

Laboratory facility for machine vision applications with CCD (Charged Couple Device) camera and ringlight. The contours of the control object are rendered visible on the monitor.

Thilo Horvatsch
Journalist
Mainz, Germany

Long-Lasting and Light-Fast

Intelligent LED lighting complements Schott's know-how in fiber optics to provide a broader spectrum of lighting solutions for machine vision solutions. Innovative, patented functions improve application potential for industrial quality control.

▶ LED technology (light-emitting diode) has developed at a tremendous pace over the last 30 years. Every ten years, the producers of LEDs have increased the illumination power of these electronic light sources by a factor of 30. The growing spectrum of applications, as well as, supply and demand have developed at a corresponding pace.

One such application is machine vision. Here, LED solutions have become a much-desired illumination alternative for complex automated quality control applications in industries as varied as electronics, semiconductor production, automobiles, packaging and food processing.

With machine vision, computer controlled conveyer belts are monitored by video cameras, which check that the very thin circuits on the silicon semiconductor wafer are properly laid, that the printing on packages is correct, or that the material surface of steel, plastic or paper meets the required standards. The lighting medium that supports the visual checking process must conform to increasingly strict requirements. Camera resolutions are constantly improving, and the ever-increasing speed of industrial processing demands appropriate light intensities as well as reliable, unvarying light conditions. The accuracy of the computer evaluation is dependant upon the appropriate lighting.

Highly durable lighting components are also important to keep maintenance at a minimum. Every minute of production time lost can add up to tens of thousands of euros.

Expanded competency for machine vision

Durable and light-stable LED components now meet these requirements just as well as the fiber optic light sources most often used in machine vision systems.

Customized components and products with white, blue, green and yellow LEDs are available, as well as UV (ultraviolet) and

IR (infrared) wavelength-emitting LEDs. In addition to standard products with red LEDs, all LED components can be employed in a continuous emission mode as well as in stroboscopic and over-drive mode for higher processing speed and increased light pulse intensity. There are various controllers and interfaces to monitor and control the module depending on the desired application.

Intelligent LED functions

The development of unique intelligent functions is the highlight of this new product line. Optimized temperature management improves the durability of the LED and its light output. A matrix layer is

used here as an efficient, mechanical heat sink. Temperature changes that could influence the emission levels can be measured with an integrated sensor. In addition, there is an optional light feedback sensor, which is useful in producing and maintaining a constant and stable light for the duration of operation. Finally, there is an error indicator that can provide the system with a warning of possible LED defects. The combination of these new developments has already been patented.

LEDs – Less maintenance, lower power consumption

Similar to optical fibers, light-emitting diodes can also be arranged in arrays. The

formation of a beam using serial optics is possible as well. LEDs can be produced and installed in many colors (also UV and IR), brightness levels, and focal intervals in order to meet adjustments in contrast and color or other needs.

The great advantage to LEDs is their long life span. Red LEDs that have been carefully manufactured and integrated in a system can function perfectly for as long as 100,000 hours (MTBF – mean time between failure). They require less maintenance and power in comparison to fiber optic alternatives. This means lower operating costs. LEDs can also function in pulse mode (with a pulse frequency of roughly 0.5 microseconds) without any great loss in life span. There are additional advantages. The lightweight LEDs are extremely compatible for use in moving platforms. LEDs are electronic sources of light and as such can be integrated in precise computer controlled functions and processes. This increases reliability and efficiency.

A better view with machine vision

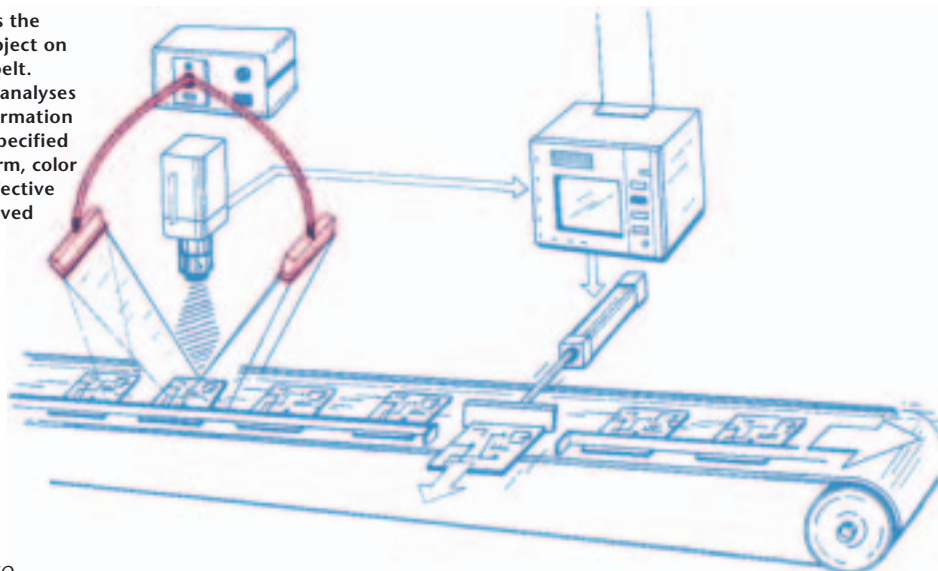
Application examples for electronic light sources

