Achieving Optimal Image Quality With Appropriate Lighting And Camera Technology

Introduction

Unlocking the Potential of Machine Vision.
In modern industrial imaging and machine vision applications, achieving high-quality, consistent image data is critical for accurate inspection, measurement, and decision-making. The clarity of an image directly determines inspection accuracy, production yield, and overall operational efficiency.

Welcome to this in-depth case study, demonstrated, with products of our two key principals, SCHOTT and OMRON SENTECH. The case study aims to illustrate how optimal image quality is achieved by leveraging both appropriate lighting and cutting-edge camera technology.

SCHOTT LED Light And Omron Camera STC-HD213DV

EasyLED Backlights / Direct LED Illumination



Schott and Omron Sentech

Transmitted Light • Ringlights • VisiLED • Gooseneck lightguide Camera Systems DVI over HDMI, Full HD 1080p, Color, CMOS Sony IMX291, 1/2.8'', 2.8 µm, 60 fps, Rolling Shutter, C Mount, cased High SNR / High Frame-Rate Image Capture.

Product Overview


Problem Statement And Impact

During extended continuous-operation, Standard LED lights generate heat that transfers directly to the camera sensor. This causes thermal expansion, pixel noise, and image degradation over long shifts.

Impact 1: Digital Image Degradation: Focus drift and digital noise severely reduces image clarity, color accuracy, and sharpness.

Impact 2 : Pixel Noise: Heat agitates electrons inside the sensor pixels, creating "dark current" that appears as grainy, colored digital noise.

Impact 3: Thermal Expansion: Physical camera components and the sensor substrate expand slightly due to the rise in temperature Component Wear: Continuous high-temperature operation shortens the operational lifespan of the image sensor and surrounding processors.

Impact

Lower Signal-to-Noise Ratio (SNR): As heat increases sensor noise, the camera struggles to distinguish between real light data and heat-induced artifacts, especially in shadow areas.

Component Wear: Continuous high-temperature operation shortens the operational lifespan of the image sensor and surrounding processors.

High SNR vs Low SNR Imaging Comparison : Mannequin Test Subject

Figure 1: low SNR Original Noisy Data

Figure 2: High SNR image Clean Data

Why it is needed: Industrial Imaging & Machine Vision, both the camera (Omron Sentech) and the lighting (Schott).

Both camera and the lighting are critical and complementary components. You cannot achieve reliable inspection with only one of them—they work together to produce clear, repeatable, and analyzable images.

Role of Omron Sentech Camera is the “eye” of the system. Why it is needed.

Image acquisition-Captures the object, image processing

Resolution & accuracy – Detects fine defects (scratches, particles, alignment issues)

Speed – High frame rates for inline automation
Sensor quality – CMOS sensors provide low noise and high dynamic range

Example 1: Inspecting semiconductor wafers need high-resolution sensor to detect micron-level defects

Example 2: Barcode reading on fast conveyor need high-speed imaging . Without a good camera: No usable data for processing(AI/vision software cannot work)

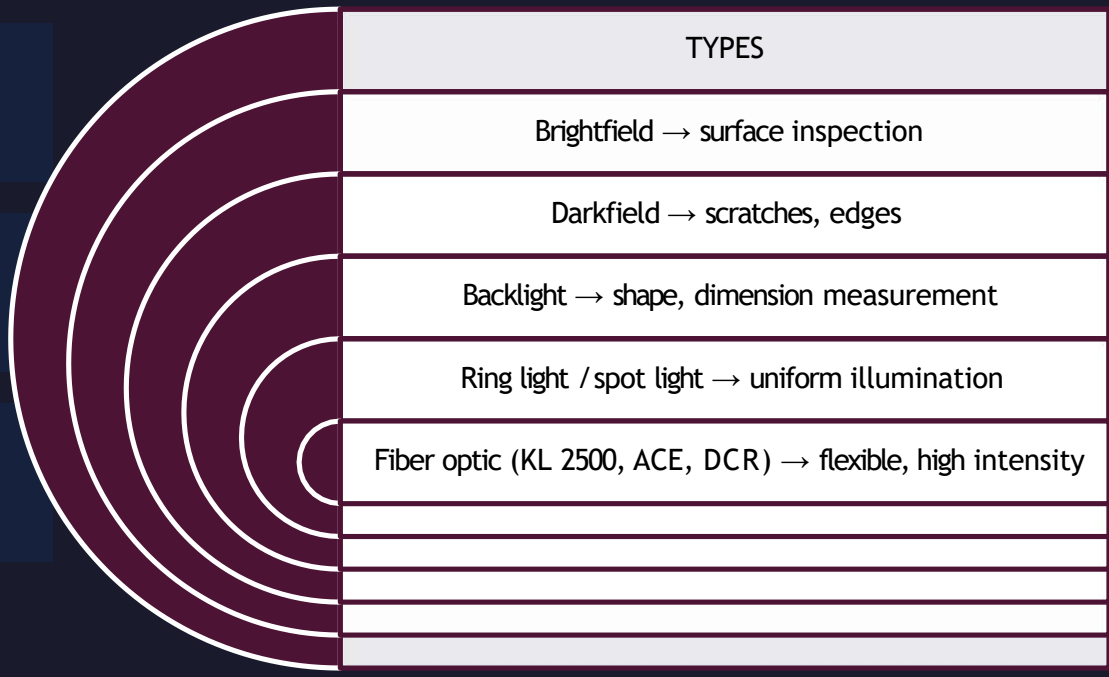
Role of Schott Lighting and Why it is needed and Type?

