



BY LING-MEI WONG

The lens is a crucial part of a camera. When light strikes, the lens focuses those photons to the image sensor to capture a complete picture.

Lenses perform an essential function for cameras. "IMS Research estimates that the worldwide market for security camera lenses was worth US\$276.3 million in 2009," said Gary Wong, Research Analyst for Video Surveillance and VCA, IMS Research. The IMS figure only includes CS-mount lenses for fixed box cameras. It does not count other mount types such as C- or F-mounts, dome lenses and integrated lenses in IR and bullet cameras.

Lenses come in a variety of mounts and functions, but some overarching principles govern what makes a lens good. "What makes a lens good or bad isn't the type of lens, but its density and quality," said Alf Chang, Senior Consultant for A&S magazines and a former installer. "The denser a lens is, the better its transparency will be."

Ease of installation is another priority. "The lens should have well-defined focus parts so an individual can easily focus and adjust the field of view on the lens," said T. Riley Pierce, Senior

Consultant and Project Manager, R. Grossman & Associates, an electronic security consulting firm. "My personal pet peeve on a lens is when they use adjustment set screws that are so small you can't grab and easily adjust the unit."

### MAKE OR BREAK

Each type of lens performs a unique function, which changes its performance requirements. Varifocal lenses are probably the most widely used lenses on the market and should have easier to use focal parts, Pierce said.

A good varifocal lens on a camera is usually 2.8 to 12 mm, while other common sizes are 5 to 50 mm for tighter zooming. "Varifocal gives you the ability to make adjustments to your field of view," said Peter Brissette, owner of [www.cctv-security-camera-systems.com](http://www.cctv-security-camera-systems.com). "It is usually a one-time setup."

Sensitivity makes or breaks an auto-iris lens. The lens maintains a constant light level so users get the best picture in the given lighting conditions. These lenses are more adaptable than manual iris lenses, which manually set the iris opening for fixed lighting conditions. "Except for video drive, most auto-iris lenses require a DC source to compare ambient light," Chang said. "If the sensitivity sensor is poor, and the iris is closed at night or open in the day, it's not good."



**Gary Wong**, Research Analyst for Video Surveillance and VCA, IMS Research



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**David Wang**, Project Manager for Hikvision Digital Technology

Auto-iris lenses are powered through a socket connected to the camera body, which requires a sufficiently long wire — or whip — for different models. “Some manufacturers that believe a 2-inch whip on their lens is sufficient for any camera body,” Pierce said. “News flash to those folks — not every camera body manufacturer puts the lens connection socket in the same place! Give the lens a sufficient whip to work with.”

Most cameras move the auto-iris whip closer to the lens, since the cameras move and a short whip could get tangled. “If the camera is in an enclosure and the wire is not properly installed, you will see a black line in your image,” Chang said.

A good IR lens works with the camera’s IR-cut filter. “You must use an aspherical lens to get the proper focal correction for the night view,” Pierce said. Without the proper lens, the images may look fine in the day, but terrible at night.

Materials will also make a difference, such as metal or plastic



▲ Lens density affects transparency and quality.

mounts. “When the lens moves, the focusing accuracy will have a gap with a plastic mount,” Chang said.

## MEGAPIXEL

A megapixel camera requires a lens that can deliver the most megapixels it will work with. “You can lose image quality trying

to use a SD lens on a megapixel camera,” Brissette said. “It’s good to use fisheye lenses with megapixel cameras as well as panoramic-view lenses. These types of lenses allow you to get the most out of the image capability of the camera.”

Fisheye lenses also need to ensure peripheral views on the edge are not distorted, Pierce said. They work for SD and megapixel cameras, but require software that corrects the image, Brissette said.

## OPTIONS

Each lens maker specializes in different lenses. This means most installers may buy varifocal lenses from Vendor A, but opt for fisheye lenses from Vendor B, Chang said.

Tamron was one of the first companies to offer varifocal lenses, said Tommy Tsunoyama, Section Manager, Section 3 of the Sales Department, Industrial Optics Business Unit, Tamron. “The varifocal lens was first introduced in this industry in 1987 and since then, all the common lenses today were introduced by Tamron.”

CBC specializes in network camera lenses, megapixel lenses and IR lenses. “CBC provides a full range of lenses for various applications such as surveillance, machine vision,



**Tommy Tsunoyama**, Section Manager  
Section 3 of the Sales Department,  
Industrial Optics Business Unit, Tamron



**Andrea Iñiguez**, VP of Business  
Development, Theia Technologies

ITS, car, door phone and so on,” said Takuya Ogawa, Senior Leader, Image and Information Technology Division, Optronics Technical and Production Group, CBC.

