

# Built-in IR illumination in Axis' cameras

## Leveraging new long-life LED technology

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## Introduction

Axis offers easy-to-install network cameras with infrared (IR) illumination, where the IR LEDs are built-in. The IR illumination includes new, long-life LED technology that is highly power-efficient and minimizes heat dissipation. This results in high-quality, low-noise video also when the environment is completely dark.

Axis' intelligent and unique built-in IR solution makes the network cameras easy to install, cost-efficient and environmental-friendly.

### 1. Why do you need IR illumination?

All Axis' network cameras with built-in IR illumination are day & night cameras that deliver color images during the day and black and white images during the night. Near-infrared light, which spans from 700 nanometers (nm) up to about 1000 nm, is beyond what the human eye can see, but most camera sensors can detect it and make use of it. The cameras have an IR-cut filter that filters out IR light during the day. IR light is filtered out so that it does not distort the colors of images as the human eye sees them. As light diminishes below a certain level, the camera can automatically remove the IR-cut filter allowing the camera to make use of near-IR light. Figure 1 shows how a color image sensor responds to visible and near-IR light.

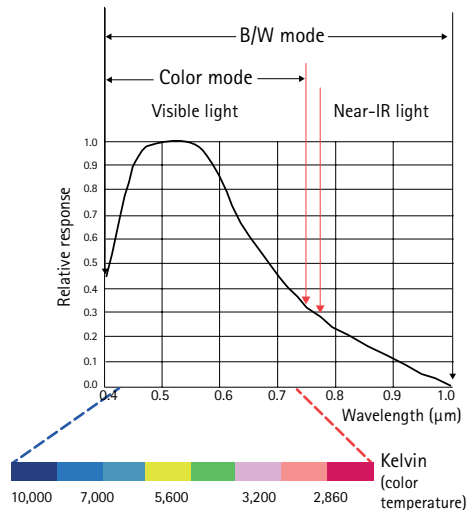


Figure 1: Color image sensor response to visible and near-IR light.

See Section 5, Useful links, 'Day & Night network cameras' and 'Lighting for Network Video – Lighting Design Guide', for more information on IR illumination.

### Why use IR illumination instead of white light?

Only thermal cameras can provide usable images in complete darkness. Day&night cameras need some kind of light source to be able to provide usable images. Even though IR light is not visible to the human eye, the sensor of a color camera is generally sensitive not only to visible light but also to IR light according to the Figure 1 – provided that the IR cut filter is removed.

Using IR illumination instead of white light has several advantages. With IR illumination, there is no light pollution. IR illumination makes discreet or covert surveillance possible in places where white light would be too intrusive, such as in nighttime traffic surveillance, or when you need to monitor people without anyone noticing. On the other hand, since people in this case are not aware that they are being monitored, there is no deterrent effect, which might be desirable in some situations.

The images in grayscale have better contrast, less noise, and better definition. This is an advantage when color information is not required, such as in license plate recognition (LPR). On the other hand, when color information is needed, IR illumination is not a feasible solution. For color video in low-light situations, an extremely light-sensitive camera – such as Axis cameras with Lightfinder technology – is a better option. See Section 5, Useful links, 'Lightfinder – Outstanding performance in difficult lighting conditions', for more information on Axis' Lightfinder technology.

IR illumination has inherently low power consumption, but it also lasts a lot longer – typically around 10 years and requires zero maintenance – compared to a halogen light which can last as little as 5 months. The images in grayscale, produced with the help of an IR illumination, contain less image noise if compared to black and white images produced without the IR source. The result is an image that occupies less storage space, hence reducing storage costs. Compared with images without the aid of IR illumination, images provided by using IR illumination in indoor installations saves up to 95% bit rate and storage space. In dark outdoor installations, it saves up to 75% bit rate and storage space.

### **When do you use IR illumination?**

IR illumination is used when white light is not an option, when color information is not critical and when the natural IR lighting is not sufficient. The black and white images have better contrast than color images, which makes images in black and white suitable for video analytics, for example license plate recognition (LPR). Figure 2 shows an example of traffic surveillance with a day & night camera and the aid of a stand-alone IR illuminator.

