

# Novel Machine Vision Lighting Design Delivers 10X Brighter Light Pulses



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## *Dual OverDrive lighting mode addresses common challenges in logistics, food and beverage, and beyond*

For machine vision and industrial automation, the arrow continues to trend upward. Recent challenges stemming from the workforce shortage and COVID-19 disruptions have highlighted the growing importance of automation for businesses of all types as a means to enhance productivity and drive revenue. Industry figures confirm that automation is indeed being deployed at record rates, but as processes evolve and new needs arise, the vendor community must adapt and innovate their products to rise to the challenge.

### Machine Vision on the Rise

Machine vision had seen steady, incremental growth in North America from 2014 through 2016, and then made a sizeable leap from \$2.29 billion to \$2.63 billion in 2017, according to the Association for Advancing Automation (A3). The following year, that number jumped up to \$2.87 billion in 2018, a new height for the North American market, while the following two years saw dips to \$2.77 billion (2019) AND \$2.65 billion (2020). One year after the COVID-19 pandemic began, however, the machine vision market bounced back in a big way. In 2021, machine vision sales in North America reached \$3.03 billion as companies sought ways

to protect themselves against pandemic-related disruptions, workforce shortages, and generally just remain productive and efficient during trying times.

Robotics figures look similar, as the International Federation of Robotics (IFR) World Robots report shows that in 2021, an all-time high of new industrial robots were installed, which represents 31% year-over-year growth and exceeds pre-pandemic record in 2018 by 22%. Additionally, A3 figures show that robot sales in North America hit record highs in each quarter of 2022.

Automation systems are becoming more crucial to manufacturers and businesses of all types. Systems that incorporate machine vision and robotics technologies can remove humans from dull, dirty, or dangerous jobs while offering protection against any disruptions occurring now or in the future. In addition, these systems can enhance efficiency, boost productivity, and drive revenue. Building a PC-based machine vision system involves specifying, designing, and integrating all necessary components, including cameras, cables, lenses, industrial computer, software, and of course, lighting – without which the cameras cannot “see.”

## Rev Up Your Light Engines

Today's machine vision systems are operating at increasingly higher speeds, which requires lighting that can help capture the right images. Pulsing (or strobing) an LED light helps freeze images of fast-moving objects. LED light controllers typically offer two modes of operations: continuous mode (LEDs designed, tuned and tested to meet the thermal constraints of running for an indefinite period of time, without a duty cycle associated), and strobed/pulsed (LEDs that are switched on through a controller only when required). These controllers typically allow fine tuning of the pulse timing, providing more flexibility than adjusting the camera timing. Pulse mode operation also allows the LEDs to be overdriven past a manufacturer's rating, which produces more light, but also more heat.

Known as "overdrive," this mode allows certain machine vision lights to be strobed/pulsed at up to 10x the intensity of a continuous operation drive. Lights running in overdrive mode may feature an integrated strobe driver for complete control of the LED without need for an external driver. The driver should monitor the strobe operation, maximizing the lights output during machine vision inspections. The LED controller must ensure that the lights only run in overdrive for a set period of time before a rest period – i.e., the duty cycle – as they run the risk of quickly burning out.

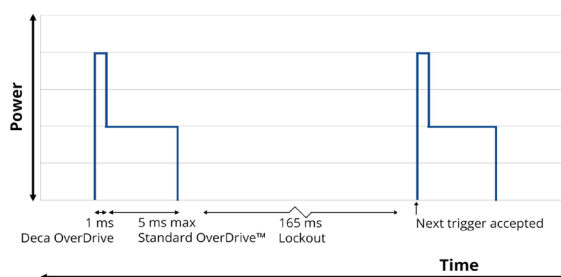
LEDs operating in overdrive mode may benefit a wide range of different machine vision applications, but specifically suit tasks in which objects or conveyor lines are moving at high speeds and require a bright strobe to freeze an object's motion but can't use a longer exposure. These may include logistics, food and beverage, consumer goods, and pharmaceutical applications, for example.

