Advanced Test, Measurement, and Inspection Solutions

Light & Color

COLORIMETERS • PHOTOMETERS • GONIOMETERS • NEAR FIELD MEASUREMENT SYSTEMS • SOFTWARE

RADIANT
VISION SYSTEMS

A KONICA MINOLTA Company

Reliable Measurement Solutions for Today's Manufacturers

Light and color are central to the way you interact with many products in your daily life. Consider the critical role of touchscreen displays in today's smartphones, laptop and tablet PCs, and wearable electronic devices; the safety implications of flat-panel automotive dashboards and airplane instruments; and the impact of lighting sources from the overhead fluorescents in your office building to the streetlights on your block to the headlights in your car.

As manufacturers of these products, you need accurate, repeatable, and easy-to-use solutions to ensure product quality, generate accurate specification data, and improve efficiencies. Radiant Vision Systems offers a broad portfolio of light measurement products, including imaging photometers and colorimeters, as well as software, to measure, characterize, and inspect light and color in the lab or on the production line. Our specialized CCD-based systems help manufacturers gain a competitive advantage in today's marketplace, where margins are thin and customer expectations high. Calibrated to replicate human perception of brightness and color, they combine the benefits of automation – speed, flexibility, and repeatability – with the relevancy and accuracy of human vision.

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![Radiant Vision Systems — A KONICA MINOLTA Company logo]

Radiant Vision Systems' products for light and color measurement can be found in test, measurement, and inspection systems throughout the world. With field-proven integrated solutions, a pioneering history of technological innovation, and unparalleled customer support, Radiant is the choice of leading manufacturers in the consumer electronics, lighting, automotive, and other industries. Typical applications include:

- Automated production and manufacturing
- Research and development
- Quality assurance and control

Radiant Vision Systems has earned its place as a technology leader by operating on a few simple principles:

Customer First
We listen to, learn from and stay close to you-our customer. Understanding your needs and challenges and creating working solutions is central to our development as a company.

Quality Products
Our products are engineered to meet the rigorous standards of reliable, repeatable performance with the highest levels of accuracy and speed in the industry.

Deliver Solutions
You need more than just hardware and software, you need solutions. We manufacture and support the best equipment available, but our real deliverable is working solutions.

Continuous Improvement
Rapid changes in the industry and your specific needs require continual innovations in technology, manufacturing, and product development. At Radiant Vision Systems, a healthy obsession to modify and improve products drives the development of new features and products to solve evolving challenges in a dynamic business environment.

Global Support

A variety of one-on-one support is as close as your phone or keyboard:

- Application Specific Programming
- Production Line Integration
- Consulting and Applications
- Software
- Engineering

Radiant Vision Systems is a global partner committed to your success. Our hardware, software, systems, and products always include the support of our consulting and engineering teams. Our experienced personnel leverage decades of real-world experience and a wide range of capabilities to deploy systems that are optimized for your specific application. Our global infrastructure includes offices in China, Korea, and North America to ensure delivery of exceptional worldwide support.

ProMetric® Imaging Colorimeters and Photometers

## Precise Spatial Measurements of Luminance and Chromaticity

Thousands of our imaging systems are used in high volume, 24/7 production environments and a wide variety of R&D settings to measure:

- Light sources
- Information displays
- Light emitting and transmitting materials

Our ProMetric® line comes in a range of models to accommodate different application parameters. This allows us to provide the optimal solution to meet our customers' requirements for speed, resolution, and optical configuration.
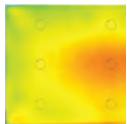
Critical Parameters to Consider
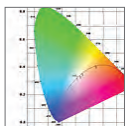
Color Accuracy:
The ability to accurately match measurements to a color coordinate system, such as the CIE or L*a*b* Color Space.

Luminance Accuracy:
Absolute accuracy of luminance measurements; calibration compensates for system noise and photopic filter accuracy.