Axis has the largest application development partner program in the industry. The partners offer customized and specialized surveillance solutions for any system complexity or size – small, medium or enterprise – single-site or multiple sites. There are systems on the market that support hundreds of thousands of cameras in extremely large installations.



*Figure 2: IR illumination used for license plate recognition (LPR).*

### **How do you use IR illumination?**

Indoors, light is reflected from all surrounding surfaces, such as the walls and ceiling, which gives more light on the subject. Outdoors, all light except for the light hitting and reflecting off the subject, is lost. This means that it is much easier to get a clear image indoors. To improve the image quality outdoors, the camera with built-in IR should be aimed downwards not to lose more light than necessary.



Figure 3: Placement of an outdoor camera.

### Comparison with thermal cameras

Cameras with built-in IR have both advantages and disadvantages compared with thermal cameras. Cameras with built-in IR can be used as stand-alone systems, but can also be integrated into existing surveillance systems. Thermal cameras can complement an existing system, but they cannot replace it; color cameras are generally needed somewhere in the system for identification purposes. Both technologies have different purposes: thermal to detect, infrared to recognize. See Section 5, Useful links, 'Some like it hot – Thermal cameras in surveillance', for more information on thermal cameras.

Cameras with built-in IR have better resolution, image quality, definition, and field of view than thermal cameras. They are also less expensive. However, their viewing distance is shorter than what thermal cameras can provide. Depending of the type of Axis' cameras, the built-in IR can be used at a distance over 30 m (100 ft.), whereas thermal cameras have a range of detection up to 5 km (5400 yards) with the right model and in the right conditions. Figure 4 shows a comparison between a thermal camera and an Axis network camera with built-in IR.



Figure 4 and 5: To the left an image from an Axis thermal camera, and to the right an image from an Axis network camera with built-in IR.

## 2. Built-in or stand-alone IR illumination?

A day & night network camera can either work with a stand-alone IR illumination, or integrate the IR illumination into the camera. Axis has chosen 850 nm LED illuminators for its built-in or stand-alone IR solutions instead of 940 nm LEDs because the color sensor used on Axis cameras is generally more sensitive to 850nm than to 940 nm LEDs. Hence, the camera can reach farther when using an 850 nm LED illuminator than with a 940nm LED illuminator. The disadvantage of using 850 nm LEDs is that they show up as a visible red dot, while 940nm LEDs provide completely covert illumination.

Axis network cameras with built-in IR have several advantages, such as very simple installation and integration. They do not require external cables or any extra power supply since their IR LEDs are power-supplied from the camera, using standard, environmental-friendly Power over Ethernet IEEE 802.3af.

Network cameras with built-in IR conveniently deliver surveillance all in one package and have a very low environmental impact, since only a camera needs to be installed and no additional IR light sources. This is especially important when installing cameras in older or listed buildings, such as museums and historical buildings. For the same reason, each built-in IR system becomes less expensive, since fewer units will have to be installed – and fewer units installed also mean fewer units to service.

There are two areas where standalone IR illumination remains a better option than built-in IR illumination. Network cameras with standalone IR illumination have, in many cases, a longer viewing distance than cameras with built-in IR. Also, there is a wider range of cameras available that work with stand-alone IR illumination, which gives more flexibility when choosing a camera.

A stand-alone IR illuminator produces more light, and the illumination can be aimed more freely. Up to now, network cameras with built-in IR have rarely been adjustable, which can cause the IR illumination to mismatch the camera field of view or the image being overexposed. However, most of Axis network cameras with built-in IR are adjustable owing to their built-in intelligence. See Section 3, 'How Axis' network cameras with built-in IR work', for more information.

### **3. How Axis' network cameras with built-in IR work**

Axis' built-in IR technology gives an even illumination across the entire image. In general, the colder the sensor and the more light, the better the image quality will be. However, the more light, the hotter the sensor will be, resulting in an increase of noise disturbance in the image. Axis built-in IR technology gives the maximum possible amount of light at the scene combined with the minimum possible heat in the sensor, ensuring excellent image quality.

