# 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
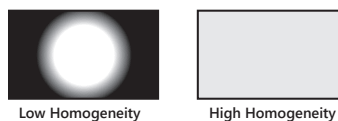
Contrast

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.

HighContrast   Low Contrast
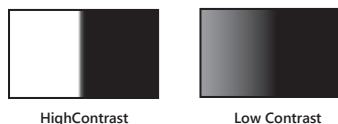
Homogeneity

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.

Low Homogeneity   High Homogeneity

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.

Bright   Dim
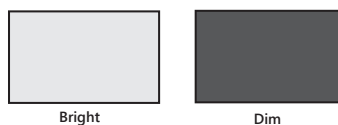
It is true that if you put more current through an LED, it will get brighter. But one of the worst things for an LED's lifespan is over-current. Even though more current means a brighter LED, that brightness comes at a cost, for the brighter the LED gets the more heat is generated and the more its lifespan 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 the ambient light present 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.

# 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.
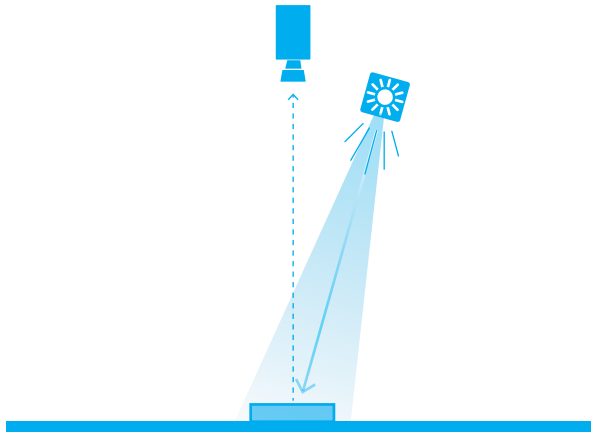
Bright field

- 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.
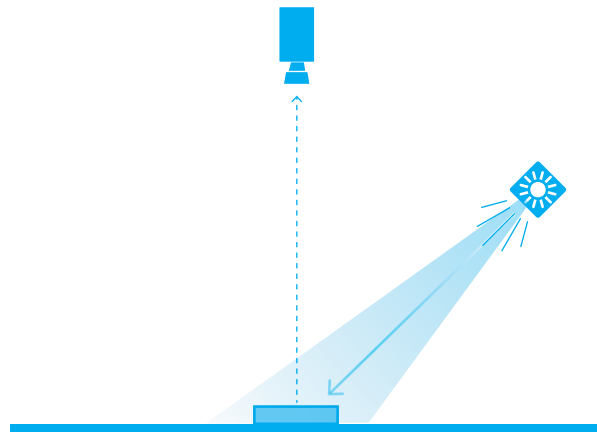
Low angle

- 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
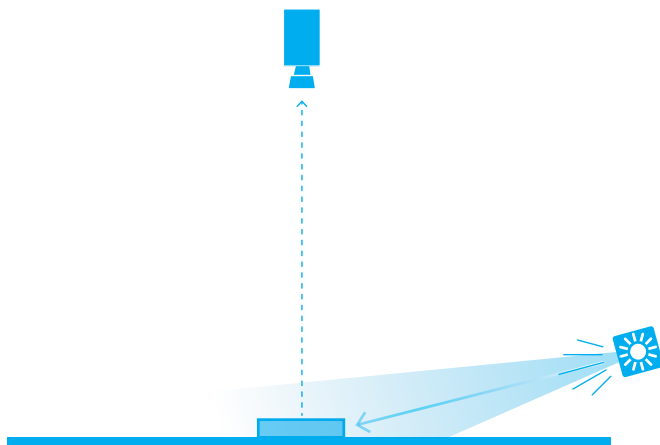
Dark field