Signal to Noise:
Larger electron well depths and low system noise yields greater precision and higher contrast ratios in a single image. HDR imaging capabilities are also available for higher contrast measurements if required.
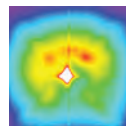
Pixel Resolution:
Distinguish fine detail within images; for a given field of view, higher CCD pixel resolution means greater spatial detail.
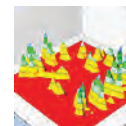
Imaging and Readout Speed: Time required to capture and readout images from the CCD. A trade-off exists between speed, noise, and captured image detail.
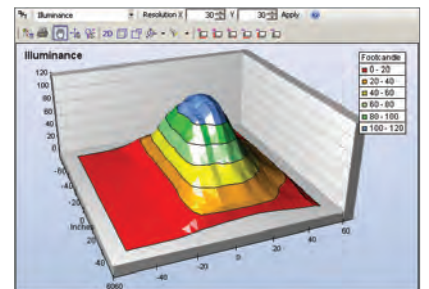
Thermally regulated CCDs:
CCDs provide fast imaging, and the highest image quality. Keeping the CCD cool ensures very low system noise. Interline CCDs provide optimal image acquisition speed.

Field of View and Electronic lenses:
The CCD and lens must be chosen based upon the required Field of View and working distance. Smart lenses allow camera operation at any working distance. This enables the same camera to be used for many future applications.

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ProMetric® Specifications

Photometers	IP-PMY2	IP-PMY16	IP-PMY29
Primary Application	Uniformity testing, NFMS, in R&D Lighting	Production Line Testing	
CCD Type	Interline, cooled to + 5°C		
CCD Megapixels	1.9	16.0	28.8
CCD Pixels	1600 x 1200	4896 x 3264	6576 x 4384
Pixel Resolution	1600 x 1200	4896 x 3264	6576 x 4384
System Dynamic Range (single exposure, per pixel)	61.4 dB (1 x 1 binning)		
	73.4 dB (2 x 2 binning)		
High Dynamic Range (multi-exposure)	> 1,000,000:1		
Luminance - Minimum	0.00001 cd/m² Limit of Detection 0.0001 cd/m²@ SNR = 60 0.0005 cd/m²@ SNR = 100		
Luminance - Maximum	10¹⁰ cd/m² with optional ND filters		
System Accuracy	Illuminance ± 3% Luminance (Y) ± 3%		
Short-Term Repeatability	Illuminance ± 0.02% Luminance (Y) ± 0.02%		
Lens Type / Focal Distances Available	Electronically controlled focus and aperture; 24, 35, 50, 100, 200 mm	Electronically controlled focus and aperture; 35, 50, 100, 200 mm	
Field of View (Full Angle, H x V Degrees)	24 mm 20° x 15° 35 mm 14° x 10° 50 mm 10° x 8° 100 mm 5° x 4° 200 mm 3° x 2°	35 mm 41° x 28° 50 mm 30° x 20° 100 mm 15° x 10° 200 mm 8° x 5°	35 mm 55° x 37° 50 mm 40° x 28° 100 mm 20° x 14° 200 mm 11° x 7°
Minimum Measurement Time (for 100 cd/m²)	0.28 seconds - photopic	0.9 seconds - photopic	1.9 seconds - photopic
Spatial Measurement Capabilities	Luminance, Radiance, Illuminance, Irradiance, Luminous Intensity, Radiant Intensity		
Units	foot-lambert, cd/m², nit, W/sr/m², foot-candles, lux, lux-s, W/m², W-s/m², candela, W/sr		
Communication Interface	Ethernet 100/1000, USB 2.0		
Power	AC / DC adapter, 100-240 V, 50-60 Hz, 80 Watts		
LCD Touch Panel	None		
Dimensions (H x W x D)	86 mm x 86 mm x 154 mm		
Weight	1.4 kg		
Operating Temperature	0 - 30° C		
Operating Humidity	20 - 70% non-condensing		

