

With Thermal Cameras, Image Matters.



The simple fact is: not all thermal security cameras are created equal. Simply comparing manufacturer's specification sheets won't give you the information you need to get the most effective imagers for your money.

For many security professionals, the process of evaluating thermal cameras for purchase or recommendation is a new endeavor that exposes them to a whole new set of specifications and performance parameters that they are unfamiliar with. This unfamiliarity makes them vulnerable to the vagaries of slick marketing literature.

So, how can you get the right cameras? Don't leave it up to an analysis of specifications; see the camera's image quality for yourself, because image quality matters.

The quality of the images a given camera produces is a function of a number of factors including detector resolution, optics, and image processing.

How Is A Thermal Camera's Resolution Measured, And Why Do I Care?

The detector is the heart of any thermal security camera. It's the part that gathers the infrared energy and allows the creation of an image made from this energy. A thermal camera's detector plays the same role as the CCD detector chip in a standard video camera – whether it's on a pole outside of a nuclear facility or in your handi-cam at home.

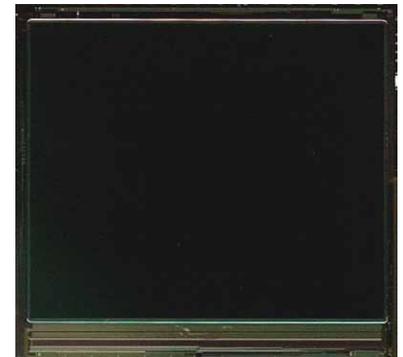
The detector's resolution is the number of individual detector elements found on that chip, usually measured in horizontal and vertical dimensions. The low-end options for thermal resolution typically offered are the 160x120 detector or the 320x240 detector formats, but the standard is quickly becoming the 640x480 detector. There's good reason for this.

A detector's resolution is the first vital element in determining a camera's ability to generate a high-quality image (more on image quality in a minute). The more detector elements a detector has (meaning, the higher its resolution), the more energy will be gathered, and the more detail you'll be able to see in the image.

Also, if you were to compare a camera with 640x480 resolution and a camera with 320x240 resolution that use the same size of lens, you'll find that the 640's angular field of view will actually be wider, yet will also detect threats from farther away. In the real world, this means that you'll be able to cover the same amount of area with fewer cameras using 640 resolution, and still be able to detect intruders from farther away. In other words: lower cost with better performance.

Let's take two notional thermal cameras that use the same uncooled VOx detectors and 35 mm lenses as an example. The 320 camera will have a 13°x10° FOV, while the 640 camera will have an 18°x14° FOV. This will give you a nearly 40% increase in coverage area, while still being able to detect a person from nearly 50% farther away. The tactical and economic benefits of increased resolution are measurable and undeniable.

The detector's pixel pitch is a specification that should be readily available from the manufacturer, as it is an important piece to the puzzle in predicting image quality and range



A 640x480 infrared detector like this packs all of its imaging power into an area less than 12mm across.

performance. Typically measured in micrometers, or "microns," when you're looking at a camera's pixel pitch, keep in mind that lower numbers are better – the smaller the pixel pitch, the more image detail you'll get in a smaller package.

This time, let's compare uncooled VOx cameras with 100 mm f/1.6 lenses; one camera has 25 micron pixels, and the other has 17 micron pixels. All other things being equal, the 17 micron camera will detect a person from over 22% farther away than the camera with 25 micron pixels.

Just as important, however, the 17 micron camera will produce more detailed, higher contrast images that will get better results from analytics and VMD packages.

These technical factors aren't enough to maximize a thermal camera's performance. The technical factors like detector type, lens design, detector resolution, and pixel pitch will make sure you get the most thermal energy into the system's electronics as possible, but what the camera does with that information is vitally important as well. That's where image processing comes in.

A thermal camera's internal image processing software can help bring out object edges and enhanced details that can make the difference in final image quality.

Image Quality – Isn't It Really Just Pretty Pictures?

NO!

As with the technical attributes mentioned earlier (detector type, f/number, resolution, pixel pitch, and image processing), the benefits of what may be superficially regarded as a subjectively better image have objective and measurable benefits.

First let's look at a couple of examples of the better image quality provided by FLIR images. These image pairs were taken with a FLIR F324 and an Axis Q1921. Both have 320 resolution and they use similar lenses (a slight difference in the angular FOV can be noticed), and both are using their "out of the box" image settings. No optimization was done to either camera, and none of the images have been manipulated in any way other than to re-size them for publication.



This set of images was taken at 6PM. The FLIR image (on the left) has greater contrast, shows more small details (take particular note of the areas outlined in red), and is in focus throughout the entire depth of the image. These points are notable because this is one of the times of the day that can be most challenging for thermal imagers. Remember that thermal cameras don't just make pictures from heat; they make pictures from tiny differences in heat.

There are two times of the day in which items within an image are most likely to have the smallest differences in temperature (isothermal): just before the sun goes down, when things have been soaking up the sun's rays all day and have reached a critical point of solar loading, and in the middle of the night, when everything has radiated off its stored energy and cooled to a similar degree. Both conditions are called points of "thermal crossover."

FLIR cameras keep imaging well during periods of thermal crossover, ensuring that you will continue to get solid coverage in the most challenging environmental conditions. The image from the Axis camera has noticeably poorer contrast and significant areas of lost detail which could lead to faulty alarms and missed threats, while the image at right has not.



These three images were captured with a 160x120 thermal camera (top), a 320x240 camera (middle), and 640x480 camera (bottom). The 640 resolution camera shows more detail and allows the viewer to see things from farther away, than its lower resolution counterparts.



The other side of the coin is even more dramatic. These images were taken at midnight, when things have become more uniformly cool. Again, the FLIR maintains its image contrast and detail, while the Axis image has suffered noticeably on both counts and produces a flat, washed-out image.

In both instances, the FLIR camera outperforms the Axis camera consistently in a number of important areas:

- Threat detection: Detection by any means – direct human observation or alarms through VMD – will be dramatically improved with the better image quality provided by FLIR thermal imagers.
- Analytics performance: Better contrast and scene detail gives you better edge differentiation, better segmentation, and better classification, all of which help analytics perform better.
- Range performance: Superior spatial detail provides significantly greater range performance. The FLIR camera images show small objects and small scene features with higher contrast and sharper edges, making them more readily recognizable across all distances from the camera. Range performance is a critical element of any intrusion detection or surveillance system, and better image quality provides a substantial advantage.
- Inclement weather: Fog, haze, and precipitation of all forms reduce thermal contrast. FLIR cameras have demonstrated superior image contrast in these low-contrast conditions and will continue to provide optimal performance in conditions when the Axis cameras suffer from reduced performance.

Conclusion

The sophisticated physics and engineering involved with making a thermal camera are impressive; the work required to squeeze every last bit of performance out of the technology is daunting. You can learn a lot about different products by studying the manufacturer's camera specs and having in-depth discussions with their applications engineers and integration teams.

FLIR cameras consistently outperform Axis cameras in the areas that matter most: imaging performance and image quality. Test them side-by-side and see for yourself.

The details matter, especially the details in the image. Make sure you're getting what you need.



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