Megapixel lenses are the main product for Leading Optics, which carries 1/9-inch to 1-inch lenses, as well as surveillance lenses for machine vision and panoramic lenses. It offers HD lenses for IP surveillance, video conferencing and motion capture. “We can customize our products based on customer requirements,” said Beth Wu, VP of Sales, Leading Optics. As each camera manufacturer uses different components and deploys customized backend software, each camera requires a different lens.

Myutron offers varifocal, zoom, megapixel and IR lenses. “In addition to the optical design, we focus on development of the lenses that are easy to use for customers,” said Hiroto Oka, Overseas Market Manager, Myutron.

Another megapixel specialist is Theia Technologies. “We currently have two lens options available that provide an ultrawide field of view that allows you to cover a greater area with fewer cameras, and performs real-time distortion correction that takes out the fisheye distortion

without the use of software,” said Andrea Iñiguez, VP of Business Development, Theia Technologies. “In addition, resolution at the edges of the image is improved.”

## SELECTION CRITERIA

A key benchmark for installers and integrators is quality over price. “I consider quality and where the lens was produced before I consider price,” Chang said. “Some makers use plastic housings to save cost, but the mounts are metal.”

Performance beat out cost for lens selection, as cheap lenses are problematic. “The quality of the lens itself is the most important consideration for me — trying to save a few dollars by buying an inferior-quality lens is just asking for trouble in the long run,” Pierce said.

Lens quality depends on the type, design and quality of the manufacturing. “The best lenses have always been fixed lenses, because there are fewer elements to distort the image,” said Paul Bodell, VP of Global Business Development for

IQinVision. “However, since fixed lenses are not always practical, varifocal lenses have become very popular. They are not as high quality as fixed lenses, but they are much friendlier for installations and can still be of very good quality.”

“When evaluating lenses, we select first for quality,” Bodell continued. “Putting a bad lens on an HD / megapixel camera is like putting bicycle tires on a Ferrari: you will not get everything you want out of your camera.”

Lens clarity, color correction, contrast, distortion, blooming and ghosting are key criteria, said David Wang, Project Manager for Hikvision Digital Technology. “If a lens falls short in any of these areas, we will consider the lens to be poor.”

Blooming and ghosting are critical for scenes with multiple light sources, such as traffic monitoring. “A bad lens suffering from either blooming or ghosting could affect the whole image and obscure the license plate, interfering with ALPR,” Wang said.

## QUALITY MATERIAL


Dense lens blanks provide high-quality lenses that combat optical faults. Optical glass is the main material for CBC lenses, but optical plastics are sometimes used for low-cost lenses. “In order to maintain high qualities and reasonable prices, we are always considering the best allocation of the production sites in Japan, China and Bangladesh,” Ogawa said.

Theia’s lenses are made from several materials, including metal and glass. “They contain a variety of elements, including aspheres, low-dispersion glass and high-transmission coatings,” Iñiguez said. “Our manufacturing is done by our Japanese manufacturer Nittoh Kogaku in its Indonesian plant to reduce labor cost.”

Tamron not only designs, polishes and assembles its lenses, it produces the molds for their plastic parts, Tsunoyama said. It makes high-precision, comprehensive molds so its plastic mounts keep the alignment of the optical glass.

IR megapixel lenses are rare, as both IR and megapixel put different requirements on lenses. “We developed and adopted an IR multiband coating for megapixel lenses, which adjusts the non-focus shift between visible light and the IR light range,” said Tomoaki Katano, Sales Manager, Seikou Optical.

Myutron has a pragmatic approach to lens design. As there are not many innovative materials, it decides lens specifications based on the lens’ combined performance with the camera and the estimated market price, Oka said.

Finding a quality lens is no small feat, but with these selection tips in mind, it should be made easier. 

## PUTTING LENSES TO THE TEST

Integrators Peter Brissette, Alf Chang and T. Riley Pierce offered expert advice on how to test a lens.

- Check how fast the lens reacts to bright lighting changes.
- See how the lens responds to low-light conditions, especially when a camera goes from color to black and white.
- Check auto iris operation or electronic shutter settings to see its effect (where applicable).
- Find out whether an adapter is required or not.
- Test for how easy the lens is to install, focus and attach.
- Make sure there is an absence of any artifacts in the images (defects in the glass).
- Try how the lens fits on different styles of cameras (box, dome and more).
- Test the lens performance at several distances.
- Check transparency.
- Check the packaging, which should include desiccant to get rid of moisture. A lens stocked in a humid environment may develop mold and become blurred.
- Check if the lens mount holds the lens securely. A loosely mounted lens will negatively affect focus.