The lighting is the "brain behind visibility" often more important than the camera. Why it's needed?

Enhances contrast – Makes defects visible
Controls shadows & reflections

Highlights specific features (edges, scratches, texture, height differences)

Without proper lighting:
Even the best camera sees "nothing useful" (poor contrast, glare, shadows)
Ensures repeatability – stable, uniform illumination

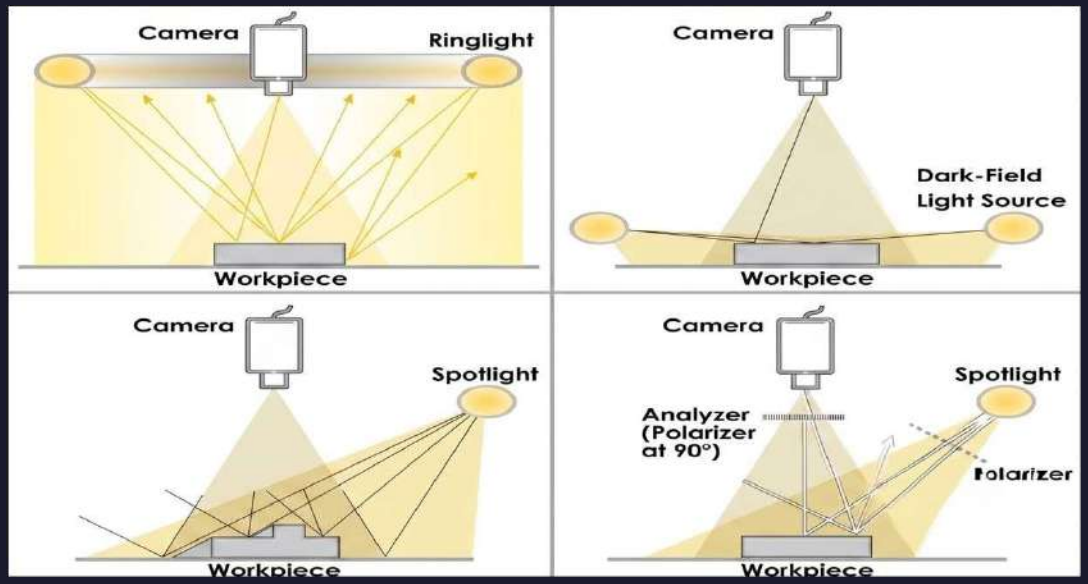


Why both Omron Sentech Camera and Schott Lighting required Integration?

Pairing a high-performance Omron industrial camera with specialized Schott illumination creates a powerful synergy. Together, they control the two most critical variables in industrial imaging: optical throughput and contrast isolation. Key Principle:

Machine vision = Camera + Lighting + Optics + Software

This integration achieves high-precision, repeatable, and reliable inspection in industrial machine vision systems through two primary mechanisms.

