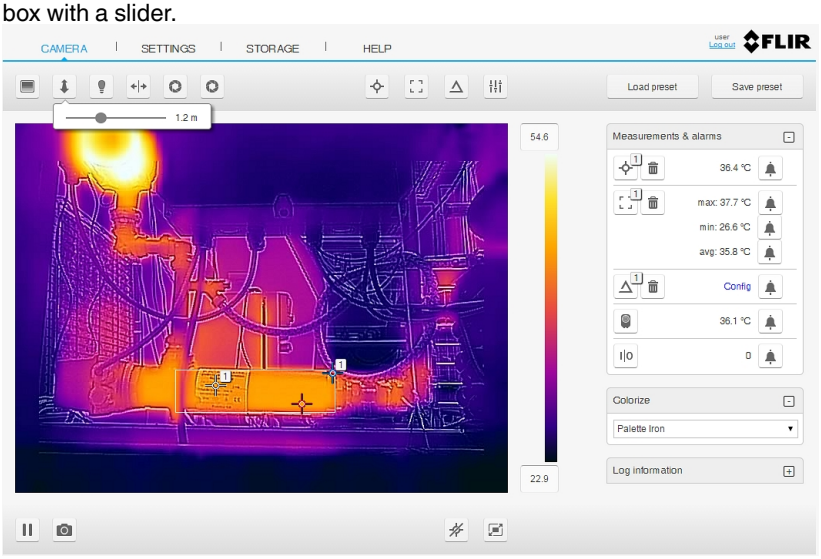
12.3.1.1 Selecting the image mode

To select the image mode, follow this procedure:

1. On the upper toolbar, click the *Adjust image mode* icon . This displays a dialog box with radio buttons.



2. Select one of the radio buttons:
   - *Thermal MSX*
   - *Thermal*
   - *Visual*
3. If you have selected *Thermal MSX* mode, also set the distance to the object by doing the following:
   3.1. On the upper toolbar, click the *Adjust distance* icon . This displays a dialog box with a slider.



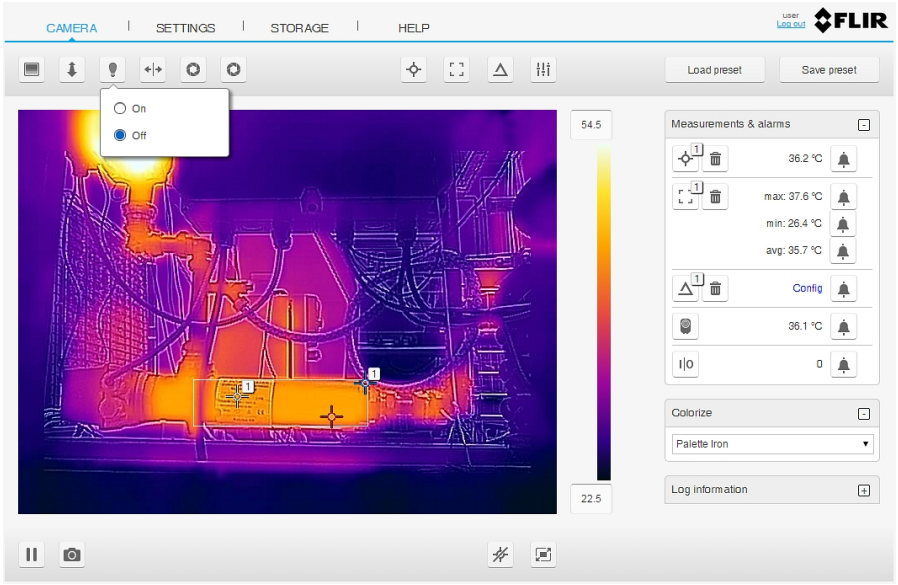
   3.2. Use the slider to select the distance to the object.

12.3.2 Using the camera lamp

The camera is equipped with a lamp.

To turn the lamp on and off, follow this procedure:

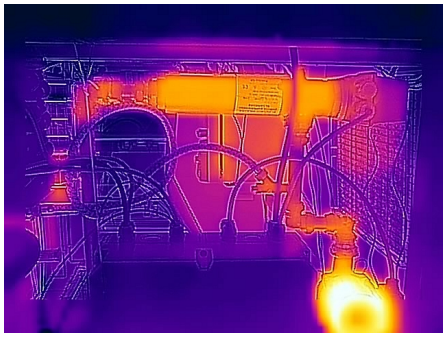
1. On the upper toolbar, click the *Lamp setting* icon  . This displays a dialog box with radio buttons.



2. Select one of the radio buttons:
   - *On*
   - *Off*

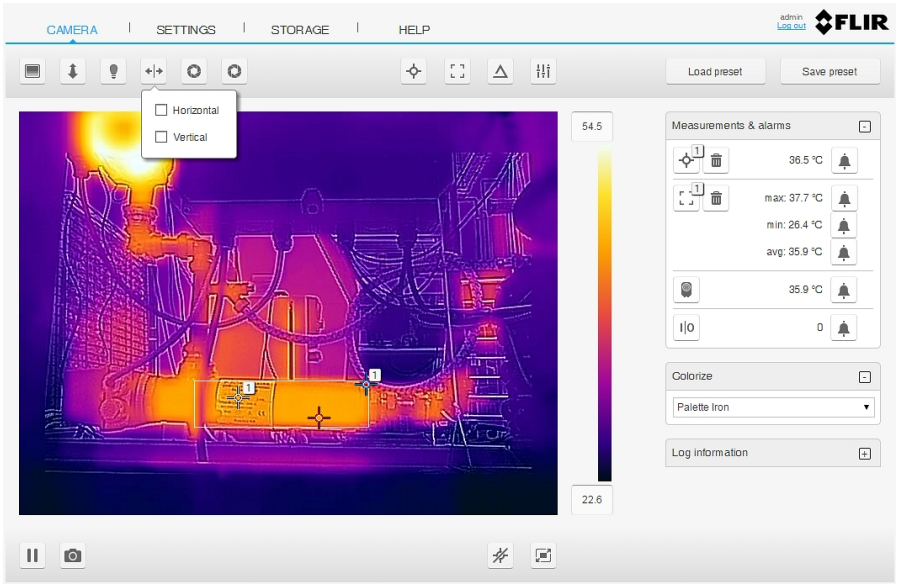
12.3.3 Flipping the video image

The image can be flipped horizontally or vertically.

Normal 	Horizontal flip 
Vertical flip 	Horizontal + vertical flip 

To change the flip setting, follow this procedure:

1. On the upper toolbar, click the *Flip video* icon . This displays a dialog box with check boxes.



2. Select one or both of the check boxes:
   - *Horizontal*: When selected, the image is flipped horizontally.
   - *Vertical*: When selected, the image is flipped vertically.
3. While the change of the flip setting is in progress, the video stream is paused.

12.3.4 Calibrating the camera

12.3.4.1 General

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

Calibration is needed whenever the output image becomes spatially noisy. This may, for example, happen when the ambient temperature changes.

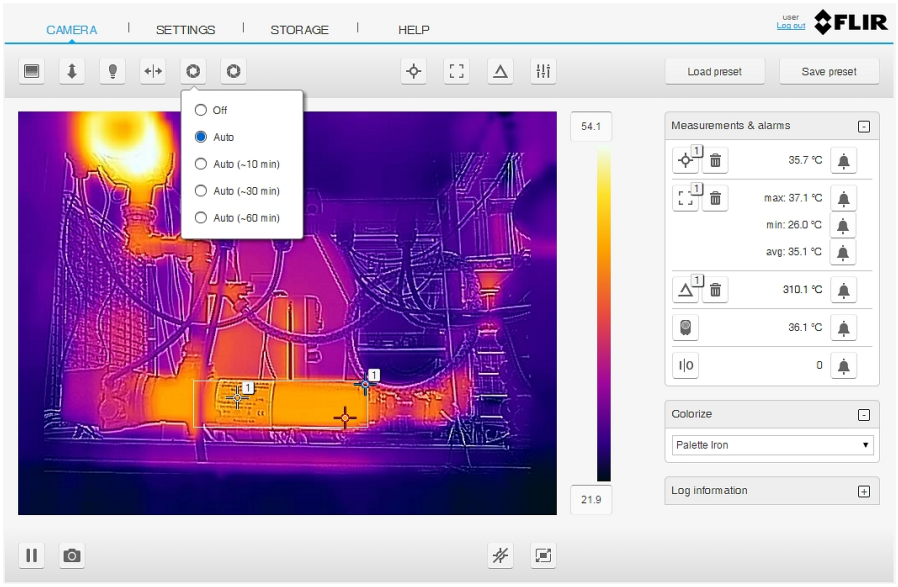
The calibration can be carried out automatically, with different selectable intervals. It is also possible to perform a calibration manually.

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

12.3.4.2 Automatic calibration

To set the automatic calibration, follow this procedure:

1. On the upper toolbar, click the *Periodic calibration* icon  . This displays a dialog box with radio buttons.

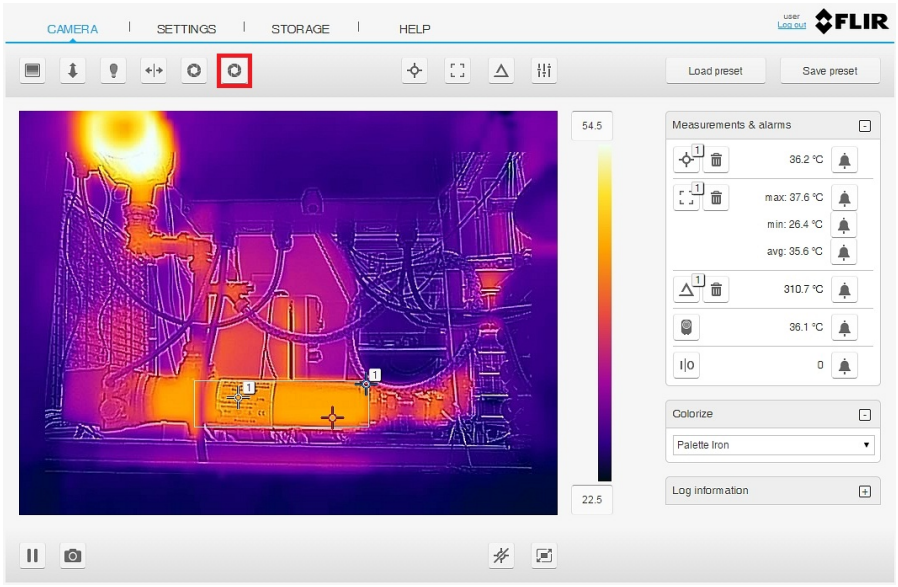


2. Select one of the radio buttons:
   - *Off*: Disable automatic calibration.
   - *Auto*: Calibration is automatically carried out when needed.
   - *Auto (~10 min)*: Calibration is automatically carried out approximately every 10 minutes.
   - *Auto (~30 min)*: Calibration is automatically carried out approximately every 30 minutes.
   - *Auto (~60 min)*: Calibration is automatically carried out approximately every 60 minutes.
3. While the automatic calibration is in progress, the text *Calibrating...* is displayed under the image on the screen.

12.3.4.3 Manual calibration

To perform a manual calibration, follow this procedure:

1. On the upper toolbar, click the *Calibrate* icon .



2. While the manual calibration is in progress, the text *Calibrating...* is displayed under the image on the screen.

12.3.5 Working with measurement tools

12.3.5.1 General

To measure a temperature, you can use one or more measurement tools, e.g., a spot, box, or delta.

The measurement tools are labeled with a number for identification, according to the order of their creation.

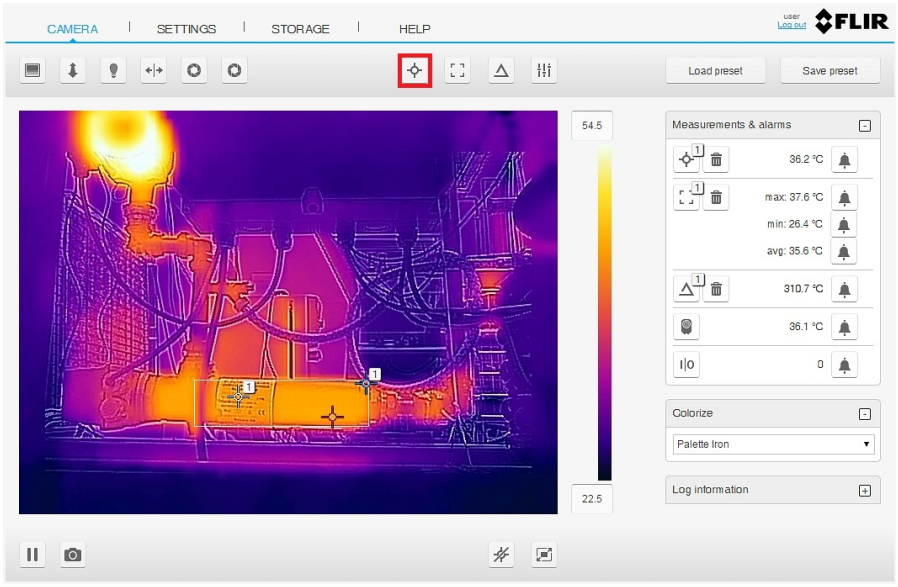
Added measurement tools show up in the *Measurements & alarms* section, where the they can be managed and where the measured temperatures are displayed.

12.3.5.2 Spot measurement tool

A spot measurement tool shows the temperature of a specific spot in the image. It is possible to add up to six spots.

To add a spot measurement tool, follow this procedure:

1. On the upper toolbar, click the *Spot measurement* icon . This displays a spot on the image, labeled with a number. The spot tool is also displayed in the *Measurements & alarms* section.



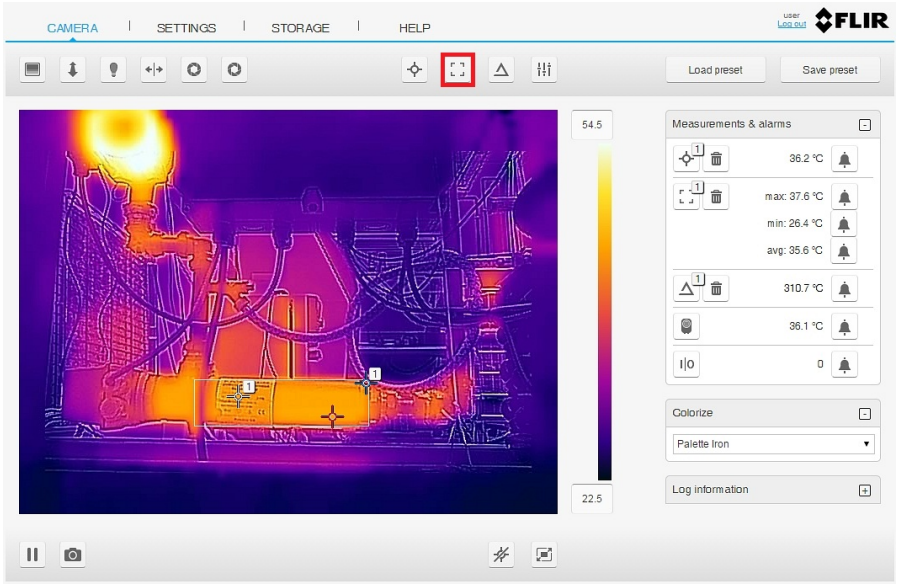
2. To move the spot, click the spot in the image and drag it to the desired location.
3. To set local parameters for the spot, see section 12.3.6.3 *Local parameters*, page 27.
4. To associate an alarm with the spot, see section 12.3.7 *Working with alarms*, page 27.
5. To remove the spot, click the *Delete* icon next to the tool in the *Measurements & alarms* menu.

12.3.5.3 Box measurement tool

A box measurement tool shows the minimum temperature, the maximum temperature, and the average temperature within a chosen area of the image. It is possible to add up to six boxes.

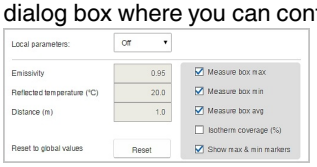
To add a box measurement tool, follow this procedure:

1. On the upper toolbar, click the *Box measurement* icon . This displays a box on the image, labeled with a number and including a hot spot and a cold spot. The box tool is also displayed in the *Measurements & alarms* section.



2. To move the box, click inside the box in the image and drag the box to the desired location.
3. To resize the box, click the border of the box in the image and drag the border to the desired location.
4. To configure settings for the box, do the following:

   4.1. In the *Measurements & alarms* section, click the *Box* icon . This displays a dialog box where you can configure the settings.



   4.2. To set local parameters for the box, see section 12.3.6.3 *Local parameters*, page 27.
   4.3. To select what measurement results to display, use the check boxes *Measure box max*, *Measure box min*, and *Measure box avg*.
   4.4. To display how much of the box is covered by an isotherm, select the check box *Isotherm coverage (%)*. This setting is only applicable if you have selected a color alarm (isotherm). For more information, see section 12.3.8.3 *Isotherms*, page 31.
   4.5. To show/hide the maximum and minimum markers (hot spot and cold spot) in the overlay graphics, select/deselect the check box *Show max & min markers*.

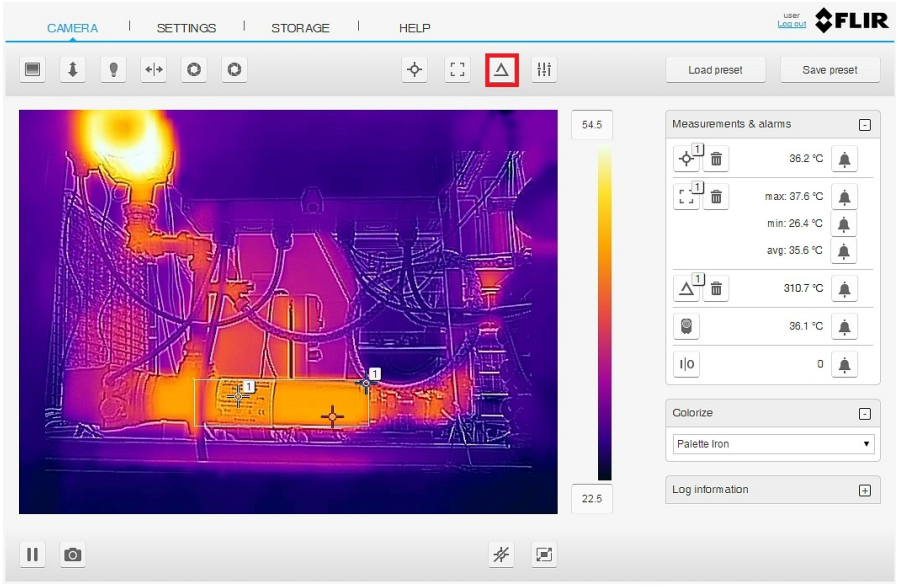
5. To associate an alarm with the box, see section 12.3.7 *Working with alarms*, page 27.
6. To remove the box, click the *Delete* icon next to the tool in the *Measurements & alarms* menu.

12.3.5.4 Delta measurement tool

The delta measurement tool is used to calculate the difference between two measurement results. It is possible to set up a difference calculation between results from added spots and boxes, as well as a fixed temperature.

To add a delta measurement tool, follow this procedure:

1. On the upper toolbar, click the *Delta measurement* icon . This displays the delta tool in the *Measurements & alarms* section.



2. In the *Measurements & alarms* section, click the *Delta* icon . This displays a dialog box where you can select the measurement tools you want to use in the difference calculation.

3. Select the first and second parameters from the list boxes. If you select the parameter *Temp*, also enter the fixed temperature in the *Temp* list box.
4. When completed, click anywhere outside the dialog box.

12.3.6 Changing object parameters

12.3.6.1 General

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

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

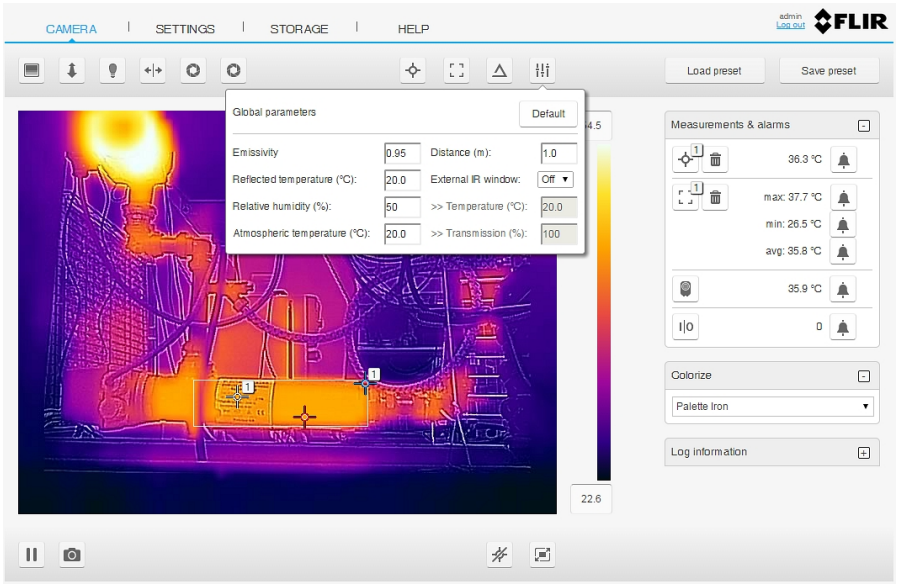
You can set the object parameters globally. You can also change the *Emissivity*, *Reflected temperature*, and *Distance* parameters locally for a measurement tool.

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

12.3.6.2 Global measurement parameters

To change the global measurement parameters, follow this procedure:

1. On the upper toolbar, click the *Global measurement parameters* icon . This displays a dialog box where you can change the values for the object parameters.



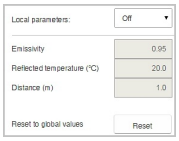
2. To reset the object parameters to the default values provided by FLIR, click the *Default* button.
3. When completed, click anywhere outside the dialog box.

12.3.6.3 Local parameters

It is possible to set local object parameters for spots and boxes. The local parameter settings override the global values.

To change the local object parameters, follow this procedure:

1. In the *Measurements & alarms* section, click the *Spot* icon or the *Box* icon . This displays a dialog box.



2. In the *Local parameters* list box, select *On*. This activates the use of local parameters and allows you to change the values for the object parameters *Emissivity*, *Reflected temperature*, and *Distance*.
3. To reset the object parameters to the global values, click the *Reset* button.
4. To deactivate the use of local parameters, select *Off* in the *Local parameters* list box.
5. When completed, click anywhere outside the dialog box.

12.3.7 Working with alarms

12.3.7.1 General

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

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

When an alarm is activated, the *Alarm settings* icon is marked with a blue frame:  .

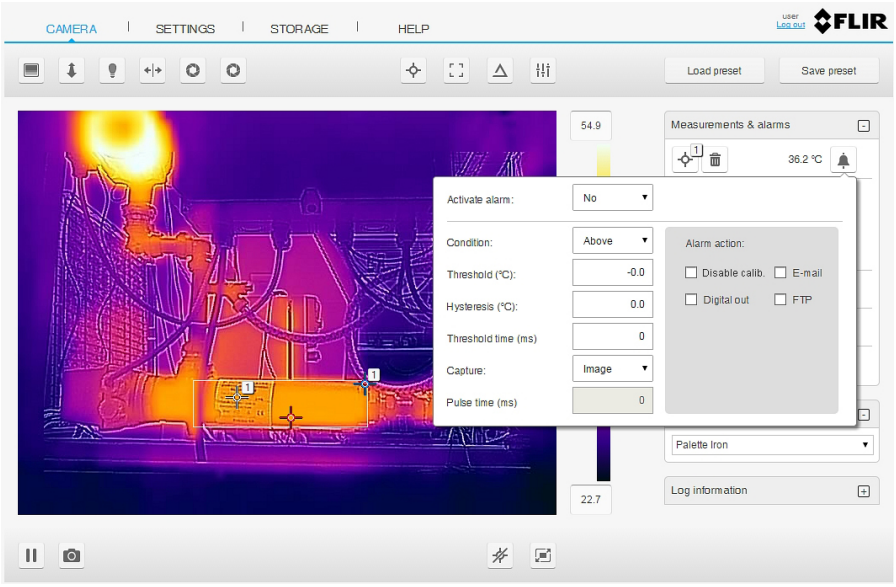
When an alarm is triggered, the *Alarm settings* icon is marked with a red frame:  .

12.3.7.2 Setting an alarm based on a measurement result

It is possible to configure alarms based on the temperature measurement results from the spot, box, and delta measurement tools. An alarm can also be configured for the internal temperature sensor, which can act as a thermometer for the ambient temperature.

To configure an alarm based on a measurement result, follow this procedure:

1. In the *Measurements & alarms* section, click the *Alarm* icon  next to the measurement result to be used for the alarm. This displays a dialog box where you can configure the alarm parameters and actions.



2. In the *Activate alarm* list box, select *Yes* to activate the alarm.
3. In the *Condition* list box, select the condition that triggers the alarm:
   - *Above*: Triggers an alarm when the temperature is above the threshold value.
   - *Below*: Triggers an alarm when the temperature is below the threshold value.
4. In the *Threshold* text box, enter the temperature value to be used as the trigger limit.
5. In the *Hysteresis* text box, enter the hysteresis value.

   Hysteresis is the interval within which the temperature value is allowed to vary without causing a change in the trigger. If the threshold is set above 30.0°C and the hysteresis is set at 2.0°C, the trigger goes high when the temperature rises above 30.0°C and stays high until the temperature drops below 28.0°C. In contrast, if the threshold is set below 30.0°C, and the same hysteresis value is kept, the trigger goes high if the temperature drops below 30.0°C and stays high until the temperature rises above 32.0°C.
6. In the *Threshold time* text box, enter the duration that must be matched or exceeded in order for the alarm to be triggered.

   The duration specifies the amount of time that has to pass before an alarm is triggered. This can be used as a powerful tool to avoid false alarms.

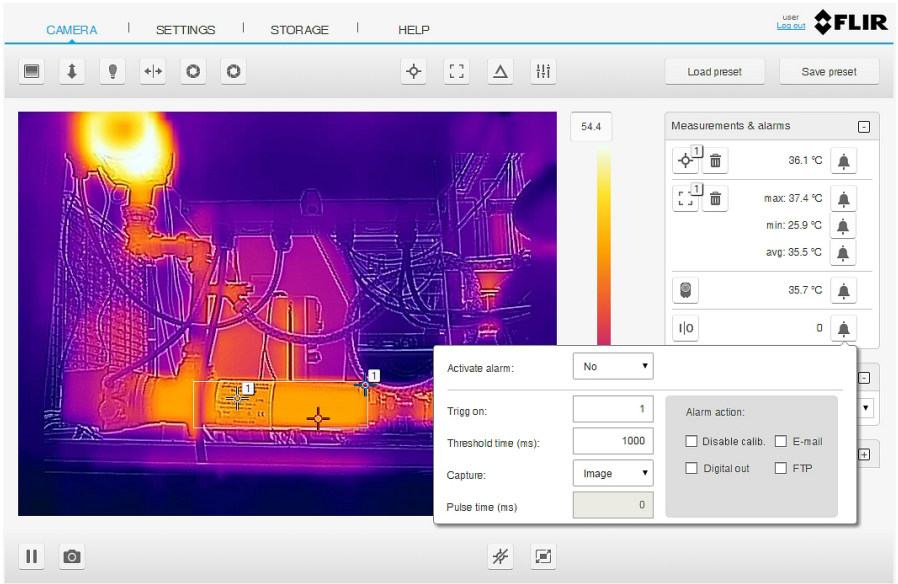
7. In the *Capture* list box, select if an image or a video sequence will be captured and saved when an alarm is triggered. The image/video can later be viewed and managed under the *Storage* tab.
   - Select *Image* to capture the image frame that triggered the alarm.
   - Select *Video* to capture a 5 second video sequence when the alarm is triggered.
   - If you select *None*, no image/video will be captured.
8. Under *Alarm action*, use the check boxes to select which actions the camera will perform when an alarm is triggered:
   - *Disable calib.*: Temporarily disables the periodic calibration while the image/video is being captured.
   - *E-mail*: Automatically sends the captured image/video to the recipients defined in *Settings* > *Alarm recipients*.
   - *Digital out*: Outputs a digital pulse.
   - *FTP*: Automatically sends the captured image/video to the FTP site defined in *Settings* > *Alarm recipients*.
9. If you have selected the alarm action *Digital out*, enter the pulse length (in milliseconds) in the *Pulse time* text box.
10. When completed, click anywhere outside the dialog box.

12.3.7.3 Setting an alarm based on the digital input

It is possible to set an alarm based on the digital input.

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

1. In the *Measurements & alarms* section, click the *Alarm* icon  next to the digital input result. This displays a dialog box where you can configure the alarm parameters and actions.



2. In the *Activate alarm* list box, select *Yes* to activate the alarm.
3. In the *Trigg on* text box, enter 0 to trigger the alarm on a low signal or 1 to trigger on a high signal.
4. In the *Threshold time* text box, enter the duration that must be matched or exceeded in order for the alarm to be triggered.

   The duration specifies the amount of time that has to pass before an alarm is triggered. This can be used as a powerful tool to avoid false alarms.

5. In the *Capture* list box, select if an image or a video sequence will be captured and saved when an alarm is triggered. The image/video can later be viewed and managed under the *Storage* tab.
   - Select *Image* to capture the image frame that triggered the alarm.
   - Select *Video* to capture a 5 second video sequence when the alarm is triggered.
   - If you select *None*, no image/video will be captured.
6. Under *Alarm action*, use the check boxes to select which actions the camera will perform when an alarm is triggered:
   - *Disable calib.*: Temporarily disables the periodic calibration while the image/video is being captured.
   - *E-mail*: Automatically sends the captured image/video to the recipients defined in *Settings* > *Alarm recipients*.
   - *Digital out*: Outputs a digital pulse.
   - *FTP*: Automatically sends the captured image/video to the FTP site defined in *Settings* > *Alarm recipients*.
7. If you have selected the alarm action *Digital out*, enter the pulse length (in milliseconds) in the *Pulse time* text box.
8. When completed, click anywhere outside the dialog box.

12.3.8 Colorizing the image

12.3.8.1 General

The camera can colorize the image in different ways. You can select different color palettes or apply color alarms (isotherms).

