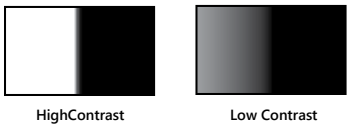
Machine Vision Lighting Overview

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

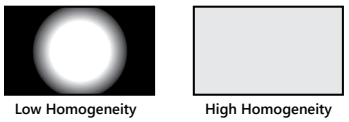
Maximizing contrast is the ultimate goal for any machine vision lighting system. If high contrast can be obtained, then detection is going to be a lot easier. In fact, maximizing contrast is the reason that most camera vision applications are monochrome. Contrast in monochrome images makes image processing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



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

Homogeneity

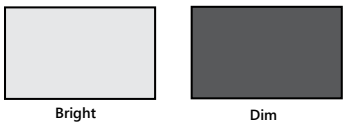
Homogeneity can be thought of as uniformity. The light needs to illuminate the whole field of view uniformly. Hot spots or dark spots remove contrast from specific regions of the field of view and can adversely impact vision accuracy, while a homogenous (uniform) field of illumination can greatly enhance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

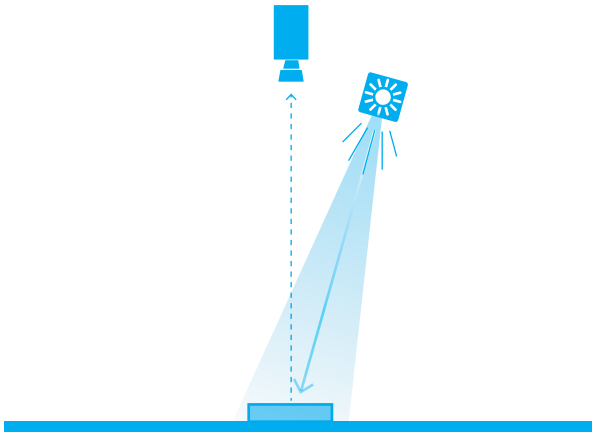
There are situations in which building a shroud around the inspection area is the most appropriate way to deal with ambient light. In other situations, the best way to deal with it is to increase the brightness of the light source.

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

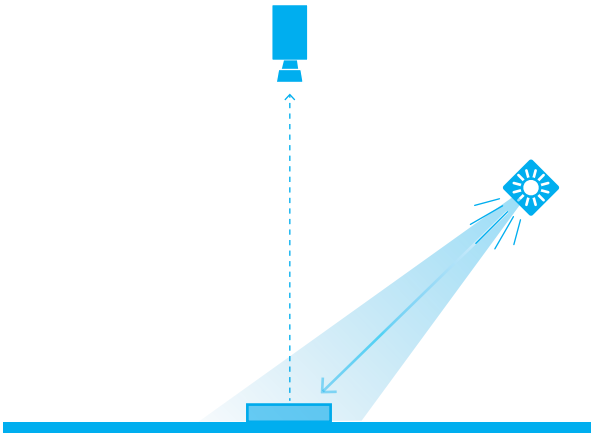
Lighting Principles

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.



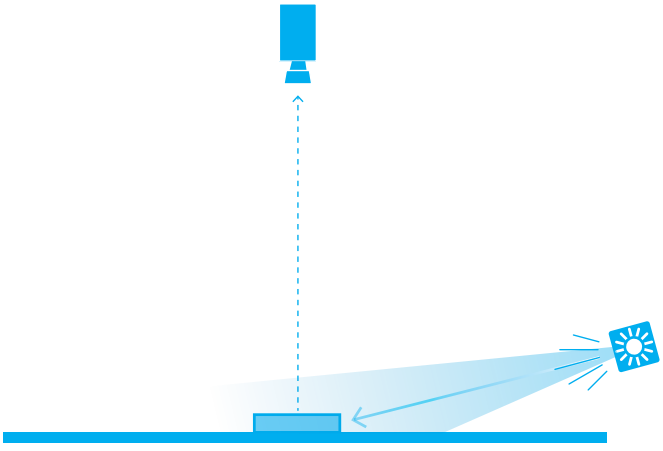
Bright field

- 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.