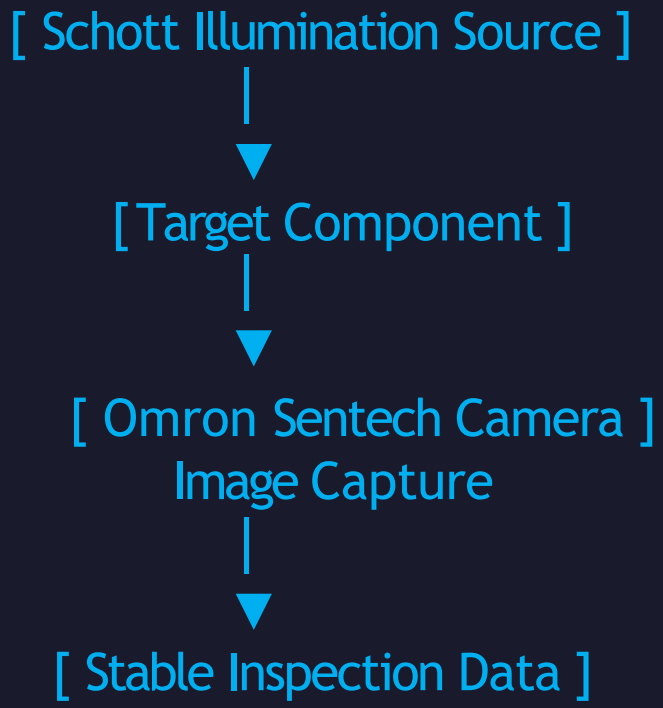


Omron Sentech Camera + Schott

Component	Function	Result if Missing
Camera (Omron Sentech)	Captures image	No data
Lighting (Schott)	Reveals features	Poor or unusable image

Integration	Function	Result
Omron Camera + Schott light	Reliability + Extremely stable illumination	Optimized imaging performance
Omron Camera + Schott light	High-speed interfaces(STC-HD213DV,USB3, GigE)+Precision-engineered optics	Reduces false rejection / missed defects
Omron Camera + Schott light	High image quality + Wide portfolio (fiber optic, LED, backlight, darkfield)	Improves yield in manufacturing

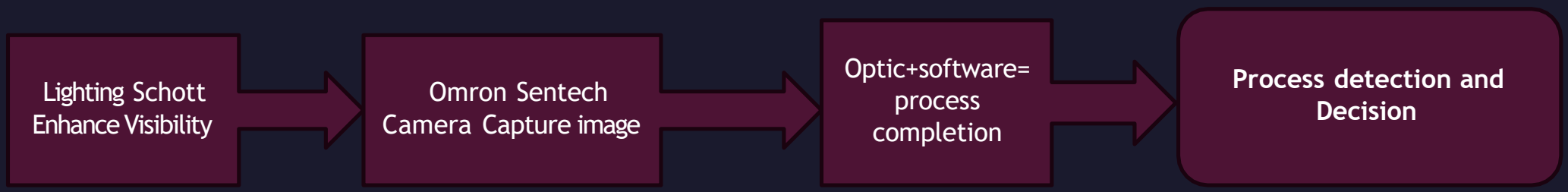
The Imaging Solution Structure (Camera + Lighting)



The Core Industrial Imaging Solution (Lighting + Camera)

To overcome the challenges of unpredictable contrast, distortion, and high-speed motion blur, machine vision setup requires distinct optical isolation. The solution lies in a synchronized, application-specific hardware pairing.

- **Lighting defines visibility (Schott)**
- **Camera captures accurate image (Omron Sentech)**
- **Optics & software refine the data**



Advantages of Standardizing on Omron Sentech & Schott

The combination of Omron Sentech and Schott provides distinct, long-term competitive advantages for industrial automation.

High-quality glass & optical materials
Excellent thermal stability and lifetime consistency

Industrial-grade camera design
Long-term stability for 24/7 operation
Low failure rate in harsh environments

Strong Application Engineering Support
Pre-sales application consultation
Lighting selection guidance
Camera + optics matching

Benefit to customer:
Stable performance over time → less recalibration → lower maintenance cost

Proven Industrial Track Record Both brands are widely used in:Semiconductor manufacturing Electronics (PCB, IC inspection)Automotive inspection Medical and precision industries

Sales Ready

- Our solution combines Omron Sentech industrial cameras with Schott precision lighting to deliver a complete and reliable imaging system.
- With a wide product range, proven optical quality, and strong engineering support, we ensure not only high image performance but also long-term stability and reduced operational risk for your production line.

