

Advancing XR: Market Trends and Metrology Solutions

Presented by: Chris Williamson

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Chris Williamson

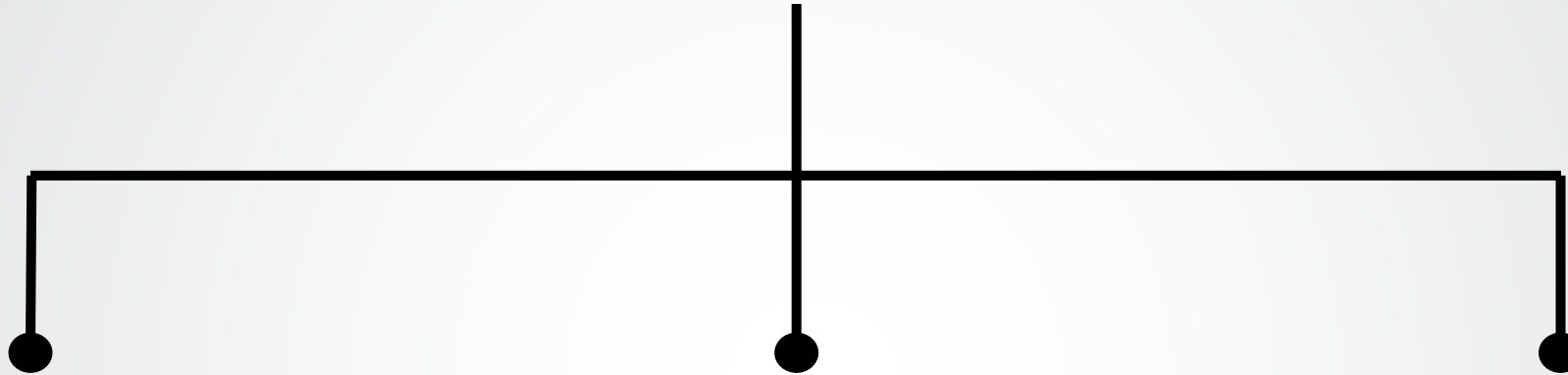
Business Development Manager

Chris directly supports global customers on the Konica Minolta Sensing Americas sales team, where he works across application and product groups to implement solutions that address unique challenges in display and light measurement. He has travelled throughout North America, Asia, and Europe, joining engineers and manufacturers directly in their facilities to understand how Konica Minolta Sensing Americas (KMSA) solutions can meet needs in the field. Chris has in-depth knowledge of how to adapt the KMSA product suite to address new and demanding test and inspection applications.



KONICA MINOLTA

**RETHINK
WHAT'S
POSSIBLE**



Today's Agenda

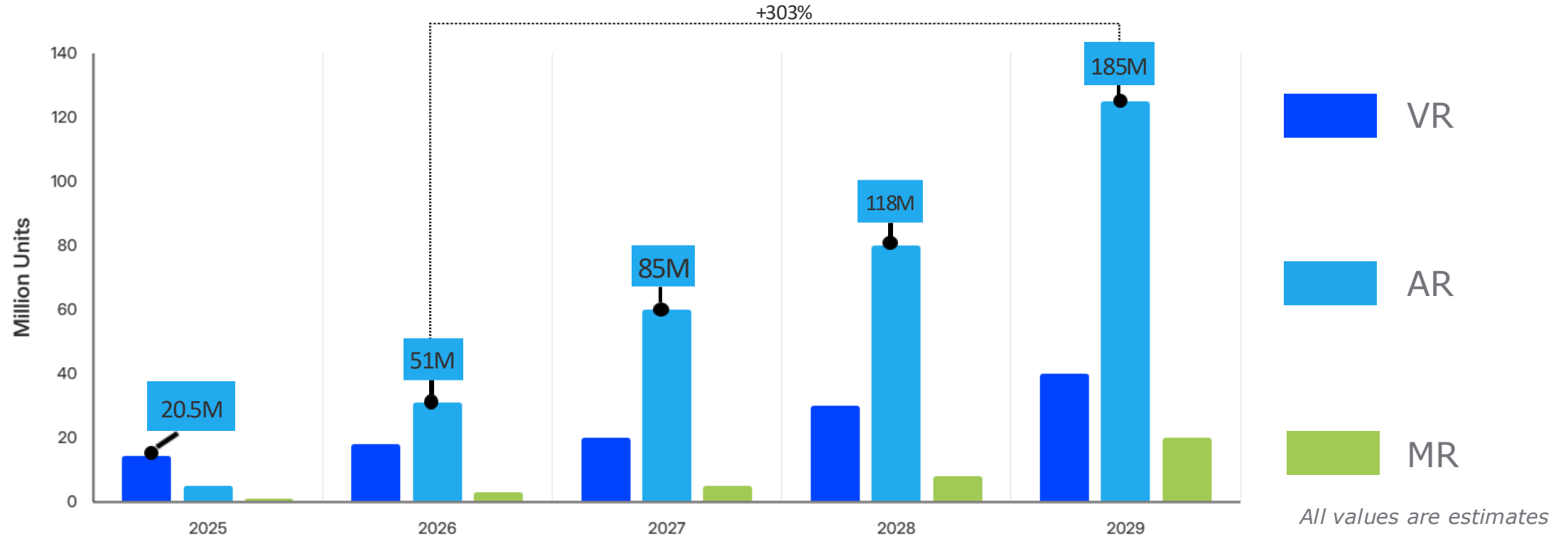
- The XR Market & Technology Landscape
- Measurement Solutions Across the XR Development Cycle
- Microdisplay Measurement Needs
- Waveguide & Near-Eye Optics Measurement
- Final Device & Production Testing
- Key Takeaways / Q&A