Colorimeters	IC-PMI2	IC-PMI8	IC-PMI16	IC-PMI29
Primary Application	Uniformity Testing, NFMS, ProMetric in R&D Setting	Production Line Testing		
CCD Type	Interline, cooled to + 5°C			
CCD Megapixels	1.9	8.1	16.0	28.8
CCD Pixels	1600 x 1200 pixels	3296 x 2472 pixels	4896 x 3264 pixels	6576 x 4384 pixels
Pixel Resolution	1600 x 1200 pixels	3296 x 2472 pixels	4896 x 3264 pixels	6576 x 4384 pixels
System Dynamic Range (single exposure, per pixel)	61.4 dB (1 x 1 binning)			
	73.4 dB (2 x 2 binning)			
High Dynamic Range (multi-exposure)	> 1,000,000:1			
Luminance - Minimum	0.00001 cd/m² Limit of Detection 0.0001 cd/m²@ SNR = 60 0.0005 cd/m²@ SNR = 100			
Luminance - Maximum	10¹⁰ cd/m² with optional ND filters			
System Accuracy	Illuminance ± 3%, Luminance (Y) ± 3%, Color Coordinates (x,y) ± 0.003			
Short-term Repeatability	Illuminance ± 0.02% Luminance (Y) ± 0.02% Color Coordinates (x,y) ± 0.00005			
Lens Type / Focal Distances Available	Electronically controlled focus and aperture; 24, 35, 50, 100, 200 mm		Electronically controlled focus and aperture; 35, 50, 100, 200 mm	Electronically controlled focus and aperture; 50, 100, 200 mm
Field of View (Full Angle, H x V Degrees)	24 mm 20° x 15° 35 mm 14° x 10° 50 mm 10° x 8° 100 mm 5° x 4° 200 mm 3° x 2°	24 mm 38° x 30° 35 mm 29° x 22° 50 mm 21° x 16° 100 mm 10° x 8° 200 mm 5° x 4°	35 mm 41° x 28° 50 mm 30° x 20° 100 mm 15° x 10° 200 mm 8° x 5°	50 mm 40° x 28° 100 mm 20° x 14° 200 mm 11° x 7°
Minimum Measurement Time (for 100 cd/m²)	0.3 sec - photopic 1.1 sec - color	0.4 sec - photopic 1.2 sec - color	0.6 sec - photopic 1.5 sec - color	0.9 sec - photopic 2.4 sec - color
Spatial Measurement Capabilities	Luminance, Radiance, Illuminance, Irradiance, Luminous Intensity, Radiant Intensity, CIE Chromaticity Coordinates, L*a*b* Color Scale, Correlated Color Temperature (CCT), Dominant Wavelength			
Units	foot-lambert, cd/m², nit, W/sr/m², foot-candles, lux, lux-s, W/m², W-s/m², candela, W/sr, CIE (x,y) and (u', v'), Kelvin (CCT)			
Communication Interface	Ethernet 100/1000, USB 2.0			
Power	100-240 V, 50-60 Hz, 140 Watts			
LCD Touch Panel	Resolution: 800 x 600 Diagonal: 125 mm			
Dimensions (H x W x D)	238 mm x 181 mm x 230 mm			
Weight	4.9 kg			
Operating Temperature	0 - 30° C			
Operating Humidity	20 - 70% non-condensing			

Specifications subject to change without notice.

ProMetric® I Imaging Colorimeters

Purpose-Built for High-Speed Manufacturing

The ProMetric® I family provides the speed, flexibility, and seamless operation required of production operations.

Production Line Testing

- Color and Luminance
- Contrast
- Uniformity
- Defect Detection

Lighting Characterization

Evaluate and qualify lighting systems against application-specific requirements for light output, color, and illumination.

LED Measurement

Measurement solutions designed for LED and LED lighting system design, development, and QC in high-volume production.

Light and Color Measurement

- Electronic Displays
- Flat Panel Displays
- Illuminated Keyboards
- Back-light Displays
- Lighting Products, including LEDs, near-UV and near-IR

Production Line Test Integrity

The ProMetric® I is the core hardware for fast, accurate, consistent and repeatable testing from line to line.