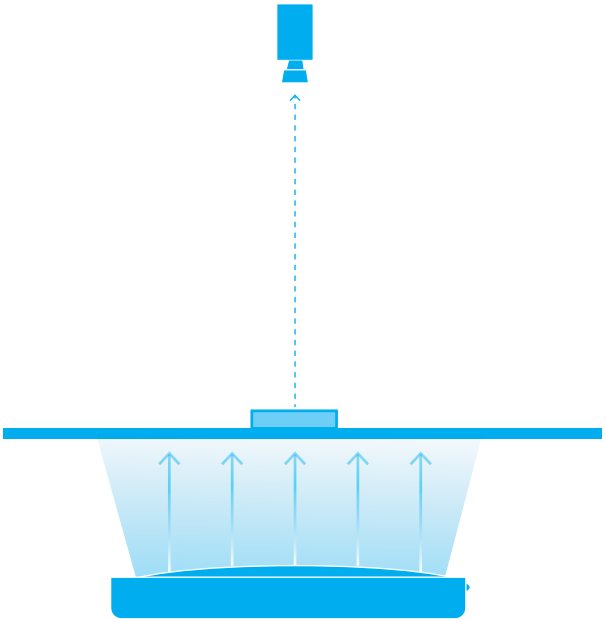
Low angle

- 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.

Lumher Ring Lighting (RD Series)

RD2PD5CY

RD1PD5CY

Lumher's RD Series of ring lights provides an exceptionally durable and robust solution when direct illumination is required. The RD Series lights are built in a one-piece anodized aluminum frame. Thanks to the compact and versatile form factors of the lights, the illumination they provide facilitates precise object detection, tracking, and inspection. This makes them ideal for applications requiring reliable and comprehensive visual analysis in industrial and automation environments.

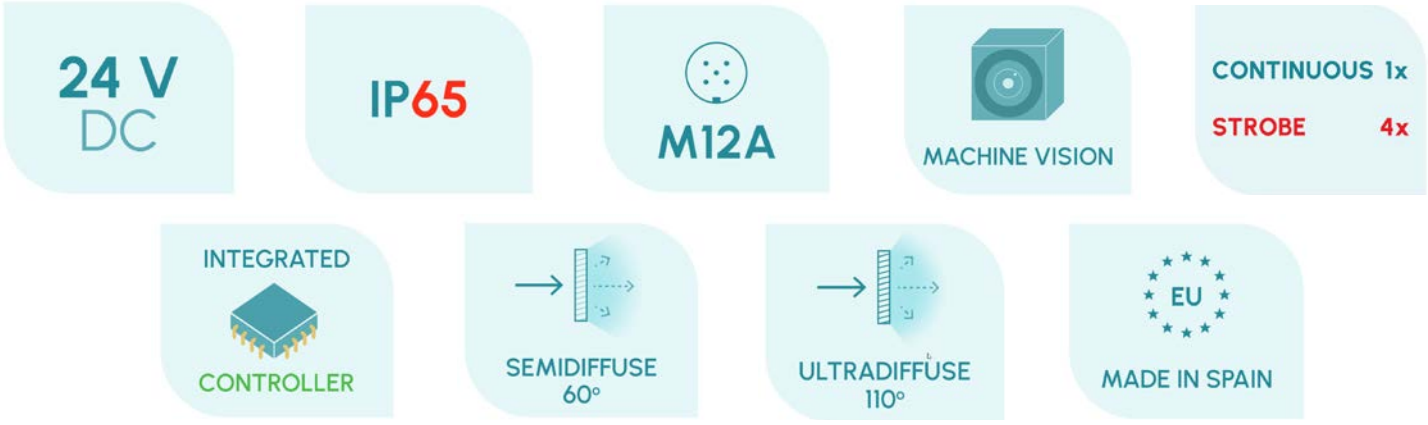
This type of light fixture is widely used in robotics, where (because the robot is in motion) it is recommended that lighting devices have the smallest possible dimensions to avoid possible mechanical interference. Such lighting is also recommended for certain production lines, where limited space calls for the use of compact lighting.