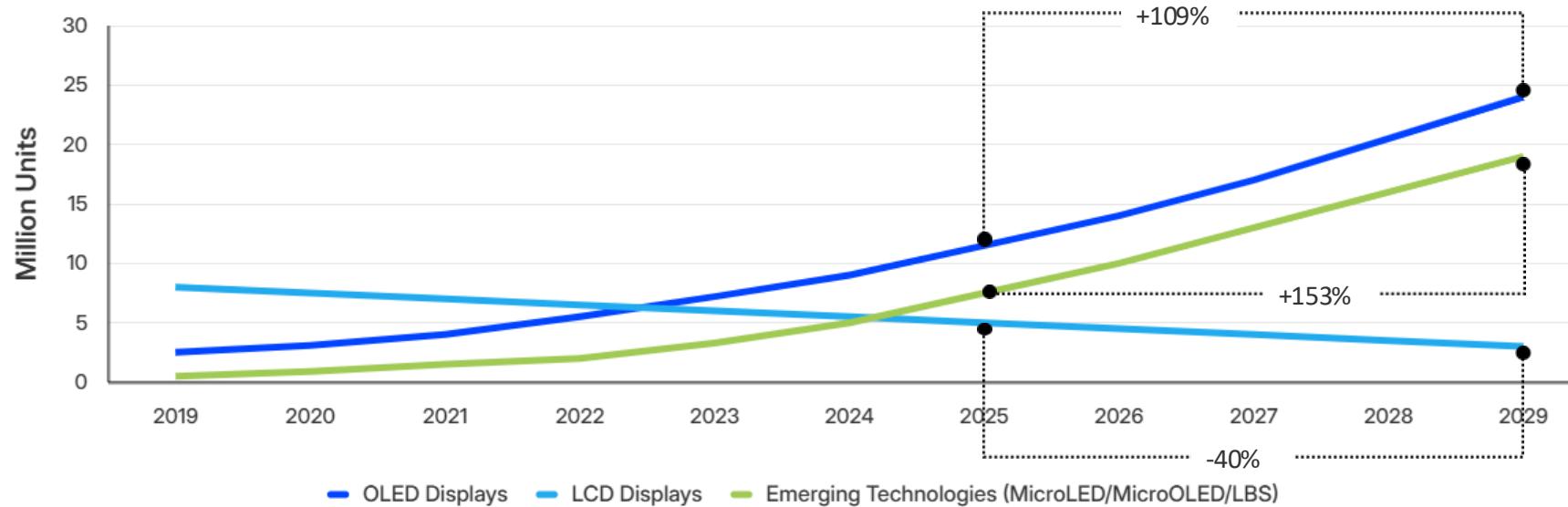
The XR Market & Technology Landscape

Headset Sales Per Year



The overall market continues to grow, with large growth in AR technology through 2027 - 2029

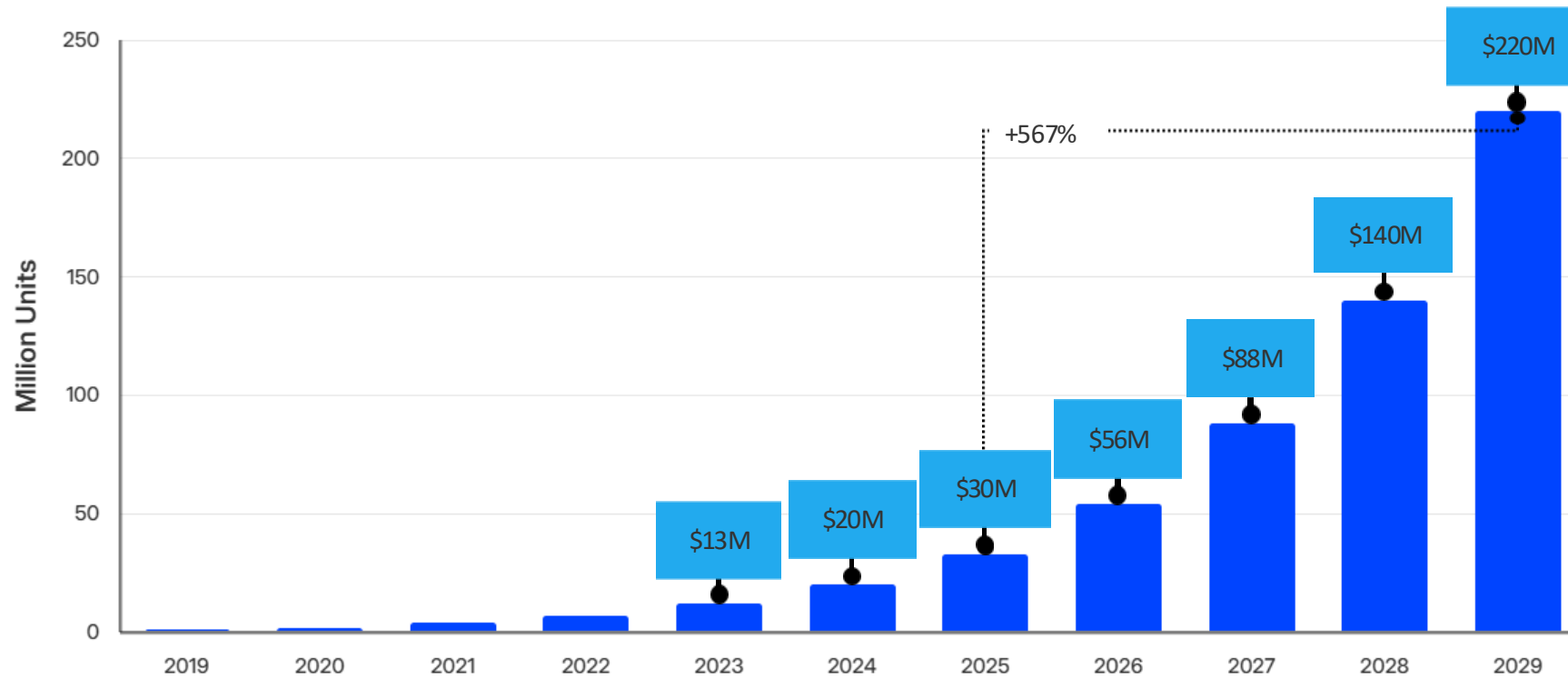
Technology Breakdown (2019 – 2029) in Million Units