Lighting represents a prime example of a technology that continues to evolve as processes progress and new challenges arise. In logistics scenarios, for example, highly reflective plastic wraps and shipping bags present challenges in barcode reading and optical character recognition (OCR) applications. Plastic is highly reflective, resulting in hot spots in captured images that can make it impossible for a camera or code reader to read a barcode underneath. While polarizers reduce reflections on specular surfaces, these filters eliminate most of the available light, thus reducing contrast and making it difficult to read barcodes. A new electronic design that boosts light output far beyond traditional overdrive light modes can help overcome the plastic wrap challenge, however.

## Dual vs. Deca Explained

In the new electronic design, the LED lights deliver Dual OverDrive mode, which combines two overdrive engines: standard OverDrive™ and a new "deca" OverDrive.

By itself, Smart Vision Lights' standard OverDrive™ mode delivers more than five times the output of continuous mode, which is more than many other manufacturers' lesser overdrive modes. With the new Deca mode, end users get a 1 millisecond light pulse that is 10 times brighter than continuous mode. Combined in a Dual OverDrive design, standard OverDrive™ and Deca OverDrive form a single integrated unit that allows a user to select a lighting mode via the strobe duration. Dual OverDrive mode always begins with 1 ms of Deca mode, which delivers the 10x brighter light pulse. If the exposure continues beyond 1 ms, the light falls to standard OverDrive™ mode to extend the output. Dual OverDrive seamlessly combines the operation of the two modes into one function.

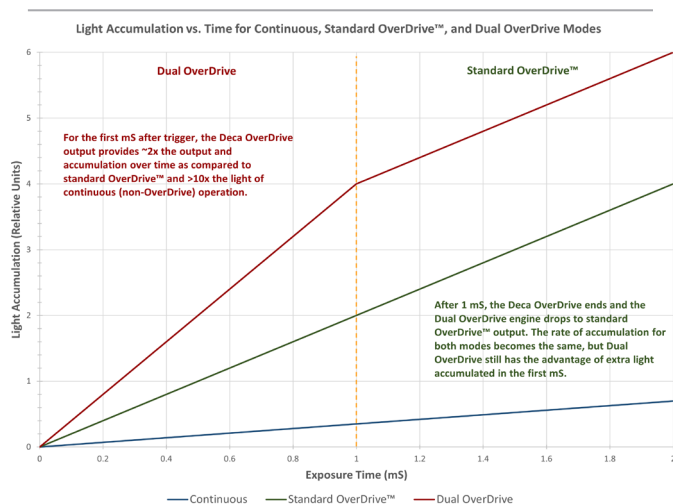


The duty cycle of Dual OverDrive on the LHI-DO Series is 3.5%.

**Figure 1 — Duty cycle of the LHI300 light in Dual OverDrive mode**

Like other lights with OverDrive™ mode, to prevent burnout, a Dual OverDrive light has a shorter duty cycle than a light operating in continuous mode. Duty cycle values are represented in percentages, indicating the total ratio of the light being on versus the light resting. Figure 1 shows an example: an

LHI300 LED light running for 1 ms in deca mode and 5 ms max in standard overdrive mode, with a 165 ms rest period for a 3.5% duty cycle. A short duty cycle on a Deca OverDrive light might not impact users as expected, or even at all. For example, an application with a 100 μs pulse width at a 3% duty cycle can repeat the Deca OverDrive pulse every 3.3 ms. In terms of frame rate, this equates to 300 fps. Even an application with a 500 μs pulse width and a 3% duty cycle can run at 60 fps, which suits many industrial machine vision applications. In addition, 500 μs of Deca OverDrive still provides more light than 5 ms in continuous mode.



**Figure 2 — Light accumulation versus time for continuous, standard OverDrive™, and Dual OverDrive modes in the first two milliseconds**

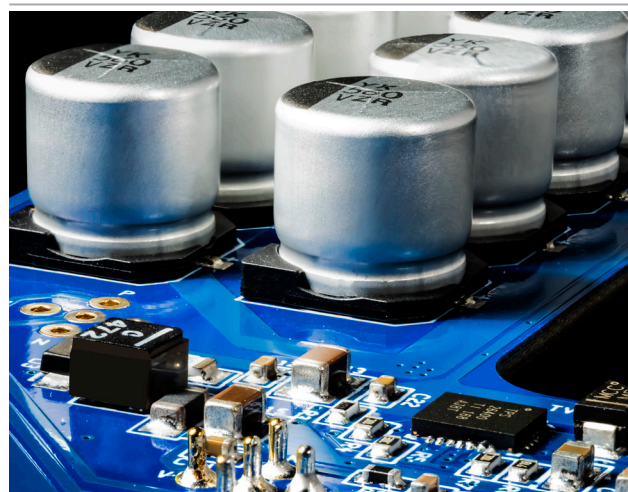
Figure 2 shows the three different modes using the same LEDs: Continuous, standard OverDrive™, and Dual OverDrive. In the first millisecond after trigger, Deca mode delivers two times the output and accumulation over time compared to standard OverDrive™