Features

- Robust aluminum body
- IP65
- Integrated controller
- Available in compact or extended size
- Continuous only or strobe-capable models available
- Semi-diffused or ultra-diffused illumination options available

Lumher RD Series Ring Lighting Selection Guide

Part Number	Price	Light Emission	Inside Dimension (mm [in])	Diffuser	Mode of Operation	Drawings
RD1PD5CY	$;06h]u:	White (5000K)	59 [2.32] diameter	Semi-diffused (±30°)	Continuous only	PDF
RD2PD5CY	$;06h]v:	White (5000K)	135 x 135 [5.31 x 5.31]	Semi-diffused (±30°)	Continuous only	PDF
RD1ZD5CY	$;06h]x:	White (5000K)	59 [2.32] diameter	Semi-diffused (±30°)	Strobe-capable	PDF
RD2ZD5CY	$;;006h]z:	White (5000K)	135 x 135 [5.31 x 5.31]	Semi-diffused (±30°)	Strobe-capable	PDF
RD1ZD5UY	$;;06h]]:	White (5000K)	59 [2.32] diameter	Ultra-diffused (±55°)	Strobe-capable	PDF
RD2ZD5UY	$;;;006h][:	White (5000K)	135 x 135 [5.31 x 5.31]	Ultra-diffused (±55°)	Strobe-capable	PDF
RD1PF5CY	$;06h[7:	Infrared (850nm)	59 [2.32] diameter	Semi-diffused (±30°)	Continuous only	PDF
RD2PF5CY	$;06h[c:	Infrared (850nm)	135 x 135 [5.31 x 5.31]	Semi-diffused (±30°)	Continuous only	PDF



Lumher Ring Lighting (RD Series)

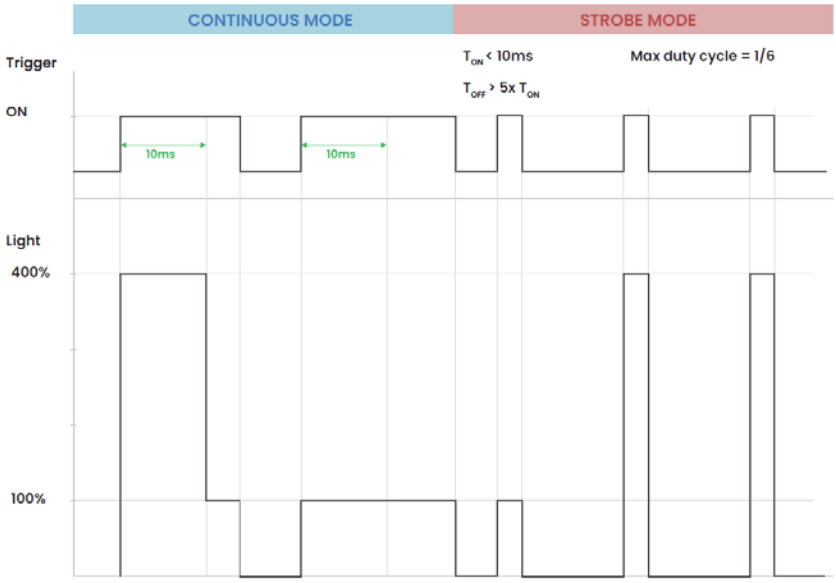
Lumher RD Series Ring Lighting Specifications		
	Continuous Mode	***Strobe Mode***
Strobe Input	–	PNP: More than 22V for ON; Less than 1V for OFF NPN: Less than 1V for ON; More than 23V for OFF
Overdrive	No	Yes
Strobe Conditions (ON time, duty cycle)	–	For first 10ms, 4X normal brightness; then normal brightness. To re-engage strobe, LEDs must be off for at least 50ms.
Maximum Rising Time	3µs	
Maximum Falling Time	3µs	
Connection	M12 A-coded 4-pole connector	
Consumption	RD1 models: White: 7.6 W RD2 models: White: 15.2 W RD1 models: Infrared: 4.0 W RD2 models: Infrared: 8.0 W	RD1 models: White: 30.4 W RD2 models: White: 60.8 W
Minimum Functioning Voltage	22.8 VDC	
Normal Functioning Voltage	24VDC ±5%	
Maximum Functioning Voltage	25.2 VDC	
Maximum Consumption Strobe Signal	–	1.5 mA
Maximum Strobe Duty Cycle	–	16%
Operating Temperature	-10°C to 40°C [14°F to 104°F]	
Operating Maximum Humidity	80% without condensation	
Weight	RD1: 0.615 kg [1.36 lb] RD2: 1.276 kg [2.81 lb]	
Materials	Body: Anodized aluminum Side cover: Anodized Aluminum Diffuser: Polycarbonate	
Storage Temperature	0°C to 60°C [32°F to 140°F]	
Lifespan of LEDs (ON time)	6.8 years	
IP Protection	IP65	