All values are estimates

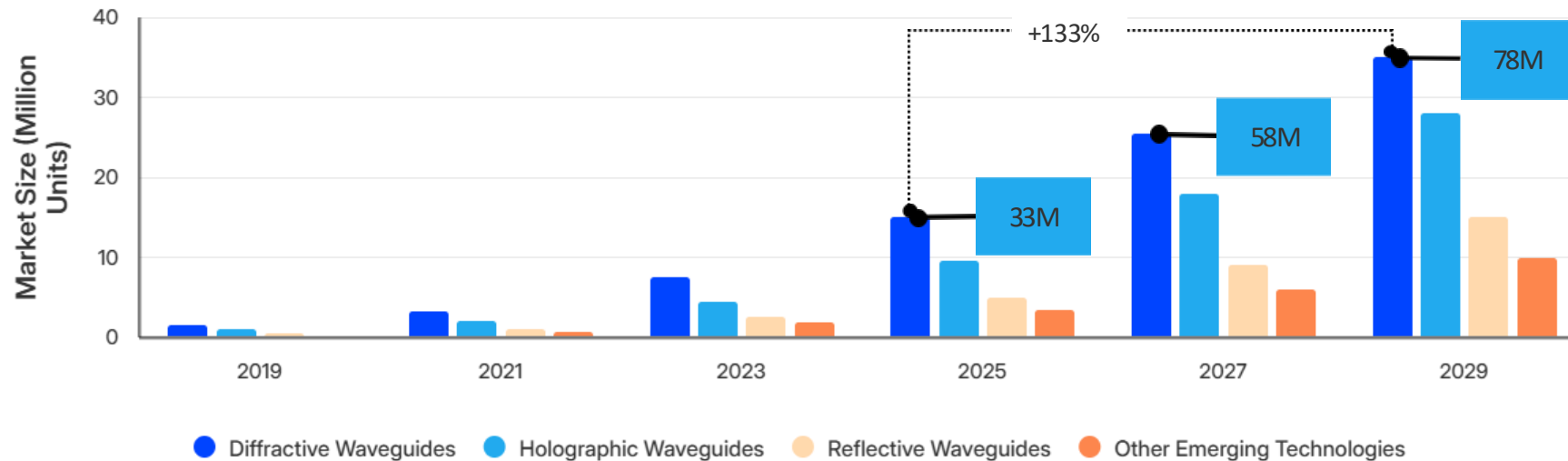
OLED and Emerging Technologies are projected to drive VR display market growth, while LCDs will maintain a presence in cost-sensitive segments

Forecast From 2019-2029 (in Million Units)



All values are estimates

Forecast for Waveguide-Based Eyepieces (2019-2029)



All values are estimates

The waveguide-based eyepiece market is projected for significant growth, with diffractive and holographic technologies leading the adoption.

Application Slide (How are these devices being used?)



Consumer Electronics

AR is projected to grow faster than VR

- **Applications:** VR – Video games, AR – consumer products
- **Examples:** Meta AR (Rayban) and VR (Quest Series) devices, Apple Vision Pro, Xreal



Military / Aerospace

- **Applications:** Training and flight simulation, Electro-Optic / Infrared (EO/IR) devices, night vision, helmet-mounted displays (HMDs) in the cockpit, augmented soldier vision
- **Examples:** Integrated Visual Augmentation System (IVAS), F-35 HMD, Enhanced Night Vision Goggle-Binocular (ENVG-B)



Enterprise

- **Applications:** Training, logistics, education
- **Examples:** Using commercially available devices like the Varjo XR-4, HTC Vive, Meta Quest 3



Medical

- **Applications:** Surgical robotics, augmented surgeon vision aid
- **Examples:** DaVinci (Intuitive Surgical), Ottave (Johnson and Johnson)



Sports

- **Applications:** Augmented Sports Glasses, Augmented goggles
- **Examples:** Engo, Rekkie goggles



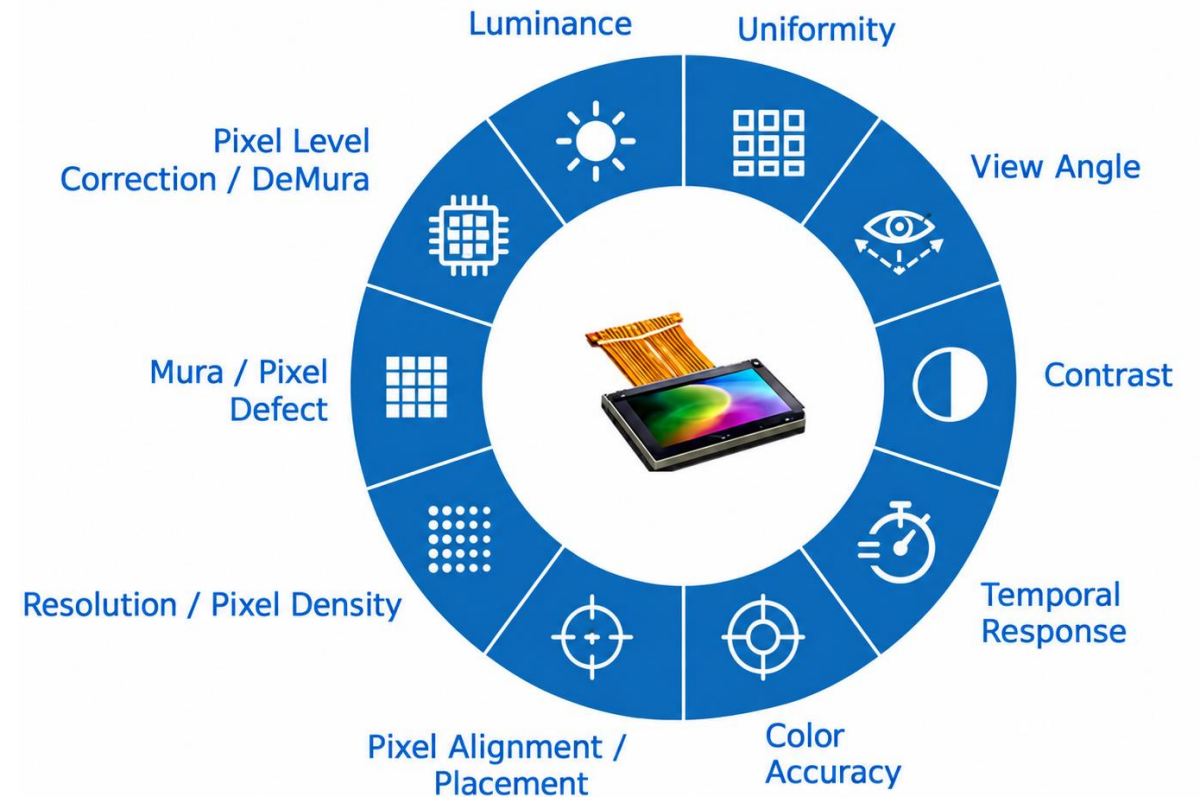
Measurement Solutions Across the XR Development Cycle