I2 / I8 / I16 / I29 Key Features and Highlights:

- Multi-exposure High Dynamic Range mode
- Increased speed for reduced measurement times
- Optimized for speed, resolution, and accuracy
- Simplified measurement setup
- Fully-automated remote configuration of production testing
- ProMetric® control and analysis software included
- Controlled via Ethernet / USB Interface
- I2 - 2 megapixel 1600 x 1200 CCD sensor
- I8 - 8 megapixel 3296 x 2472 CCD sensor
- I16 - 16 megapixel 4896 x 3264 CCD sensor
- I29 - 29 megapixel 6576 x 4384 CCD sensor

Purpose-built for manufacturing test of flat panel displays, illuminated keyboards, and LED lighting.

Works seamlessly with TrueTest™ automated visual inspection software.

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ProMetric® Y Imaging Photometers

Optimized for High-Production Environments

High-speed measurement from a compact form factor make ProMetric® Y ideal for photopic and radiometric production applications.

Production Line Testing

- Luminance
- Uniformity
- Contrast
- Defect Detection

FPD Test

Inspect for particle and line defects, surface defects (bubble, scratch), uniformity, light leakage, Mura, and luminance.

- Flat Panel Displays
- Cell Phones
- Tablets
- Notebooks
- Keyboards
- Lighting Products

Production Line Test Environments

Improve quality while reducing costs:

- Faster measurements deliver shorter takt times
- Objective quantification replaces subjective human inspection
- Reliable test analysis improves yield

Y2 / Y16 / Y29 Key Features and Highlights

- High-speed, high-resolution, cooled interline CCDs
- PM-IP Imaging Photometer with internal Tristimulus Y filter for accurate photometric measurements
- PM-IR Imaging Radiometer for IR measurements
- Multiple lens choices with Smart Calibration™ for a wide range of focus and aperture settings
- Supports high-speed USB and Ethernet communications
- Y2 - 2 megapixel 1600 x 1200 CCD sensor
- Y16 - 16 megapixel 4896 x 3264 CCD sensor
- Y29 - 29 megapixel 6576 x 4384 CCD sensor

ProMetric® Software

Rapid, accurate measurements of luminance and color in R&D applications.

- **Simplified Measurement Control**
  To reduce complexity, ProMetric® software provides easy-to-use measurement controls for camera operation and calibration database management.

- **Basic Image Analysis Tools**
  Data representation and analysis capabilities include bitmap review, CIE color chart, color analysis, 2-D / 3-D isoplots, and more.
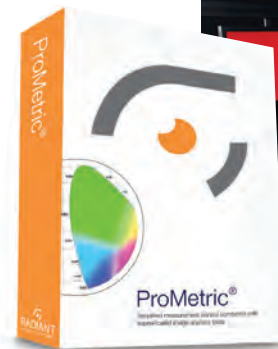
PM-KB™

High-speed automated inspection of keyboards and keypads in production environments.

- **Color and Luminance Uniformity Testing**
  Rapid, automated inspections of keyboards/keypads for overall color and luminance uniformity.

- **Verification of Correct Keycap Installation**
  PM-KB™ provides optical character recognition to ensure keycap placement including the correct location and orientation.

- **Testing for any Configuration of Illuminated Icons**
  PM-KB™ can even ensure correct placement and orientation of logos and labels.

VisionCAL™

Correction of large LED video screens for consistent, uniform color and brightness.


- **Manufacturing**
  The system can address LED module calibration needs in a controlled factory environment.

- **Installation**
  VisionCal™ performs in-field calibration of large, spectacular LED video screens.

- **Maintenance**
  On-site optimization of indoor/outdoor stadium, arena, and billboard media displays.