Connections

M12 A-Coded Connections		
Pin Number and Wire Color	***Continuous-Only Models***	***Strobe-Capable Models***
Pin 1 – Brown	+24VDC	+24VDC
Pin 2 – White	Not Connected	Trigger NPN
Pin 3 – Blue	0VDC	0VDC
Pin 4 – Black	Not connected	Trigger PNP

M12 A-Coded Male Connector

Timing Chart



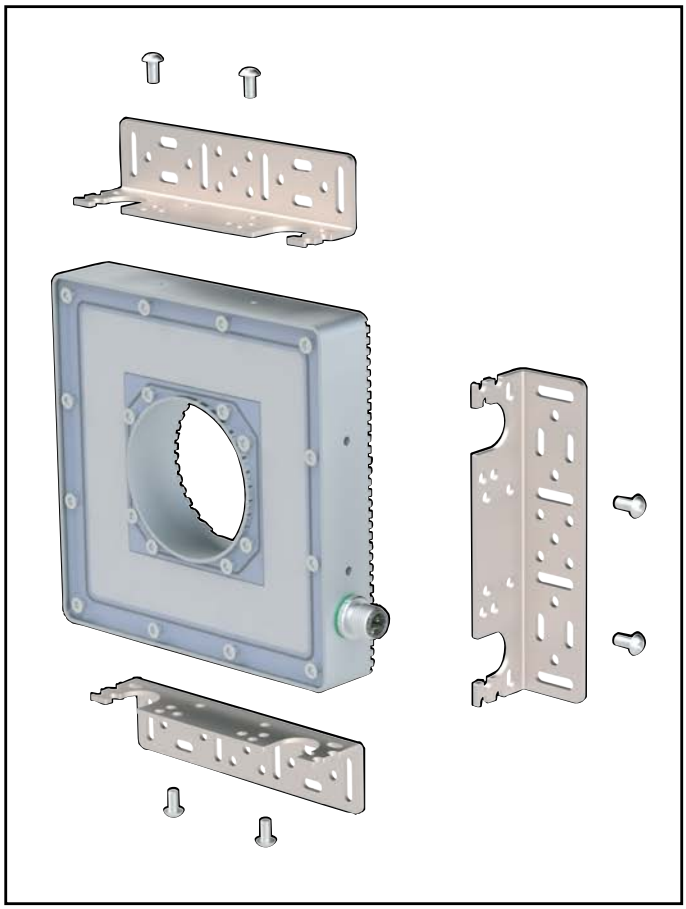
Lumher Mounting Accessories For RD, BS and BD Series Lights

lumher

Lumher RD, BS and BD Series Mounting Bracket Selection Guide				
Part Number	***Price***	***Material***	***Mounting***	***Drawings***
B00S1	$;-6h[i:	Stainless steel	For mounting lights: Use supplied screws For mounting brackets: Use customer-supplied screws	PDF

B00S1

Mounting Assembly for B00S1 With RD Series Light



Mounting Assembly for B00S1 With BS or BD Series Light