12.3.8.2 Palette

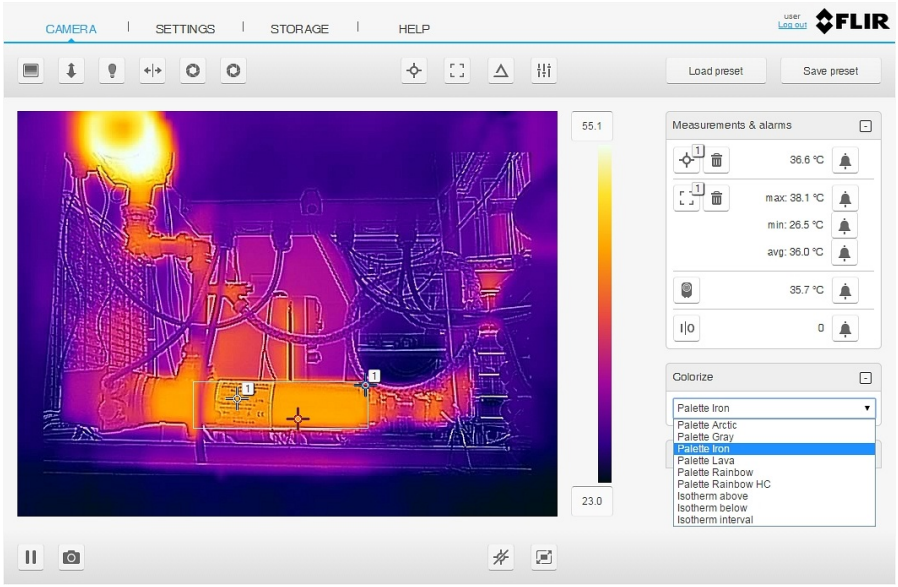
You can change the palette that the software uses to display the different temperatures within an image. A different palette can make it easier to analyze the image. The most suitable palette for a certain application depends on many different factors, such as the target temperature and emissivity, the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

The camera supports the following palettes:

- *Palette Arctic*
- *Palette Gray*
- *Palette Iron*
- *Palette Lava*
- *Palette Rainbow*
- *Palette Rainbow HC*

To change the palette, follow this procedure:

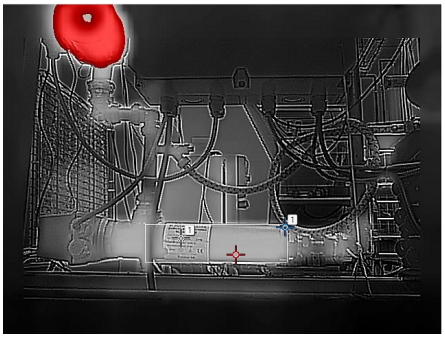
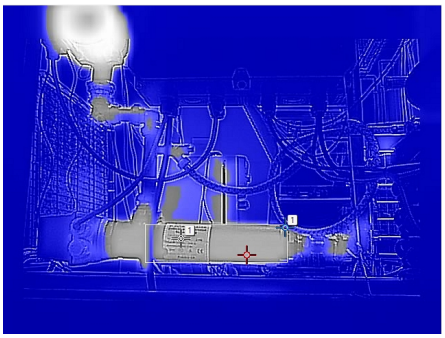
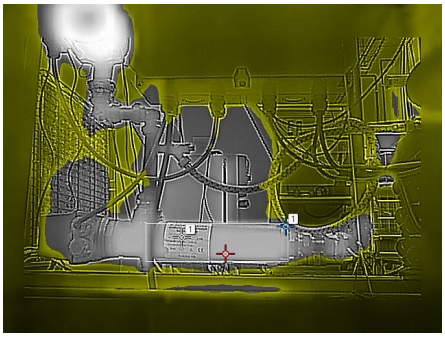
1. In the *Colorize* list box, select one of the palettes.



12.3.8.3 Isotherms

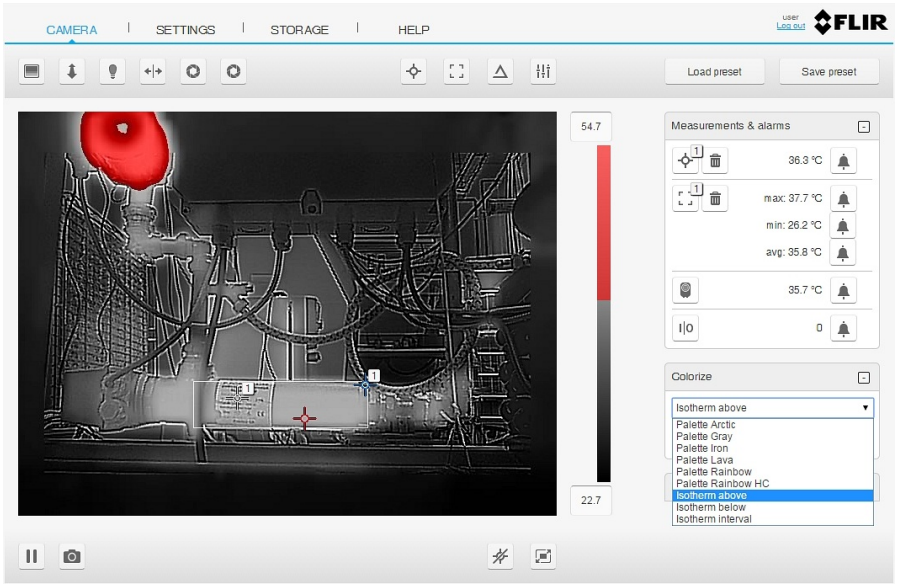
By using color alarms (isotherms), anomalies can easily be discovered in an infrared image. The isotherm command applies a contrasting color to all pixels with a temperature above, below, or between the set temperature levels.

The camera supports the following color alarms (isotherms):

Color alarm	Image
Isotherm above Applies a contrasting color (red) to all pixels with a temperature above the specified temperature level.	
Isotherm below Applies a contrasting color (blue) to all pixels with a temperature below the specified temperature level.	
Isotherm interval Applies a contrasting color (yellow) to all pixels with a temperature between two specified temperature levels.	

To configure a color alarm (isotherm), follow this procedure:

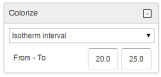
1. In the *Colorize* list box, select one of the color alarms:
   - *Isotherm above*
   - *Isotherm below*
   - *Isotherm interval*



2. When a color alarm is selected, the threshold temperature(s) are displayed in the *Colorize* section.

   To change the threshold temperature, do the following:

   - For the *Isotherm above*, enter the threshold temperature in the *From* text box.
   - For the *Isotherm below*, enter the threshold temperature in the *To* text box.
   - For the *Isotherm interval*, enter the threshold temperatures in the *From* and *To* text boxes.



12.3.9 Adjusting the temperature scale

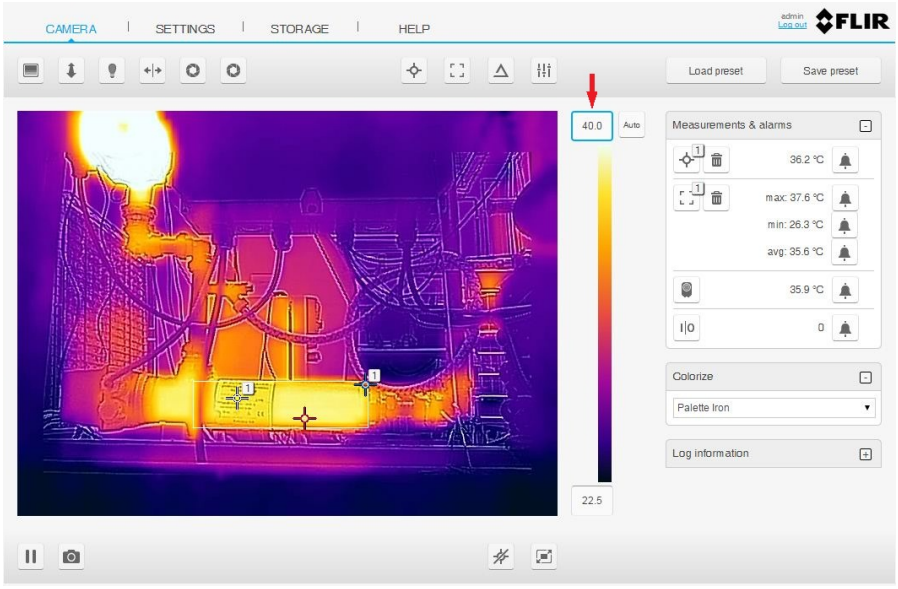
The camera continuously auto-adjusts the image for the best image brightness and contrast. In some situations, manual adjustments can make it easier to analyze details in the image. For example, by manually changing the maximum and/or minimum temperature levels to levels near a certain object in the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

When a temperature level is manually adjusted, the temperature level text box is marked with a blue frame and the *Auto* button is displayed: 

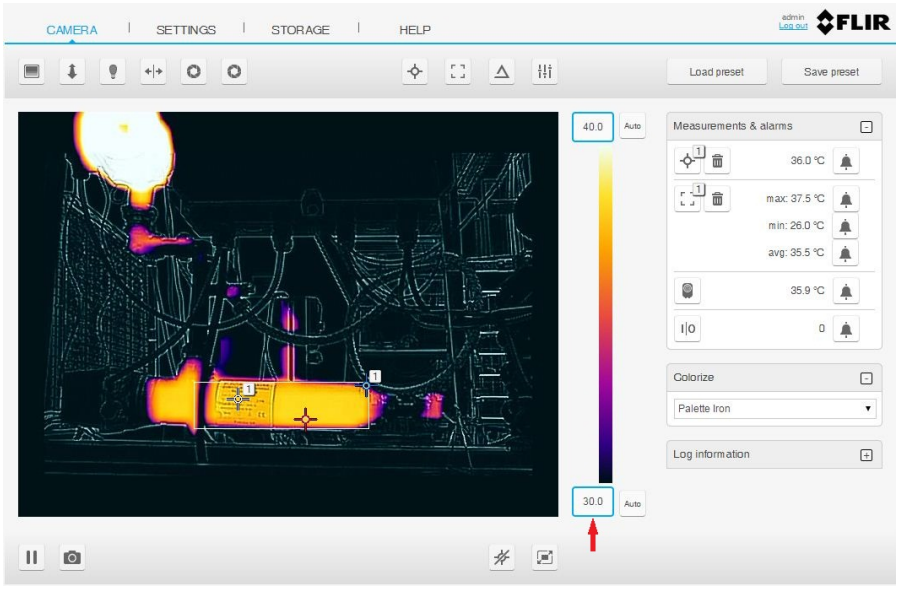
To return to auto-adjustment of the temperature level, click the *Auto* button.

To manually adjust the image, follow this procedure:

1. To change the maximum temperature level, enter the temperature in the upper temperature scale text box. When completed, click anywhere outside the text box.



2. To change the minimum temperature level, enter the temperature in the lower temperature scale text box. When completed, click anywhere outside the text box.



3. To return to auto-adjustment, click the *Auto* button(s).

12.3.10 Log information

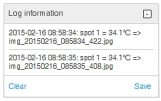
The *Log information* section lists information about triggered alarms.

It is possible to save the displayed log information to a text file. The log file is saved to disk in your Downloads folder.

To manage the log information, follow this procedure:

1. In the *Log information* section, click the expand icon.

2. This displays the list with information about triggered alarms.



3. To clear the log information list, click *Clear*.
4. To save the log information list to a text file, click *Save*.

12.3.11 Camera presets

12.3.11.1 General

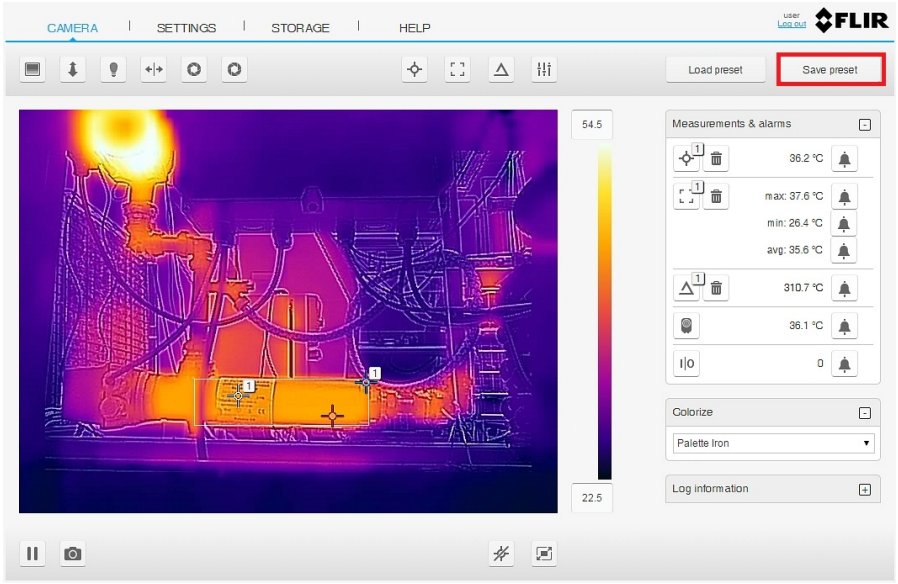
It is possible to save the current camera setup, including measurement tool configurations, alarms, and colorization settings. The file with the presets is saved to disk in your Downloads folder.

The presets file can later be uploaded and applied.

12.3.11.2 Saving a preset

To save the current camera setup, follow this procedure:

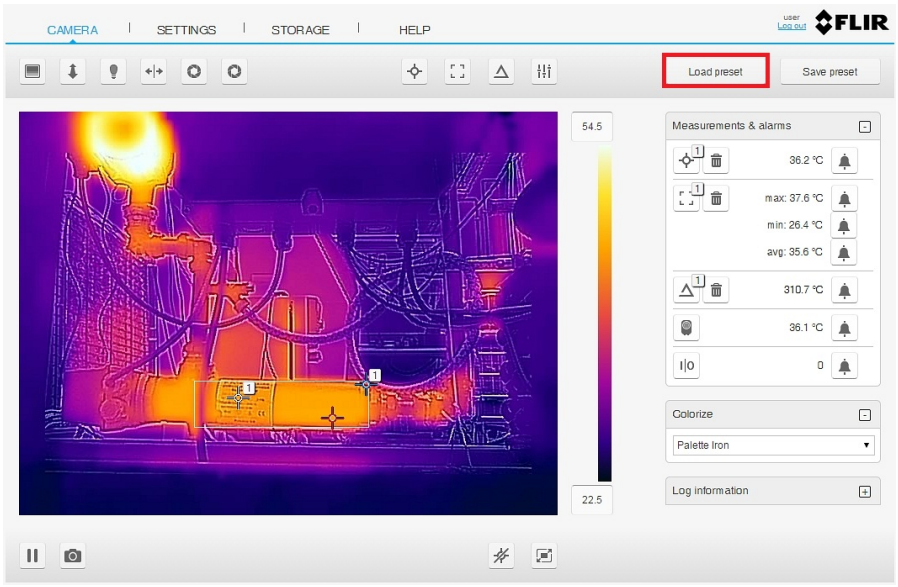
1. On the upper toolbar, click the *Save preset* button.



12.3.11.3 Loading a preset

To load a saved preset file, follow this procedure:

1. On the upper toolbar, click the *Load preset* button. This opens the standard Windows Open dialog box.



2. Browse to the Downloads folder (or to the folder where you have stored the preset files).

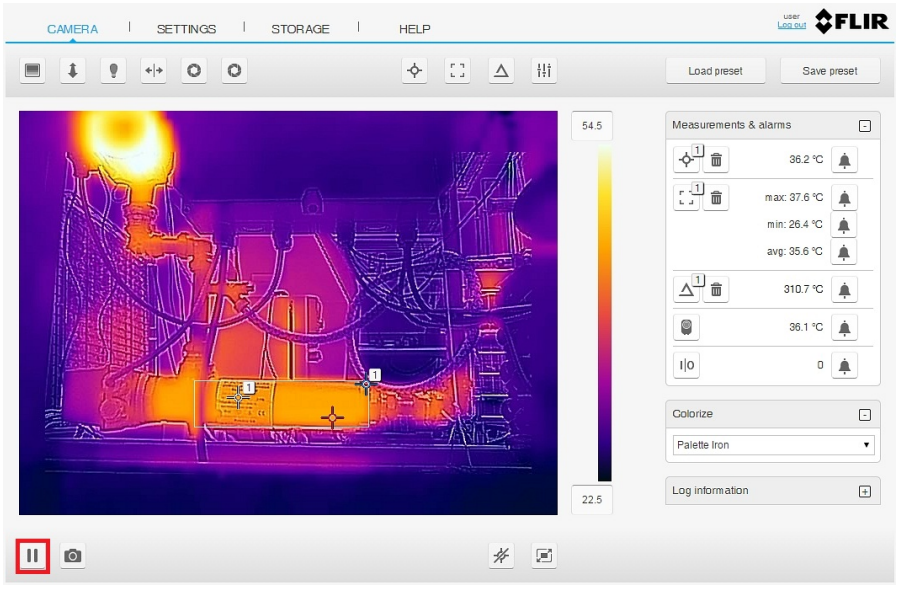
3. Select the file and click the *Open* button. This loads and applies the presets.

12.3.12 Pausing the live video

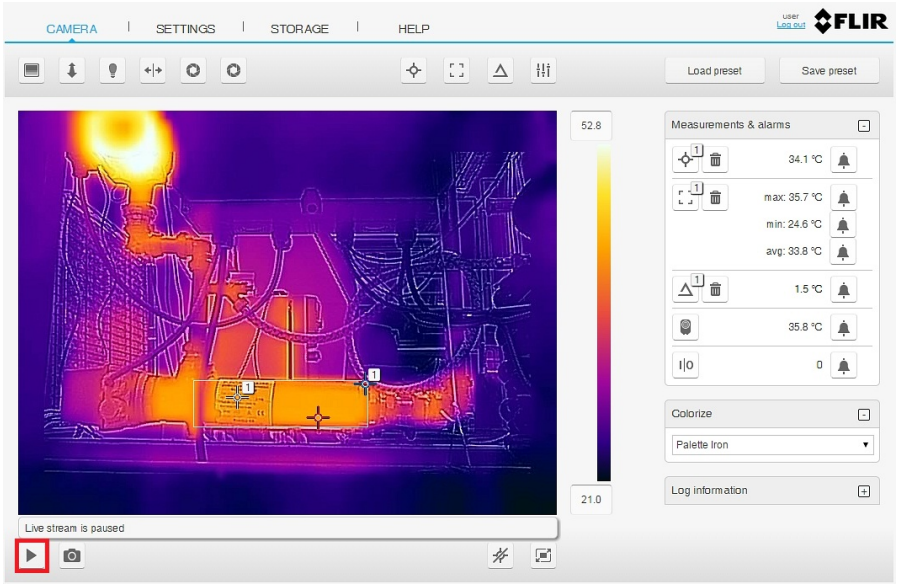
It is possible to pause (freeze) the live video stream.

To pause the video stream, follow this procedure:

1. On the lower toolbar, click the *Pause* icon  .



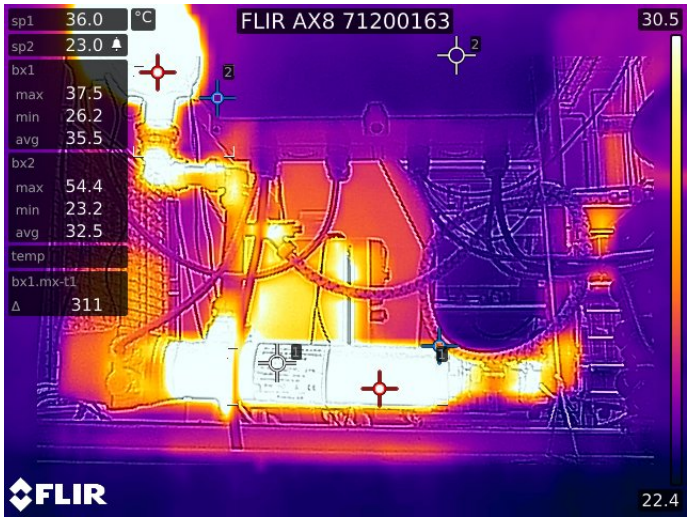
2. When the video stream is paused, the text *Live stream is paused* is temporarily displayed under the image on the screen.
3. To resume the live video stream, click the *Play* icon on the lower toolbar.



12.3.13 Saving a snapshot

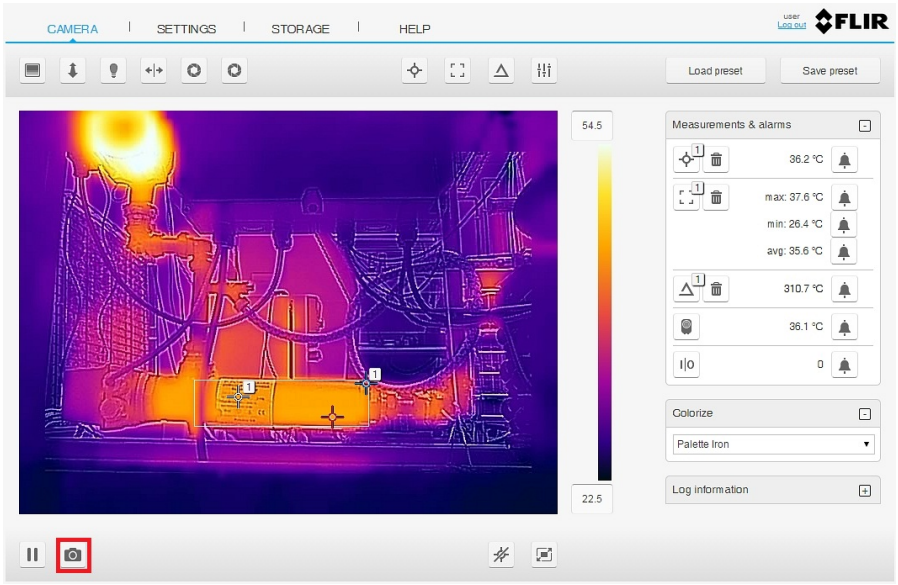
It is possible to take a snapshot and save the image with the current measurement results. The image can later be viewed and managed under the *Storage* tab. Up to 50 images can be saved.

Example of a saved snapshot:



To take a snapshot, follow this procedure:

1. On the lower toolbar, click the *Save snapshot* icon .



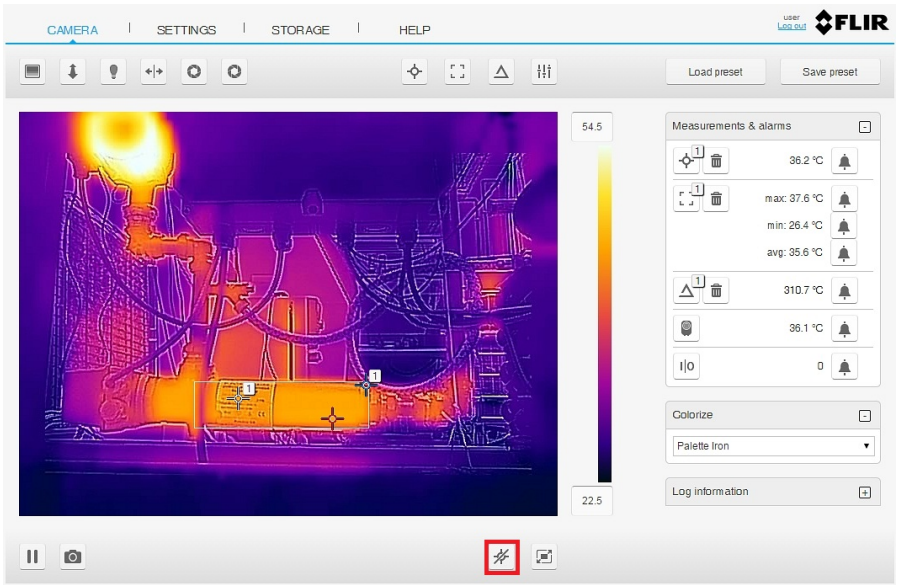
2. When saving is in progress, the image filename is temporarily displayed under the image on the screen.

12.3.14 Hiding the overlay graphics

The overlay graphics provide information about the image, e.g., measurement tools. You can choose to hide all overlay graphics.

To hide the overlay graphics, follow this procedure:

1. On the lower toolbar, click the *Hide overlay* icon .



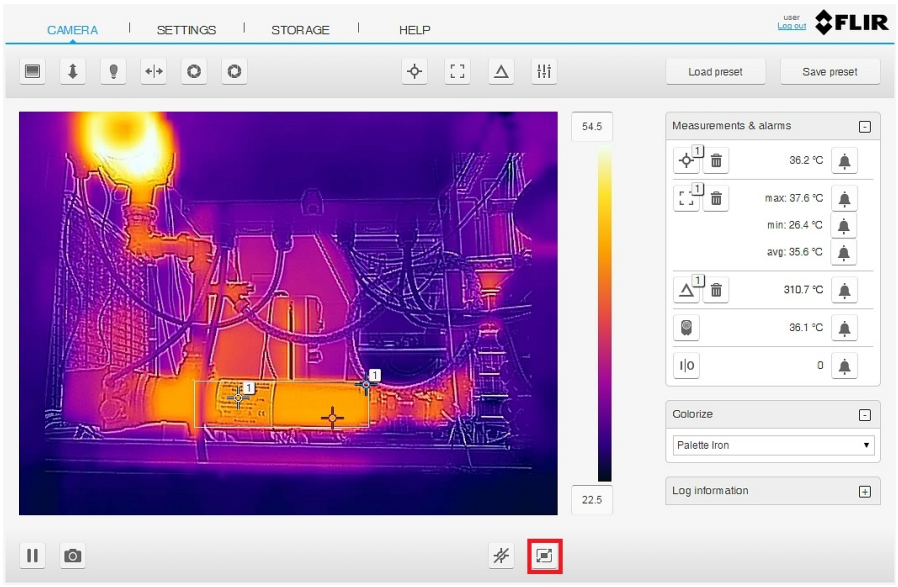
2. To show the overlay graphics, click the *Hide overlay* icon once more.

12.3.15 Full screen view

It is possible to display a full screen view of the image.

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

1. On the lower toolbar, click the *Full screen* icon .



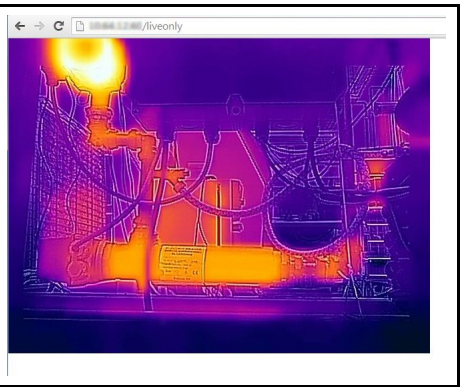
2. To return to normal view, press the Esc (Escape) key on the computer keyboard.

12.3.16 Live image only

It is possible to navigate to a web page that displays only the live image, with or without the overlay graphics.

Note JavaScript has to be enabled in your web browser.

Examples of live image web pages:

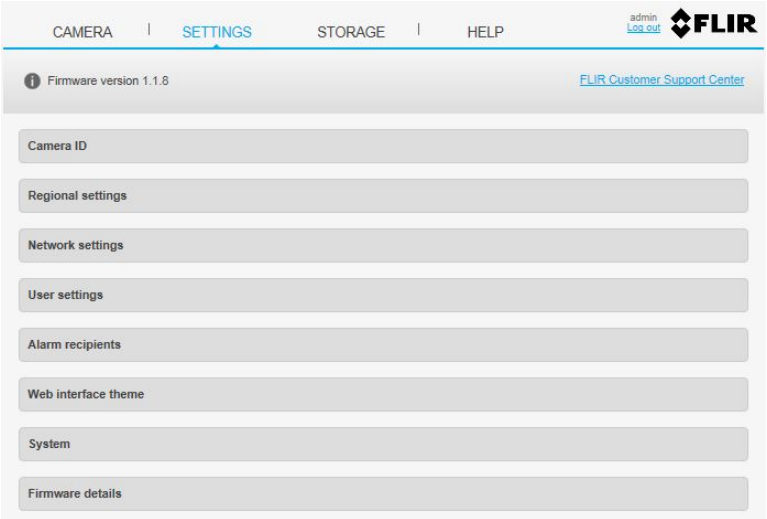
Live image only, without overlay.	
Live image only, with overlay.	

To navigate to a live image web page, follow this procedure:

1. In the address bar of a web browser, enter one of the following:
   - <ip-address>/liveonly—shows the live image, without overlay, if already logged in, otherwise the login view is displayed.
   - <ip-address>/liveonly/username:password—logs in automatically and shows the live image, without overlay.
   - <ip-address>/liveoverlay—shows the live image, with overlay, if already logged in, otherwise the login view is displayed.
   - <ip-address>/liveoverlay/username:password—logs in automatically and shows the live image, with overlay.

12.4 Settings tab

Under the *Settings* tab it is possible to manage the Camera ID, Regional settings, Network settings, User settings, Alarm recipients, Web interface theme, System, and Firmware details.



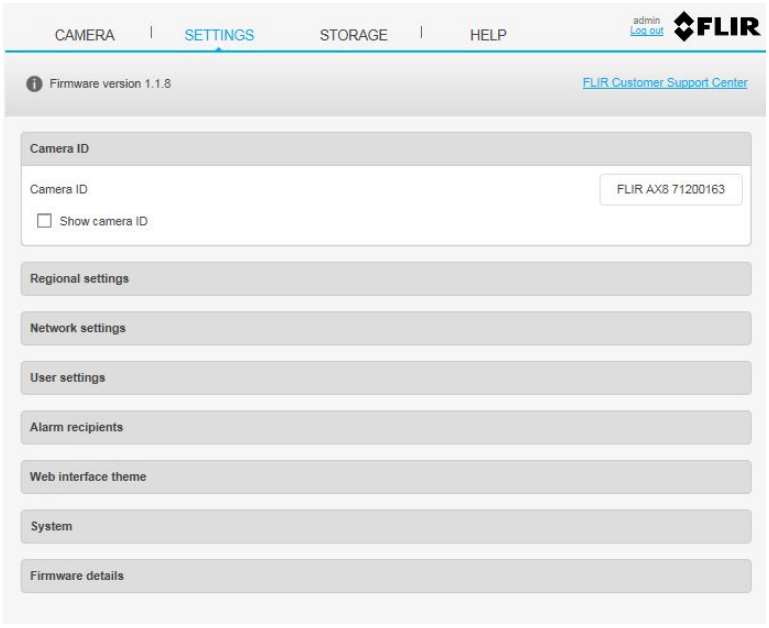
12.4.1 Camera ID

You can choose to show or hide the camera ID. When shown, the camera ID appears as the tab ID in the web browser and in the upper part of saved snapshots.