Microdisplay Measurement Needs

Measurement Device Needs

- High dynamic range spectroradiometer with extremely low luminance measurement capabilities for emerging display technology for production and R&D
- Fast spectral measurements for accurate luminance and color measurement
- High-resolution, spectrally calibrated imaging measurements for pixel-level characterization in product development
- Fast, high-resolution images for pixel-level correction in production
- Software options to perform pixel-level display correction
- Time-based measurement for flicker and waveform detection
- Large field-of-view measurements for measurements of multiple displays in a single capture



CS-3000: High Dynamic Range Spectroradiometer to Support Emerging Display Technology

Wide Luminance Measurement Range

- **CS-3000HDR (Flagship Model):** 0.0001–100,000 cd/m² (High-dynamic range measurement)
- **CS-3000 (Standard Model):** 0.0005–5,000 cd/m² (Equivalent to CS-2000A)
- **CS-2000Plus (Cost-Performance Model):** 0.003–5,000 cd/m² (Equivalent to CS-2000)

Measurement Angle Options

- **CS-3000HDR:** Powered measurement angle selection, suitable for automated systems
- **CS-3000 / CS-2000Plus:** Manual measurement angle selection
- **Available measurement angles:** 1°, 0.2°, and 0.1°

High-Accuracy Spectral Measurement

- Optical frequency detection for improved measurement accuracy

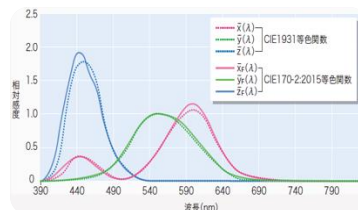
Faster, More Efficient Measurements

- Fast measurement modes (SUPER FAST1, SUPER FAST2)
- Intelligent Dark function to reduce measurement time

Software and Measurement Compatibility

- Standard CS-S30 software
- CIE 170-2:2015 color matching functions (CMFs)
- Data agreement with CS-2000 Series

Other Features: **Standard software CS-S30 / CIE170-2:2015 CMFs / Data agreement with CS-2000 Series**



Problem solved: Fast, highly accurate spectral measurements of displays, with options for low luminance measurement.

CA-527: Fast Spot Based Colorimeter for Full Photometry Test + Flicker

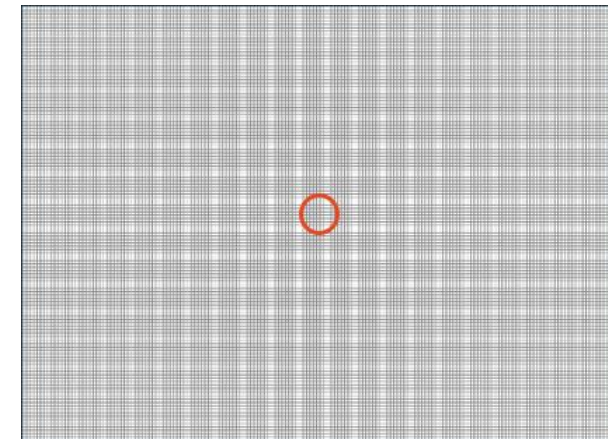
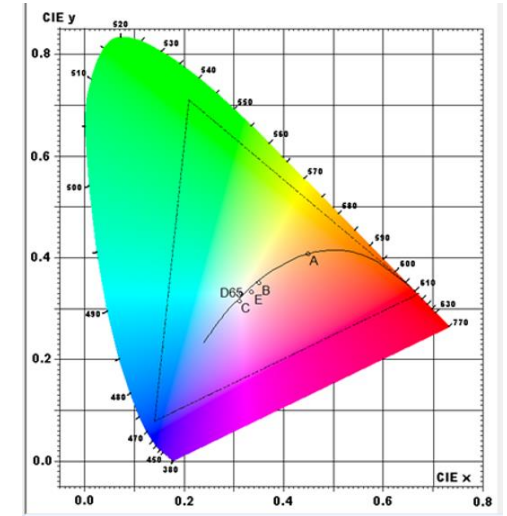
- 1. Expanded accuracy guaranteed range of luminance: 0.0001 to 10,000 cd/m²**
*Chromaticity: 0.001–10,000 cd/m²
- 2. Even faster measurements for ultra-low luminance: 0.0001 cd/m² at 1 second**
*Using [AUTO] measurement speed mode
- 3. Significantly improved waveform detection: 200kHz sampling rate**
*Measurement range: 0.1–10,000 cd/m²
- 4. VRR flicker measurement — NEW 0.25 to 240Hz detectable**
*VRR (Variable Refresh Rate)
*Measurement range: 0.5–10,000 cd/m²
- 5. Full software support by providing PC Software, SDK, and Protocol**
*Software solutions can be downloaded from the website

Problem solved: Ultrafast luminance and color measurements for display correction as well as flicker and waveform detection