KL 1600 LED

Easy LEDBack Light

KL 2500 LED

Application to Hardware

The Omron Sentech STC-HD213DV is a DVI/HDMI direct-to-monitor camera (not a camera processing data natively via a high-speed factory PLC network interface like GigE or USB3 Vision), it is ideal for manual or semi-automated inspection stations (e.g., operator-guided quality control benches, rework stations, and microscopy labs)

Technical Feature	Sales /Business Value Proposition
Schott Cold Light Sources (Fiber/Advanced LED)	Minimizes heat transfer to the camera, preventing drifting inspection metrics and eliminating the need for constant, costly system recalibrations.
Omron 60 fps Full HD Direct DVI Output	Plugs directly into a monitor without requiring a PC, providing zero-latency real-time viewing that speeds up manual PCB/wafer inspection workflows.
Segmented Ringlight Rotation	Allows operators to dynamically change contrast angles without physically moving the sample, reducing operator fatigue and increasing daily throughput.

Direct LED Illumination

Schott — Standard illumination for stereo microscopy

Direct LED Illumination

Schott — Standard illumination for stereo microscopy

- Transmitted brightfield Stage (TLS-BF)
- 80 white LEDs in 8 segments
- light density up to 20,000 cd/m2

Transmitted Light Stage

EasyLED Backlight — Area 600 400 Max

Adaptors for Transmitted Light Stage

Adaptor Range	Part No.
Ø 84 mm to Ø 90 mm	**157 630**
Ø 84 mm to Ø 100 mm	**157 600**
Ø 84 mm to Ø 120 mm	**157 610**
Ø 84 mm to Ø 180 mm	**157 620**

ILLUMINATED AREA

Ø 50 mm (1.97")

MAX. LUMINANCE

12,000 cd/m²

DIAMETER

84 mm (3.31")

INPUT

12 V DC

EasyLED Ringlights

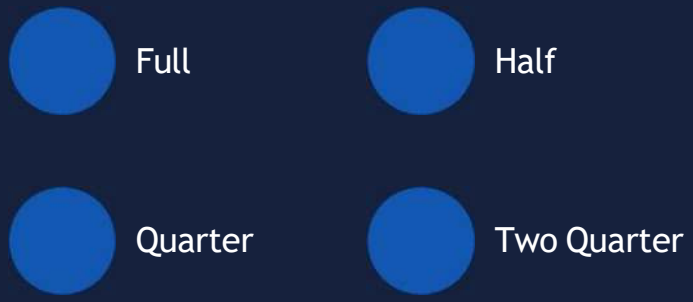
Ergonomic and compact illumination for stereo microscopy and macroscopy

- **No separate controller box**
- **Ergonomic operating (not necessary to remove eyes from the eyepieces)**
- **Continuous dimming from 0 to 100%**
- **Wide input range power supply (100 – 240 V)**
- **Worldwide plug (clip system)**

Basic segment features: Full / Half / Quarter / Two Quarter

Ringlight Plus

Controllable segment features with segment rotation. Easy and intuitive operation via integrated "jog dial" wheel.

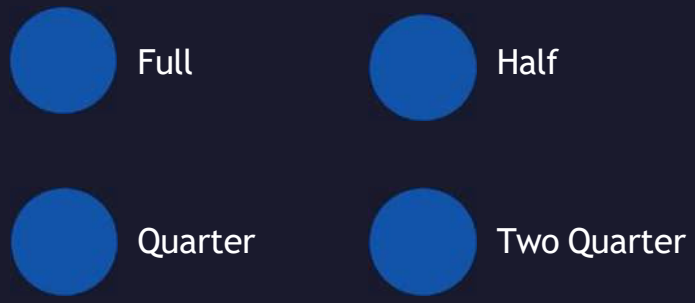


EasyLED Ringlights

Ergonomic and compact illumination for stereo microscopy and macroscopy

Basic segment features: Full / Half / Quarter / Two Quarter

- MC1500 Control of two channels
- Save up to four complex illumination scenarios
- Foot switch operation & USB-connectivity



VisiLED Brightfield Light Heads

Illumination system specially developed for stereo microscopy and macroscopy

- **Easily adaptable to microscope objectives by means of thumb screw and clamp ring**
- **Homogeneous illumination**
- **Long operating life: usually 50,000 h by actively controlling the LED's temperature**
- **Segments controllable in different preset modes for optimum contrasting**

Unique ultra slim ringlight — adjustable for various working distances

Unique darkfield ringlight for specialized contrasting

System Overview

VisiLED Brightfield and EasyLED product line integrates advanced LED illumination with control functionality in a compact device. Designed for routine inspection using the SCHOTT VisiLED MC 1500 controller. Able to rotate the lights in the desired direction.

A wide variety of LED ringlights optimised for different working distances guarantees the best performance for each microscope system.