It is also possible to change the camera ID text.

To manage the camera ID, follow this procedure:

1. Click on *Camera ID*. This displays the camera ID settings.



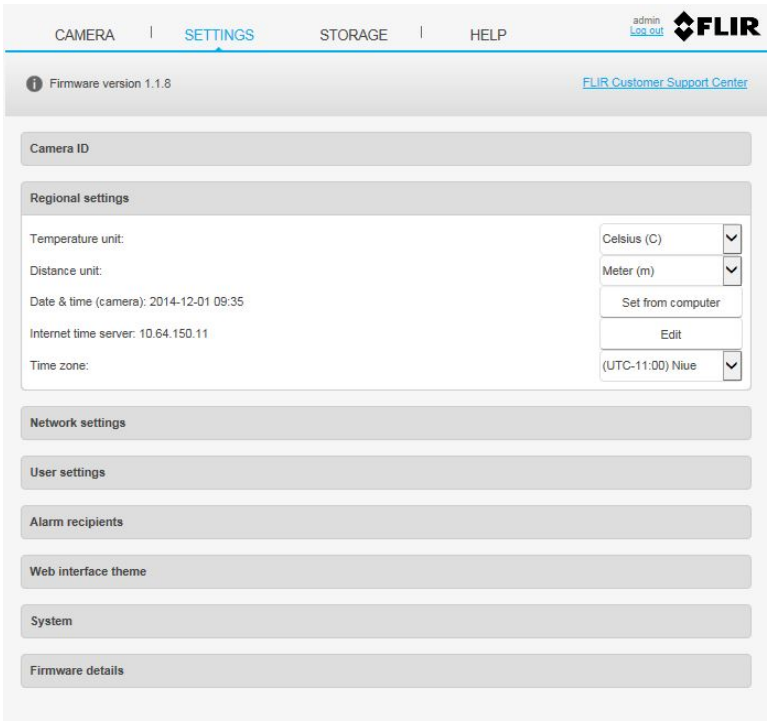
2. To show the camera ID, select the check box *Show camera ID*.
3. To change the camera ID, enter the text in the text box to the right.

12.4.2 Regional settings

It is possible to change the regional settings, such as the temperature and distance units, date and time settings, and time zone.

To manage the regional settings, follow this procedure:

1. Click on *Regional settings*. This displays the regional settings.



2. To change the temperature unit, select *Celsius (C)* or *Fahrenheit (F)* from the *Temperature unit* list box.
3. To change the distance unit, select *Meter (m)* or *Feet (ft)* from the *Distance unit* list box.
4. To apply the date and time settings from the computer, click the *Set from computer* button.
5. To apply the date and time settings from an internet time server (SNTP), do the following:
   5.1. Click the *Edit* button. This displays a text box.
   5.2. In the text box, enter the IP address of the internet time server.
   5.3. Click the *Apply* button.
6. To change the time zone, select the correct time zone from *Time zone* the list box.

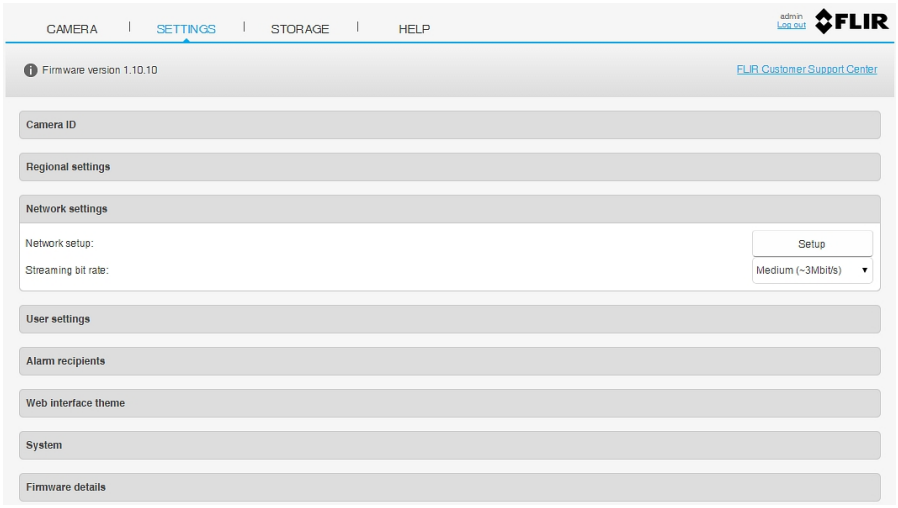
12.4.3 Network settings

It is possible to manage the network setup and to select the streaming bit rate.

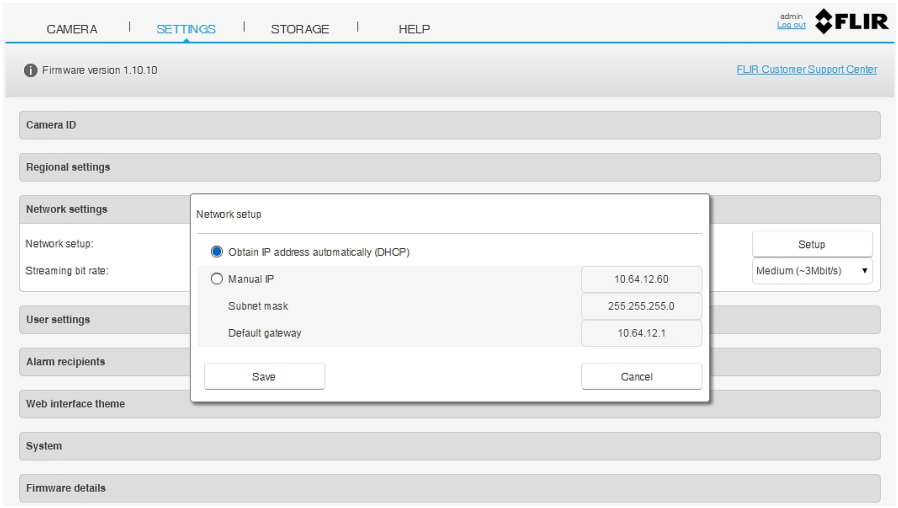
Note When altering the network settings, the address of the camera might change. Make sure your settings are correct before saving them or the camera might not be reachable afterwards. If this occurs, you can use FLIR IP Config to locate the camera again or reset the camera to its default settings.

To manage the network settings, follow this procedure:

1. Click on *Network settings*. This displays the network settings.



2. To manage the network setup, click the *Setup* button. This displays a dialog box.



3. To obtain the IP address automatically, select the radio button *Obtain IP address automatically (DHCP)*.
4. To set the IP address manually, select the radio button *Manual IP* and do the following:
   4.1. Enter the IP address of the camera.
   4.2. Enter the Subnet mask.
   4.3. Enter the IP address of the default gateway.
   4.4. When completed, click the *Save* button.
5. To change the streaming bit rate, select *Low*, *Medium*, or *High* from the *Streaming bit rate* list box.

12.4.4 User settings

There are three types of users: *admin*, *user*, and *viewer*.

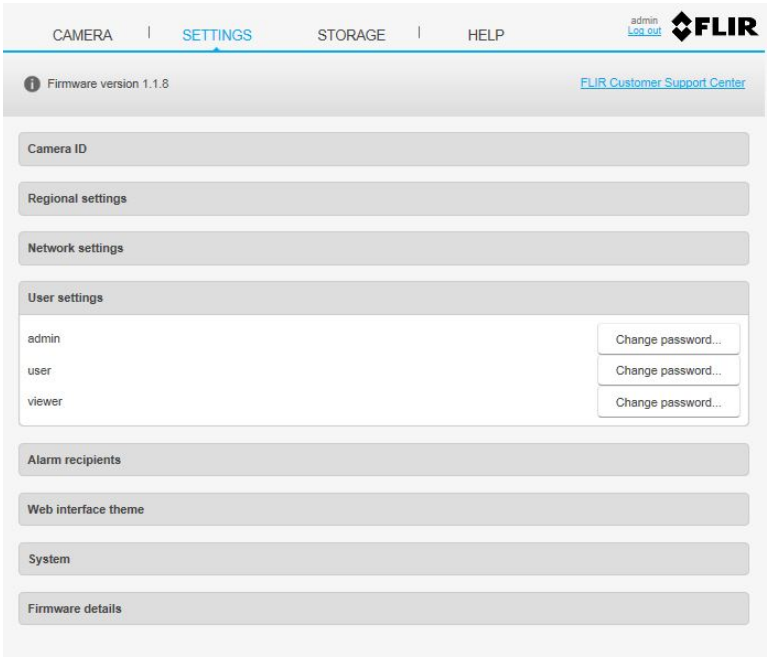
A user of the *admin* type can change the passwords for all types of users.

If a password is changed for a logged-in user, their web user interface will restart.

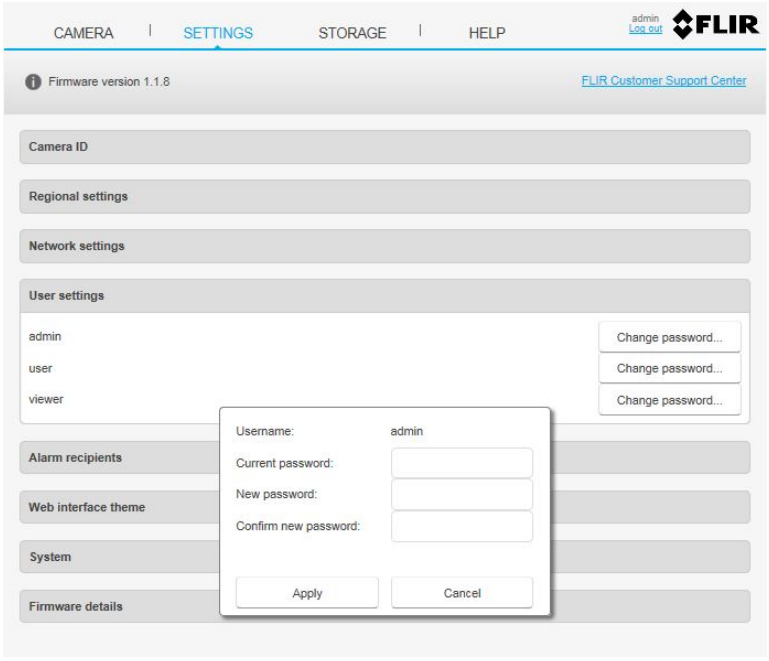
To change a password, follow this procedure:

1. Log in to the camera web server as an *admin* user.

2. Click on *User settings*. This displays the user settings.



3. Click the *Change password...* button. This displays a dialog box.



4. Enter the current and new passwords in the *Current password*, *New password*, and *Confirm new password* text boxes.
5. Click the *Apply* button.

12.4.5 Alarm recipients

It is possible to change the e-mail and FTP recipients of alarm notifications. You can also enter the login credentials, in case the mail server requires authentication.

Note Only SMTP mail servers are supported.
Supported authentication methods are PLAIN and LOGIN. SSL authentication is not supported.

To manage the alarm recipients, follow this procedure:

1. Click on *Alarm recipients*. This displays the alarm recipients settings.

2. To change the *E-mail* address, do the following:
   2.1. Click the *Edit* button and enter the e-mail address in the displayed text box. The format should be user@domain:mailserver. The mailserver needs to be an IP number and not a DNS name, e.g., john.doe@company.com:XX.XX.XX.XX. The following characters can be used:
      - a–z
      - A–Z
      - 0–9
      - $ - _ . + ! * ' { } | ^ [ ] ` # % ? @ & =
   2.2. If the mail server requires a login, select the check box *Authenticate e-mail*.
   2.3. To enter the *User* for the mail server authentication, click the *Edit* button.
   2.4. To enter the *Password* for the mail server authentication, click the *Edit* button.
3. To change the *FTP* address, do the following:
   3.1. Click the *Edit* button and enter the IP address of the FTP server in the displayed text box. The format should be user:password@ftpserver-ip-address.
   3.2. To specify which *Folder* to save the notifications to, click the *Edit* button. This can be useful if you have multiple cameras connected to the same FTP server.

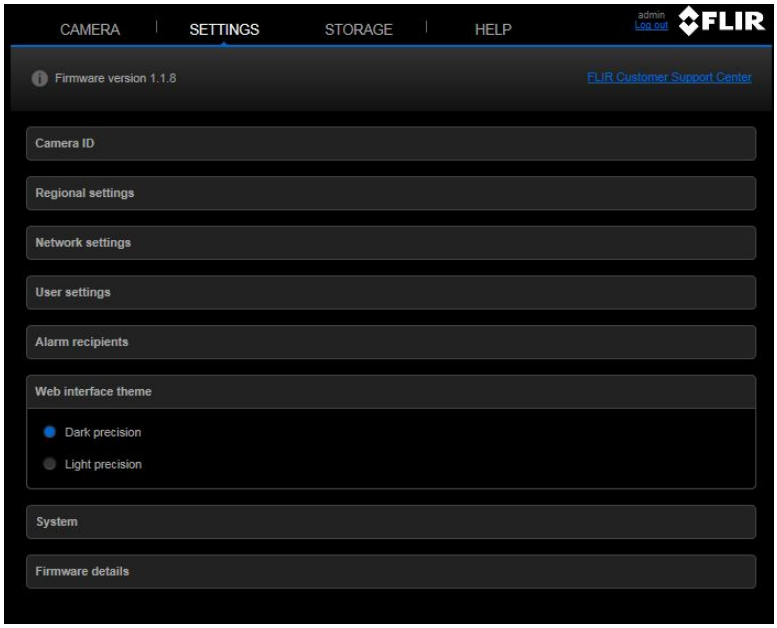
12.4.6 Web interface theme

It is possible to change the theme (background color) for the web interface. Choose between Dark precision and Light precision.

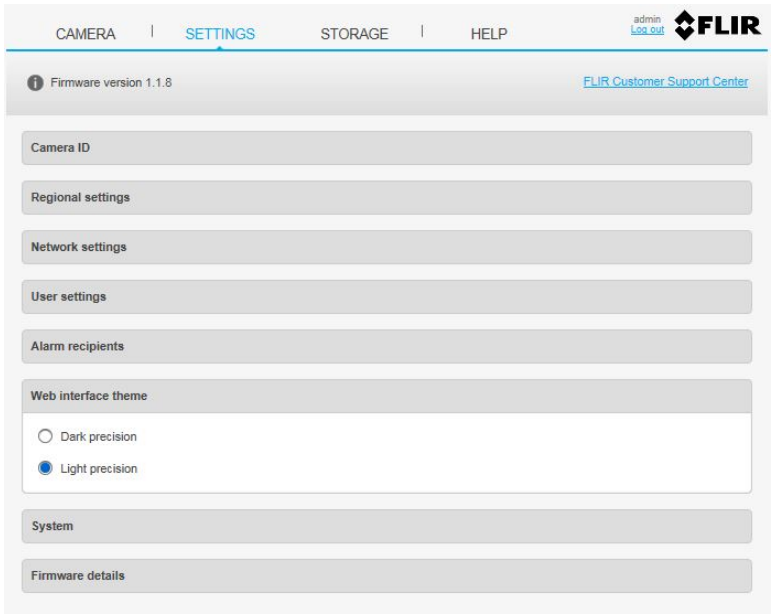
To manage the web interface theme, follow this procedure:

1. Click on *Web interface theme*. This displays the theme settings.

2. For the dark background color, select the radio button *Dark precision*.



3. For the light background color, select the radio button *Light precision*.

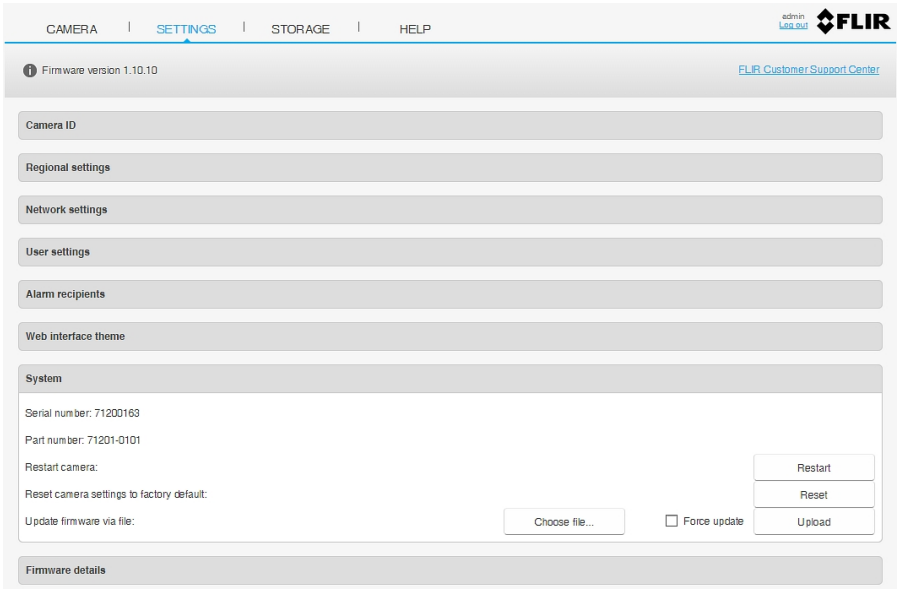


12.4.7 System

The *System* section displays the serial number and the part number of the camera. Here, you can also restart the camera, reset the camera to factory default settings, and update the camera firmware.

To manage the system functions, follow this procedure:

1. Click on *System*. This displays the system functions.



2. To restart the camera, do the following:
   2.1. Click the *Restart* button. This displays a dialog box.
   2.2. In the dialog box, click the *OK* button.
3. To reset the camera settings to the factory default, do the following:
   3.1. Click the *Restart* button. This displays a dialog box.
   3.2. In the dialog box, click the *OK* button. This will affect all camera settings, including regional settings. Saved images will not be affected. The camera will restart.
4. To update the firmware via a file, do the following:
   4.1. Click the *Choose file...* button. This opens the standard Windows Open dialog box.
   4.2. Browse to the location of the firmware file. Select the file and click the *Open* button.
   4.3. By selecting the check box *Force update*, any error messages will be overridden and the update will be installed even if you, for example, try to install an older version of the firmware. Only select the check box if you know what you are doing.
   4.4. Click the *Upload* button.

12.4.8 Firmware details

The *Firmware details* section displays information about the camera firmware: Package, OS, Kernel, Boot, and Configuration.

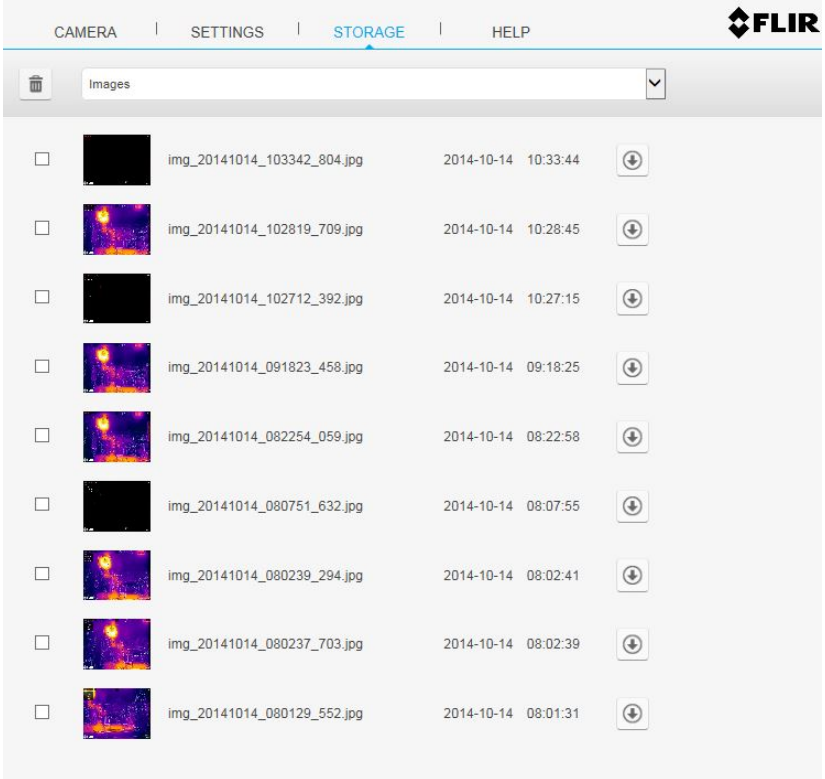
To view the firmware details, follow this procedure:

1. Click on *Firmware details*. This displays information about the camera firmware.

12.5 *Storage* tab

12.5.1 General

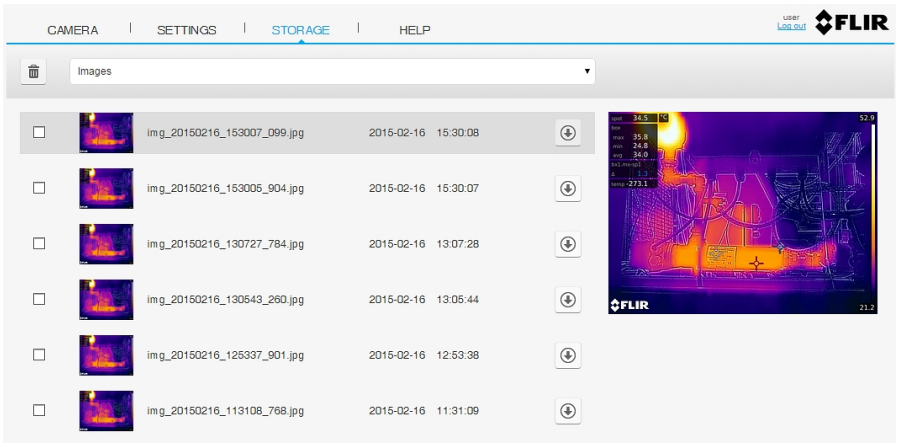
Under the *Storage* tab it is possible to view and manage saved images and videos from alarms and snapshots.



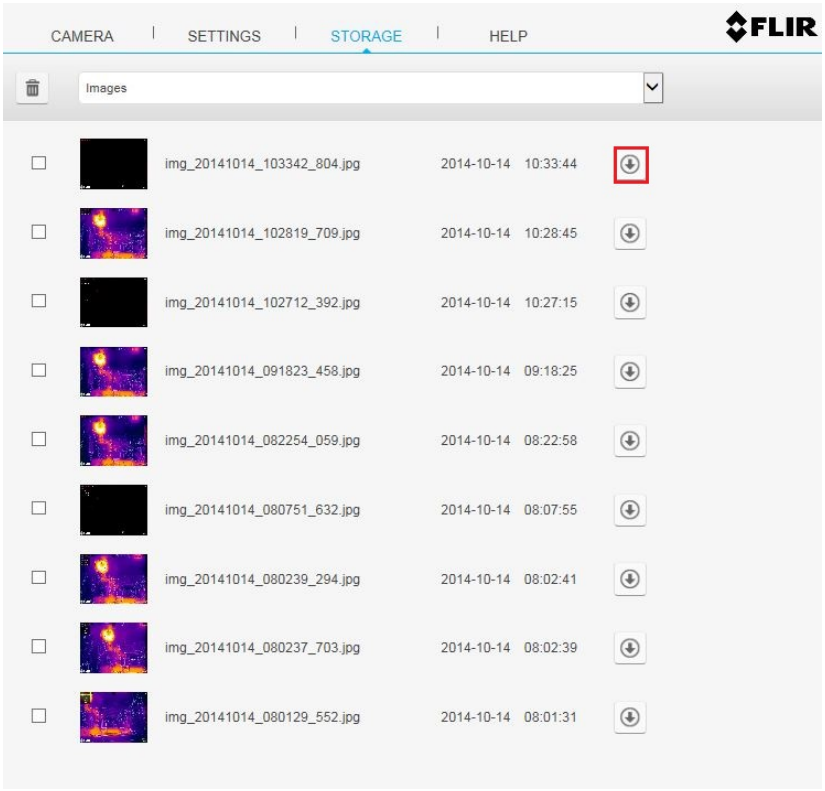
12.5.2 Managing images

To view and manage image files, follow this procedure:

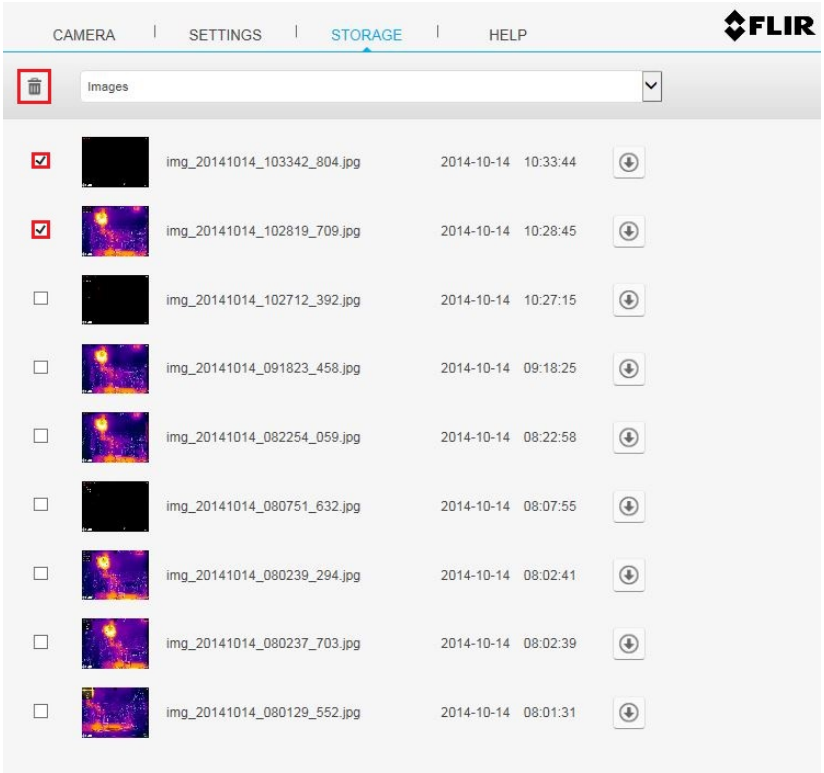
1. From the upper list box, select *Images*.
2. To display a preview of an image, click the thumbnail or the filename of the image.



3. To download an image, click the *Download* icon to the right of the image.



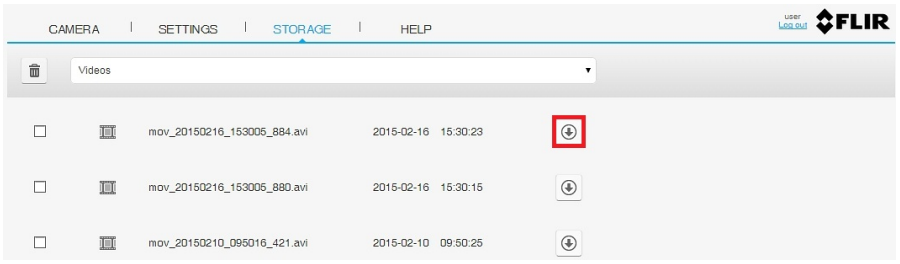
4. To delete one or more image files, do the following:
   4.1. Select the check box(es) to the left of the image thumbnail(s).
   4.2. Click the *Delete* icon.



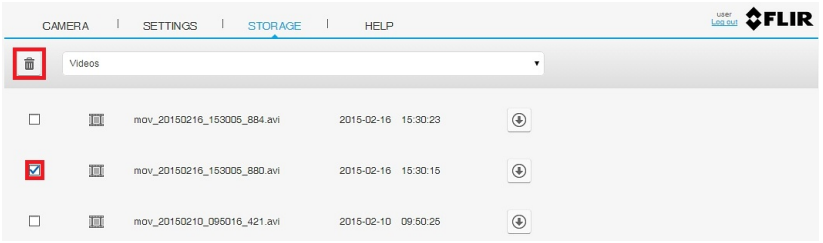
12.5.3 Managing videos

To view and manage video files, follow this procedure:

1. From the upper list box, select *Videos*.
2. To download a video, click the *Download* icon to the right of the video.



3. To delete one or more video files, do the following:
   3.1. Select the check box(es) to the left of the video thumbnail(s).
   3.2. Click the *Delete* icon.



13 Software supporting FLIR AX series cameras

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

Software	Support	Comment
FLIR IP Config **Note** The FLIR IP Config version must be 1.9 or later.	**Yes**	• Detecting FLIR AX series cameras on the network. • Assigning IP addresses. • Accessing the built-in camera web server.
Camera web server	**Yes**	Configuration and setup of analysis and alarms.
FLIR Tools/Tools+	No	—
FLIR IR Monitor	No	—
EthernetIP & Modbus TCP	**Yes**	Connecting to a PLC for readout of analysis and alarms.
Pleora Ebus SDK	No	—
FLIR GEV Demo	No	—
ThermoVision System Developers Kit	No	—
ThermoVision LabVIEW Digital Toolkit	No	—

14 FLIR IP Config

To access the latest FLIR IP Config user manual, go to https://support.flir.com/resources/wkqz/.

15 Minimum measurement areas

In order to obtain reliable measurement results, the following minimum measurement areas apply.

Distance	Instantaneous field of view (IFOV) (radians)	Minimum measurement areas
0.3 m (1 ft.)	0.003	2.7 × 2.7 cm (1.1 × 1.1 in.)
0.5 m (1.6 ft.)	0.0055	4.95 × 4.95 cm (1.9 × 1.9 in.)
1 m (3.3 ft.)	0.011	9.9 × 9.9 cm (3.9 × 3.9 in.)
2 m (6.6 ft.)	0.022	19.8 × 19.8 cm (7.8 × 7.8 in.)
3 m (9.8 ft.)	0.033	29.7 × 29.7 cm (11.7 × 11.7 in.)

16 Technical data

Table of contents

16.1 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.

16.2 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.

16.3 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.

16.4 FLIR AX8 9 Hz

P/N: 71201-0101
Rev.: 78779

General description
The FLIR AX8 camera/sensor provides an affordable and accurate temperature measurement solution for anyone who needs to solve problems that need built in “smartness” such as analysis, alarm functionality, and autonomous communication using standard protocols. The FLIR AX8 also has all the necessary features and functions to build distributed single- or multi-camera solutions utilizing standard Ethernet hardware and software protocols.
The FLIR AX8 also has built-in support to connect to industrial control equipment such as PLCs, and allows the sharing of analysis and alarm results and simple control using the Ethernet/IP and Modbus TCP field bus protocols.
Key features:
• Support for the EthernetIP field bus protocol (analyze, alarm, and simple camera control). • Support for the Modbus TCP field bus protocol (analyze, alarm, and simple camera control). • Built-in analysis functionality. • Alarm functionality, as a function of analysis and more. • Built-in web server for control and set up. • MJPEG, MPEG-4, or H.264 image streaming. • PoE (Power over Ethernet). • General-purpose output. • 100 Mbps Ethernet (100 m cable). • On alarm: file sending (FTP) or e-mail (SMTP) of analysis results or images.
Typical applications:
• Electrical and mechanical condition-monitoring applications where temperature or temperature trends can be an indication of a potential risk of failure. • Simple process control applications.