ProMetric I-SC: Unmatched Accuracy for a Challenging Industry

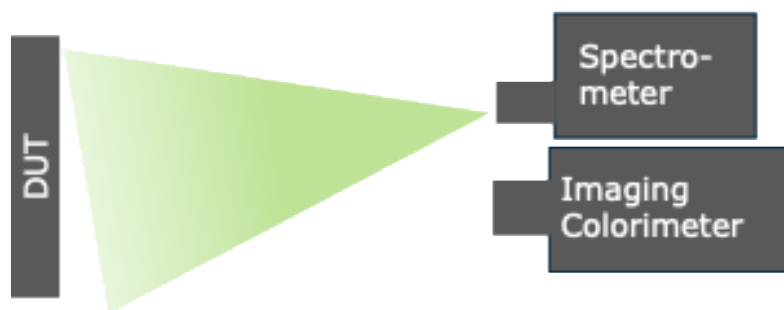
- **ProMetric I61 (61 MP)** colorimeter with integrated CAS-140D Spectrometer
 - I-SC = "Spectrometer Connected"
- Simultaneously:
 - Measures spectral data at the center point of 2D measurements
 - Quantifies and compares spatial luminance (cd/m²) and chromaticity (CIE x,y and u'v') values
- Enables **better** calibration for greater accuracy
- Enables calibration **in real-time for each measurement**
- Single software platform
- Accuracy Improvements
 - Spectrally enhanced color calibration can be used for color variation up to 0.01 in Cx, Cy
 - Results expected to be uniform up to +/-2% in Lv and +/-0.002 in Cx,Cy up to +/- 20°
 - Results expected to be uniform up to +/-3% in Lv and +/-0.003 in Cx, Cy for field angles > 20°



Advantages of a single lens used for both measurements

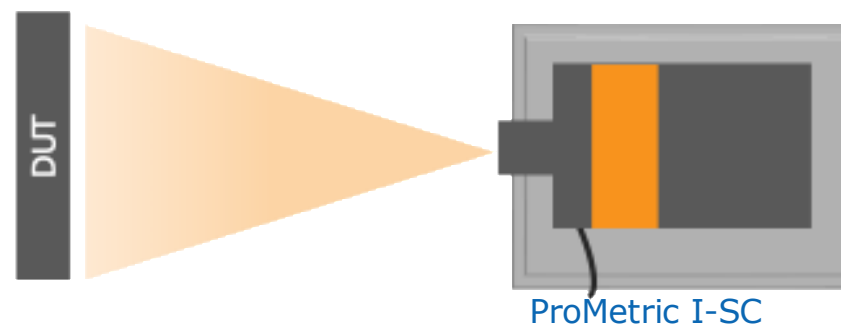
- Ensures accuracy
 - Same view angle = same light with no angular variation
 - No need to account for angular offset
 - Moving instruments can introduce additional error
- Improves convenience
 - Eliminates need to swap instruments
 - Saves setup time
 - Improved accuracy due to alignment and repeatable spot placement.

Two Instruments



vs.

Integrated System



Microscope Lenses: Subpixel Evaluation for Display Correction

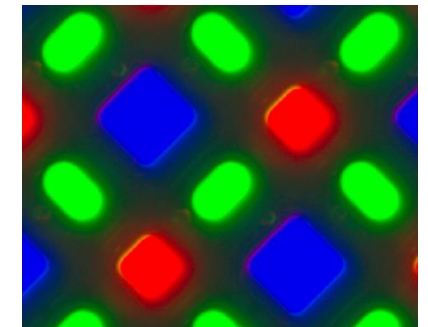
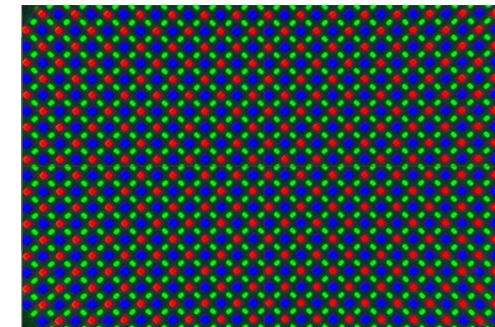


5x Microscope Lens



10x Microscope Lens

Approx. Field of View* (by camera sensor size)	2MP: 1.7 x 1.3 mm	2MP: 0.8 x 0.6 mm
	8MP: 3.6 x 2.7 mm	8MP: 1.8 x 1.4 mm
Spatial Resolution*	29MP: 6.5 x 4.3 mm	29MP: 3.4 x 2.2 mm
	45MP: 5.4 x 3.6 mm	45MP: 2.6 x 1.7 mm
Spatial Resolution* (by camera sensor size)	61MP: 6.5 x 4.3 mm	61MP: 3.4 x 2.2 mm
	Up to 29MP: 1.10 μm / sensor pixel	Up to 29MP: 0.55 μm / sensor pixel
Spatial Resolution* (by camera sensor size)	45MP: 0.64 μm / sensor pixel	45MP: 0.32 μm / sensor pixel
	61MP: 0.74 μm / sensor pixel	61MP: 0.37 μm / sensor pixel



Measurements of an OLED display with a 20x microscope lens



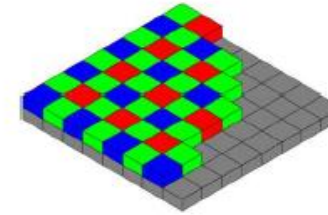
20x Microscope Lens

Approx. Field of View	0.4 mm x 0.3 mm	0.9 mm x 0.7 mm	0.7 mm x 0.4 mm	1.8 mm x 1.2 mm	1.8 mm x 1.2 mm
Spatial Resolution (per sensor pixel)	0.28 μm	0.28 μm	0.14 μm	0.28 μm	0.19 μm

Faster Acquisition Times for Mass Production

Y Series Colorimeter

- YC61 (15 megapixel)
- YC31 (8 megapixel)



Benefits:

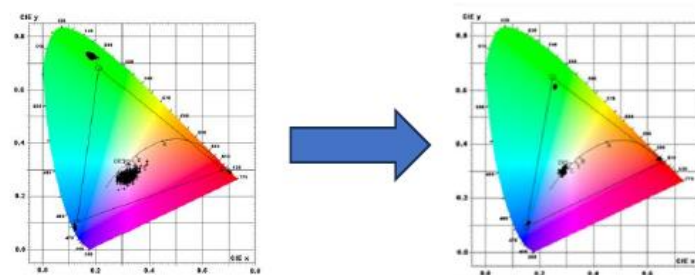
- Enhanced Color Calibration Engine for higher accuracy color measurements
 - During setup a color calibration is performed on the system. After calibration: Luminance accuracy = $\pm 6\%$, ± 0.006 in Cx, Cy
- Faster acquisition times vs. a tristimulus system
- Small form factor
- Compatible with full software suite for photometric testing and automated inspection