and 10 times the light of continuous mode operation. After 1 ms, the Deca mode ends and the Dual OverDrive engine drops to standard OverDrive™. At this point, the rate of accumulation for both modes becomes the same, but Dual OverDrive™ has the advantage of extra light accumulated in the first millisecond.

### Bright Lights. Low Power

Traditional overdrive circuits providing extra bursts of bright light are fed by high currents, often as high as 15 or 20 A. Many smart cameras and other machine vision components are limited to a much lower threshold and cannot support the higher bursts of overdrive lights. The supply lines commonly found on factory floors often require supplied power to remain under 100 W (4 A at 24 VDC) at all times to be compliant with NEMA Class 2 supply line regulations.

With the new Dual OverDrive technology, the current draw — even on larger lights — can be limited to less than 3 A peak, with most models staying under 2 A. A novel onboard energy storage and power management design coupled with a charging management circuit helps ensure powerful bursts of light while maintaining a low consistent electrical draw. With the slow charging of the storage bank of capacitors during the rest period in the duty cycle, a full charge can be reached over a longer time without a high current ever being pulled from the source.



**Figure 3 — Example of circuit design showing the energy storage and power management system**

### A Canning Line Speed Boost

In a recent application, the new Dual OverDrive lights saw deployment on a canning line running 100 parts per second. The previous design used a bar light operating in OverDrive™ mode, running between 40 and 50 ms of exposure time on the cans, with the variation occurring due to pixel blur. In this setup, the LED's gain was set at 12x, and resulting images were noisy and not as sharp as the system required. By replacing these lights with four Dual OverDrive lights, the integrator went from 40 to 50 ms, motion blur, and 12x gain down to 12 ms exposure with zero motion blur or gain.

In this application, the integrator was able to replace the lights in less than a day, which is important considering the cost of downtime. To that end, the new Dual OverDrive lights were designed with ease of use and space in mind. Available in ring and linear formats, the lights offer direct connection and control

through a camera's trigger output. The linear lights come in 300- or 600-mm lengths and can be used to create tunnel systems capable of illuminating a package of any size, while the ring lights can be mounted directly to most common machine vision camera housings through optional mounting plates. Additionally, the lights feature a new integrated cable that connects to the camera, light, and controller and reaches up to 15 meters.

## Connect for a Test Today

As automation applications in the logistics industry and beyond continue to evolve, so too must the technologies that drive the systems. Lighting – a key technology to any visible light-based machine vision system – is no different. Many high-speed inspection systems today need bright light in short exposure times, with zero motion blur or gain, to capture the right image for a camera or barcode reader. Designed specifically to overcome the plastic wrap challenge in logistics applications, Lightgistics series machine vision lights from Smart Vision Lights allow end users to attach polarizers, optical filters, or additional diffusion while retaining exceptional light output that can handle any speed, without adding significant power requirements to the light for a range of different applications.

To learn more about these lights or to schedule a test with us, please reach out to [sales@smartvisionlights.com](mailto:sales@smartvisionlights.com) or call us at +1 (231) 722-1199.

## About Smart Vision Lights

Smart Vision Lights (Norton Shores, Michigan) is a leading designer and manufacturer of high-brightness LED lights for industrial applications, including machine vision. Smart Vision Lights products come with universal internal current-control drivers, offering constant or strobed operation, reduced wiring requirements, and easy installation. Smart Vision Lights products are also the safest on the market thanks to the company's in-house IEC 62741 light-testing laboratory, guaranteeing conformity and compliance for your lighting systems, regardless of where they are installed around the globe.

Learn more at [SmartVisionLights.com](http://SmartVisionLights.com) or by calling +1 (231) 722-1199.