Imaging and optical data	
IR resolution	80 × 60 pixels
Thermal sensitivity/NETD	< 0.10°C @ +30°C (+86°F) / 100 mK
Field of view (FOV)	48° × 37°
Depth of field	0.1 m (0.33 ft.), infinity
Focal length	1.54 mm (0.061 in.)
Spatial resolution (IFOV)	11.1 mrad
F-number	1.1
Image frequency	9 Hz
Focus	Fixed

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

Visual camera	
Built-in digital camera	640 × 480
Digital camera, FOV	Adapts to the IR lens
Sensitivity	Minimum 10 lux without illuminator

Measurement	
Object temperature range	–10 to +150°C (14 to +302°F)
Accuracy	±2°C (±3.6°F) or ±2% of reading (+10 to +100°C @ +10 to +35°C ambient)

Measurement analysis	
Spotmeter	6
Area	6 boxes with max./min./average
Automatic hot/cold detection	Max./min. temperature value and position shown within box
Measurement presets	Yes
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 0.01 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

Alarm	
Alarm functions	Automatic alarms on any selected measurement function. A maximum of 5 alarms can be set.
Alarm output	Digital out, store image, file sending (FTP), email (SMTP), notification

Set-up	
Color palettes	• Arctic • Gray • Iron • Lava • Rainbow • Rainbow HC
Set-up commands	Date/time, Temperature (°C/°F)
Web interface	Yes

Storage of images	
Storage media	Built-in memory for image storage
Image storage mode	IR, visual, MSX
File formats	JPEG + FFF

Image streaming	
Image streaming formats	• Motion JPEG stream MJPEG Baseline Process Encoder Baseline ISO/IEC 10918-1 JPEG compliance • MPEG stream Stream format MPEG-4 ISO/IEC 14496-2 Simple Profile level 2 • H.264 stream Stream format H.264 Baseline Profile level 2.0
Image streaming resolution	640 × 480
Image modes	• Thermal • Visual • MSX

Image streaming	
Automatic image adjustment	Continuous
Multi Spectral Dynamic Imaging (MSX)	IR image with enhanced detail presentation

Ethernet	
Ethernet	Control, result and image
Ethernet, type	100 Mbps
Ethernet, standard	IEEE 802.3
Ethernet, connector type	M12 8-pin X-coded
Ethernet, communication	TCP/IP socket-based FLIR proprietary
Ethernet, video streaming	Yes
Ethernet, power	Power over Ethernet, PoE IEEE 802.3af class 2.
Ethernet, protocols	Ethernet/IP, Modbus TCP, TCP, UDP, SNTP, RTSP, RTP, HTTP, ICMP, IGMP, sftp, SMTP, DHCP, MDNS (Bonjour)

Digital input/output	
Digital input, purpose	NUC, NUC disable, Alarm
Digital input	1 opto-isolated, 10–25 VDC
Digital output, purpose	As function of alarm, output to ext. device (programmatically set)
Digital output	1 opto-isolated, 10–25 VDC, max. 100 mA
Digital I/O, isolation voltage	500 VRMS
Digital I/O, supply voltage	10-25 VDC, max. 200 mA
Digital I/O, connector type	M12 8-pin A-coded (shared with ext. power)

Power system	
External power operation	12/24 VDC, 2 W continuously/ 4.7 W absolute max
External power, connector type	M12 8-pin A-coded (Shared with digital I/O)
Voltage	Allowed range 10.8–30 VDC
Power supply rating	Class 2 / LPS

Environmental data	
Operating temperature range	–0°C to +50°C (+32°F to +122°F)
Storage temperature range	–40°C to +70°C (–40°F to +158°F) according to IEC 68-2-1 and IEC 68-2-2
Humidity (operating and storage)	IEC 60068-2-30/24 h 95% relative humidity +25°C to +40°C (+77°F to +104°F)/ 2 cycles
EMC	• EN 61000-6-2:2001 (Immunity) • EN 61000-6-3:2001 (Emission) • FCC 47 CFR Part 15 Class B (Emission)
Encapsulation	IP 67 (IEC 60529)
Bump	25 g (IEC 60068-2-29)
Vibration	2 g (IEC 60068-2-6)

Physical data	
Weight	0.125 kg (0.28 lb.)
Camera size (L × W × H)	• 54 × 25 × 79 mm (2.1 × 1 × 3.1 in.) without connectors • 54 × 25 × 95 mm (2.1 × 1 × 3.7 in.) with connectors

Physical data	
Base mounting	4× mounting hole depth max 4.8 mm for screw type Delta PT 22 (ø2.2 mm)
Housing material	PA6 with 30% GF (glass fiber reinforced)

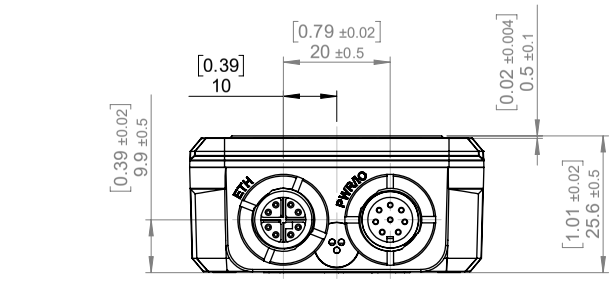
Shipping information	
Packaging, type	Cardboard box
List of contents	• Infrared camera with lens • Cardboard box • Printed documentation
Packaging, weight	0.48 kg (1.06 lb.)
Packaging, size	210 × 142 × 70 mm (8.27 × 5.59 × 2.76 in.)
EAN-13	4743254001725
UPC-12	845188009373
Country of origin	Estonia

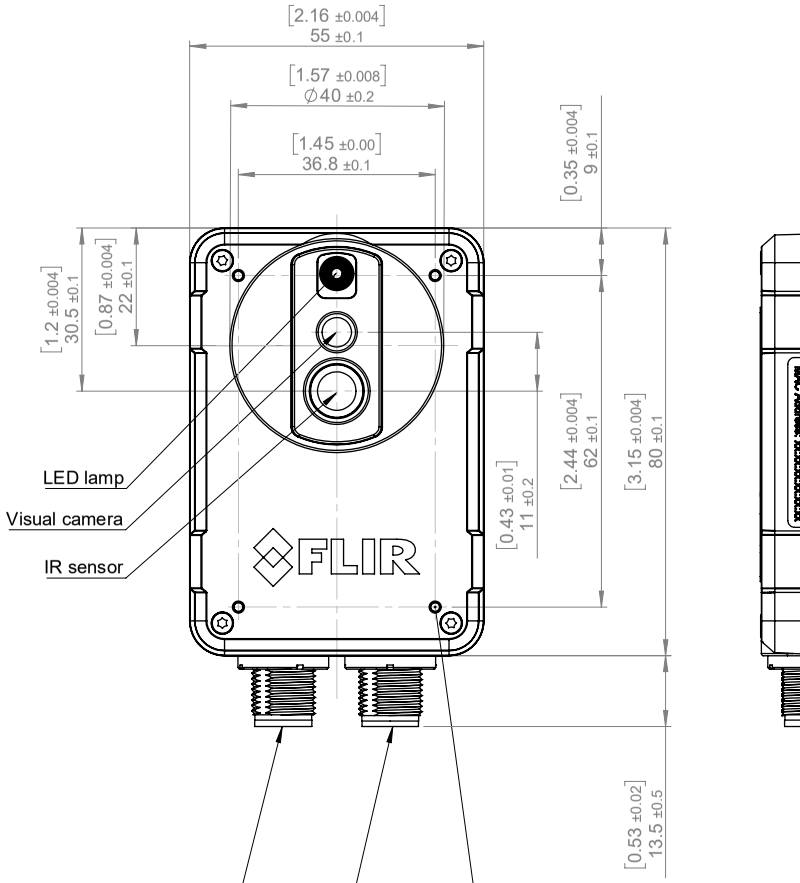
Supplies & accessories:

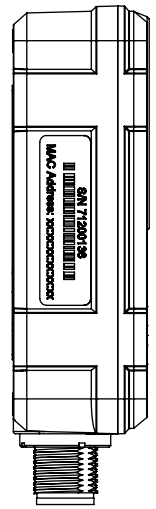
- T130086; I/O module MIO-AX8-1
- T130087; I/O module MIO-AX8-7
- T199713; ThermoVision CM Panel, max. 4 cameras
- T199712; ThermoVision CM Panel, max. 9 cameras
- T130169; Thermovision CM, max. 4 cameras
- T130170; Thermovision CM, max. 9 cameras
- T129259ACC; Cable M12 to pigtail, 10 m
- T129258ACC; Cable M12 to pigtail, 5 m
- T129886ACC; Cable M12, FLIR X-Coded to standard X-Coded
- T128391ACC; Cable, M12 to pigtail
- T198821; Cooling bracket
- T129257ACC; Ethernet cable M12 to RJ45, 10 m
- T128390ACC; Ethernet cable M12 to RJ45, 2 m
- T129256ACC; Ethernet cable M12 to RJ45, 5 m
- 71200-0002; FLIR AX8 accessory starter kit
- T199163; Front mounting plate kit (incl. cooling bracket)
- T199342; One-ball joint mounting bracket kit
- T199343; PoE injector, 12/24 V
- T128775ACC; Rear mounting plate kit
- T199341; Two-ball joint mounting bracket kit
- INST-EW-0110; Extended Warranty 1 Year for AX8, E4, E5

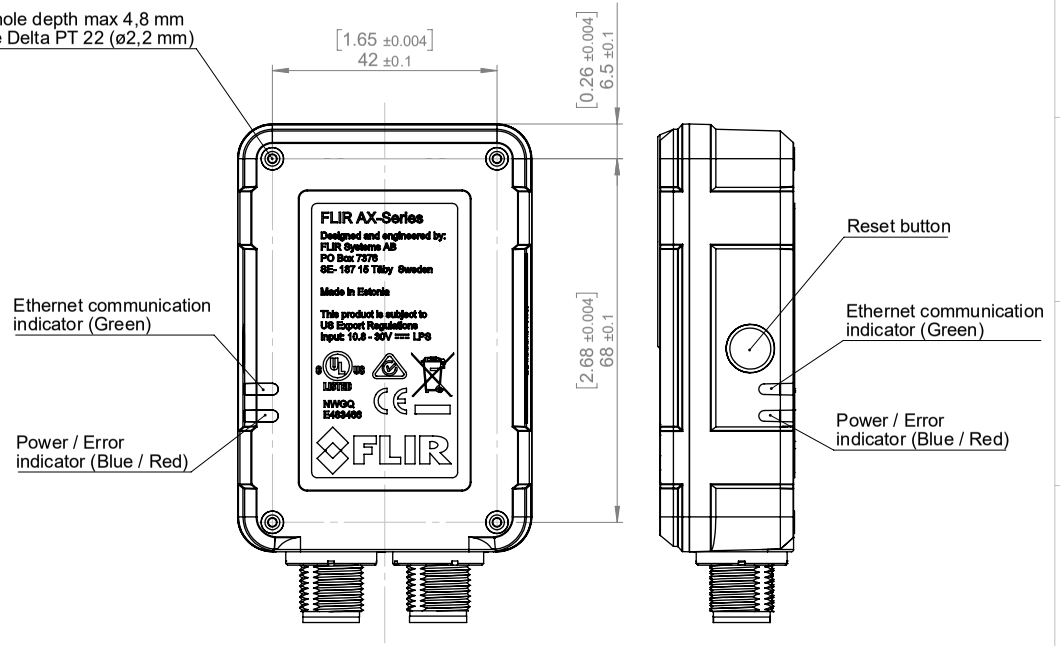
17 Mechanical drawings

[See next page]









According to following P/N numbers
71201-0101
71202-0201
E70321

Konstr/Drawn: P. MARCUS	Datum/Date: 2014-08-27	Kontr/Check: JOHE	Material: -
Ändrad av/Modified by: Å. ZETTERLUND	Ändrad/Modified: 2019-03-04	Ytjämnhet/Roughness: Ra µm	Ytbehandling/Surface treatment

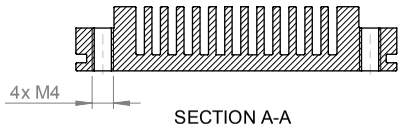
Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

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

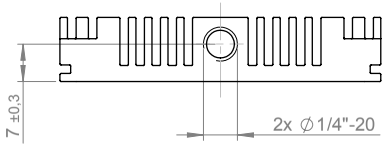
Benämning/Denomination: Basic dimensions AX-series

Skala/Scale 1:1 | Blad/Sheet 1(1)
ArtNo.
Size A3
Ritn nr/Drawing No T128360 | Rev D

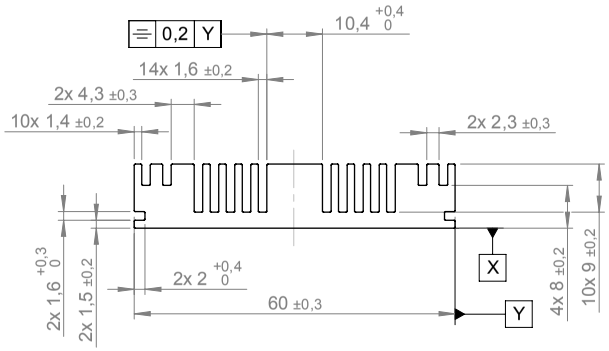
Machined from extruded or machined profile

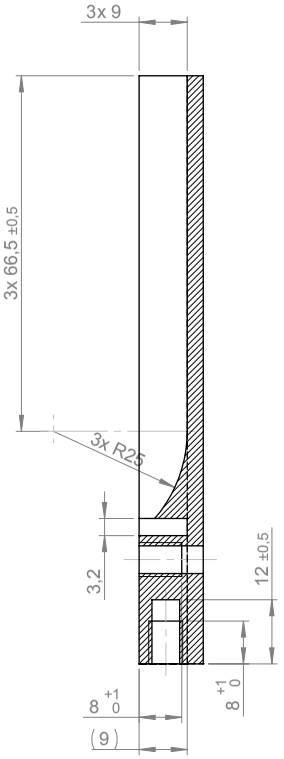


SECTION A-A

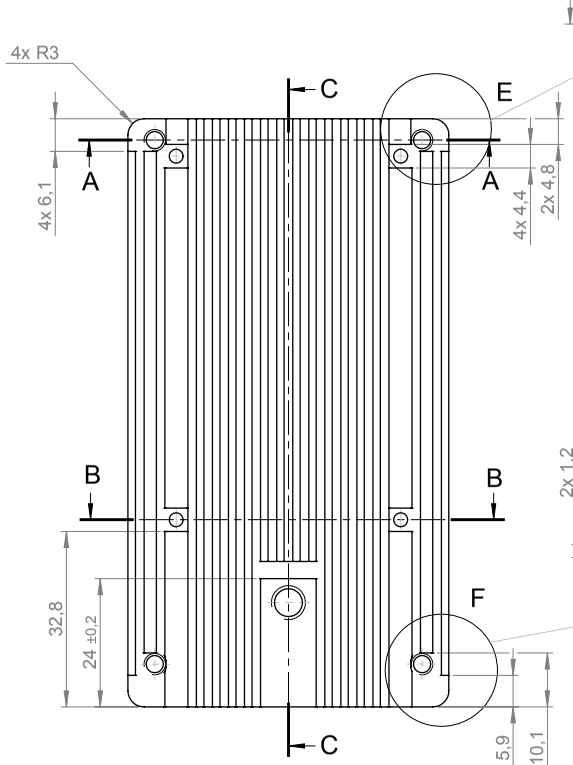


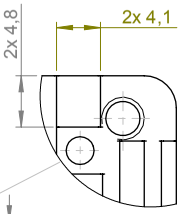
Profile Extruded or machined



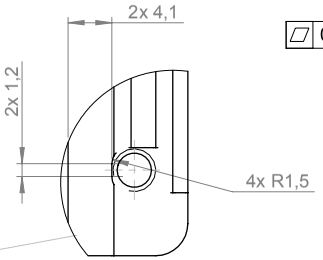


SECTION C-C

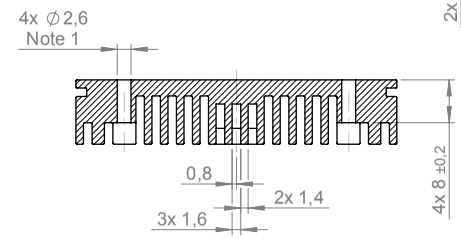




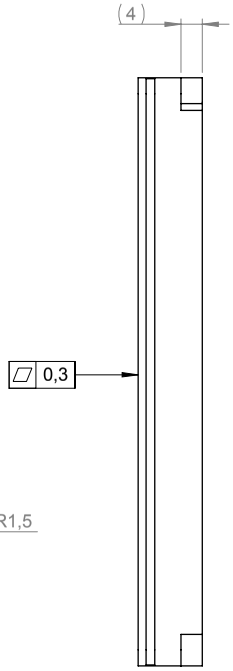
DETAIL E
SCALE 2 : 1

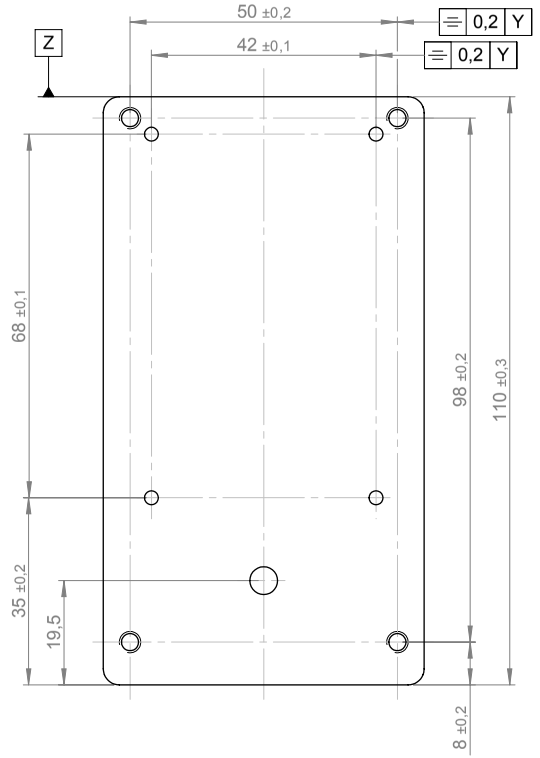


DETAIL F
SCALE 2 : 1



SECTION B-B





Note 1
4x ø2,6 used to hold the part during surface treatment.

Note 2
Appearance according to FLIR Appearance standard 403093-B Class C, grade 2.

Additional geometry is taken from 3D-file: T128394 A

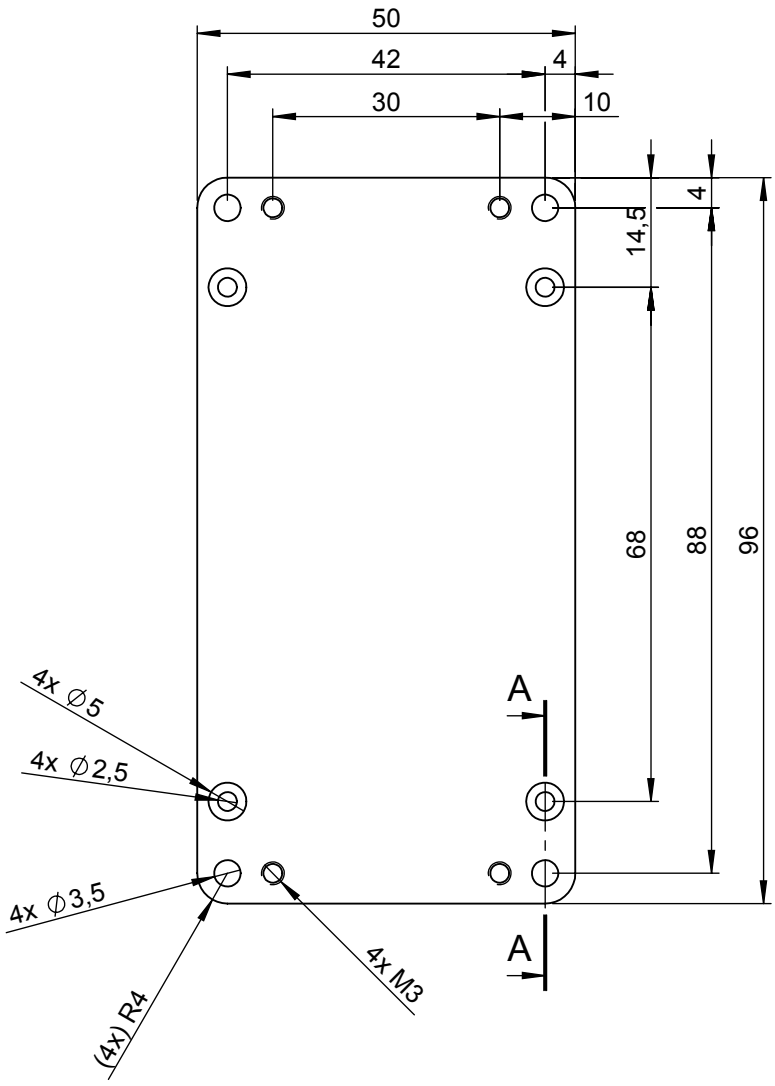
Konstr/Drawn: P. MARCUS	Datum/Date: 2014-09-18	Kontr/Check: JAMA	Material: EN AW-6262 R
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2015-03-10	Ytjämnhet/Roughness: Ra 3.2 µm	Ytbehandling/Surface treatment: Anodized colorless matt

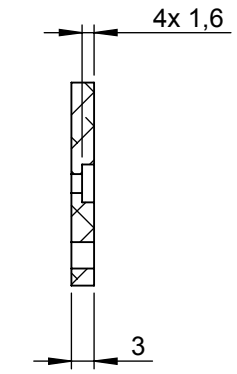
Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

0,5-6	±0,1	Hålkälsradier	0.1-0.3
(6)-30	±0,2	Fillet radii	
(30)-120	±0,3		
(120)-400	±0,5	Kanter brutna	0.1-0.3
(400)-1000	±0,8	Edges broken	

Benämning/Denomination: Bracket cooling

Skala/Scale: 1:1 | Blad/Sheet: 1(1)
ArtNo.
Size: A3
Ritn nr/Drawing No: T128394
Rev: A





SECTION A-A

-

Konstr/Drawn J. MÄKINEN	Datum/Date 2015-03-06	Kontr/Check HAOS	Material EN AW-5052 or EN AW-5754	FLIR
Ändrad av/Modified by J. MÄKINEN	Ändrad/Modified 2015-05-21	Ytjämnhet/Roughness Ra µm	Ytbehandling/Surface treatment	

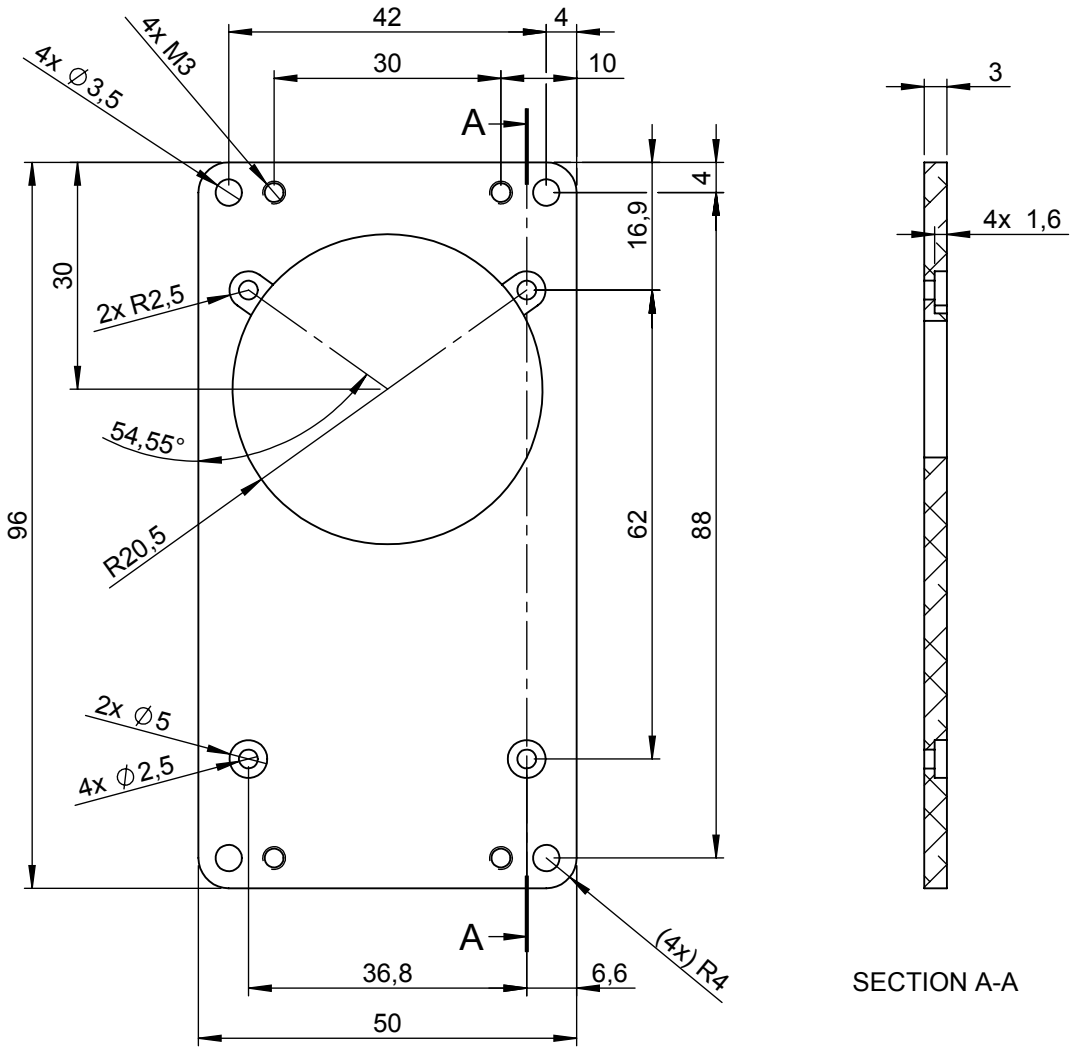
Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

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

Plate mounting rear

Skala/Scale 1:1		Blad/Sheet 1(1)
Art.No.		Size A4
Ritn nr/Drawing No T128775		Rev A



-

Konstr/Drawn	Datum/Date	Kontr/Check	Material
J. MÄKINEN	2015-03-06	HAOS	EN AW-5052 or EN AW-5754
Ändrad av/Modified by	**Ändrad/Modified**	**Ytjämnhet/Roughness**	**Ytbehandling/Surface treatment**
J. MÄKINEN	2015-05-21	Ra µm	

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

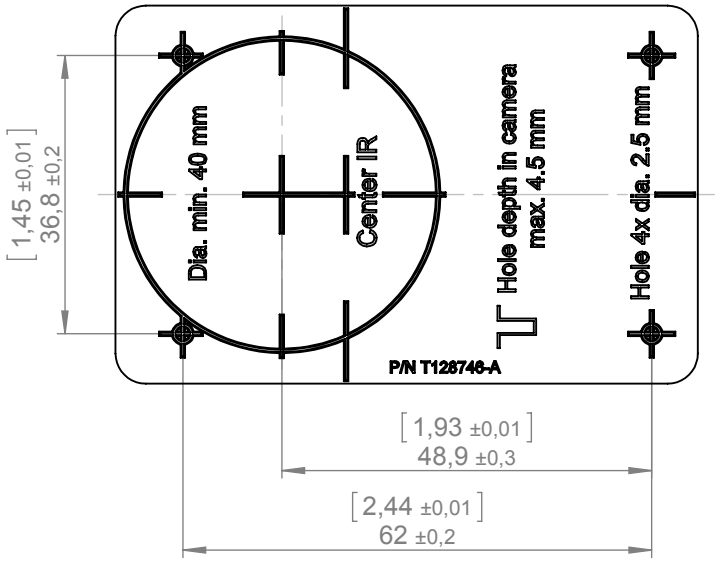
Plate mounting front

Skala/Scale	Blad/Sheet
1:1	1(1)
Art.No.	Size
	A4
Ritn nr/Drawing No	Rev
T128774	A

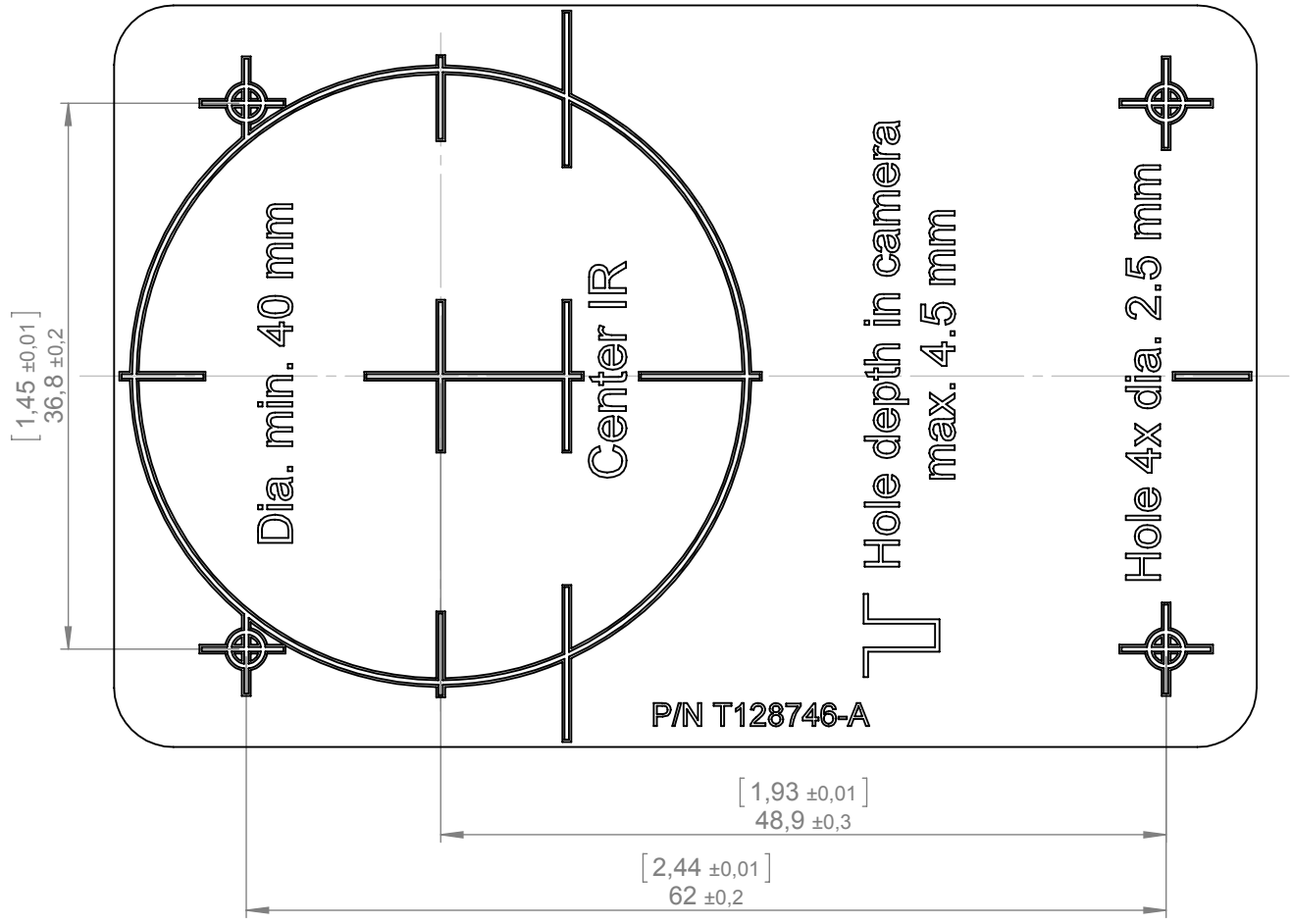
18 Drilling templates

[See next page]

Note The original size of the drilling templates sheets is ISO A4 (210 × 297 mm (8.27 × 11.69 in.)) and they must be printed at that size to work as templates.