MC151: Pixel Defect Detection and Correction

- 151 megapixel RGB camera for defect detection and relative luminance and color measurement
- Key Specifications:
 - **DeMURA:** Per-pixel luminance & color correction coefficients for display controller integration
 - **Color Mura:** Detects color-only blemishes invisible to luminance cameras — critical for OLED & MicroLED
 - **Defect Detection:** Particle, line, surface & light leakage defects classified in a single pass
 - **Single Pass:** Full correction map + complete cosmetic inspection from one 1.2 sec exposure
 - **TrueTestSoftware:** Automated visual inspection —Field-proven with millions of devices tested in production worldwide.
 - **Scalable FOV:** Sub-pixel resolution maintained from smartwatch (<1") to large TV (85"+)



Pixel Level Correction



151 MP

CMOS Bayer Sensor

75 dB

Dynamic Range

1.2 sec

Meas. Cycle

±0.1%

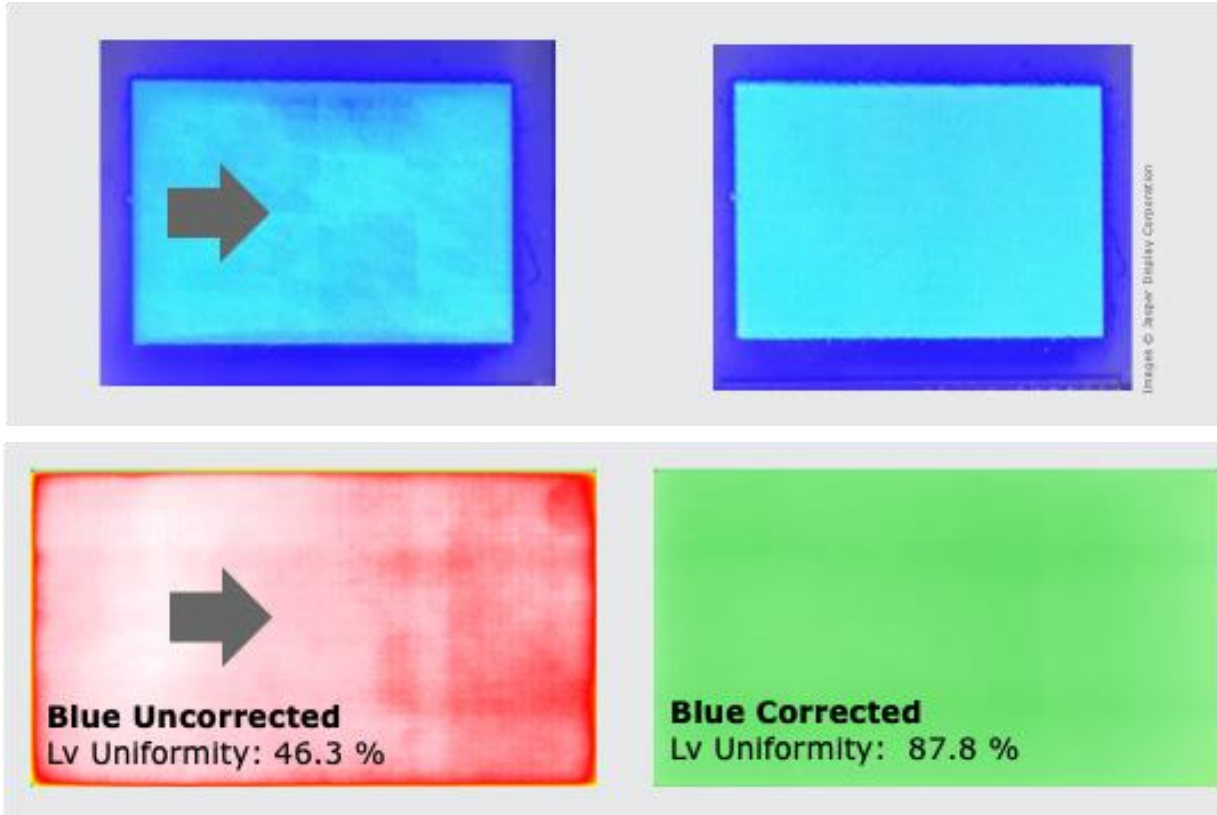
R,G,B Repeat.

Customized Lens Options

Lens	Min. FOV	Max. FOV	Aperture	Application
FV1	35 mm	42 mm	f/4.5	Watch
FV3	107 mm	241 mm	f/8	Phone
FV4	204 mm	889 mm	f/8	Tablet
FV5	451 mm	1,830 mm	f/8	TV
ARVR Lens	120° circular		3.6 mm	AR/VR/XR

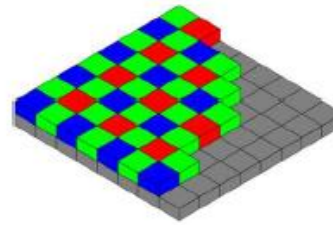
BEFORE

AFTER

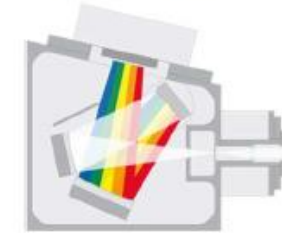


Problem solved: Display correction increases yield and reduces resources spent on assembling defect products.