The combination of the camera intelligence and IR LEDs makes Axis network cameras with built-in IR unique on the market. Axis network cameras are safe to use according to the European standard EN 62471:2008 based on the international standard IEC 62471. Since they comply with this standard it means that the cameras are not harmful to the eyes of any living creature that might look straight at the camera.

#### **Axis' IR illumination solution**

The IR illumination solution has been developed especially by Axis and is custom-made for the illumination requirements of Axis network cameras with built-in IR.

The IR solution has been optimized for the camera's view angles and gives a very even illumination across the entire area of illumination.

In most of Axis cameras with built-in IR, the illumination intelligence adjusts the distribution angles of the illumination to make it evenly distributed across the entire area. Figure 6 and 7 show a comparison between an even and uneven IR illumination.



Figure 6 and 7: To the left, an image example without an even illumination, and to the right an image example with Axis' IR illumination solution.



Figure 8 and 9: Same images as per figure 6 and 7, but taken with a Tele lens. To the left, the subject is not receiving enough IR illumination; while to the right the IR illumination is evenly distributed and the subject is not underexposed.

## Intelligence

A too narrowly illuminated area will produce 'white out or glare' in the middle of the scene, and some areas will not be correctly illuminated. On the other hand, a too widely illuminated area means that light will shine on objects outside the area of interest, and also that the viewing distance will be reduced. Depending on camera model, the built-in IR illumination can reach over 30 m (100 ft.) with low, environmental-friendly power consumption, supplied by standard Power over Ethernet (IEEE 802.3af).

When the field of view is adjusted at the installation of an Axis camera with remote zoom and built-in IR, the angle of illumination automatically adapts to the zoom level. (This is not applicable in all Axis cameras with built-in IR). The illumination angle follows the camera's zoom movements to always provide the maximum amount of light in the image. Figures 10-12 show how the exposure time adapts when a subject is approaching the camera.



Figure 10-12: When the subject is far away from the camera the whole area is illuminated.

When the subject is approaching the camera, the exposure time is adapting.

When the subject is by the camera, it is illuminated and not overexposed.



#### 4. How Axis' network cameras with built-in IR work

Axis' intelligent and unique built-in IR illumination solution, based on new, power-efficient LED technology and providing an adaptable angle of IR illumination, is designed for easy, cost-efficient and environmental-friendly installation.

#### 5. Useful links

For more information, see the following links:

- > Axis Communications – 'Day & Night network cameras':  
[www.axis.com/products/video/camera/about\\_cameras/day\\_night.htm](http://www.axis.com/products/video/camera/about_cameras/day_night.htm)
- > Axis Communications – 'Lightfinder – Outstanding performance in difficult lighting conditions':  
[www.axis.com/files/whitepaper/wp\\_lightfinder\\_43131\\_en\\_1105\\_lo.pdf](http://www.axis.com/files/whitepaper/wp_lightfinder_43131_en_1105_lo.pdf)
- > Axis Communications – 'Lighting for Network Video – Lighting Design Guide':  
[www.axis.com/files/whitepaper/wp\\_lighting\\_for\\_netvid\\_41222\\_en\\_1012\\_lo.pdf](http://www.axis.com/files/whitepaper/wp_lighting_for_netvid_41222_en_1012_lo.pdf)
- > Axis Communications – 'Some like it hot – Thermal cameras in surveillance':  
[www.axis.com/files/whitepaper/wp\\_axis\\_thermal\\_cameras\\_en\\_37661\\_0912\\_lo.pdf](http://www.axis.com/files/whitepaper/wp_axis_thermal_cameras_en_37661_0912_lo.pdf)
- > Axis Communications – 'Power over Ethernet':  
[www.axis.com/products/poel/system.htm](http://www.axis.com/products/poel/system.htm)



## About Axis Communications

As the market leader in network video, Axis is leading the way to a smarter, safer, more secure world — driving the shift from analog to digital video surveillance. Offering network video solutions for professional installations, Axis' products and solutions are based on an innovative, open technology platform.

Axis has more than 1,400 dedicated employees in 40 locations around the world and cooperates with partners covering 179 countries. Founded in 1984, Axis is a Sweden-based IT company listed on NASDAQ OMX Stockholm under the ticker AXIS. For more information about Axis, please visit our website [www.axis.com](http://www.axis.com)