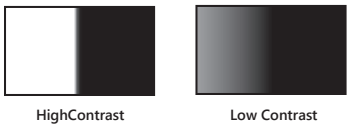
Machine Vision Lighting Overview

Generic lighting products are designed to provide basic illumination. However, lights designed for use as part of machine vision systems are designed with high-quality LEDs to provide consistent and uniform light across the desired field of view. Here are some considerations that should be kept in mind when designing an optimized machine vision lighting system.

Goals for Machine Vision Lighting

Contrast

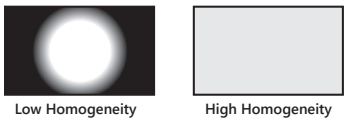
Maximizing contrast is the ultimate goal for any machine vision lighting system. If high contrast can be obtained, then detection is going to be a lot easier. In fact, maximizing contrast is the reason that most camera vision applications are monochrome. Contrast in monochrome images makes image processing easier.



To achieve the best contrast, the user must have a balance between homogeneity and brightness.

Homogeneity

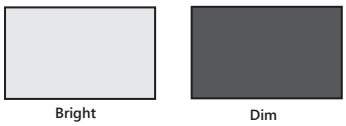
Homogeneity can be thought of as uniformity. The light needs to illuminate the whole field of view uniformly. Hot spots or dark spots remove contrast from specific regions of the field of view and can adversely impact vision accuracy, while a homogenous (uniform) field of illumination can greatly enhance accuracy.



Brightness

Brightness, which is essential in creating contrast, is important in machine vision systems.

By increasing the brightness, system designers can create more robust systems using shorter exposure times. As an added benefit, this will also reduce motion blur.



It is true that if you put more current through an LED, it will get brighter. But one of the worst things for an LED's lifespan is over-current. Even though more current means a brighter LED, that brightness comes at a cost, for the brighter the LED gets the more heat is generated and the more its lifespan is reduced. In other words, the lifespan of an LED is directly related to the current through the LED.

The manufacturers of our machine vision lights have taken great care in selecting the brightest and highest quality LEDs. They have also carefully engineered these lights to maximize light output and LED lifespan in order to deliver a product that will work consistently well for a long period of time. For instance, in order to achieve higher brightness, some of our lights can be strobed with higher current. In these lights, built-in microprocessors manage strobe duration to maximize brightness without adversely impacting life expectancy of the LEDs.

Dealing With Ambient Light

One of the hardest things to design out of a machine vision application is interference with your controlled lighting coming from unwanted ambient light in the location where the system will be used. Ambient light varies greatly from location to location, so designers must keep potential ambient light impacts in mind when designing machine vision lighting systems.

A common misconception is that ambient light comes only from overhead. However, the truth is that ambient light can come from several sources. Among the conditions which can impact ambient lighting are sunlight through a window, the reflection off of a reflective surface, or even a shadow.

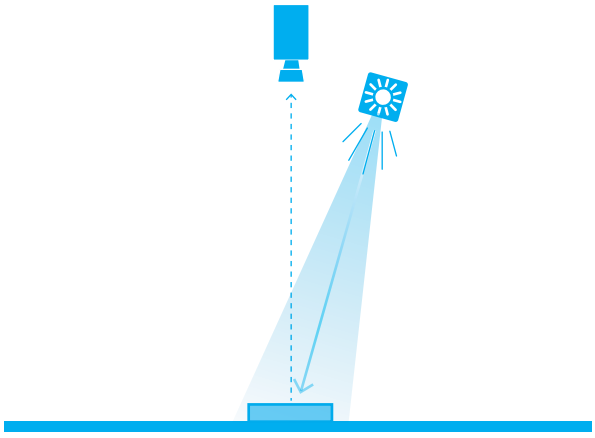
There are situations in which building a shroud around the inspection area is the most appropriate way to deal with ambient light. In other situations, the best way to deal with it is to increase the brightness of the light source.

Another solution to deal with ambient light is to use a specific color (wavelength) of light along with a corresponding filter to only allow that color of light to pass through to the camera. For example, when using a red light (625nm), you can use a 625nm bandpass filter to block out unwanted ambient light of other wavelengths.