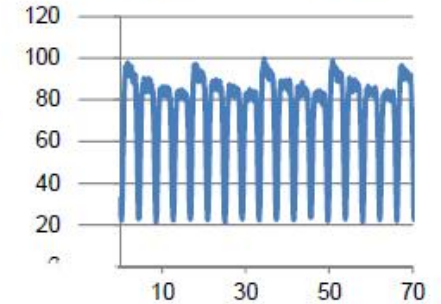
RGB CCD/CMOS Sensor



CAS140D



Fast photometer



High Speed, Spectrally Corrected Images

- Three in one solution:
 1. RGB camera sensor
 2. Spectroradiometer
 3. Fast Photometer
- Multiple analysis in one
 - Spectrally corrected luminance and color measurements
 - Fast spatial acquisitions
 - Fast photometer for flicker measurements

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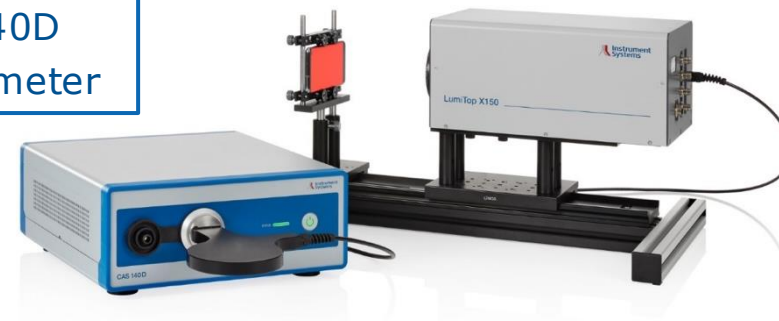


LumiTop X150: Ultra High Resolution for Higher Throughput

- Complete color and luminance information for each DUT pixel
 - High-resolution imaging up to 600 Mpix by pixel shifter
- Highest color and luminance accuracy
 - Spectrally enhanced imaging colorimeter based on reference high-accuracy spectrometer
- Outstanding low luminance performance
 - Due to increased light throughput and sensitivity
- Various lens options for a wide range of DUT sizes and applications
- Multiple displays can be measured in the same field of view, end of line or at the wafer level
- Pixel shift capabilities for enhanced resolution imaging, making sub pixel level analysis possible in production

CAS140D
Spectrometer

LumiTop X150
Camera



Short profile X150

Sensor: 151MP CMOS (14192 x 10640 pixels)

Pixel size: 3.76 μm x 3.76 μm

Measurement range: L = 0.003 cd/m^2 – 50,000 cd/m^2

ND filter options: *on demand*

Minimum measurement time: 0.55 s



Lens options	FoV	Achieved Resolution	Typical applications
x 1.54	34 mm x 26 mm	2.4 $\mu\text{m}/\text{pixel}$	Microdisplays
x 1.0	53 mm x 40 mm	3.7 $\mu\text{m}/\text{pixel}$	Watch
x 0.33	161 mm x 121 mm	11 $\mu\text{m}/\text{pixel}$	Phone
x 0.2	266 mm x 200 mm	19 $\mu\text{m}/\text{pixel}$	Wafer, tablets, LED tiles
x 0.05	1067 mm x 800 mm	75 $\mu\text{m}/\text{pixel}$	Large μLED displays, e.g. Automotive exterior, video wall

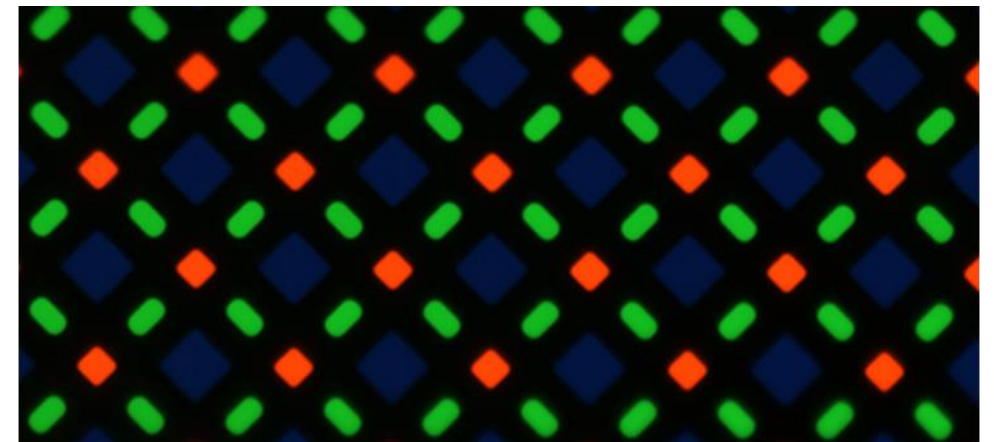
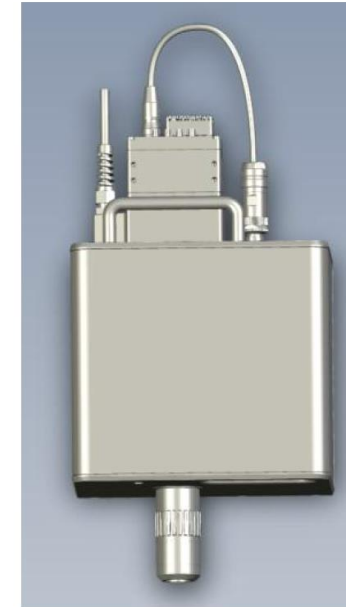
Unparalleled image clarity and resolution at ultrafast speed

Variable magnification lenses for subpixel analysis

- 5x lens standard – 4.4mm x 4.4mm FOV
- Up to 11.25x available – 0.335 μm /camera pixel!