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TrueTest™ Automated Visual Inspection Solutions

For Flat Panel Displays, Backlight Units, and cosmetic defects in production environments.
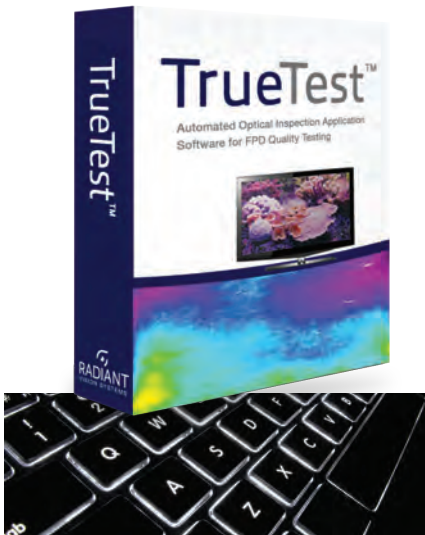
High-Volume Production
Reduce costs, add flexibility, and provide line-to-line and location-to-location consistency with TrueTest™ automated visual inspection.

Embedded Display
Display integrators can focus on their total product with easy control over display quality.


FPD Supply Chain
Improve supply chain performance and processes with data-rich reporting for better results and reduced risk.

Quality and Defect Tests in TrueTest™

- Gradient
- Line Defects
- Particle Defects
- Pixel Defects
- ANSI Brightness
- ANSI Color Uniformity

- Checkerboard Contrast
- Chromaticity
- Distortion
- Focus Uniformity
- Points Of Interest
- Uniformity

- Color Edge Mura
- Color Mura
- Diagonal Pattern Mura
- Polarizer Deformation
- Spot Pattern Mura

Advanced Tests in Optional TrueMURA Module

- Black Mura
- Blob Analysis
- Butterfly Mura
- Corner Light
- Diagonal Line Mura
- Edge Mura

- LED Mura
- Line Mura
- Random Mura
- Spot Mura
- TrueMURATest
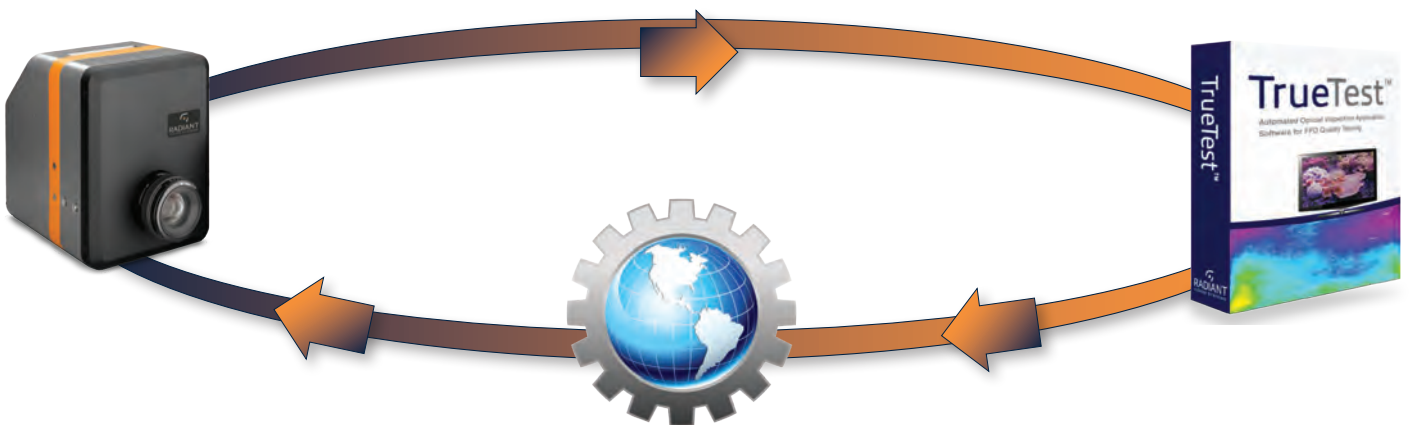
ProMetric® Imaging Colorimeters and Photometers

Reliable, scientific grade CCD-based systems for fast, accurate color and luminance measurements. A ProMetric® Imaging Colorimeter or Photometer is the core piece of hardware in a TrueTest™ system.