Scale 1:1



Scale 2:1

Konstr/Drawn: P. MARCUS	Datum/Date: 2014-10-06	Kontr/Check: JAMA	Material: Note 1
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2015-03-04	Ytjämnhet/Roughness: Ra µm	Ytbehandling/Surface treatment

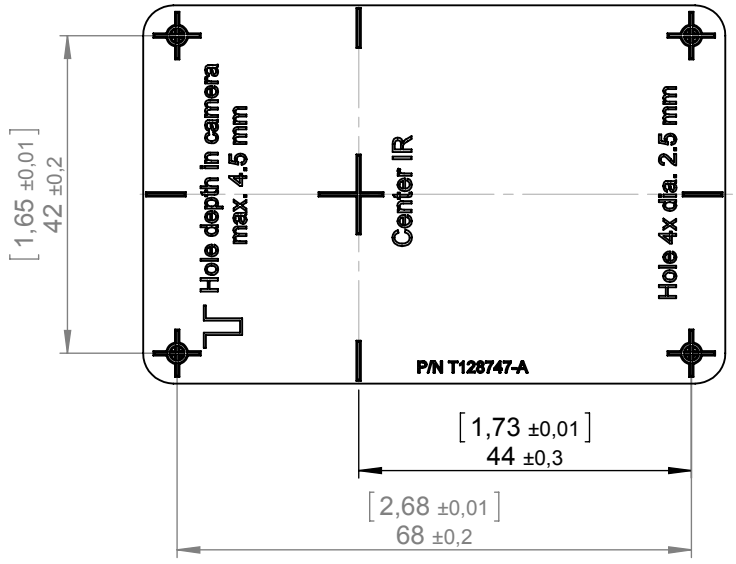
Där ej annat anges/Unless otherwise stated
Gen tol ISO 2768-mK
Utdrag ur/Excerpt from ISO 2768-m

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

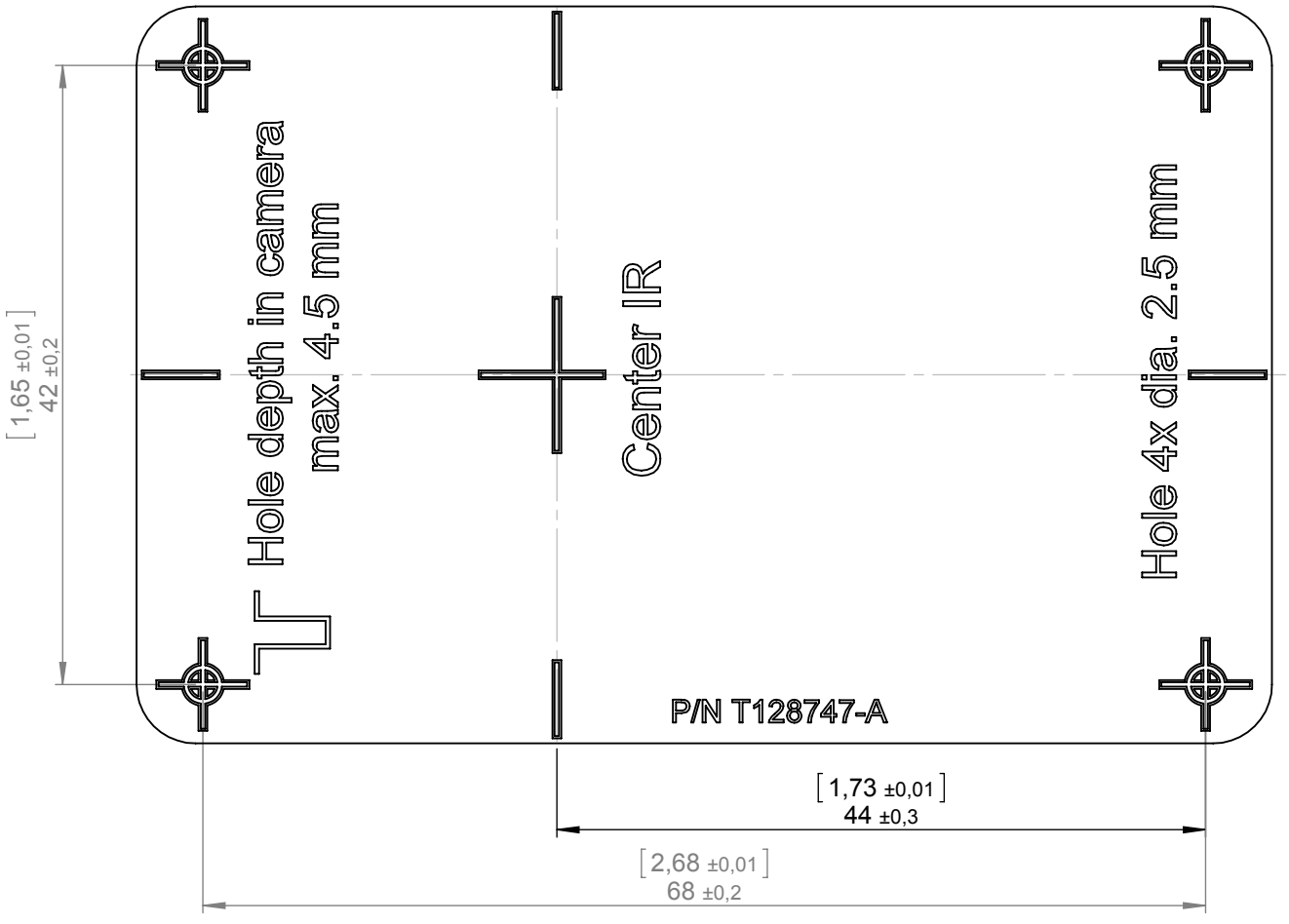
Benämning/Denomination

Drilling template front

Skala/Scale 2:1		Blad/Sheet 2(2)
Art.No.		Size A4
Ritn nr/Drawing No T128746		Rev A



Scale 1:1



Scale 2:1

Konstr/Drawn: P. MARCUS	Datum/Date: 2014-10-06	Kontr/Check: JAMA	Material: Note 1
Ändrad av/Modified by: P. MARCUS	Ändrad/Modified: 2015-03-04	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

Drilling template rear

Skala/Scale 2:1		Blad/Sheet 2(2)
Art.No.		Size A4
Ritn nr/Drawing No T128747		Rev A

19 CE Declaration of conformity

[See next page]

FLIR | The World's Sixth Sense™

September 29, 2017 Täby, Sweden AQ320259

CE Declaration of Conformity – EU Declaration of Conformity

Product: FLIR AX8 -series
Name and address of the manufacturer:
FLIR Systems AB
PO Box 7376
SE-187 15 Täby, Sweden

This declaration of conformity is issued under the sole responsibility of the manufacturer.
The object of the declaration: FLIR Ax8 -series.
The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

Directives:

Directive	2014/30/EU	Electromagnetic Compability
Directive	2012/19/EU	Waste electrical and electric equipment
Directive	2011/65/EU	RoHS

Standards:

Emission:	EN 61000-6-3:2007+A1:2011	EMC – Generic standards Emission
	EN 55022:2010/AC:2011	Radio disturbance characteristics - Limits
Immunity:	EN 61000-6-2:2011	Electromagnetic Compability Generic
	EN 55024:2010	Immunity characteristics - Limits
RoHS	EN 50581:2012	Technical documentation

FLIR Systems AB
Quality Assurance

Lea Dabiri
Quality Manager

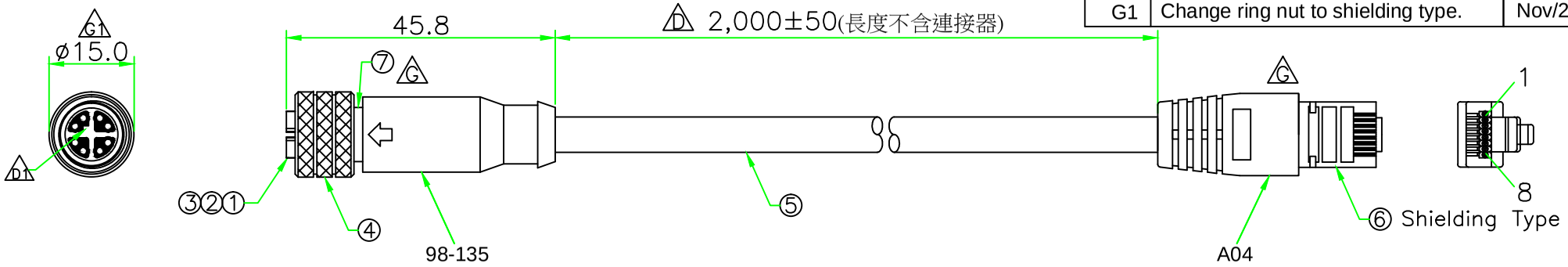
20 Cable drawings

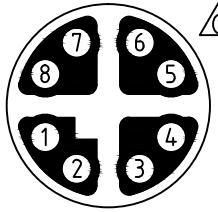
[See next page]

RoHS Ⓔ

IP67

REV.	DESCRIPTION	DATE
A	ISSUE	Dec/23/2013
B	Modify the wire diagram.	Dec/25/2013
C	Modify M12 Pin Assignment.	Dec/25/2013
D	Modify cable length.	Dec/25/2013
D1	Correct key direction.	Jan/22/2014
E	Add note.	Mar/30/2014
F	Modify P/N.	Sep/25/2014
G	Modify connector to shielding type.	Nov/12/2014
G1	Change ring nut to shielding type.	Nov/25/2014





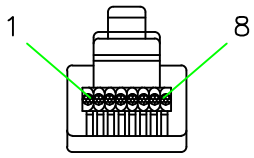
Pin Assignment
Front View
(前視圖)

Ⓒ

Ⓑ Wiring Diagram

M12			RJ45
1	Orange/White	(橙/白)	1
2	Orange	(橙)	2
3	Green/White	(綠/白)	3
4	Green	(綠)	6
5	Blue	(藍)	7
6	Blue/White	(藍/白)	8
7	Brown/White	(棕/白)	5
8	Brown	(棕)	4

SHILED —— DRAIN WIRE —— SHIELD



Pin Assignment
Front View
(前視圖)

No.	PART NAME	DESCRIPTION	COLOR	Q'TY	REMARKS
7	SHIELD	Brass, Nickel Plated.		1	
6	RJ45 PLUG	RJ45 8P8C PLUG (shielding type).		1	
5	CABLE	CAT5E FTP 24AWG x 4 PAIR + AL/MY + Drain wire.	BLACK	1	WAC2B0026
4	RING NUT	Brass, Nickel Plated.		1	M12S-RN-D985
3	O-RING	Viton.	BLACK	1	M12-O-VK
2	CONTACT	Brass , Female pin ,6 u" Gold plated .		8	AASPF-1008-0.8
1	CONNECTOR	M12 X-coding Female connector insert. Nylon+GF.	BLACK	1	M12X-08F

Customer: FLIR

UNIT: mm

SCALE 1:1

UNLESS OTHERWISE SPECIPED TOLERANCES:
x ± 0.25 xx ± 0.1
xxx ± 0.05 ANGLE ± 1°

TITLE: M12 X-Coding Female Molded Cable Ass'y

P/N: K129351004

DR. Stanley

CH. ERIC

AP.

REV. G1

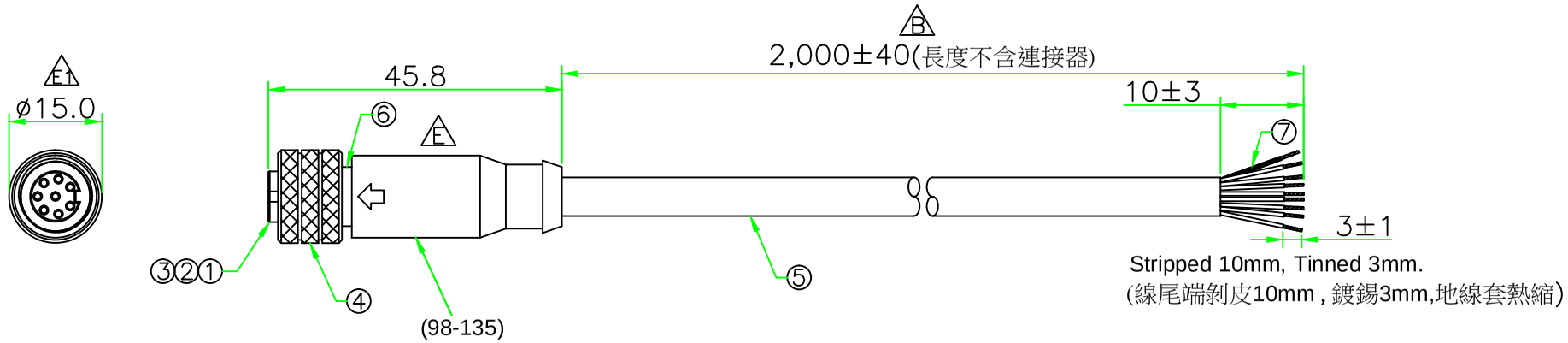
SHEET 1/1

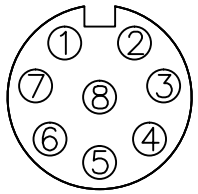
DWG.NO: T128390 Ⓕ

RoHS Ⓒ

IP67

REV.	DESCRIPTION	DATE
A	ISSUE	Dec/23/2013
B	Modify cable length.	Dec/25/2013
C	Add note.	Mar/20/2014
D	Modify P/N.	Sep/25/2014
E	Modify connector to shielding type.	Nov/12/2014
E1	Change ring nut to shielding type.	Nov/25/2014





Pin Assignment
Front View
(前視圖)

Wiring Diagram

1	Orange/White	(橙/白)
2	Orange	(橙)
3	Green/White	(綠/白)
4	Green	(綠)
5	Blue	(藍)
6	Blue/White	(藍/白)
7	Brown/White	(棕/白)
8	Brown	(棕)

Shield—drain wire—Shield 地線

No.	PART NAME	DESCRIPTION	COLOR	Q'TY	REMARKS
7	TUBE	Heat shrink tube.	BLACK	1	
6	SHIELD	Brass, Nickel Plated. Ⓔ		1	
5	CABLE	CAT5E FTP 24AWG x 4 PAIR + AL/MY + Drain wire.	BLACK	1	WAC2B0026
4	RING NUT	Brass, Nickel Plated.		1	M12S-RN-D985
3	O-RING	Viton.	BLACK	1	M12-O-VK
2	CONTACT	Brass , Female pin ,6 u" Gold plated .		8	AASPF-1008-0.8
1	CONNECTOR	M12 A-coding Female connector insert. Nylon+GF.	BLACK	1	M12A-08F

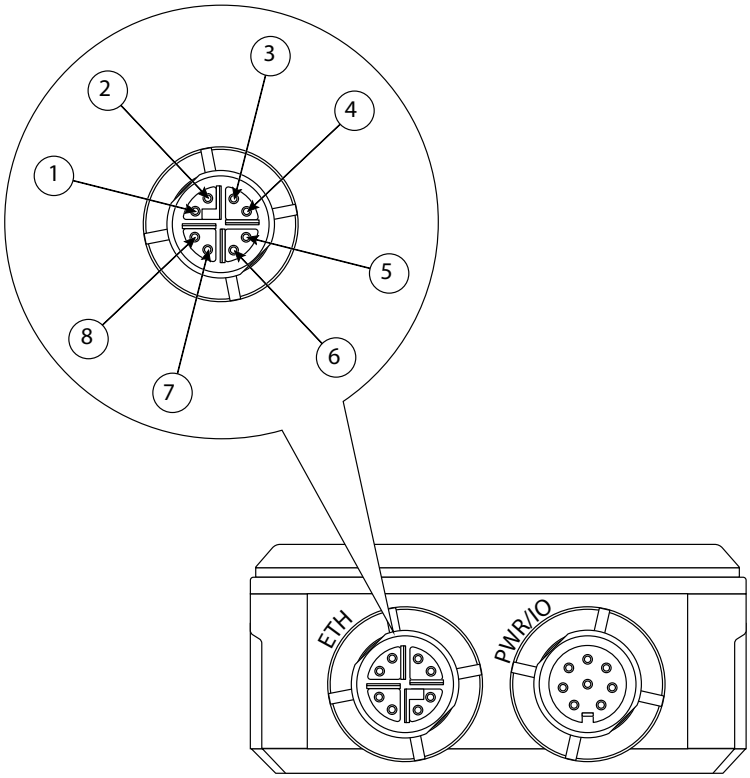
Customer: FLIR

UNIT: mm
SCALE 1:1
UNLESS OTHERWISE SPECIPED TOLERANCES:
x ± 0.25 xx ± 0.1
xxx ± 0.05 ANGLE ± 1°
REV. E1
SHEET 1/1

TITLE: M12 A-Coding 8P Female Molded Cable Ass'y
P/N: K129351003
DWG.NO: T128391 Ⓓ
DR. Stanley
CH. ERIC
AP.

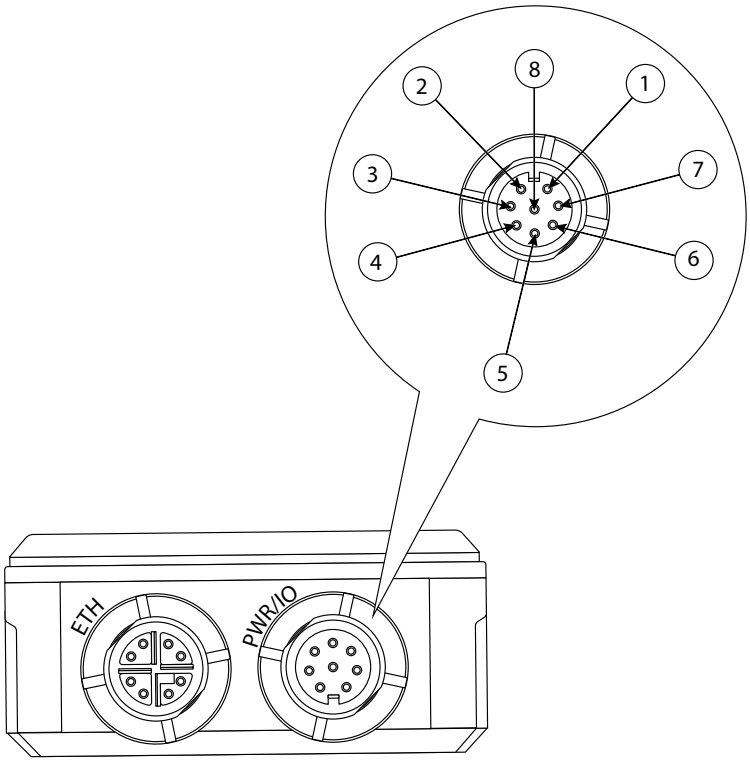
21 Pin configurations

21.1 Pin configuration Ethernet X-coded



Pin	Configuration
1	TPO+
2	TPO-
3	TPI+
4	TPI-
5	EXT_POE-
6	EXT_POE-
7	EXT_POE+
8	EXT_POE+

21.2 Pin configuration power A-coded

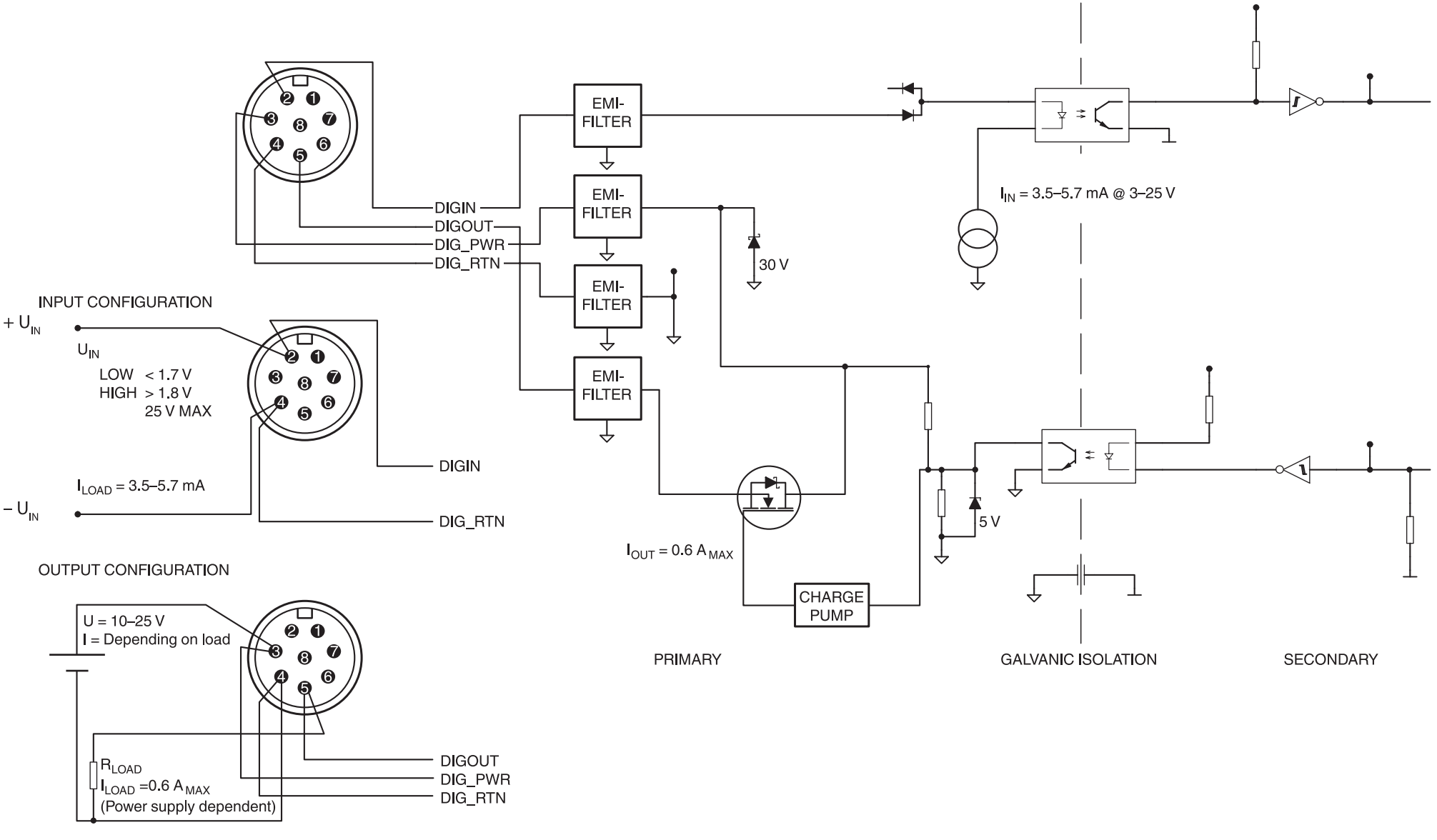


Pin	Configuration	Cable color on cable P/N T128391 (order P/N T128391ACC)
1	EXT_POWER	Orange/white
2	DIGIN	Orange
3	DIG_PWR	Green/white
4	DIG_RTN	Green
5	DIGOUT	Blue
6	Not connected	Blue/white
7	Not connected	Brown/white
8	GND	Brown

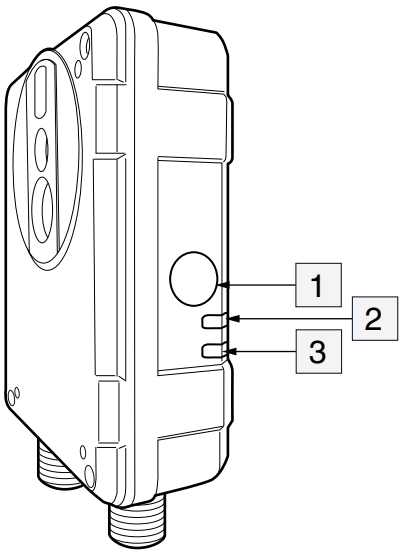
22 Digital I/O connection diagrams

[See next page]

Digital I/O connection diagrams FLIR AX8



23 Indicator LEDs and factory reset button



1. Factory reset button.
2. Ethernet communication indicator LED (green).
3. Power/error indicator LED (blue/red).

23.1 Power/error indicator LED and factory reset button

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

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

23.2 Power/error indicator LED and power modes

Indicator LED status	Explanation
The power/error indicator LED displays a pink light for 10 seconds.	Power is applied.
The power/error indicator LED displays a blue light.	Normal operation.

23.3 Ethernet communication indicator LED

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

24 Cleaning the camera

24.1 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.

24.2 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.

25 About calibration

25.1 Introduction

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

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

25.2 Definition—what is calibration?

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

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

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

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

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

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

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

25.3 Camera calibration at FLIR Systems

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

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

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

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

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

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

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

25.5 Calibration, verification and adjustment

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

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

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

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

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

25.6 Non-uniformity correction

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

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

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

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

25.7 Thermal image adjustment (thermal tuning)

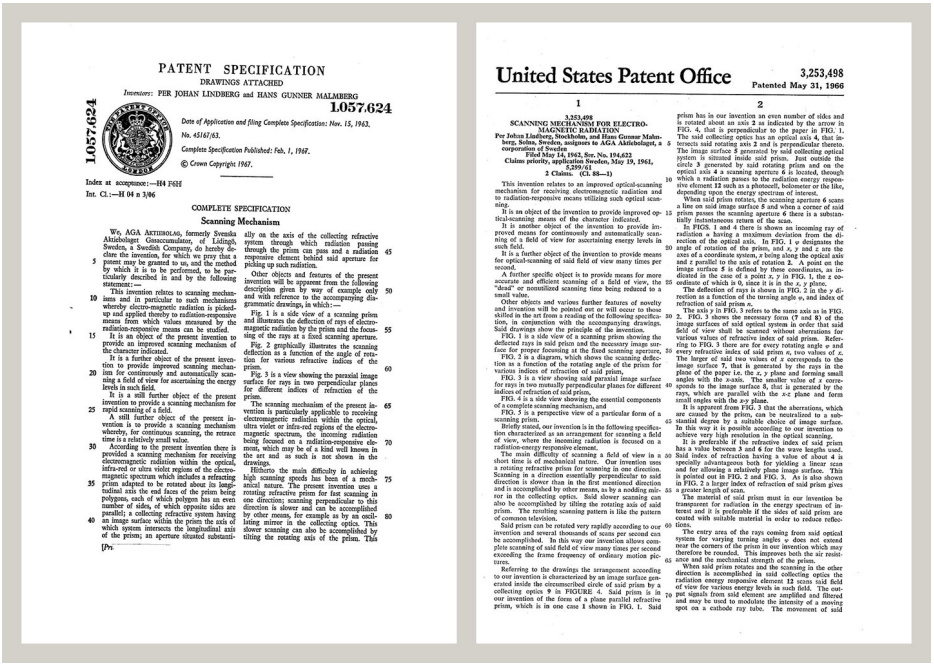
Some people use the term “image calibration” when adjusting the thermal contrast and brightness in the image to enhance specific details. During this operation, the temperature interval is set in such a way that all available colors are used to show only (or mainly) the temperatures in the region of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

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

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

3,253,498

SCANNING MECHANISM FOR ELECTRO-MAGNETIC RADIATION

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

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

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

2 Claims. (Cl. 88—1)

Figure 26.1 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.

26.1 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.

26.2 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.

26.3 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.

FLIR Systems

EtherNet/IP and Modbus TCP Object Models

Object Model revision: 1.22

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Chapter 1 Introduction to EtherNet/IP

Ethernet/IP™ (EIP) is a high-level industrial application layer protocol for industrial automation applications. Built on the standard TCP/IP protocol suite, EIP uses all the traditional Ethernet hardware and software to define an application layer protocol that structures the task of configuring, accessing and controlling industrial automation devices. Ethernet/IP classifies Ethernet nodes as predefined device types with specific behaviors. The set of device types and the EIP application layer protocol is based on the Control and Information Protocol (CIP) layer used in both Devicenet™ and Controlnet™. Building on these widely used protocol suites, Ethernet/IP for the first time provides a seamless integrated system from the sensor-actuator network to the controller and enterprise networks. EIP provides a wide-ranging, comprehensive, certifiable standard suitable to a wide variety of automation devices.