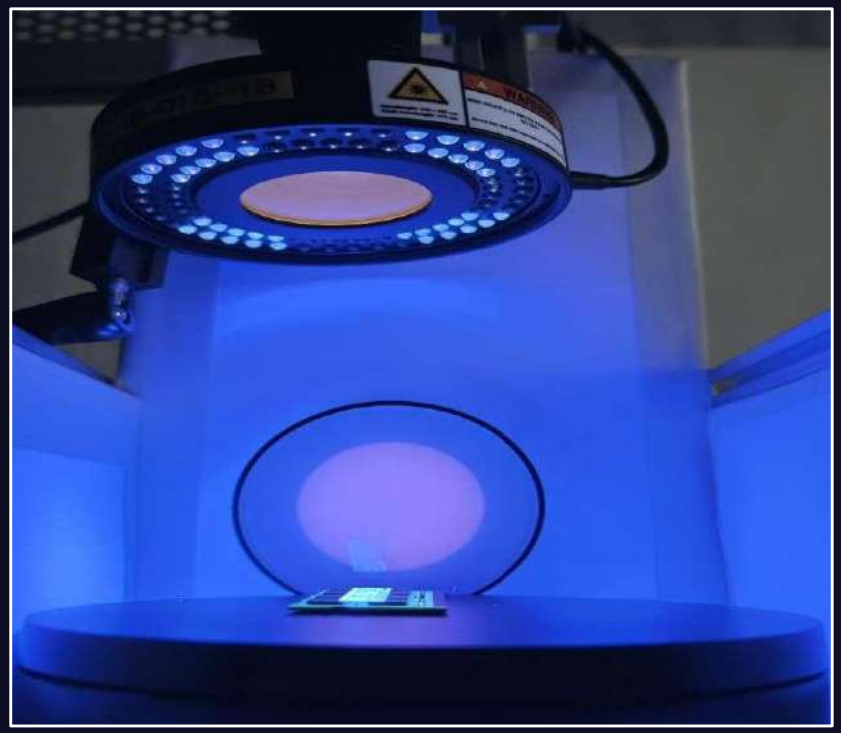
Brightfield, Darkfield, Polarized Light Image

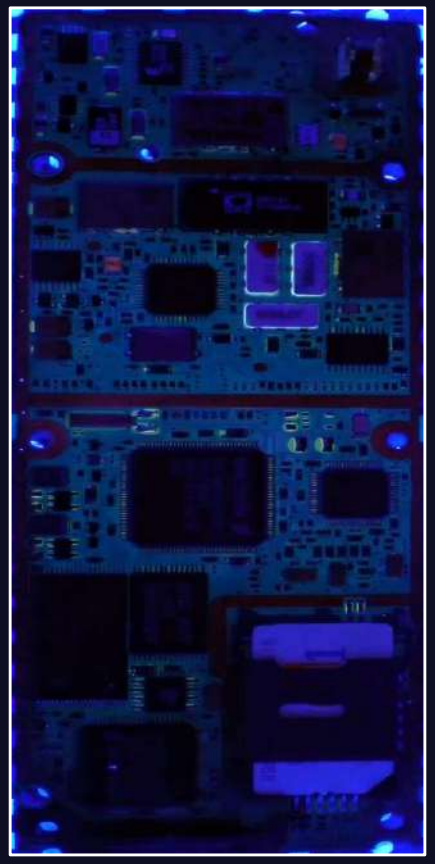
Illumination system specially developed for stereo microscopy and macroscopy Quick comparison

Feature	Brightfield 🔆	Darkfield 🟣	Polarized 🌈
Background Color	⚪ Bright white	⚫ Pitch black	⚫ Dark / black
Specimen Appearance	🎨 Natural or stained colours	✨ Glowing white / silver edges	🌈 Rainbow (interference colours)
Primary Mechanism	🔅 Light absorption	💫 Light scattering	🔁 Light wave rotation

VisiLED Brightfield Light Heads

Illumination system specially developed for stereo microscopy





- S80-55 Perfect brightness for every demand
- 80 white LEDs in 8 segments
- working distance 55 - 135 mm
- max. illuminance 200 klx (at 75 mm WD)

VisiLED Controllers MC1500 & MC 1000

Advanced control units for SCHOTT VisiLED illumination systems

- MC 1500
- Control of two channels
- Save up to four complex illumination scenarios
- Foot switch operation & USB-connectivity

- MC 1000
- Very intuitive operation
- Ergonomics
- Blindfold operation
- Segmentation & rotation

Omron STC-HD213DV

Digital Video Camera (Suit for HDMI Video Output) Remote Control Unit for all DVI/SDI camera models

DVI-Type Digital Video Signal

DVI output refers to a video signal format (DVI) that the camera sends out through its video port — not traditional HDMI audio/video. Accessories available RC-HD133

The STC-HD213DV is well suited for microscope applications with moderate to high levels of available illumination (e.g. Brightfield, darkfield, POL, phase contrast, reflected and transmitted microscopy). Ideal for classroom projection systems.