Machine Vision Lighting Overview, continued

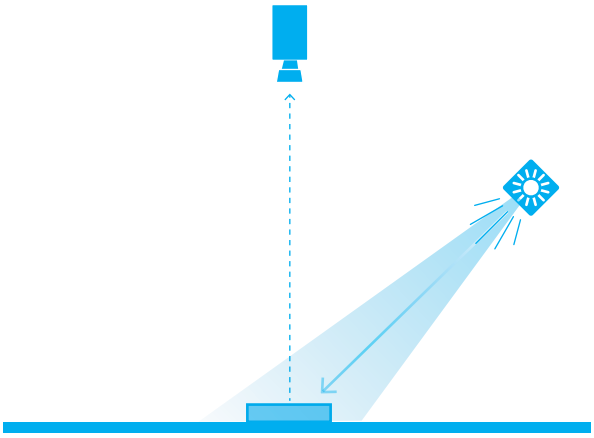
Lighting Principles

Effective machine vision lighting relies on several factors, including what is known as the "angle of incidence." Angle of incidence is defined as the angle at which the light strikes the object being illuminated. This angle is measured from an imaginary line between the camera and the light source, The examples below illustrate how different lighting angles can be used in various applications.



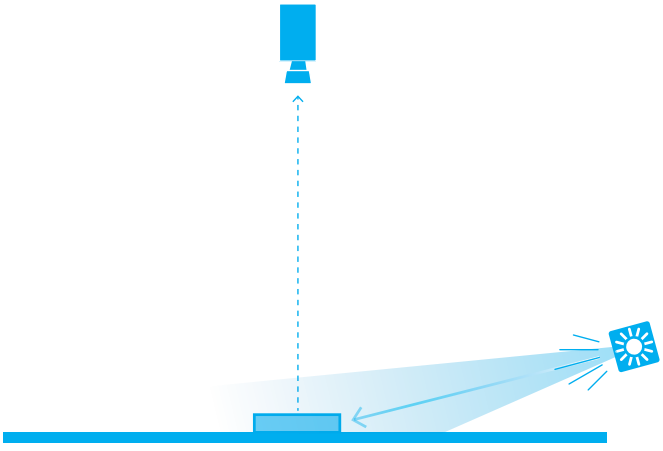
Bright field

- Usually, the angle of incidence is between 0 and 30 degrees.
- Bright field is the easiest type of lighting principle for humans to understand, because this is how we generally see the world. However, this type of lighting system may not be well suited for use where shiny parts are involved.
- Diffusers or polarizers might be needed to decrease the unintended direct reflections.



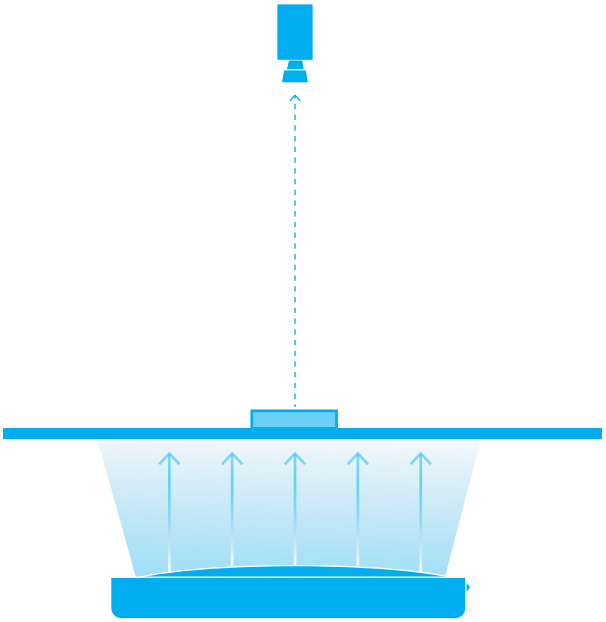
Low angle

- Usually, the angle of incidence is between 30 and 80 degrees.
- The lighting source is placed between the dark field and the bright field so that the user can take advantage of both illumination methods.
- Good for engravings



Dark field

- Usually, the angle of incidence is between 80 and 90 degrees
- This lighting configuration will generally bring high contrast to the edges. For parts that are not shiny, a narrow beam angle is usually best. For shiny parts, a diffused light source usually works best.
- Applications include edge detection and measurement.



Backlight

- The light source is placed behind the object.
- When using this method, it is important that the light is bigger than the field of view.
- Backlighting light sources should be highly diffused and offer high homogeneity.
- Backlighting makes it possible to see a silhouette.

WenglorTPL Vision Lighting High-Powered Back Light

OPT2420

The WenglorTPL Vision Back light is a high-powered solution for all backlighting applications and quality control tasks, including detection of presence/absence, analysing edge defects, liquid fill level measurement and silhouetting.