Ethernet/IP uses the tools and technologies of traditional Ethernet

Ethernet/IP uses all the transport and control protocols used in traditional Ethernet, including the Transport Control Protocol (TCP), the Internet Protocol (IP), and the media access and signaling technologies found in off-the-shelf Ethernet interface cards. Building on these standard PC technologies means that EIP works transparently with all the standard off-the-shelf Ethernet devices found in today's marketplace. It also means that EIP can be easily supported on standard PCs and all their derivatives. Even more importantly, basing EIP on a standard technology platform ensures that EIP will move forward as the base technologies evolve.

Ethernet/IP is a certifiable standard

EtherNet/IP ensures a comprehensive, consistent standard by careful, multi-vendor attention to the specification and through certified test labs as is used for other well-known communication standards like DeviceNet and ControlNet. The EtherNet/IP Certification program ensures the consistency and quality of field devices.

EIP is built on a widely accepted protocol layer

EIP is constructed from a very widely implemented standard used in DeviceNet and ControlNet called the Control and Information Protocol (CIP). This standard organizes networked devices as a collection of objects. It defines the access, object behavior and extensions which allow widely disparate devices to be accessed using a common mechanism. Over 500 vendors now support the CIP protocol in present day products. Using this technology in EIP means that EIP is based on a widely understood, widely implemented standard that does not require a new technology shakedown period.

CIP – The Core of EtherNet/IP

The Communications and Information Protocol (CIP) is a communications protocol for transferring automation data between two devices. In the CIP Protocol, every network device represents itself as a series of objects. Each object is simply a grouping of the related data values in a device. For example, every CIP device is required to make an Identity object available to the network. The identity object contains related identity data values called attributes. Attributes for the identity object include the vendor ID, date of manufacture, device serial number, and other identity data. CIP does not specify at all how this object data is implemented, only what data values or attributes must be supported and that these attributes must be available to other CIP devices.

The Identity object is an example of a required object. There are three types of objects defined by the CIP protocol; Required Object, Application Objects and Vendor Specific Objects. The collection of specific object for a particular device is known as the device's **Object Model**.

REQUIRED OBJECTS

Required objects are required by the specification to be included in every CIP device. These objects include the Identity object, a Message Router object and a Network object.

The identity object contains related identity data values called attributes. Attributes for the identity object include the vendor ID, date of manufacturer, device serial number, and other identity data.

The Message Router object is an object which routes explicit request messages from object to object in a device.

A Network object contains the physical connection data for the object. For a CIP device on DeviceNet, the network object contains the MacID and other data describing the interface to the CAN network. For EIP devices, the network object contains the IP address and other data describing the interface to the Ethernet port on the device.

APPLICATION OBJECTS

Application objects are the objects that define the data encapsulated by the device. These objects are specific to the device type and function. For example, a Motor object on a Drive System has attributes describing the frequency, current rating and motor size. An Analog Input object on an I/O device has attributes that define the type, resolution and current value for the analog input.

These application layer objects are predefined for a large number of common device types. All CIP devices with the same device type (Drive Systems, Motion Control, Valve Transducer…etc) must contain the identical series of application objects. The series of application objects for a particular device type is known as the device profile. A large number of profiles for many device types have been defined. Supporting a device profile allows a user to easily understand and switch from a vendor of one device type to another vendor with that same device type.

A device vendor can also group Application Layer Objects into assembly objects. These super objects contain attributes of one or more Application Layer Objects. Assembly objects form a convenient package for transporting data between devices. For example, a vendor of a

Temperature Controller with multiple temperature loops may define assemblies for each of the temperature loops and an assembly with data from all temperature loops. The user can then pick the assembly that is most suited for the application and how often to access each assembly. For example, one temperature assembly may be configured to report every time it changes state while the second may be configured to report every one-second regardless of a change in state.

Assemblies are usually predefined by the vendor, but CIP also defines a mechanism in which the user can dynamically create an assembly from application layer object attributes.

VENDOR SPECIFIC OBJECTS

Objects not found in the profile for a device class are termed Vendor Specific. The vendor includes these objects as additional features of the device. The CIP protocol provides access to these vendor extension objects in exactly the same method as either application or required objects. This data is strictly of the vendor's choosing and is organized in whatever method makes sense to the device vendor.

In addition to specifying how device data is represented to the network, the CIP protocol specifies a number of different ways in which that data can be accessed such as cyclic, polled and change-of-state.

ADVANTAGES TO EIP

The advantages of the CIP protocol layer over EtherNet/IP are numerous. The consistent device access means that a single configuration tool can configure CIP devices on different networks from a single access point without using vendor specific software. The classification of all devices as objects decreases the training and startup required when new devices are brought online. EIP provides improved response time and greater data throughput than DeviceNet and ControlNet. EIP links devices from the sensor bus level to the control level to the enterprise level with a consistent application layer interface.

PLC COMMUNICATION OVER ETHERNET/IP

Two types of devices communicate over EtherNet/IP. One type, Adapters, are the devices that move I/O between the physical world and the EtherNet/IP network. Adapter devices are "end" devices in a network. Valves, Drives, I/O Devices and Cameras are typically Adapter devices. The Flir camera is an Adapter device. The other device is a Scanners device. Scanners open connections and send outputs to one or more Adapter devices. A Programmable Controller is a typically a Scanner device in an EtherNet/IP network.

Scanner devices send outputs to one or more Adapter devices. Adapter devices send inputs to a Scanner. The Output Assembly Instances defined later in this document defines the outputs sent from the Scanner device to the FLIR Camera. The Input Assembly Instance defined later in this document defines the inputs sent from the Camera to the Scanner device.

EtherNet/IP Electronic Data Sheets Files

Electronic Data Sheets (EDS) are simply ASCII files that describe how a device can be used on an EtherNet/IP network. It describes the objects, attributes and services available in the device.

At the minimum, an EDS file conveys the identity information required for a network tool to recognize the device. For EtherNet/IP Scanners, the EDS File conveys information on the EtherNet/IP Adapters I/O messages. It details the specifics of the Input Message produced by the EtherNet/IP Adapter and the Output message consumed by the Adapter.

The amount of information stored in an EDS file varies from device to device. Some manufacturers store the minimum amount of information in the EDS file while other devices store all the details of every object and attribute in the device.

EDS files are sometimes shipped with a device in some media format like a CD or made available on the device manufacturers website. Some devices with extended data storage contain the EDS file internally within the device.

EDS File Structure

- File Section – Administers the EDS file. Sometimes the URL keyword provides a link to a website where the latest version of the EDS can be found.
- Device Section – Provides keying information that matches the EDS to a particular revision of a device. The first three attributes of the Identity Object (Object #1) are used by network tools to verify that this EDS file (Vendor, Model,…etc) plus the device revision matches the information found in the device. The network tool will not connect to a device unless all four Identity Object Parameters match. Some people mistakenly believe that the Minor Revision number is included in this match but that is not true.
- Device Classification Section – Classifies the EDS for an EtherNet/IP network. The Device Classification Section is required for all EtherNet/IP devices.
- Connection Manager Section – Identifies the CIP connections that are available in the device. This section indicates to the EtherNet/IP Scanner the Triggers and Transports available in the device. If a device supports multiple connections then every connection must be detailed in this section. Only connections that are specified in this section can be used in an EDS-based configuration tool.
- Assembly, Params and ParamClass section – These sections are filled in as needed. For values that are limited to a limited to a defined set of values, Enumeration can be used to specify those values. Value ranges can be specified here also for Configurable parameters.
- Capacity Section – This section indicates the number of connections available in the device and the connection speeds
- Port Section – This section describes the Ethernet port. It is only applicable to devices that perform CIP routing. It is unnecessary for devices containing a single CIP port.

EtherNet/IP Add-on Profiles

The RSLogix5000 Programming Tool from Rockwell Automation uses EtherNet/IP EDS files to understand the Object Model of an EtherNet/IP device. The EDS file describes what data is contained in the messages received from the EtherNet/IP device and what data it should send to the EtherNet/IP device. The addition of an EDS file to the standard RSLogix5000 device library is called an Add-on Profile by Rockwell Automation.

EDS files can be loaded into the RSLogix5000 programming tool in one of two ways. EDS files from vendors which are not highly integrated with Rockwell Automation are loaded manually. EDS files from vendors which are highly integrated with Rockwell Automation, like Flir, are automatically loaded and available with the more recent versions of RSLogix5000.

Chapter 2 EtherNet/IP Object Model

Table 2-1 describes data types used in this Object Model.

Table 2-1 Data types

Data Type	Description
USINT	Unsigned Short Integer (8-bit)
UINT	Unsigned Integer (16-bit)
UDINT	Unsigned Double Integer (32-bit)
DINT	Signed Double Integer (32-bit)
INT	Signed Integer (16-bit)
STRING	Character String (1 byte per character)
SHORT STRING*nn*	Character String (1st byte is length; up to *nn* characters)
BYTE	Bit String (8-bits)
WORD	Bit String (16-bits)
DWORD	Bit String (32-bits)
REAL	IEEE 32-bit Single Precision Floating Point

The following sections list each object's required attributes and services, if any.

IMPORTANT NOTES:

- All Double Precision Floating Point Values in the camera will be converted to Single Precision Floating Point Values over EtherNet/IP.
- We are assuming that every call to the camera is a blocking call. Verify that the I/O RPI is large enough so no connections are dropped.
- EtherNet/IP is a Little-Endian protocol, meaning that the data order is least significant byte to most significant byte.

Objects included in Model

1.1 Identity Object (01_{HEX} - 1 Instance)

The following tables contain the attribute, status, and common services information for the Identity Object.

Table 2-2 Identity Object (01_{HEX} - 1 Instance)

Instance	Attribute ID	Name	Data Type	Data value	Access rule
Class (Instance 0)	1	Revision	UINT	1	Get
Instance 1	1	Vendor number	UINT	1161	Get
	2	Device type	UINT	43	Get
	3	Product code number	UINT	320 = “FLIR A310” 321 = “FLIR Ax8”	Get
	4	Product major revision Product minor revision	USINT USINT	02 40	Get
	5	Status	WORD	Always 0	Get

Instance	Attribute ID	Name	Data Type	Data value	Access rule
	6	Serial number	UDINT	Unique 32 bit value	Get
	7	Product name	SHORT STRING32	Depends on camera model.	Get

Table 2-3 Identity Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
05_{Hex}	No	Yes	Reset[1]
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single

1.2 Message Router Object (02_{HEX} - 0 Instances)

No supported services or attributes

1.3 Assembly Object (04_{HEX} - 8 Instances)

The following tables contain the attribute, instance, data mapping, and common services information for the Assembly Object.

Table 2-4 Assembly Object (04_{HEX} - 2 Instances)

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule
Class (Instance 0)	1	Revision	UINT	2	Get
	2	Max instance	UINT	0x81	Get

[1] If the Reset Service Code is sent with just a Class ID of 0x01 and Instance ID of 0x01, then a Normal Reset will occur.
If the Reset Service Code is send with a Class ID of 0x01, Instance ID of 0x01, and an additional value of 1, then the camera will resume with Factory Default settings.

<table>
<tr><th>Instance</th><th>Attribute ID</th><th>Name</th><th>Data Type</th><th>Data Value</th><th>Access Rule</th></tr>
<tr><td>Output
0x70</td><td>3</td><td>Output Data
<table>
<tr><th>Byte</th><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>0</td><td>Reserved</td><td>Force Image One Shot</td><td>Save Image</td><td>One Time Image Auto Adjust</td><td>Auto Focus Fast</td><td>Auto Focus Full</td><td>Force NUC</td><td>Auto NUC</td></tr>
<tr><td>1</td><td>Reserved</td><td>Reserved</td><td>Image Live</td><td>Image Freeze</td><td>Reserved</td><td>Reserved</td><td>DO 2</td><td>DO 1</td></tr>
<tr><td>2</td><td>Atmospheric Temp. Graphic</td><td>Reflected Temp. Graphic</td><td>Distance Graphic</td><td>Emissivity Graphic</td><td>Date/Time Graphic</td><td>Scale Graphic</td><td>Camera Label Graphic</td><td>Enable Overlay Graphics</td></tr>
<tr><td>3</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Measurement Mark Graphic</td><td>Lens Graphic</td><td>Relative Humidity Graphic</td></tr>
</table></td><td></td><td></td><td>Get/Set</td></tr>
<tr><td>Output
0x71</td><td>3</td><td>Output Data
<table>
<tr><th>Byte</th><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>0</td><td>Reserved</td><td>Force Image One Shot</td><td>Save Image</td><td>One Time Image Auto Adjust</td><td>Auto Focus Fast</td><td>Auto Focus Full</td><td>Force NUC</td><td>Auto NUC</td></tr>
<tr><td>1</td><td>Reserved</td><td>Reserved</td><td>Image Live</td><td>Image Freeze</td><td>Reserved</td><td>Reserved</td><td>DO 2</td><td>DO 1</td></tr>
<tr><td>2</td><td>Atmospheric Temp. Graphic</td><td>Reflected Temp. Graphic</td><td>Distance Graphic</td><td>Emissivity Graphic</td><td>Date/Time Graphic</td><td>Scale Graphic</td><td>Camera Label Graphic</td><td>Enable Overlay Graphics</td></tr>
<tr><td>3</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Measurement Mark Graphic</td><td>Lens Graphic</td><td>Relative Humidity Graphic</td></tr>
<tr><td>4</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td></tr>
<tr><td>5</td><td colspan="8">Set Configuration Preset (RESERVED FOR FUTURE USE)</td></tr>
<tr><td>6</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td></tr>
<tr><td>7</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td></tr>
</table></td><td></td><td></td><td>Get/Set</td></tr>
</table>

Input *0x64* | 3 | Input Data | Get

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC	Auto NUC
1	Disable Alarms[1]	Reserved	Image Live	Image Freeze	DI 2	DI 1	DO 2	DO 1
2	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic	Enable Overlay Graphics
3	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic	Relative Humidity Graphic
4	Alarm 8	Alarm 7	Alarm 6	Alarm 5	Alarm 4	Alarm 3	Alarm 2	Alarm 1
5	Set Configuration Preset (RESERVED FOR FUTURE USE)							
6	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
7	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
8-11	Delta Temperature 1							
12-15	Delta Temperature 2							
16-19	Delta Temperature 3							
20-23	Delta Temperature 4							
24-27	Delta Temperature 5							
28-31	Delta Temperature 6							
32-35	Internal Camera Temperature							
36-39	Spot 1 Temperature							
40-43	Box 1 Min Temperature							
44-47	Box 1 Max Temperature							
48-51	Box 1 Average Temperature							
52	Spot 1 Temperature Valid State							
53	Box 1 Min Temperature Valid State							
54	Box 1 Max Temperature Valid State							
55	Box 1 Avg Temperature Valid State							
56-59	Spot 2 Temperature							
60-63	Box 2 Min Temperature							
64-67	Box 2 Max Temperature							
68-71	Box 2 Average Temperature							
72	Spot 2 Temperature Valid State							
73	Box 2 Min Temperature Valid State							
74	Box 2 Max Temperature Valid State							
75	Box 2 Avg Temperature Valid State							
76-79	Spot 3 Temperature							
80-83	Box 3 Min Temperature							
84-87	Box 3 Max Temperature							
88-91	Box 3 Average Temperature							

[1] This alarm is the BATCH alarm. It has the ability to enable or disable all the other 8 alarms.

Input *0x64* *(cont)*	3	92	Spot 3 Temperature Valid State	Get
		93	Box 3 Min Temperature Valid State	
		94	Box 3 Max Temperature Valid State	
		95	Box 3 Avg Temperature Valid State	
		96-99	Spot 4 Temperature	
		100-103	Box 4 Min Temperature	
		104-107	Box 4 Max Temperature	
		108-111	Box 4 Average Temperature	
		112	Spot 4 Temperature Valid State	
		113	Box 4 Min Temperature Valid State	
		114	Box 4 Max Temperature Valid State	
		115	Box 4 Avg Temperature Valid State	

Input *0x65* — 3 — Input Data — Get

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC	Auto NUC
1	Disable Alarm[1]	Reserved	Image Live	Image Freeze	DI 2	DI 1	DO 2	DO 1
2	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic	Enable Overlay Graphics
3	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic	Relative Humidity Graphic
4	Alarm 8	Alarm 7	Alarm 6	Alarm 5	Alarm 4	Alarm 3	Alarm 2	Alarm 1
5	Set Configuration Preset (RESERVED FOR FUTURE USE)							
6	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
7	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
8-11	Delta Temperature 1							
12-15	Delta Temperature 2							
16-19	Delta Temperature 3							
20-23	Delta Temperature 4							
24-27	Delta Temperature 5							
28-31	Delta Temperature 6							
32-35	Internal Camera Temperature							
36-39	Spot 1 Temperature							
40-43	Box 1 Min Temperature							
44-47	Box 1 Max Temperature							
48-51	Box 1 Average Temperature							
52	Spot 1 Temperature Valid State							
53	Box 1 Min Temperature Valid State							
54	Box 1 Max Temperature Valid State							

[1] This alarm is the BATCH alarm. It has the ability to enable or disable all the other 8 alarms.

Input *0x65* (cont.)	3	55	Box 1 Avg Temperature Valid State	Get
		56-59	Spot 2 Temperature	
		60-63	Box 2 Min Temperature	
		64-67	Box 2 Max Temperature	
		68-71	Box 2 Average Temperature	
		72	Spot 2 Temperature Valid State	
		73	Box 2 Min Temperature Valid State	
		74	Box 2 Max Temperature Valid State	
		75	Box 2 Avg Temperature Valid State	
		76-79	Spot 3 Temperature	
		80-83	Box 3 Min Temperature	
		84-87	Box 3 Max Temperature	
		88-91	Box 3 Average Temperature	
		92	Spot 3 Temperature Valid State	
		93	Box 3 Min Temperature Valid State	
		94	Box 3 Max Temperature Valid State	
		95	Box 3 Avg Temperature Valid State	
		96-99	Spot 4 Temperature	
		100-103	Box 4 Min Temperature	
		104-107	Box 4 Max Temperature	
		108-111	Box 4 Average Temperature	
		112	Spot 4 Temperature Valid State	
		113	Box 4 Min Temperature Valid State	
		114	Box 4 Max Temperature Valid State	
		115	Box 4 Avg Temperature Valid State	
		116-135	…..Spot 5/ Box 5…..	
		136-155	…..Spot 6/ Box 6…..	
		156-175	…..Spot 7/ Box 7…..	
		176-195	…..Spot 8/ Box 8…..	
		196-215	…..Spot 9/ Box 9…..	
		216-235	…..Spot 10/ Box 10…..	
		236-255	…..Spot 11/ Box 11…..	
		256-275	…..Spot 12/ Box 12…..	
		276-295	…..Spot 13/ Box 13…..	
		296-315	…..Spot 14/ Box 14…..	
		316-335	…..Spot 15/ Box 15…..	
		336-355	…..Spot 16/ Box 16…..	
		356-375	…..Spot 17/ Box 17…..	
		376-395	…..Spot 18/ Box 18…..	
		396-415	…..Spot 19/ Box 19…..	

Input *0x65* (cont.)	3	416-435 …..Spot 20/ Box 20…..	Get
Input *0x66*	3	Input Data	Get

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-3	Delta Temperature 1							
4-7	Delta Temperature 2							
8-11	Delta Temperature 3							
12-15	Delta Temperature 4							
16-19	Delta Temperature 5							
20-23	Delta Temperature 6							
24-27	Internal Camera Temperature							
28-31	Spot 1 Temperature							
32-35	Box 1 Min Temperature							
36-39	Box 1 Max Temperature							
40-43	Box 1 Average Temperature							
44	Spot 1 Temperature Valid State							
45	Box 1 Min Temperature Valid State							
46	Box 1 Max Temperature Valid State							
47	Box 1 Avg Temperature Valid State							
48-51	Spot 2 Temperature							
52-55	Box 2 Min Temperature							
56-59	Box 2 Max Temperature							
60-63	Box 2 Average Temperature							
64	Spot 2 Temperature Valid State							
65	Box 2 Min Temperature Valid State							
66	Box 2 Max Temperature Valid State							
67	Box 2 Avg Temperature Valid State							
68-71	Spot 3 Temperature							
72-75	Box 3 Min Temperature							
76-79	Box 3 Max Temperature							
80-83	Box 3 Average Temperature							
84	Spot 3 Temperature Valid State							
85	Box 3 Min Temperature Valid State							
86	Box 3 Max Temperature Valid State							
87	Box 3 Avg Temperature Valid State							
88-91	Spot 4 Temperature							
92-95	Box 4 Min Temperature							
96-99	Box 4 Max Temperature							
100-103	Box 4 Average Temperature							

<table>
<tr><td>Input
0x66 (cont.)</td><td>3</td><td>
<table>
<tr><td>104</td><td>Spot 4 Temperature Valid State</td></tr>
<tr><td>105</td><td>Box 4 Min Temperature Valid State</td></tr>
<tr><td>106</td><td>Box 4 Max Temperature Valid State</td></tr>
<tr><td>107</td><td>Box 4 Avg Temperature Valid State</td></tr>
</table>
</td><td>Get</td></tr>
<tr><td>Input
0x67</td><td>3</td><td>Input Data
<table>
<tr><th>Byte</th><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>0-3</td><td colspan="8">Delta Temperature 1</td></tr>
<tr><td>4-7</td><td colspan="8">Delta Temperature 2</td></tr>
<tr><td>8-11</td><td colspan="8">Delta Temperature 3</td></tr>
<tr><td>12-15</td><td colspan="8">Delta Temperature 4</td></tr>
<tr><td>16-19</td><td colspan="8">Delta Temperature 5</td></tr>
<tr><td>20-23</td><td colspan="8">Delta Temperature 6</td></tr>
<tr><td>24-27</td><td colspan="8">Internal Camera Temperature</td></tr>
<tr><td>28-31</td><td colspan="8">Spot 1 Temperature</td></tr>
<tr><td>32-35</td><td colspan="8">Box 1 Min Temperature</td></tr>
<tr><td>36-39</td><td colspan="8">Box 1 Max Temperature</td></tr>
<tr><td>40-43</td><td colspan="8">Box 1 Average Temperature</td></tr>
<tr><td>44</td><td colspan="8">Spot 1 Temperature Valid State</td></tr>
<tr><td>45</td><td colspan="8">Box 1 Min Temperature Valid State</td></tr>
<tr><td>46</td><td colspan="8">Box 1 Max Temperature Valid State</td></tr>
<tr><td>47</td><td colspan="8">Box 1 Avg Temperature Valid State</td></tr>
<tr><td>48-51</td><td colspan="8">Spot 2 Temperature</td></tr>
<tr><td>52-55</td><td colspan="8">Box 2 Min Temperature</td></tr>
<tr><td>56-59</td><td colspan="8">Box 2 Max Temperature</td></tr>
<tr><td>60-63</td><td colspan="8">Box 2 Average Temperature</td></tr>
<tr><td>64</td><td colspan="8">Spot 2 Temperature Valid State</td></tr>
<tr><td>65</td><td colspan="8">Box 2 Min Temperature Valid State</td></tr>
<tr><td>66</td><td colspan="8">Box 2 Max Temperature Valid State</td></tr>
<tr><td>67</td><td colspan="8">Box 2 Avg Temperature Valid State</td></tr>
<tr><td>68-71</td><td colspan="8">Spot 3 Temperature</td></tr>
<tr><td>72-75</td><td colspan="8">Box 3 Min Temperature</td></tr>
<tr><td>76-79</td><td colspan="8">Box 3 Max Temperature</td></tr>
<tr><td>80-83</td><td colspan="8">Box 3 Average Temperature</td></tr>
<tr><td>84</td><td colspan="8">Spot 3 Temperature Valid State</td></tr>
<tr><td>85</td><td colspan="8">Box 3 Min Temperature Valid State</td></tr>
<tr><td>86</td><td colspan="8">Box 3 Max Temperature Valid State</td></tr>
<tr><td>87</td><td colspan="8">Box 3 Avg Temperature Valid State</td></tr>
<tr><td>88-91</td><td colspan="8">Spot 4 Temperature</td></tr>
</table>
</td><td>Get</td></tr>
</table>

<table>
<tr><td>Input
0x67 (cont.)</td><td>3</td><td>
<table>
<tr><td>92-95</td><td>Box 4 Min Temperature</td></tr>
<tr><td>96-99</td><td>Box 4 Max Temperature</td></tr>
<tr><td>100-103</td><td>Box 4 Average Temperature</td></tr>
<tr><td>104</td><td>Spot 4 Temperature Valid State</td></tr>
<tr><td>105</td><td>Box 4 Min Temperature Valid State</td></tr>
<tr><td>106</td><td>Box 4 Max Temperature Valid State</td></tr>
<tr><td>107</td><td>Box 4 Avg Temperature Valid State</td></tr>
<tr><td>108-127</td><td>…..Spot 5/ Box 5…..</td></tr>
<tr><td>128-147</td><td>…..Spot 6/ Box 6…..</td></tr>
<tr><td>148-167</td><td>…..Spot 7/ Box 7…..</td></tr>
<tr><td>168-187</td><td>…..Spot 8/ Box 8…..</td></tr>
<tr><td>188-207</td><td>…..Spot 9/ Box 9…..</td></tr>
<tr><td>208-227</td><td>…..Spot 10/ Box 10…..</td></tr>
<tr><td>228-247</td><td>…..Spot 11/ Box 11…..</td></tr>
<tr><td>248-267</td><td>…..Spot 12/ Box 12…..</td></tr>
<tr><td>268-287</td><td>…..Spot 13/ Box 13…..</td></tr>
<tr><td>288-307</td><td>…..Spot 14/ Box 14…..</td></tr>
<tr><td>308-327</td><td>…..Spot 15/ Box 15…..</td></tr>
<tr><td>328-347</td><td>…..Spot 16/ Box 16…..</td></tr>
<tr><td>348-367</td><td>…..Spot 17/ Box 17…..</td></tr>
<tr><td>368-387</td><td>…..Spot 18/ Box 18…..</td></tr>
<tr><td>388-407</td><td>…..Spot 19/ Box 19…..</td></tr>
<tr><td>408-427</td><td>…..Spot 20/ Box 20…..</td></tr>
</table>
</td><td></td><td>Get</td></tr>
<tr><td>Input
0x68</td><td>3</td><td>Input Data
<table>
<tr><th>Byte</th><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>0</td><td>Reserved</td><td>Force Image One Shot</td><td>Save Image</td><td>One Time Image Auto Adjust</td><td>Auto Focus Fast</td><td>Auto Focus Full</td><td>Force NUC</td><td>Auto NUC</td></tr>
<tr><td>1</td><td>Disable Alarm[1]</td><td>Reserved</td><td>Image Live</td><td>Image Freeze</td><td>DI 2</td><td>DI 1</td><td>DO 2</td><td>DO 1</td></tr>
<tr><td>2</td><td>Atmospheric Temp. Graphic</td><td>Reflected Temp. Graphic</td><td>Distance Graphic</td><td>Emissivity Graphic</td><td>Date/Time Graphic</td><td>Scale Graphic</td><td>Camera Label Graphic</td><td>Enable Overlay Graphics</td></tr>
<tr><td>3</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Measurement Mark Graphic</td><td>Lens Graphic</td><td>Relative Humidity Graphic</td></tr>
<tr><td>4</td><td>Alarm 8</td><td>Alarm 7</td><td>Alarm 6</td><td>Alarm 5</td><td>Alarm 4</td><td>Alarm 3</td><td>Alarm 2</td><td>Alarm 1</td></tr>
<tr><td>5</td><td colspan="8">Set Configuration Preset (RESERVED FOR FUTURE USE)</td></tr>
<tr><td>6</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td></tr>
<tr><td>7</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td></tr>
</table>
</td><td>Get</td></tr>
</table>

[1] This alarm is the BATCH alarm. It has the ability to enable or disable all the other 8 alarms.

Heartbeat and Configuration Instances

Input Only Heartbeat (Instance 128 (0x80))

This instance allows clients to monitor input data without providing output data.

Listen Only Heartbeat (Instance 129 (0x81))

This instance allows clients to monitor input data without providing output data. To utilize this connection type, an owning connection must exist from a second client and the configuration of the connection must match exactly.

Configuration Instance (Unused)

Since some PLC's require a configuration instance, enter 1.

Table 2-5 Assembly Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single
10_{Hex}	No	Yes	Set_Attribute_Single

1.4 Connection Manager Object (06_{HEX}- 0 Instances)

No supported services or attributes

1.5 PCCC Object (67_{HEX} - 1 Instance)

The PCCC Object has no class or instance attributes. The following tables contain common services information and PCCC Mapping parameters for the PCCC Object.

Table 1-6 PCCC Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
$4B_{Hex}$*	No	Yes	Execute PCCC Request

* EtherNet/IP devices use the "Execute PCCC Request" service code ($4B_{Hex}$) to communicate with older controllers like the PLC5E and the SLC 5/05.

Table 1-7 PCCC Object (67_{HEX}) Output Integers– Read/Write

PCCC Register	Data								Description
N10:0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Output Integers (Read/Write)
	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC	Auto NUC	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Image Live	Image Freeze	Reserved	Reserved	DO 2	DO 1	
N10:1	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic	Enable Overlay Graphics	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic	Relative Humidity Graphic	
N10:2	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Set Configuration Preset (RESERVED FOR FUTURE USE)								
N10:3	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	

Table 1-8 PCCC Object (67_{HEX}) Input Integers Little Endian– Read Only

PCCC Register	Data								Description
N11:0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Input Integers Little-Endian (READ ONLY)
	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC	Auto NUC	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Disable Alarm[1]	Reserved	Image Live	Image Freeze	DI 2	DI 1	DO 2	DO 1	
N11:1	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic	Enable Overlay Graphics	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic	Relative Humidity Graphic	
N11:2	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Alarm 8	Alarm 7	Alarm 6	Alarm 5	Alarm 4	Alarm 3	Alarm 2	Alarm 1	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Set Configuration Preset (RESERVED FOR FUTURE USE)								
N11:3	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
N11:4-5	Delta Temperature 1								
N11:6-7	Delta Temperature 2								
N11:8-9	Delta Temperature 3								
N11:10-11	Delta Temperature 4								
N11:12-13	Delta Temperature 5								
N11:14-15	Delta Temperature 6								
N11:16-17	Internal Camera Temperature								
N11:18-19	Spot 1 Temperature								
N11:20-21	Box 1 Min Temperature								
N11:22-23	Box 1 Max Temperature								
N11:24-25	Box 1 Average Temperature								

[1] This alarm is the BATCH alarm. It has the ability to enable or disable all the other 8 alarms.