- 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.
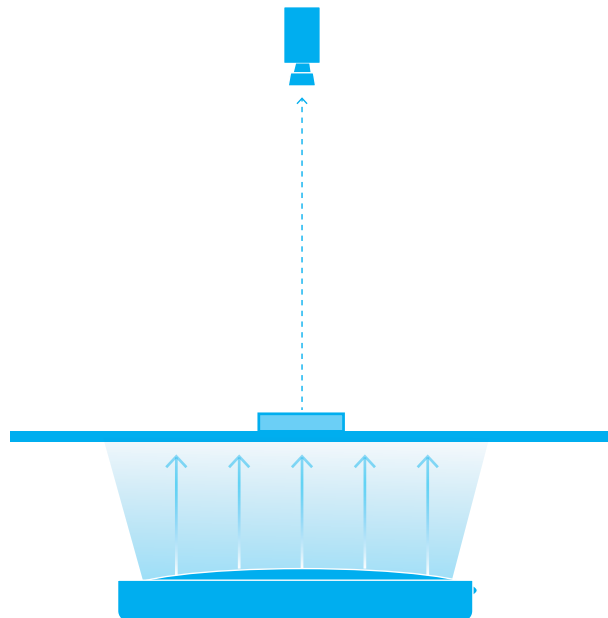
Backlight

- 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 Flat Dome Light

wenglor TPL

OPT2435

WenglorTPL Vision's Flat Dome Light is a high-power flat dome illumination solution for machine vision applications such as Pick and Place or Logistics. The LEDs are mounted with highly efficient lenses, engineered to distribute the highest brightness and uniformity balance available for machine vision applications.

The Flat Dome Light also also features integrated current control, making it easy to wire, install and use. The central opening allows for simple placement of cameras using lenses up to 65mm [2.56 in] in diameter.

WenglorTPL Vision White Illumination Flat Dome Light Selection Guide

Part Number	Price	Color of Light Emmission	Temperature	Area of Light	Overdrive	Mode of Operation	Drawings
OPT2435	$1,002.00	White	5700K	200 x 200mm	No	Continuous or strobe	PDF
OPT2437	$1,432.00			300 x 300mm			PDF

WenglorTPL Vision Infrared Illumination Flat Dome Light Selection Guide

Part Number	Price	Color of Light Emmission	Wavelength	Area of Light	Overdrive	Mode of Operation	Drawings
OPT2436	$1,169.00	Infared	850nm	200 x 200 mm	No	Continuous or Strobe	PDF
OPT2438	$1,682.00			300x300 mm			PDF

Part Number	Price	Description	Material	QTY in Package	Drawings
OPT2433	$82.00	Mounting Bracket	Aluminium	4	PDF

OPT2433

WenglorTPL Vision Lighting Flat Dome Light

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Flat Dome 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	15us
Maximum Falling Time	10us
Control	Conector M12 5 poles
Consumption	White: 21.6 W (OPT2435), 48.6 W (OPT2437) Infrared: 27.5 W (OPT2436), 61.9 W (OPT2438)
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
Internal Diameter	65mm
Weight	23.8 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 10°C in 24 hours)
Storage Temperature	-20°C to 60°C / 80% humidity without condensation No thermal shock (maximum temperature variation 10°C in 24 hours)
IP Protection	IP40

Connections

5 grey DIM 0-10V

STROBE PNP black 4

3 blue GND

+24V brown 1

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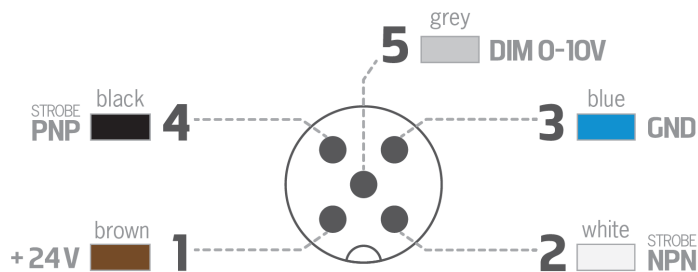
Strobe PNP	
1	+24V
2	Not connected
3	Ground
4	PNP
5	Dim 0-10 V

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	Ground
4	+24V	Not connected
5	Dim 0-10 V	Dim 0-10 V

(OR between the two columns)