Support and Integration Services

Application specialists, engineers, and support teams deploy custom tailored systems for your specific application or environment. TrueTest™ systems are fully integrated into your production process by our on-site engineers.

TrueTest™ Automated Visual Inspection Software

Captured visual inspection data is processed to yield relevant, actionable information for production and development. A built-in library of quality and defect tests enables custom test sequencing and reporting.

Source Imaging Goniometers® (SIG)

The Industry Standard for Near-Field Modeling of Light Sources

Source Imaging Goniometers™ are fully-automated goniometric systems that capture a highly accurate model of a light source's near-field output. The image data and the generated Radiant Source Model™ (RSM) provide a complete and precise characterization of the light source that may be exported, via ProSource® Software, to any major optical design package. Using a ProMetric® Imaging Colorimeter, the SIG-400™ provides precise measurement of near-field luminous intensity for LEDs and other small light sources. The SIG-400™ is optimized to meet the needs of LED researchers, developers, and manufacturers for LED die and device characterization.

Applications

- LED design / package design
- LED characterization
- Provides LED models

Benefits

- Collects image and ray set data
- Generates industry standard Radiant Source Models™
- Exports ray sets to optical design programs using ProSource®

Radiant Source Models™

Accurate modeling of near-field output of real light sources used in optical and illumination design software. RSMs are used to simulate virtually any light source, including LEDs, fluorescent, arc, tungsten halogen, and HID lamps. RSMs are used to generate ray sets that are compatible with optical design software programs.
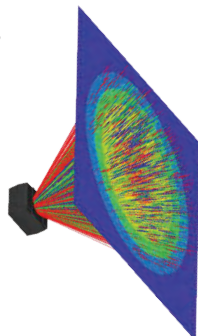
ProSource®

ProSource®-generated ray sets contain an arbitrary number of rays for export to optical design software programs, or as general file formats. Ray sets generated by ProSource® from RSMs are more efficient than random Monte Carlo-generated ray sets, resulting in faster optical design analysis times with higher accuracy.

PM-NFMS™

Test and Measure Near-Field Brightness and Color of Light Sources and Luminaires

1.

2.

Near-field luminance distribution data for developers of large light sources for automotive, transportation, architectural, and other applications. The NFMS delivers comprehensive information in a smaller measurement space than traditional methods.

The PM-NFMS™ system consists of a:

1. **PM-NFMS™ Two-Axis Goniometer**
2. **ProMetric® Imaging Colorimeter**
3. **PM-NFMS™ Software**
4. **ProSource® Software**
5. **Optional Integrated spectrometer**

3.

Applications

- Large light source characterization: luminance, intensity, color vs. angle
- Intensity distribution measurement
- Creation of IES, EULUMDAT, and Radiant Source Model™ files for large sources

Benefits

- Large light source characterization - including illumination distribution - is performed in a compact space
- Generates Radiant Source Model™ for full description of light source performance
- Collects more complete information than far-field measurement techniques

Key Features

- Full ±90° range of motion in two axes
- Laser alignment tool provided to minimize set-up error
- Two sizes of goniometer, with fully-automated measurement control
- Compatible with any ProMetric® Imaging Colorimeter or Photometer
- Near-field to far-field extrapolation integrated into analysis software

*Available w/ optional Integrated spectrometer

Measurement Capabilities

- Luminance
- Color (x,y) and (u',v')
- Tristimulus (X,Y,Z)
- Color difference (u'v')
- Intensity
- UGR
- CRI*
- Spectral data*

Data Representation

- Cross-section graphs
- Histograms
- 3-dimensional surface plot, 2-dimensional isometric surface plot
- CIE color chart plot

Radiant Vision Systems enables you to truly See The Difference™

Radiant partners with leaders in displays, lighting, and controls to help them stay in the lead. Our breakthrough tools and systems for R&D and production testing reduce cost, lower risk, and shorten time-to-innovation.

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