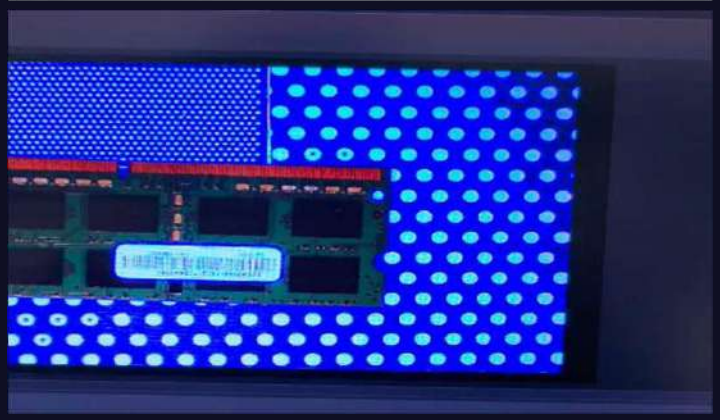
Illumination Modes

- Brightfield
- Darkfield
- POL
- Phase Contrast
- Reflected
- Transmitted

Compatible Systems

- Stereo or Compound Microscope
- Monozoom optical systems
- Stand alone optical systems

Omron STC-HD213DV



Camera Applications

Omron Sentech STC-HD213DV — Ideal choice for diverse environments

Industrial Manufacturing

Quality control, inspection, and precision measurement in production environments. Reliable imaging for demanding industrial workflows.

Student Laboratory / Classroom

Ideal for classroom projection systems. Enables group viewing and real-time teaching of microscopy techniques.

Biomedical Sub-assembly Build

Precision imaging for biomedical device assembly. Supports quality assurance in cleanroom and laboratory settings.

System Integration

Combining Schott illumination with Omron camera technology

Complete imaging workflow — from precision LED illumination to digital video capture, optimized for microscopy applications across industrial, educational, and biomedical environments.

Silicon Connection

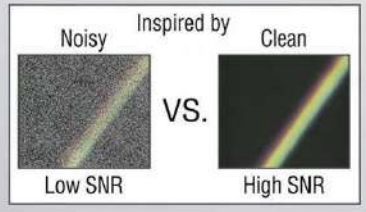
OMRON

SCHOTT
glass made of ideas

OMRON SENTECH CAMERA SYSTEMS

Digital Video Camera (HDMI/DVI), Full HD 1080p, Color, CMOS Sony IMX291, 1/2.8', 2.8 µm pixel size, 60 fps, Rolling Shutter, C Mount, cased.

Benefit:
High SNR / High Frame-Rate Image Capture



PRODUCT OVERVIEW

Complete imaging workflow solution combining specialized lighting and high-performance camera technology. Integration of optical throughput and contrast isolation.

SCHOTT PRECISION ILLUMINATION

KL 1600 LED controller

EasyLED Ringlight

Gooseneck Lightguide

VisiLED controller

- Schott LED Light and Omron Camera STC-HD213DV
- EasyLED Ringlights / Direct LED Illumination
- VisiLED MC 1500 Controller and segmented ringlights
- Gooseneck lightguides

Benefits:
- Optimal Contrast and Defect Isolation
- Segmented segment feature control with rotation

Call to Action Partnership with Silicon Connection Pte Ltd

Schedule an On-Site Demo: Let us bring the SCHOTT VisiLED system and Omron camera to your cleanroom/ lab to test on your actual sample wafers/ PCBs.

"Sample Evaluation Service:" Send your most challenging, low-contrast parts to our Silicon Connection application engineering team, and we will provide a report on the perfect lighting geometry for your defects.

Schott LED Light Source and Omron Sentech Camera

Silicon Connection Pte Ltd | Distributor You Trust
TURNING CHALLENGES INTO SOLUTIONS
https://www.si-cnx.com/products/lighting-imaging/