The WenglorTPL Vision Back Light has exceptionally narrow borders (only 4mm wide), making the useful illumination area of the light easy to integrate into your system. The unit's LEDs are mounted with highly efficient lenses, engineered to distribute the highest brightness and uniformity balance available for machine vision backlights.

The Back Light also features integrated current control, making it easy to wire, install and use.

WenglorTPL Vision Back Lighting Selection Guide

Part Number	Price	Color of Light	Light Temperature	Area of Light	Overdrive	Mode of Operation	Drawings
OPT2418	$676.00	White	5700K	200 x 200mm [7.87 x 7.87 in]	No	Continuous or strobe	PDF
OPT2420	$1,135.00			300 x 300mm [11.81 x 11.81 in]			PDF
OPT2422	$1,646.00			400 x 400mm [15.75 x 15.75 in]			PDF

WenglorTPL Vision Infrared Back Lighting Selection Guide

Part Number	Price	Color of Light	Wavelength	Area of Light	Overdrive	Mode of Operation	Drawings
OPT2419	$841.00	Infrared	850nm	200 x 200mm [7.87 x 7.87 in]	No	Continuous or strobe	PDF
OPT2421	$1,546.00			300 x 300mm [11.81 x 11.81 in]			PDF
OPT2423	$2,271.00			400 x 400mm [15.75 x 15.75 in]			PDF

WenglorTPL Vision Lighting Bracket Selection Guide

Part Number	Price	Description	Material	Qty in Package	Drawing
OPT2433	$82.00	Mounting bracket	Aluminium	4	PDF

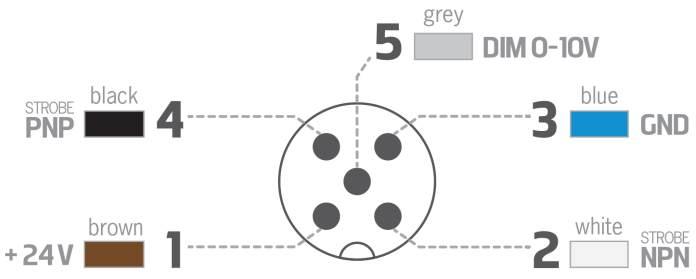
OPT2433

WenglorTPL Vision Lighting High-Powered Back Light

wenglor TPL

Back Light General Specifications	
Electronics	
Power Supply	24VDC ±10%
Functioning Mode	Continuous or strobe
Strobe Input	PNP: From 5 to 24V for 100% ON. From 0 to 1V for 100% OFF NPN: Less than 1V for 100% ON. Above 2V for 100% OFF. Max 20V
Overdrive	No
Strobe Conditions (ON time, duty cycle)	No restriction
Dimming	Pin 5 (M12 5-pole connector): 0-10 V = 100-30% respectively
Maximum Rising Time	15µs
Maximum Falling Time	10µs
Control	Conector M12 5 poles
Consumption	White: 21.6 W (OPT2418), 48.6 W (OPT2420), 86.4 W (OPT2422) Infrared: 27.5 W (OPT2419), 61.9 W (OPT2421), 110 W (OPT2423)
Minimum Functioning Voltage	20V at the light input
Normal Functioning Voltage	24V at the light output (±10%)
Maximum Functioning Voltage	30V at the light input
Maximum Consumption Strobe Signal On Largest Product (400x400 mm)	250mA
Maximum Consumption Dimming Signal On Largest Product (400x400 mm)	150mA
Optics	
Color	White (5700K) Infrared (850nm)
Mechanics	
Thickness	45mm
Weight	23.2 kg/m^2 ±15%
Materials	Aluminum and loaded ABS
Diffuser	White PMMA
Mounting	4 M4 nuts (supplied) to insert in the groove or 4 M4x20 screws (not supplied) applied to the corner slots
Environment	
Operating Temperature	-10°C to 40°C / 80% humidity without condensation No thermal shock (maximum temperature variation 10C in 24 hours)
Storage Temperature	-20°C to 60°C / 80% humidity without condensation No thermal shock (maximum temperature variation 10C in 24 hours)
IP Protection	IP40

Connections



Strobe PNP	
1	+24V
2	Not connected
3	Ground
4	PNP
5	Dim 0-10 V

Strobe NPN	
1	+24V
2	NPN
3	Ground
4	Not connected
5	Dim 0-10 V

Continuous Mode			
1	+24V		+24V
2	Not connected		Ground
3	Ground	OR	Ground
4	+24V		Not connected
5	Dim 0-10 V		Dim 0-10 V