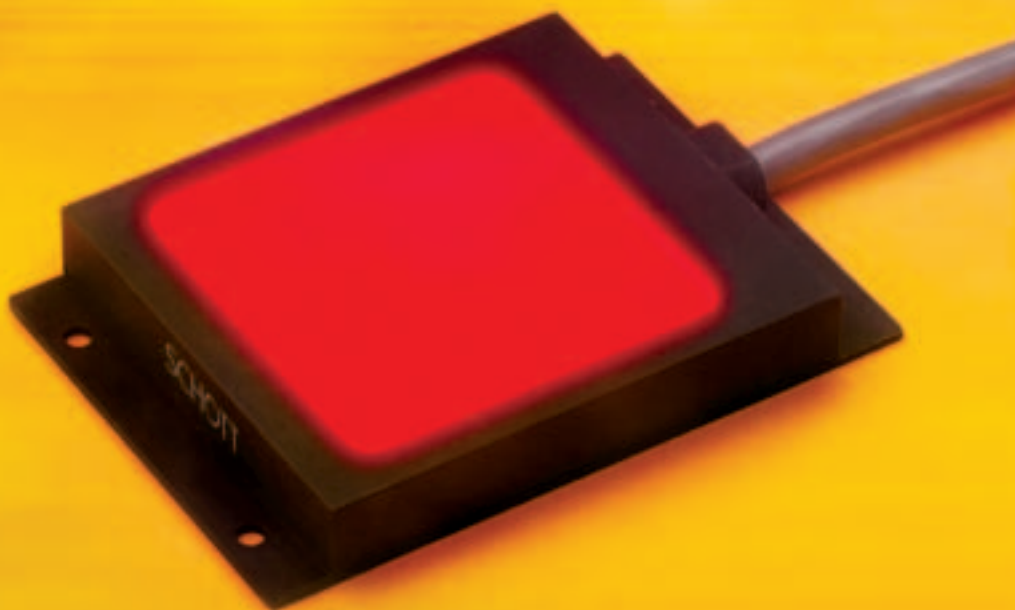
Sector	Object	What is evaluated?
Automobile industry	Injection molded parts Paint coating	Geometry, measurements, form, color Surface defects in the paint
Pharmaceutical industry	Blister Packs Ampoules, vials	Packing defects, filling defects, color, form, printing Damage, capacity, non-presence of particles, legible labeling
Semiconductor industry	Circuit board (equipped or bare)	Surface defects, broken circuit path, missing components, placing of components (in combination with robotics)
Food industry	Bottle filling Chocolate-chip cookies	Capacity, seal defects Number of chocolate chips in a cookie
Printing industry	Four color printing	Color print control, positioning
Rolled material	Paper, steel, film	Surface defects, scratches, defective sections

Light-emitting diodes are at present still less light intensive than fiber optic illumination solutions. Where greater light intensity is needed, fiber optics is the material of choice. This demonstrates that an exact knowledge of the characteristics of LED lighting components is necessary to meet the necessary requirements for specific applications.

Schott and its specialty divisions offer the all-around competency necessary to solve this problem. The US division Schott Fostec in Auburn is experienced in machine vision applications; Schott Fibre Optics in Doncaster, Great Britain, is a developer of LED lighting modules, and there is also the Fibre Optics Division at the Group's headquarters in Mainz. ◀

A camera takes the image of an object on the conveyer belt. The computer analyses the image information according to specified criteria, e.g. form, color or surface. Defective parts are removed from the belt.





Functional Diversity

The new modular LED product line for machine vision and industrial OEM use covers a wide range of user requirements:

- ▶ **Ringlight:** for shadow-free illumination in pattern recognition;
- ▶ **Diffuse Dome Ringlight:** used as an attachable accessory to eliminate reflections on shiny surfaces;
- ▶ **Darkfield Ringlight:** uses low-angle lighting to make surface structures (e.g. engravings, scratches) visible;
- ▶ **Spotlight:** for local or background illumination, also in combination with coaxial adapter, detachable diffuser, or spotlight polarizer;
- ▶ **Special Backlight:** for transmitted light recognition of transparent materials or diffuse illumination.