PCCC Register	Data	Description
N11:26	Spot 1 Temperature Valid State	Input Integers Little-Endian (continued)
N11:27	Box 1 Min Temperature Valid State	
N11:28	Box 1 Max Temperature Valid State	
N11:29	Box 1 Avg Temperature Valid State	
N11:30-31	Spot 2 Temperature	
N11:32-33	Box 2 Min Temperature	
N11:34-35	Box 2 Max Temperature	
N11:36-37	Box 2 Average Temperature	
N11:38	Spot 2 Temperature Valid State	
N11:39	Box 2 Min Temperature Valid State	
N11:40	Box 2 Max Temperature Valid State	
N11:41	Box 2 Avg Temperature Valid State	
N11:42-43	Spot 3 Temperature	
N11:44-45	Box 3 Min Temperature	
N11:46-47	Box 3 Max Temperature	
N11:48-49	Box 3 Average Temperature	
N11:50	Spot 3 Temperature Valid State	
N11:51	Box 3 Min Temperature Valid State	
N11:52	Box 3 Max Temperature Valid State	
N11:53	Box 3 Avg Temperature Valid State	
N11:54-55	Spot 4 Temperature	
N11:56-57	Box 4 Min Temperature	
N11:58-59	Box 4 Max Temperature	
N11:60-61	Box 4 Average Temperature	
N11:62	Spot 4 Temperature Valid State	
N11:63	Box 4 Min Temperature Valid State	
N11:64	Box 4 Max Temperature Valid State	
N11:65	Box 4 Avg Temperature Valid State	
N11:66-77	…..Spot 5/ Box 5…..	

PCCC Register	Data	Description
N11:78-89	…..Spot 6/ Box 6…..	Input Integers Little-Endian (continued)
N11:90-101	…..Spot 7/ Box 7…..	
N11:102-113	…..Spot 8/ Box 8…..	
N11:114-125	…..Spot 9/ Box 9…..	
N11:126-137	…..Spot 10/ Box 10…..	
N11:138-149	…..Spot 11/ Box 11…..	
N11:150-161	…..Spot 12/ Box 12…..	
N11:162-173	…..Spot 13/ Box 13…..	
N11:174-185	…..Spot 14/ Box 14…..	
N11:186-197	…..Spot 15/ Box 15…..	
N11:198-209	…..Spot 16/ Box 16…..	
N11:210-221	…..Spot 17/ Box 17…..	
N11:222-233	…..Spot 18/ Box 18…..	
N11:234-245	…..Spot 19/ Box 19…..	
N11:246-257	…..Spot 20/ Box 20…..	

Table 1-9 PCCC Object (67_{HEX}) Input Integers Big Endian– Read Only

PCCC Register	Data								Description
N12:0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Input Integers Big-Endian
	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC	Auto NUC	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Disable Alarm[1]	Reserved	Image Live	Image Freeze	DI 2	DI 1	DO 2	DO 1	

[1] This alarm is the BATCH alarm. It has the ability to enable or disable all the other 8 alarms.

PCCC Register	Data								Description
N12:1	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Input Integers Big-Endian (continued)
	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic	Enable Overlay Graphics	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic	Relative Humidity Graphic	
N12:2	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Alarm 8	Alarm 7	Alarm 6	Alarm 5	Alarm 4	Alarm 3	Alarm 2	Alarm 1	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Set Configuration Preset (RESERVED FOR FUTURE USE)								
N12:3	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
N12:4-5	Delta Temperature 1								
N12:6-7	Delta Temperature 2								
N12:8-9	Delta Temperature 3								
N12:10-11	Delta Temperature 4								
N12:12-13	Delta Temperature 5								
N12:14-15	Delta Temperature 6								
N12:16-17	Internal Camera Temperature								
N12:18-19	Spot 1 Temperature								
N12:20-21	Box 1 Min Temperature								
N12:22-23	Box 1 Max Temperature								
N12:24-25	Box 1 Average Temperature								
N12:26	Spot 1 Temperature Valid State								
N12:27	Box 1 Min Temperature Valid State								
N12:28	Box 1 Max Temperature Valid State								
N12:29	Box 1 Avg Temperature Valid State								
N12:30-31	Spot 2 Temperature								
N12:32-33	Box 2 Min Temperature								
N12:34-35	Box 2 Max Temperature								
N12:36-37	Box 2 Average Temperature								

PCCC Register	Data	Description
N12:38	Spot 2 Temperature Valid State	Input Integers Big-Endian (continued)
N12:39	Box 2 Min Temperature Valid State	
N12:40	Box 2 Max Temperature Valid State	
N12:41	Box 2 Avg Temperature Valid State	
N12:42-43	Spot 3 Temperature	
N12:44-45	Box 3 Min Temperature	
N12:46-47	Box 3 Max Temperature	
N12:48-49	Box 3 Average Temperature	
N12:50	Spot 3 Temperature Valid State	
N12:51	Box 3 Min Temperature Valid State	
N12:52	Box 3 Max Temperature Valid State	
N12:53	Box 3 Avg Temperature Valid State	
N12:54-55	Spot 4 Temperature	
N12:56-57	Box 4 Min Temperature	
N12:58-59	Box 4 Max Temperature	
N12:60-61	Box 4 Average Temperature	
N12:62	Spot 4 Temperature Valid State	
N12:63	Box 4 Min Temperature Valid State	
N12:64	Box 4 Max Temperature Valid State	
N12:65	Box 4 Avg Temperature Valid State	
N12:66-77	…..Spot 5/ Box 5…..	
N12:78-89	…..Spot 6/ Box 6…..	
N12:90-101	…..Spot 7/ Box 7…..	
N12:102-113	…..Spot 8/ Box 8…..	
N12:114-125	…..Spot 9/ Box 9…..	
N12:126-137	…..Spot 10/ Box 10…..	
N12:138-149	…..Spot 11/ Box 11…..	
N12:150-161	…..Spot 12/ Box 12…..	
N12:162-173	…..Spot 13/ Box 13…..	

PCCC Register	Data	Description
N12:174-185	…..Spot 14/ Box 14…..	Input Integers Big-Endian (continued)
N12:186-197	…..Spot 15/ Box 15…..	
N12:198-209	…..Spot 16/ Box 16…..	
N12:210-221	…..Spot 17/ Box 17…..	
N12:222-233	…..Spot 18/ Box 18…..	
N12:234-245	…..Spot 19/ Box 19…..	
N12:246-257	…..Spot 20/ Box 20…..	

Table 1-10 PCCC Object (67_{HEX}) Input Floats– Read Only

PCCC Register	Data	Description
F13:0	Delta Temperature 1	Input Floats (READ ONLY)
F13:1	Delta Temperature 2	
F13:2	Delta Temperature 3	
F13:3	Delta Temperature 4	
F13:4	Delta Temperature 5	
F13:5	Delta Temperature 6	
F13:6	Internal Camera Temperature	
F13:7	Spot 1 Temperature	
F13:8	Box 1 Min Temperature	
F13:9	Box 1 Max Temperature	
F13:10	Box 1 Average Temperature	
F13:11	Spot 2 Temperature	
F13:12	Box 2 Min Temperature	
F13:13	Box 2 Max Temperature	
F13:14	Box 2 Average Temperature	
F13:15	Spot 3 Temperature	
F13:16	Box 3 Min Temperature	

PCCC Register	Data	Description
F13:17	Box 3 Max Temperature	Input Floats (continued)
F13:18	Box 3 Average Temperature	
F13:19	Spot 4 Temperature	
F13:20	Box 4 Min Temperature	
F13:21	Box 4 Max Temperature	
F13:22	Box 4 Average Temperature	
F13:23-26	…..Spot 5/ Box 5…..	
F13:27-30	…..Spot 6/ Box 6…..	
F13:31-34	…..Spot 7/ Box 7…..	
F13:35-38	…..Spot 8/ Box 8…..	
F13:39-42	…..Spot 9/ Box 9…..	
F13:43-46	…..Spot 10/ Box 10…..	
F13:47-50	…..Spot 11/ Box 11…..	
F13:51-54	…..Spot 12/ Box 12…..	
F13:55-58	…..Spot 13/ Box 13…..	
F13:59-62	…..Spot 14/ Box 14…..	
F13:63-66	…..Spot 15/ Box 15…..	
F13:67-70	…..Spot 16/ Box 16…..	
F13:71-74	…..Spot 17/ Box 17…..	
F13:75-78	…..Spot 18/ Box 18…..	
F13:79-82	…..Spot 19/ Box 19…..	
F13:83-86	…..Spot 20/ Box 20…..	

For additional PCCC mappings, refer to Appendix A

1.6 TCP Object (F5hex- 1 instance)

The following tables contain the attribute and common services information for the TCP Object.

Table 2-11 TCP Object ($F5_{HEX}$ - 1 Instance)

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule
Class (Instance 0)	1	Revision	UINT	4	Get
Instance 1	1	Status*	DWORD	1	Get
	2	Configuration capability*	DWORD	0	Get
	3	Configuration control*	DWORD	0	Get
	4	Physical Link Object * Structure of Path Size Path	 UINT Array of Word	 2 0x20F6 0x2401	Get
	5	Interface configuration* Structure of IP Address Network Mask Gateway Address Name Server Name Server 2 Domain Name Size Domain Name	 UDINT UDINT UDINT UDINT UDINT UINT STRING	 0 0 0 0 0 0 0	Get
	6	Host name* Structure of Host Name Size Host Name	 UINT STRING	 0 0	Get

* For more details on these attributes, see *Volume 2: EtherNet/IP Adaptation of CIP*, Section 5-3.2 from ODVA.

Table 2-12 TCP Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single
10_{Hex}	No	Yes	Set_Attribute_Single

1.7 Ethernet Link Object ($F6_{HEX}$ - 1 Instance)

The following tables contain the attribute and common services information for the Ethernet Link Object.

Table 2-13 Ethernet Link Object ($F6_{HEX}$ - 1 Instance)

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule
Class (Instance 0)	1	Revision	UINT	3	Get
Instance 1	1	Interface speed*	UDINT	100	Get
	2	Interface flags*	DWORD	3	Get
	3	Physical address	USINT Array (6)	0	Get

* For more details on these attributes, see *Volume 2: EtherNet/IP Adaptation of CIP*, Section 5-4.2 from ODVA.

Table 2-14 Ethernet Link Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single

1.8 System Command Object (64_{HEX}- 1 Instance)

1.8.1 Class and Instance Attributes

The following tables contain the attribute and common services information for System Command Object.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
Instance 1						
	1	Camera Distance Units	SHORT STRING*32*	"feet", "meter"	Get/Set	
	2	Camera Temperature Units	SHORT STRING*32*	"C": Celsius "F": Fahrenheit	Get/Set	
	3	Current Preset Profile	USINT		Get/Set	For now will always return Error Code

1.8.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single
10_{Hex}	No	Yes	Set_Attribute_Single

1.8.3 Description of Instance Attributes

1.8.3-1 Camera Distance Units

This attribute sets the display units for measuring distance within IR Monitor ONLY. Acceptable unit values are "Feet" and "Meter".

1.8.3-2 Camera Temperature Units

This attribute sets the display units for measuring temperature within IR Monitor ONLY. Acceptable unit values are "C" for Celsius and "F" for Fahrenheit.

1.8.3-3 Current Preset Profile

The attribute is reserved for future expansion and has no effect on the camera.

1.9 Camera Control Command Object (65_{HEX}- 1 Instance)

1.9.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Camera Control Command Object.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
Instance 1						
	1	Auto NUC	BOOL	0: Disable 1: Enable	Get/Set	
	2	Force NUC *	BOOL	0: Do Nothing 1: Execute	Get/Set	
	3	Full Auto Focus *	BOOL	0: Do Nothing 1: Full Auto Focus	Get/Set	N/A for FLIR Ax8
	4	Fast Auto Focus *	BOOL	0: Do Nothing 1: Fast Auto Focus	Get/Set	N/A for FLIR Ax8
	5	Focus Control Speed	USINT	0-100	Get/Set	N/A for FLIR Ax8
	6	Focus Control	USINT	0: Do Nothing 1: Near (-) 2: Far (+)	Get/Set	N/A for FLIR Ax8
	7	Focus Position	DINT	0-max	Get/Set	N/A for FLIR Ax8
	8	Digital Zoom	REAL	1.0-8.0	Get/Set	
	9	Enable Overlay Graphics	BOOL	0: Disable 1: Enable	Get/Set	
	10	Overlay Graphic Camera Label	BOOL	0: Off 1: On	Get/Set	
	11	Overlay Graphic Scale	BOOL	0: Off 1: On	Get/Set	

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
	12	Overlay Graphic Date/Time	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8
	13	Overlay Graphic Emissivity	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8
	14	Overlay Graphic Distance	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8
	15	Overlay Graphic Reflected Temp.	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8
	16	Overlay Graphic Atmospheric Temp.	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8
	17	Overlay Graphic Relative Humidity	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8
	18	Overlay Graphic Lens	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8
	19	Overlay Graphic Measurement Mask	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8

*Momentary Toggle- Read will always return 0

1.9.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single
10_{Hex}	No	Yes	Set_Attribute_Single

1.9.3 Description of Instance Attributes

1.9.3-1 Auto NUC

This attribute either enables or disables the Auto NUC functionality in the camera. NUC stands for non-uniformity correction. If this attribute is enabled, the camera will auto-correct whenever necessary. If disabled, the camera will rely on the user to force an Auto NUC when needed, see 1.9.3-2.

1.9.3-2 Force NUC

This attribute forces a NUC to execute. Since this is a momentary toggle, the read will always return 0.

1.9.3-3 Full Auto Focus

This attribute forces a coarse autofocus to execute using the entire focus range. Since this is a momentary toggle, the read will always return 0.

1.9.3-4 Fast Auto Focus

This attribute forces a fine autofocus to execute using the nearby focus range. Since this is a momentary toggle, the read will always return 0.

1.9.3-5 Focus Control Speed

This attribute sets the step value for a focus. The acceptable range for this attribute is 0-100. A value of 0 indicates no change, 1 is the smallest focus step change possible, and 100 is the largest focus step change possible. Once the step change is set here, the Focus command is executed by Attribute 6, see 1.9.3-6 for more details.

1.9.3-6 Focus Control

This attribute depends on the values of Attribute 5. If a 0 is written, no change will occur. If a 1 is written, the refocus will move towards near focus for the amount given in Attribute 5. If a 2 is written, the refocus will move towards far focus for the amount given in Attribute 5. All other the values are not accepted.

1.9.3-7 Focus Position

This attribute forces the camera to refocus to the absolute position provided. The range of values depends on the camera.

1.9.3-8 Digital Zoom

This attribute controls the digital zoom factor in the camera. The acceptable range of values is 1.0-8.0, where 1.0 is the lowest zoom factor and 8.0 is the highest zoom factor.

1.9.3-9 Enable Overlay Graphics

This attribute either shows or hides the enabled overlay graphic options (Atributes 10-19) in IR Monitor. If this is disabled, it will also hide any spot or box temperature information as well.

1.9.3-10 Overlay Graphic Camera Label

This attribute either enables or disables the overlay camera label graphic in IR Monitor.

1.9.3-11 Overlay Graphic Scale

This attribute either enables or disables the overlay camera scale graphic in IR Monitor.

1.9.3-12 Overlay Graphic Date/Time

This attribute either enables or disables the overlay camera date and time graphic in IR Monitor.

1.9.3-13 Overlay Graphic Emissivity

This attribute either enables or disables the overlay camera emissivity graphic in IR Monitor.

1.9.3-14 Overlay Graphic Distance

This attribute either enables or disables the overlay camera distance graphic in IR Monitor.

1.9.3-15 Overlay Graphic Reflected Temp.

This attribute either enables or disables the overlay camera reflected temperature graphic in IR Monitor.

1.9.3-16 Overlay Graphic Atmospheric Temp.

This attribute either enables or disables the overlay camera atmospheric temperature graphic in IR Monitor.

1.9.3-17 Overlay Graphic Relative Humidity

This attribute either enables or disables the overlay camera relative humidity graphic in IR Monitor.

1.9.3-18 Overlay Graphic Lens

This attribute either enables or disables the overlay camera lens graphic in IR Monitor.

1.9.3-19 Overlay Graphic Measurement Mask

This attribute either enables or disables the overlay camera measurement mask graphic in IR Monitor.

1.10 Temperature Control Object (66_{HEX} n Instances)

1.10.1 Class and Instance Attributes

The following tables contain the attribute and common services information for the Temperature Control Object.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Commant
Class (Instance 0)	1	Revision	UINT	1	Get	
	2	Max Instance	UINT		Get	
	100	Lens name	SHORT STRING*32*		Get	
	101	Write Lens ID to ".le"	SHORT STRING*32*		Get/Set	
	102	Write "ds" to ".image.ccase.query.ds"	SHORT STRING*32*		Get/Set	
	103	Write "ap" to ".image.ccase.query.ap"	SHORT STRING*32*		Get/Set	
	104	Write "fi" to ".image.ccase.query.fi"	SHORT STRING*32*		Get/Set	
	105	Case Query	SHORT STRING*32*		Get	
	106	Current Temp. Range Case	SHORT STRING*32*		Get/Set	
	107	Change Temperature Case *	BOOL	0:Do Nothing 1:Execute	Get/Set	
Instance 1-n						
	1	Current Upper Limit Temp.	REAL	Kelvin	Get	
	2	Current Lower Limit Temp.	REAL	Kelvin	Get	
	3	Case Enabled	BOOL	0: No 1: Yes	Get	

*Momentary Toggle- Read will always return 0

1.10.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single
10_{Hex}	Yes	No	Set_Attribute_Single

1.10.3 Description of Class Attributes

In order for the lens query, get current lens case, or change current lens case to work properly, follow these steps:

- Read Class Attribute 100

  Note: The string from the Class 100 Attribute consists of a resource path and the Lens id. The path should not be a part of the Lens id when used in Class Attribute 101. The Lens id is the suffix string from the last dot, ie: ".node1.node2.<LensID>"
- Write the lens id received from Class Attribute 100 to Class Attribute 101
- Write the string "ds" to Class Attribute 102
- Write the string "ap" to Class Attribute 103
- Write the string "fi" to Class Attribute 104
- Read Class Attribute 105 to query the lens cases
- To change the current lens, write the desired lens case to Class Attribute 106 and then write a 1 to Class Attribute 107 to execute the change
- To read the current lens case, read Class Attribute 106

1.10.3-1 Max Instance

This attribute will show the number of temperature cases that are configured in the camera. This value will only be calculated after Attribute 105 is called for the first time (see 1.10.3-7 for more information), otherwise the value will stay at 0.

1.10.3-2 Lens Name

This attribute will output the name of the lens configured in the camera in a string.

1.10.3-3 Write Lens Id to ".le"

Take the response from Attribute 100 (Lens Name), and write this string into this attribute. For example, if the Lens Name returned "leE" or 0x6C 0x65 0x45, then you must write 0x03 0x6C 0x65 0x45 into this attribute (with the length of the string as the first byte).

1.10.3-4 Write "ds" to ".image.ccase.query.ds"

Write the string "ds" into this attribute. Write 0x02 0x64 0x73 (the length of the string is in the first byte).

1.10.3-5 Write "ap" to ".image.ccase.query.ap"

Write the string "ap" into this attribute. Write 0x02 0x61 0x70 (the length of the string is in the first byte).

1.10.3-6 Write "fi" to ".image.ccase.query.fi"

Write the string "fi" into this attribute. Write 0x02 0x66 0x69 (the length of the string is in the first byte).

1.10.3-7 Case Query

This attribute will display the lens cases currently configured in the camera. For example, a response of 0x04 0x20 0x30 0x20 0x31 means that cases 0 and 1 have been found.

1.10.3-8 Current Temperature Range Case

This attribute will display the current temperature range case selected in the camera. To change the temperature range case, you must first write the new temperature case in this attribute and then execute Attribute 107 (see 1.10.3-9).

1.10.3-9 Change Temperature Case

If a 0 is written, no change will occur. If a 1 is written, the current temperature range case will be overwritten by the case assigned to Attribute 106 (see 1.10.3-8). Since this is a momentary toggle, the read will always return 0.

1.10.4 Description of Instance Attributes

Instance 1 corresponds to Case 0, Instance 2 corresponds to Case 1, etc…

1.10.4-1 Current Upper Limit Temperature

This attribute returns the upper limit temperature for a particular lens case in Kelvin.

1.10.4-2 Current Lower Limit Temperature

This attribute returns the lower limit temperature for a particular lens case in Kelvin.

1.10.4-3 Case Enabled

This attribute returns a value of 1 if this lens case has been calibrated for the camera, and returns a value of 0 if this lens case does not exist in the camera.

1.11 Image Control Commands Object (67_{HEX}- 1 Instance)

1.11.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Image Control Commands

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
Instance 1						
	1	Palette	SHORT STRING*32*	"bw.pal" "iron.pal" "rainbox.pal"	Get/Set	
	2	Palette Invert	BOOL	0: Normal 1: Reverse	Get/Set	
	3	Quality	USINT	0: High (7) 1: Normal (20) 2: Low (31)	Get/Set	
	4	Image Automatic Adjust	SHORT STRING*32*	"Auto", "Manual"	Get/Set	
	5	Scale Min	REAL	Kelvin	Get/Set	
	6	Scale Max	REAL	Kelvin	Get/Set	
	7	Span	REAL	Kelvin	Get/Set	
	8	Level	REAL	Kelvin	Get/Set	
	9	One Time Image Auto Adjust *	BOOL	0: Do Nothing 1:Execute	Get/Set	
	10	Image Adjust Method	SHORT STRING*32*	"Linear", "Histogram"	Get/Set	
	11	Image Freeze	BOOL	0: Off 1: On	Get/Set	
	12	Image Live	BOOL	0: Off 1: On	Get/Set	

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
	13	Image State	SHORT STRING*32*	"LIVE", "FREEZE"	Get	
	14	Image Measure Mode	BOOL	0:Normal 1:High Prio One Shot	Get/Set	
	15	Image Measurement One Shot *	BOOL	0: Do Nothing 1:Execute	Get/Set	

*Momentary Toggle- Read will always return 0

1.11.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single
10_{Hex}	No	Yes	Set_Attribute_Single

1.11.3 Description of Instance Attributes

1.11.3-1 Palette

This attribute sets the current color palette setting for the camera. The default palette choices set up in the camera are "bw.pal", "iron.pal", and "rainbow.pal".

1.11.3-2 Palette Invert

This attribute either enables or disables the invert palette option in the camera. A value of 1 indicates that the palette colors will be inverted.

1.11.3-3 Quality

This attribute controls the quality of the image resolution in IR Monitor. A value of 0 indicates a high video quality. A value of 1 indicates a normal video quality. A value of 2 indicates a low video quality.

1.11.3-4 Image Automatic Adjust

This attribute controls whether the overall scale temperature range will be automatically updated around the temperatures being read, or the range will only be updated if the user has to send a manual request in Attribute 9 to update.

1.11.3-5 Scale Min
This attribute sets the value of the minimum temperature scale setting in Kelvin. This setting is used in conjunction with Attribute 6 and is only effective if Attribute 4 is set to Manual.

1.11.3-6 Scale Max
This attribute sets the value of the maximum temperature scale setting in Kelvin. This setting is used in conjunction with Attribute 5 and is only effective if Attribute 4 is set to Manual.

1.11.3-7 Span
This attribute sets the value of the temperature scale span setting in Kelvin. This setting is used in conjunction with Attribute 8 and is only effective if Attribute 4 is set to Manual.

1.11.3-8 Level
This attribute sets the center of the temperature scale span setting in Kelvin. This setting is used in conjunction with Attribute 7 and is only effective if Attribute 4 is set to Manual.

1.11.3-9 One Time Image Auto Adjust
This attribute forces the scale temperature ranges to be updated. This setting is only effective if Attribute 4 is set to Manual.

1.11.3-10 Image Adjust Method
This attribute sets the method used to distribute the image colors. Acceptable values are “Linear” and “Histogram”. This setting is only effective if Attribute 4 is set to Manual.

1.11.3-11 Image Freeze
This attribute sets the image stream to freeze or stop continuous streaming.

1.11.3-12 Image Live
This attribute sets the image stream to start continuous streaming.

1.11.3-13 Image State
This attribute displays whether the image stream state is set to “Freeze” or “Live”.

1.11.3-14 Image Measure Mode
This attribute controls when the temperature values are to be updated. Set to 1 if you want to control when the temperatures are updated only when Attribute 15 is executed. Set to 0 if temperatures are to be read and updated continuously.

1.11.3-15 Image Measurement One Shot
This attribute executes a command to update the temperature value readings. This setting is only effective if Attribute 14 is set to 1.

1.12 Isotherm Control Commands Object (68_{HEX}- 1 Instance)

1.12.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Isotherm Control Commands

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
	2	Max Instance	UINT		Get	
Instance 1						
	1	Isotherm Enable	BOOL	0: Off 1: On	Get/Set	
	2	Isotherm Type	SHORT STRING*32*	"Above" "Below"	Get/Set	
	3	Isotherm Level	REAL	Kelvin	Get/Set	
	4	Isotherm Color	SHORT STRING*32*	"palette1" "palette2" "red" "green" "blue" "yellow" "cyan" "magenta" "gray"	Get/Set	

1.12.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single
10_{Hex}	No	Yes	Set_Attribute_Single

1.12.3 Description of Class Attributes

Currently the camera is only enabled for one isotherm. In the future, there may be future instances for additional isotherms.

1.12.3-1 Max Instance

This attribute indicates how many isotherms are enabled in the camera and can be used.

1.12.4 Description of Instance Attributes

Currently the camera is only enabled for one isotherm. In the future, there may be future instances for additional isotherms.

1.12.4.1 Isotherm Enable

This attribute enables the isotherm control.

1.12.4.2 Isotherm Type

This attribute sets the type of the isotherm control. As of now, the acceptable values are “Below” and “Above”.

1.12.4.3 Isotherm Level

This attribute sets the value of the isotherm low temperature limit in Kelvin.

1.12.4.4 Isotherm Color

This attribute sets the color of the isotherm. Acceptable values are “palette1”, “palette2”, “red”, “green”, “blue”, “yellow”, “cyan”, “magenta”, and “gray”.

1.13 Image File Storage Object (69_{HEX}- 1 Instance)

1.13.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Image File Storage.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
Instance 1						
	1	Store Image to Camera Memory *	BOOL	0: Do Nothing 1: Execute	Get/Set	Ax8: Saves images to directory /FLIR/images

*Momentary Toggle- Read will always return 0

1.13.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single
10_{Hex}	No	Yes	Set_Attribute_Single

1.13.3 Description of Instance Attributes

1.13.3-1 Store Image to Camera Memory

The image will be stored under the \Temp\images\ directory in the FLIR A310 camera and under the /FLIR/images/ directory for FLIR Ax8. The image file name will be automatically created and is made up of the date and time to ensure a unique name with each image store. Since this is a momentary toggle, the read will always return 0. When power is cycled to the camera, the images in this folder will be deleted (A310). You may copy these files out of the camera by using ftp (A310) or sftp (Ax8).

1.14 Alarm Settings Object ($6A_{HEX}$- 9 Instances)

1.14.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Alarm Settings

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
	2	Max Instance	UINT		Get	
Instance 1 - 8						
	1	Alarm Status	BOOL	0: Off 1: On	Get	
Instance 9						
	1	Alarm Status	BOOL	0: Off 1: On	Get	

1.14.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single

1.14.3 Description of Class Attributes

Currently the camera is enabled for nine alarms. In the future, there may be more.

1.14.3-1 Max Instance

This attribute indicates how many alarms are enabled in the camera and can be used.

1.14.4 Description of Instance Attributes

Each instance corresponds to a different Alarm within the camera. Instance 1 is Alarm 1, Instance 2 is Alarm 2, etc…. Instance 9 is the Batch Alarm. The Batch Alarm is used to enable and disable the output of the other active alarms.

1.14.4-1 Alarm Status

This attribute displays whether an alarm condition state is active or not.

1.15 Object Parameters Object ($6B_{HEX}$- 1 Instance)

1.15.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Object Parameters.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
Instance 1						
	1	Atmosphere Temperature	REAL	Kelvin	Get/Set	
	2	Emissivity	REAL	0.001-1.0	Get/Set	
	3	Distance	REAL	Meters	Get/Set	
	4	Reflected Temp	REAL	Kelvin	Get/Set	
	5	Relative Humidity	REAL	0.0-1.0	Get/Set	
	6	Window Transmission Rate	REAL	0.001-1.0	Get/Set	
	7	Window Temperature	REAL	Kelvin	Get/Set	

1.15.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single
10_{Hex}	No	Yes	Set_Attribute_Single

1.15.3 Description of Instance Attributes

1.15.3-1 Atmosphere Temperature

This attribute sets the value of atmospheric temperature in Kelvin.

1.15.3-2 Emissivity

This attribute sets the value of object emissivity. Accepted range is from 0.001 to 1.0.

1.15.3-3 Distance

This attribute sets the value of the distance to the object in Meters.

1.15.3-4 Reflected Temperature

This attribute sets the value of the object temperature surroundings in Kelvin.

1.15.3-5 Relative Humidity

This attribute sets the relative humidity value of the air. Accepted range is from 0.0 to 1.0. A value of 0.30 represents 30% humidity.

1.15.3-6 Window Transmission Rate

This attribute sets the value of the External Optics transmission. Accepted range is from 0.001 to 1.0. Set to 1.0 if no external optics is present.

1.15.3-7 Window Temperature

This attribute sets the value of the External Optics temperature in Kelvin. Commonly used for heat shields, close-up lenses, etc.

1.16 Spot Meter Object ($6C_{HEX}$. 20 Instances)

1.16.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Spot Meter.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
	2	Max Instance	UINT		Get	
Instance 1 - 20						
	1	Enable Local Object Parameter Values	BOOL	0: Disabled 1: Enabled	Get/Set	
	2	Reflected Temp.	REAL	Kelvin	Get/Set	
	3	Emissivity	REAL	0.001-1.0	Get/Set	
	4	Distance	REAL	Meters	Get/Set	
	5	Enable Spotmeter	BOOL	0:Disable 1:Enable	Get/Set	
	6	Spotmeter Pixel X-Position	DINT		Get/Set	
	7	Spotmeter Pixel Y-Position	DINT		Get/Set	
	8	Spotmeter Temp.	REAL	Kelvin	Get	

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
	9	Spotmeter Temp. State	USINT	0: Undefined(U) 1: Valid (=) 2: Less Than(>) 3: More Than(<) 4: Outside(O) 5: Outside calib.(*) 6: Unstable(~) 7: Compenstated with delta correction(d)	Get	

1.16.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single
10_{Hex}	No	Yes	Set_Attribute_Single

1.16.3 Description of Class Attributes

Currently the camera is enabled for 10 spotmeters (A310) or 5 spotmeters (Ax8).

1.16.3-1 Max Instance

This attribute indicates how many spotmeter objects are enabled in the camera and can be used.

1.16.4 Description of Instance Attributes

1.16.4-1 Enable Local Object Parameter Values

When this attribute is set to enabled (1), that spot uses the Reflected Temperature, Emissivity, and Distance values in Attributes 2, 3 and 4 rather than the global object parameter values in Object 0x6B.

1.16.4-2 Reflected Temperature

This attribute sets the value of a particular spot's temperature surroundings in Kelvin. Only used when Attribute 1 is set to 1.

1.16.4-3 Emissivity

This attribute sets the value of a particular spot's emissivity. Accepted range is from 0.001 to 1.0. Only used when Attribute 1 is set to 1.

1.16.4-4 Distance

This attribute sets the value of the distance to a particular spot object in Meters. Only used when Attribute 1 is set to 1.

1.16.4-5 Enable Spotmeter

This attribute either enables (1) or disables (0) a particular spotmeter.

1.16.4-6 Spotmeter Pixel X-Position

This attribute sets the value of a particular spot's position on the X-axis. The X-axis is horizontal. As this number increases from 0, the spotmeter will move from left to right.

1.16.4-7 Spotmeter Pixel Y-Position

This attribute sets the value of a particular spot's position on the Y-axis. The Y-axis is vertical. As this number increases from 0, the spotmeter will move from top to bottom.

1.16.4-8 Spotmeter Temperature

This attribute displays the spotmeter's temperature value in Kelvin.

1.16.4-9 Spotmeter Temperature State

This attribute displays the spotmeter's temperature state. The following table shows the different values and their meanings:

Value	Meaning
0	Undefined
1	In the acceptable range
2	Less than the acceptable range
3	More than the acceptable range
4	Outside the acceptable range
5	Outside calibration
6	Unstable temperature
7	Temperature is compensated with delta correction

1.17 Box Object ($6D_{HEX}$- 20 Instances)

1.17.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Box.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
	2	Max Instance	UINT		Get	
Instance 1 - 20						
	1	Enable Local Object Parameter Values	BOOL	0: Disabled 1: Enabled	Get/Set	
	2	Reflected Temp.	REAL	Kelvin	Get/Set	
	3	Emissivity	REAL	0.001-1.0	Get/Set	
	4	Distance	REAL	Meters	Get/Set	
	5	Enable Box	BOOL	0:Disable 1:Enable	Get/Set	
	6	Box Min Temp.	REAL	Kelvin	Get	

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
	7	Box Min Temp. State	USINT	0: Undefined(U) 1: Valid (=) 2: Less Than(>) 3: More Than(<) 4: Outside(O) 5: Outside calib.(*) 6: Unstable(~) 7: Compenstated with delta correction(d)	Get	
	8	Box Max Temp.	REAL	Kelvin	Get	
	9	Box Max Temp. State	USINT	0: Undefined(U) 1: Valid (=) 2: Less Than(>) 3: More Than(<) 4: Outside(O) 5: Outside calib.(*) 6: Unstable(~) 7: Compenstated with delta correction(d)	Get	
	10	Box Avg. Temp.	REAL	Kelvin	Get	

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
	11	Box Avg. Temp. State	USINT	0: Undefined(U) 1: Valid (=) 2: Less Than(>) 3: More Than(<) 4: Outside(O) 5: Outside calib.(*) 6: Unstable(~) 7: Compenstated with delta correction(d)	Get	
	12	Box Position X	DINT		Get/Set	
	13	Box Position Y	DINT		Get/Set	
	14	Box Min Temp. Position X	DINT		Get	
	15	Box Min Temp. Position Y	DINT		Get	
	16	Box Max Temp. Position X	DINT		Get	
	17	Box Max Temp. Position Y	DINT		Get	
	18	Box Width	DINT		Get/Set	
	19	Box Height	DINT		Get/Set	
	20	Temp. Display Options	USINT	Bit 0: Display Max Temp. Bit 1: Display Min Temp. Bit 2: Display Avg Temp.	Get/Set	

1.17.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single
10_{Hex}	No	Yes	Set_Attribute_Single

1.17.3 Description of Class Attributes

Currently the camera is enabled for 10 boxes. In the future, there may be more.

1.17.3-1 Max Instance

This attribute indicates how many box objects are enabled in the camera and can be used.

1.17.4 Description of Instance Attributes

1.17.4-1 Enable Local Object Parameter Values

When this attribute is set to enabled (1), that box uses the Reflected Temperature, Emissivity, and Distance values in Attributes 2, 3 and 4 rather than the global object parameter values in Object 0x6B.

1.17.4-2 Reflected Temperature

This attribute sets the value of a particular box's temperature surroundings in Kelvin. Only used when Attribute 1 is set to 1.

1.17.4-3 Emissivity

This attribute sets the value of a particular box's emissivity. Accepted range is from 0.001 to 1.0. Only used when Attribute 1 is set to 1.

1.17.4-4 Distance

This attribute sets the value of the distance to a particular box object in Meters. Only used when Attribute 1 is set to 1.

1.17.4-5 Enable Box

This attribute either enables (1) or disables (0) a particular box.

1.17.4-6 Box Min Temperature

This attribute displays the lowest temperature value in a particular box in Kelvin.

1.17.4-7 Box Min Temperature State

This attribute displays the temperature state of a box's minimum value. The following table shows the different values and their meanings:

Value	Meaning
0	Undefined
1	In the acceptable range
2	Less than the acceptable range
3	More than the acceptable range
4	Outside the acceptable range
5	Outside calibration
6	Unstable temperature
7	Temperature is compensated with delta correction

1.17.4-8 Box Max Temperature

This attribute displays the highest temperature value in a particular box in Kelvin.

1.17.4-9 Box Max Temperature State

This attribute displays the temperature state of a box's maximum value. The following table shows the different values and their meanings:

Value	Meaning
0	Undefined
1	In the acceptable range
2	Less than the acceptable range
3	More than the acceptable range
4	Outside the acceptable range
5	Outside calibration
6	Unstable temperature
7	Temperature is compensated with delta correction

1.17.4-10 Box Average Temperature

This attribute displays the average temperature value in a particular box in Kelvin.

1.17.4-11 Box Average Temperature State

This attribute displays the temperature state of a box's average value. The following table shows the different values and their meanings:

Value	Meaning
0	Undefined
1	In the acceptable range
2	Less than the acceptable range
3	More than the acceptable range
4	Outside the acceptable range
5	Outside calibration
6	Unstable temperature
7	Temperature is compensated with delta correction

1.17.4-12 Box Position X

This attribute sets the value of a particular box's position on the X-axis. The X-axis is horizontal. As this number increases from 0, the box will move from left to right.

1.17.4-13 Box Position Y

This attribute sets the value of a particular box's position on the Y-axis. The Y-axis is vertical. As this number increases from 0, the box will move from top to bottom.

1.17.4-14 Box Min Temperature Position X

This attribute indicates where on the horizontal X-axis the minimum box temperature is located.

1.17.4-15 Box Min Temperature Position Y

This attribute indicates where on the vertical Y-axis the minimum box temperature is located.

1.17.4-16 Box Max Temperature Position X

This attribute indicates where on the horizontal X-axis the maximum box temperature is located.

1.17.4-17 Box Max Temperature Position Y

This attribute indicates where on the vertical Y-axis the maximum box temperature is located.

1.17.4-18 Box Width

This attribute sets the value of a particular box's width.

1.17.4-19 Box Height

This attribute sets the value of a particular box's height.

1.17.4-20 Temperature Display Options

This attribute controls which temperatures will be shown on IR Monitor for a particular box. When a particular bit is set to 1, then that assigned temperature display value will be shown on IR Monitor. Acceptable range is 0 (none shown) - 7 (all shown).

1.18 Temperature Difference Object ($6E_{HEX}$- - 6 Instances)

1.18.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Temperature Difference.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
	2	Max Instance	UINT		Get	
	100	Internal Camera Temp.	REAL		Get	
Instance 1-6						
	1	Enable Temp. Difference	BOOL	0:Disable 1: Enable	Get/Set	
	2	Value of Temp. Difference	REAL	Kelvin	Get	
	3	Difference Temp. Valid State	USINT	0: Undefined(U) 1: Valid (=) 2: Less Than(>) 3: More Than(<) 4: Outside(O) 5: Outside calib.(*) 6: Unstable(~) 7: Compenstated w/ delta correction(d)	Get	

1.18.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single
10_{Hex}	No	Yes	Set_Attribute_Single

1.18.3 Description of Class Attributes

Currently the camera is enabled for six boxes. In the future, there may be more.

1.18.3-1 Max Instance

This attribute indicates how many box objects are enabled in the camera and can be used.

1.18.3-2 Internal Camera Temperature

This attribute indicates the internal temperature of the camera in Kelvin.

1.18.4 Description of Instance Attributes

1.18.4-1 Enable Temperature Difference

This attribute either enables (1) or disables (0) a particular temperature difference instance.

1.18.4-2 Value of Temperature Difference

This attribute indicates the temperature difference of a particular temperature difference value set up in the camera in Kelvin.

1.18.4-3 Difference Temperature Valid State

This attribute displays the difference temperature's state. The following table shows the different values and their meanings:

Value	Meaning
0	Undefined
1	In the acceptable range
2	Less than the acceptable range
3	More than the acceptable range
4	Outside the acceptable range
5	Outside calibration
6	Unstable temperature
7	Temperature is compensated with delta correction

1.19 Physical I/O Object ($6F_{HEX}$ - - 1 Instance)

1.19.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Temperature Difference.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
Instance 1						
	1	DI 1	BOOL	0:Off 1:On	Get	
	2	DI 2	BOOL	0:Off 1:On	Get	N/A for FLIR Ax8
	101	DO 1	BOOL	0:Low 1:High	Get/Set	
	102	DO 2	BOOL	0:Low 1:High	Get/Set	N/A for FLIR Ax8

1.19.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single
10_{Hex}	No	Yes	Set_Attribute_Single

1.19.3 Description of Instance Attributes

1.19.3-1 DI 1

This attribute indicates if Digital Input 1 is active (1) or inactive (0).

1.19.3-2 DI 2

This attribute indicates if Digital Input 2 is active (1) or inactive (0).

1.19.3-3 DO 1

This attribute either sets the Digital Output 1 to an active (1) or inactive (0) state.

1.19.3-4 DO 2

This attribute either sets the Digital Output 2 to an active (1) or inactive (0) state.

1.20 Pass Through Object (70_{HEX} - 1 Instance)

1.20.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Temperature Difference.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	

1.20.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
32_{Hex}	No	Yes	Read_BOOL
33_{Hex}	No	Yes	Write_BOOL
34_{Hex}	No	Yes	Read_INT32
35_{Hex}	No	Yes	Write_INT32
36_{Hex}	No	Yes	Read_DOUBLE
37_{Hex}	No	Yes	Write_DOUBLE
38_{Hex}	No	Yes	Read_ASCII
39_{Hex}	No	Yes	Write_ASCII

Example using Service Code 0x32:

Goal: Read Status of Digital Input

Explanation: Data field is filled with the length of the camera variable ".power.states.digin1" followed by the ASCII representation of it.

Service Code	Class	Instance	Attribute	Data
0x32	0x70	0x01		14 2E 70 6F 77 65 72 2E 73 74 61 74 65 73 2E 64 69 67 69 6E 31

Example using Service Code 0x33:

Goal: Force an Auto Nuc on the camera

Explanation: Data field is filled with the length of the camera variable ".image.services.nuc.commit" followed by the ASCII representation of it, plus an additional byte of data (in this case 0x01) for the new BOOLEAN value.

Service Code	Class	Instance	Attribute	Data
0x33	0x70	0x01		1A 2E 69 6D 61 67 65 2E 73 65 72 76 69 63 65 73 2E 6E 75 63 2E 63 6F 6D 6D 69 74 01

Example using Service Code 0x34:

Goal: Read Focus Position Value

Explanation: Data field is filled with the length of the camera variable ".system.focus.position" followed by the ASCII representation of it.

Service Code	Class	Instance	Attribute	Data
0x34	0x70	0x01		16 2E 73 79 73 74 65 6D 2E 66 6F 63 75 73 2E 70 6F 73 69 74 69 6F 6E

Example using Service Code 0x35:

Goal: Write Focus Position Value to 125

Explanation: Data field is filled with the length of the camera variable ".system.focus.position" followed by the ASCII representation of it, plus 4 additional bytes of data (in this case 0x7D 0x00 0x00 0x00) for the new INT32 value. The new value should be passed in Little-Endian to match EtherNet/IP. This means that the bytes are placed in order from least significant to most significant.

Service Code	Class	Instance	Attribute	Data
0x35	0x70	0x01		16 2E 73 79 73 74 65 6D 2E 66 6F 63 75 73 2E 70 6F 73 69 74 69 6F 6E 7D 00 00 00

Example using Service Code 0x36:

Goal: Read Zoom Factor Value

Explanation: Data field is filled with the length of the camera variable ".image.zoom.zoomFactor" followed by the ASCII representation of it.

Service Code	Class	Instance	Attribute	Data
0x36	0x70	0x01		16 2E 69 6D 61 67 65 2E 7A 6F 6F 6D 2E 7A 6F 6F 6D 46 61 63 74 6F 72

Example using Service Code 0x37:

Goal: Write Focus Position Value to 8.0

Explanation: Data field is filled with the length of the camera variable ".image.zoom.zoomFactor" followed by the ASCII representation of it, plus 4 additional bytes of data (in this case 0x00 0x00 0x00 0x41) for the new REAL value. The new value should be passed in Little-Endian to match EtherNet/IP. This means that the bytes are placed in order from least significant to most significant.

Service Code	Class	Instance	Attribute	Data
0x37	0x70	0x01		16 2E 69 6D 61 67 65 2E 7A 6F 6F 6D 2E 7A 6F 6F 6D 46 61 63 74 6F 72 00 00 00 41

Example using Service Code 0x38:

Goal: Read Image Automatic Adjust Setting

Explanation: Data field is filled with the length of the camera variable ".image.contadj.adjMode" followed by the ASCII representation of it.

Service Code	Class	Instance	Attribute	Data
0x38	0x70	0x01		16 2E 69 6D 61 67 65 2E 63 6F 6E 74 61 64 6A 2E 61 64 6A 4D 6F 64 65

Example using Service Code 0x39:

Goal: Write Image Automatic Adjust Setting to "Auto"

Explanation: Data field is filled with the length of the camera variable ".image.contadj.adjMode" followed by the ASCII representation of it. The next byte of data is the size of the new ASCII string value to follow (in this case 0x04). Then, attach the new ASCII value (in this case "0x41 0x75 0x74 0x6F").

Service Code	Class	Instance	Attribute	Data
0x39	0x70	0x01		16 2E 69 6D 61 67 65 2E 63 6F 6E 74 61 64 6A 2E 61 64 6A 4D 6F 64 65 04 41 75 74 6F

Appendix A – Additional PCCC Mappings

EtherNet/IP Objects 0x64 through 0x6F are also available to access using PCCC.

Additional Integer (N) mappings

To access integer (N) mappings of Objects 0x64-0x6F use the following information:

1. The file number is the same as the decimal value of the EtherNet/IP Object number.
2. The file offset can be calculated using the following formula:
   Beginning File Offset = ((Instance# * 4000) + ((Attribute# - 1) * 20) + 1)
3. Each attribute is allocated a length of 20 for the value. You can read/write a maximum length of 20 at a time if the read or write begins from **Beginning File Offset**.
4. The first value of the length is reserved for the length (in bytes) for the data value.
5. If a value is writeable, then the new value will be displayed when read next, else there was an error.
6. If value is a DINT or REAL data type, then the following will happen:
   a. Number of bytes will be in (**Beginning File Offset**)
   b. Value in Little-Endian format will be in (**Beginning File Offset** +1) and (**Beginning File Offset** +2)
   c. Number of bytes again will be in (**Beginning File Offset** +3)
   d. Value in Big-Endian format will be in (**Beginning File Offset** +4) and (**Beginning File Offset** +5)
7. If a value is writeable and you are starting from **Beginning File Offset**, the length field is ONLY REQUIRED when changing a STRING data type.

Example reading Box 2 Min Temperature:

- File Number = 109
- Beginning File Offset = 8101
- Example Min Temperature is 302.25 Kelvin

N109:8101 = 4
N109:8102 = 0x2000
N109:8103 = 0x4397
N109:8104 = 4
N109:8105 = 0x4397
N109:8106 = 0x2000

Additional Float (F) mappings

To access Float (F) mappings of Objects 0x64-0x6F use the following information:

1. The file number can be calculated using the following formula:
   File Number = (Object# + 100)
2. The file offset can be calculated using the following formula:
   Beginning File Offset = ((Instance# * 4000) + ((Attribute# - 1) * 20) + 1)
3. Each attribute is allocated a length of 1 for the value. You will read/write the **Beginning File Offset** for a length of 1.
4. If a value is writeable, then the new value will be displayed when read next, else there was an error.
5. If the attribute is not a REAL or DINT value, then an error will appear.

Example reading Box 2 Min Temperature:

- File Number = 209
- Beginning File Offset = 8101
- Example Min Temperature is 302.25 Kelvin

F209:8101 = 302.25

Appendix B – Modbus TCP Assembly Mappings

The EtherNet/IP assemblies are also available to access using Modbus TCP.

Mapping 1 - Write Assembly Mapping

You must use Unit ID 1 to access.
This mapping gives you write access to some parameters over Modbus TCP.

Register 400XXX	Data								Data Access
1	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read/Write
	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC	Auto NUC	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Image Mode	Image Live	Image Freeze	Reserved	Reserved	DO 2	DO 1	
2	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read/Write
	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic	Enable Overlay Graphics	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic	Relative Humidity Graphic	
3	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read/Write
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Set Configuration Preset (RESERVED FOR FUTURE USE)								
4	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read/Write
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	

Mapping 2 - Read Assembly Values

You must use Unit ID 1 to access.
The Temperature values are mapped as a floating point value with the least significant word stored in the first register and the most significant word store in the second register. Registers 1001-1004 will be mapped in the same order as Mapping 3.

Example: Spot 1 temperature value of 302.25 will be mapped as follows:

Register 401019: 0x2000

Register 401020: 0x4397

Register 40XXXX	Data								Data Access
1001	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC	Auto NUC	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Disable Alarm	Image Mode	Image Live	Image Freeze	DI 2	DI 1	DO 2	DO 1	
1002	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic	Enable Overlay Graphics	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic	Relative Humidity Graphic	
1003	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Alarm 8	Alarm 7	Alarm 6	Alarm 5	Alarm 4	Alarm 3	Alarm 2	Alarm 1	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Set Configuration Preset (RESERVED FOR FUTURE USE)								
1004	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
1005-1006	Delta Temperature 1								Read Only
1007-1008	Delta Temperature 2								Read Only
1009-1010	Delta Temperature 3								Read Only

Register 40XXXX	Data	Data Access
1011-1012	Delta Temperature 4	Read Only
1013-1014	Delta Temperature 5	Read Only
1015-1016	Delta Temperature 6	Read Only
1017-1018	Internal Camera Temperature	Read Only
1019-1020	Spot 1 Temperature	Read Only
1021-1022	Box 1 Min Temperature	Read Only
1023-1024	Box 1 Max Temperature	Read Only
1025-1026	Box 1 Average Temperature	Read Only
1027	Spot 1 Temperature Valid State	Read Only
1028	Box 1 Min Temperature Valid State	Read Only
1029	Box 1 Max Temperature Valid State	Read Only
1030	Box 1 Avg Temperature Valid State	Read Only
1031-1032	Spot 2 Temperature	Read Only
1033-1034	Box 2 Min Temperature	Read Only
1035-1036	Box 2 Max Temperature	Read Only
1037-1038	Box 2 Average Temperature	Read Only
1039	Spot 2 Temperature Valid State	Read Only
1040	Box 2 Min Temperature Valid State	Read Only
1041	Box 2 Max Temperature Valid State	Read Only
1042	Box 2 Avg Temperature Valid State	Read Only
1043-1044	Spot 3 Temperature	Read Only
1045-1046	Box 3 Min Temperature	Read Only
1047-1048	Box 3 Max Temperature	Read Only
1049-1050	Box 3 Average Temperature	Read Only
1051	Spot 3 Temperature Valid State	Read Only
1052	Box 3 Min Temperature Valid State	Read Only
1053	Box 3 Max Temperature Valid State	Read Only
1054	Box 3 Avg Temperature Valid State	Read Only

Register 40XXXX	Data	Data Access
1055-1056	Spot 4 Temperature	Read Only
1057-1058	Box 4 Min Temperature	Read Only
1059-1060	Box 4 Max Temperature	Read Only
1061-1062	Box 4 Average Temperature	Read Only
1063	Spot 4 Temperature Valid State	Read Only
1064	Box 4 Min Temperature Valid State	Read Only
1065	Box 4 Max Temperature Valid State	Read Only
1066	Box 4 Avg Temperature Valid State	Read Only
1067-1078	…..Spot 5/ Box 5…..	Read Only
1079-1090	…..Spot 6/ Box 6…..	Read Only
1091-1102	…..Spot 7/ Box 7…..	Read Only
1103-1114	…..Spot 8/ Box 8…..	Read Only
1115-1126	…..Spot 9/ Box 9…..	Read Only
1127-1138	…..Spot 10/ Box 10…..	Read Only
1139-1150	…..Spot 11/ Box 11…..	Read Only
1151-1162	…..Spot 12/ Box 12…..	Read Only
1163-1174	…..Spot 13/ Box 13…..	Read Only
1175-1186	…..Spot 14/ Box 14…..	Read Only
1187-1198	…..Spot 15/ Box 15…..	Read Only
1199-1210	…..Spot 16/ Box 16…..	Read Only
1211-1222	…..Spot 17/ Box 17…..	Read Only
1223-1234	…..Spot 18/ Box 18…..	Read Only
1235-1246	…..Spot 19/ Box 19…..	Read Only
1247-1258	…..Spot 20/ Box 20…..	Read Only

Mapping 3 - Read Assembly Values

You must use Unit ID 1 to access.
The Temperature values are mapped as a floating point value with the most significant word stored in the first register and the least significant word store in the second register. Registers 2001-2004 will be mapped in the same order as Mapping 2.

Example: Spot 1 temperature value of 302.25 will be mapped as follows:

Register 402019: 0x4397

Register 402020: 0x2000

Register 40XXXX	Data								Data Access
2001	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC	Auto NUC	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Disable Alarm	Image Mode	Image Live	Image Freeze	DI 2	DI 1	DO 2	DO 1	
2002	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic	Enable Overlay Graphics	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic	Relative Humidity Graphic	
2003	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Alarm 8	Alarm 7	Alarm 6	Alarm 5	Alarm 4	Alarm 3	Alarm 2	Alarm 1	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Set Configuration Preset (RESERVED FOR FUTURE USE)								
2004	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
2005-2006	Delta Temperature 1								Read Only
2007-2008	Delta Temperature 2								Read Only
2009-2010	Delta Temperature 3								Read Only

Register 40XXXX	Data	Data Access
2011-2012	Delta Temperature 4	Read Only
2013-2014	Delta Temperature 5	Read Only
2015-2016	Delta Temperature 6	Read Only
2017-2018	Internal Camera Temperature	Read Only
2019-2020	Spot 1 Temperature	Read Only
2021-2022	Box 1 Min Temperature	Read Only
2023-2024	Box 1 Max Temperature	Read Only
2025-2026	Box 1 Average Temperature	Read Only
2027	Spot 1 Temperature Valid State	Read Only
2028	Box 1 Min Temperature Valid State	Read Only
2029	Box 1 Max Temperature Valid State	Read Only
2030	Box 1 Avg Temperature Valid State	Read Only
2031-2032	Spot 2 Temperature	Read Only
2033-2034	Box 2 Min Temperature	Read Only
2035-2036	Box 2 Max Temperature	Read Only
2037-2038	Box 2 Average Temperature	Read Only
2039	Spot 2 Temperature Valid State	Read Only
2040	Box 2 Min Temperature Valid State	Read Only
2041	Box 2 Max Temperature Valid State	Read Only
2042	Box 2 Avg Temperature Valid State	Read Only
2043-2044	Spot 3 Temperature	Read Only
2045-2046	Box 3 Min Temperature	Read Only
2047-2048	Box 3 Max Temperature	Read Only
2049-2050	Box 3 Average Temperature	Read Only
2051	Spot 3 Temperature Valid State	Read Only
2052	Box 3 Min Temperature Valid State	Read Only
2053	Box 3 Max Temperature Valid State	Read Only
2054	Box 3 Avg Temperature Valid State	Read Only

Register 40XXXX	Data	Data Access
2055-2056	Spot 4 Temperature	Read Only
2057-2058	Box 4 Min Temperature	Read Only
2059-2060	Box 4 Max Temperature	Read Only
2061-2062	Box 4 Average Temperature	Read Only
2063	Spot 4 Temperature Valid State	Read Only
2064	Box 4 Min Temperature Valid State	Read Only
2065	Box 4 Max Temperature Valid State	Read Only
2066	Box 4 Avg Temperature Valid State	Read Only
2067-2078	…..Spot 5/ Box 5…..	Read Only
2079-2090	…..Spot 6/ Box 6…..	Read Only
2091-2102	…..Spot 7/ Box 7…..	Read Only
2103-2114	…..Spot 8/ Box 8…..	Read Only
2115-2126	…..Spot 9/ Box 9…..	Read Only
2127-2138	…..Spot 10/ Box 10…..	Read Only
2139-2150	…..Spot 11/ Box 11…..	Read Only
2151-2162	…..Spot 12/ Box 12…..	Read Only
2163-2174	…..Spot 13/ Box 13…..	Read Only
2175-2186	…..Spot 14/ Box 14…..	Read Only
2187-2198	…..Spot 15/ Box 15…..	Read Only
2199-2210	…..Spot 16/ Box 16…..	Read Only
2211-2222	…..Spot 17/ Box 17…..	Read Only
2223-2234	…..Spot 18/ Box 18…..	Read Only
2235-2246	…..Spot 19/ Box 19…..	Read Only
2247-2258	…..Spot 20/ Box 20…..	Read Only

Appendix C – Additional Modbus TCP Mappings

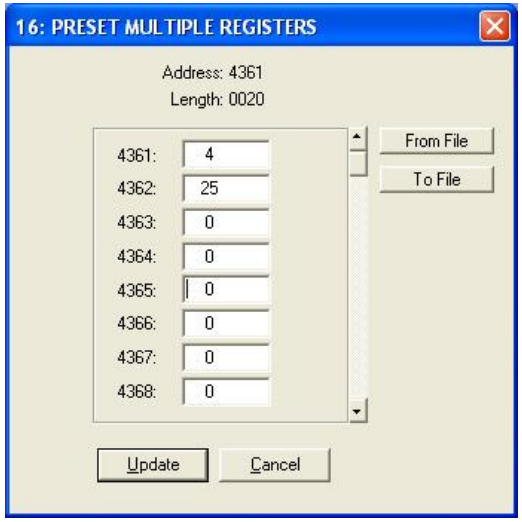
EtherNet/IP Objects 0x64 through 0x6F are also available to access using Modbus TCP.

Additional Modbus mappings

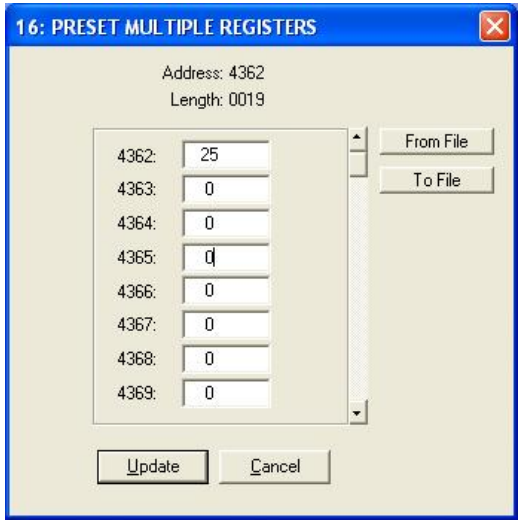
To access attributes in Objects 0x64-0x6F over Modbus TCP use the following information:

1. The Modbus Unit ID is the same as the decimal value of the EtherNet/IP Object number.
2. The starting register can be calculated using the following formula:
   Starting Register = ((Instance# * 4000) + ((Attribute# - 1) * 20) + 1)
3. Each attribute is allocated a 20 registers for the value. You can read/write a maximum length of 20 at a time if the read or write begins from **Starting Register.**
4. The first register of the 20 register range is reserved for the length (in bytes) of the data value. If the attribute is a REAL/DINT value, the size will be 4 bytes, BOOL is 1 byte, UINT is 2 bytes, and the STRING size is the number of characters in the string.
5. If a value is writeable, then the new value will be displayed when read next, else there was an error.
6. If value is a DINT or REAL data type, then the following will happen:
   a. Number of bytes will be in (**Starting Register**)
   b. Value in Little-Endian format will be in (**Starting Register** +1) and (**Starting Register** +2)
   c. Number of bytes again will be in (**Starting Register** +3)
   d. Value in Big-Endian format will be in (**Starting Register** +4) and (**Starting Register** +5)
7. If a value is writeable and you are starting from **Starting Register**, the length field is ONLY REQUIRED when changing a STRING data type.
8. Only these Modbus Function Codes are supported for these mappings:
   - 4 Read Holding Registers
   - 16 Write Multiple Holding Registers
   - 23 Read/ Write Multiple Holding Registers
9. If the data type is STRING, two characters make up a single register.
10. When you perform a write, if the starting address of the write is the size register, DO write the size in bytes of the value in the first register followed by the actual value starting at the second register. If the starting address of the write is not the size register, DO NOT write the size, just write the new attribute value.
    - Example: Execute a write of 25 to Box 1 Height.
      - Modbus Unit ID = 109
      - Modbus Range = 4361 – 4380

If you write the full 20 registers starting at 4361, then you must send the size of the data type in bytes in the first register then the data:



If you write every register but the first in the group, then there is no need to send the size in the request. You can just write the new values:



Example reading Box 2 Min Temperature:

- Modbus Unit ID (Slave ID) = 109
- Starting Register = Holding Register 8101
- Example Min Temperature is 302.25 Kelvin

8101 = 4
8102 = 0x2000
8103 = 0x4397
8104 = 4
8105 = 0x4397
8106 = 0x2000

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