Integrated with CAS140D spectrometer for accurate luminance and chromaticity measurements

Ultra high speed imaging (>60 fps) suitable for mass production of consumer devices

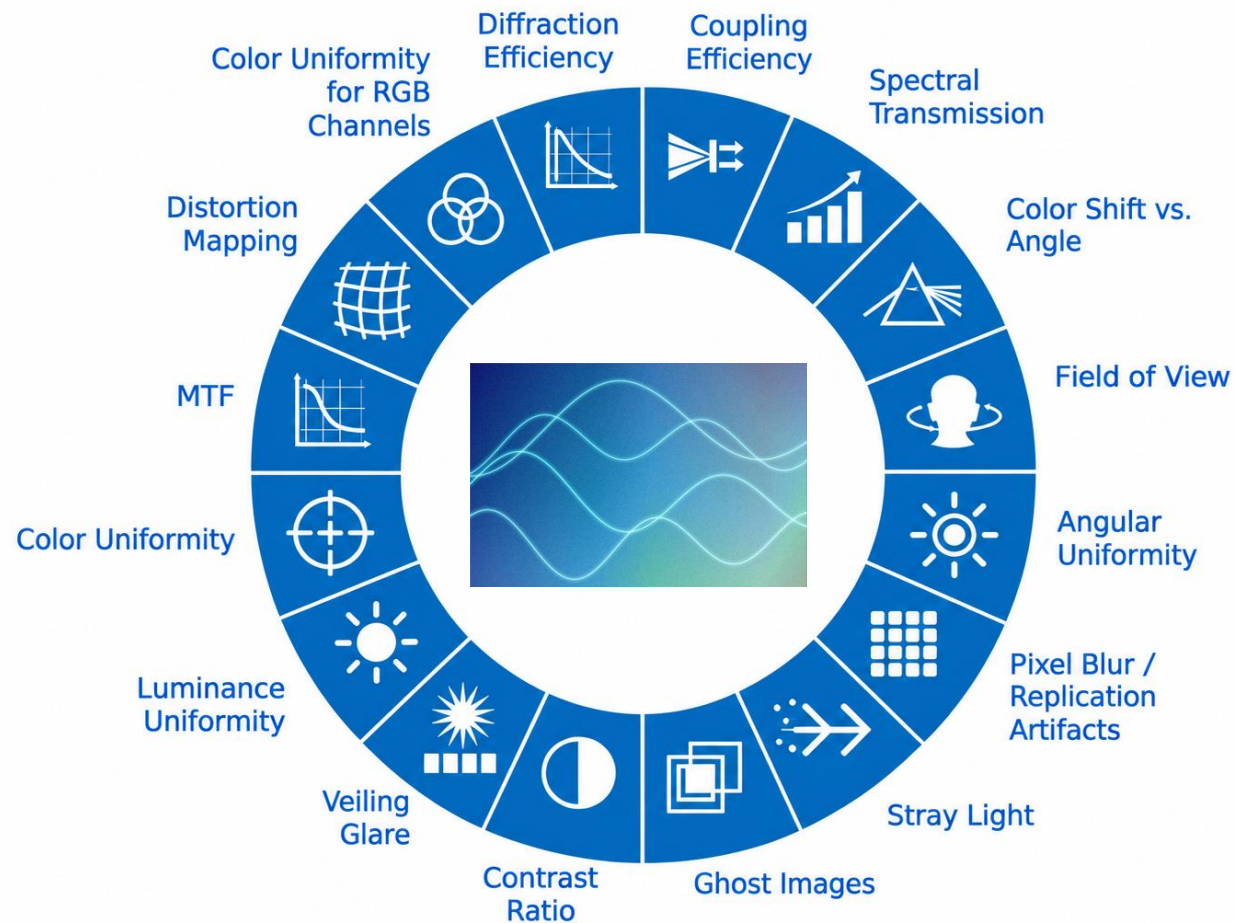




Waveguide & Near-Eye Optics Measurement

Measurement Device Needs

- Highly accurate spectroradiometer with a flexible probe for positioning to the waveguide
- Specialized optics paired with measurement device to replicate the human eye.
 - 2-5 mm aperture
 - Aperture at the front of the lens that can be positioned in the eye box
- Integration capabilities with fully positioning systems
- Fully turnkey measurement solutions
- Optics with flat focal planes for high-fidelity MTF measurement
- Rx prescription compensation integrated into the measurement device
- Fast color measurement with specialized lenses for production



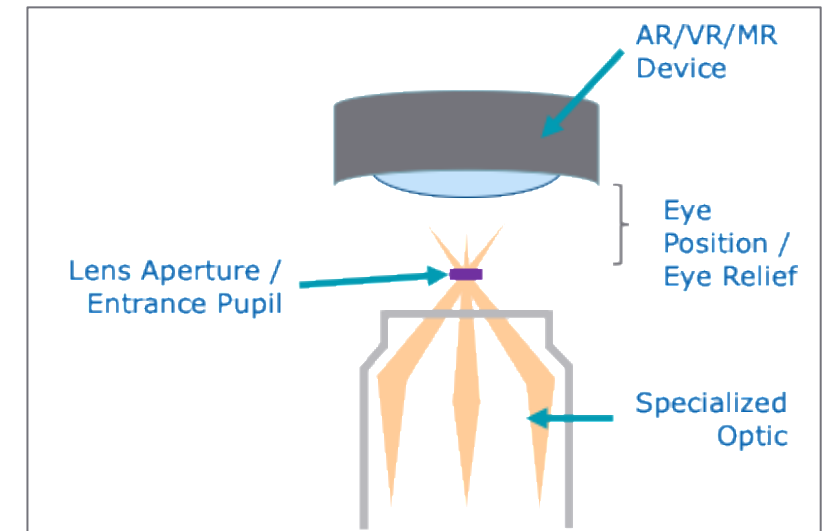
Challenge: Pairing the measurement device with an optics that replicates the human eye

Specialized optics are required to fully characterize the visual performance of the display as seen by the user. The lens paired with the measurement device must:

- Capture the necessary field of view of the device
- The aperture or entrance pupil of the lens must be able to align with the designed eye position or eye relief
- The optics must be able to fit inside the headset or align with the waveguide / optics
- Accurately measure the luminance, chromaticity, and photometric performance of the projected display, *as seen by the user*
- Offer an aperture that matches the typical pupil size of the human eye
- Variable measurement distances to focus on the projected image
- Remove distortion from the measurement that is introduced by the lens

Solutions from KMSA offer:

- Both spot based and imaging optics for device characterization
- A range of field of view offerings to support current and emerging device field of views
- Variable pupil sizes to replicate the human eye
- Variable focuses to capture a range of projection distances



CAS 140D: Highly Accurate Spectroradiometer, Integrated with Specialized Optics

- Model variant from 200 – 1700nm
- Cooled “back-thinned” detector for minimum dark current
- Spectrograph with maximum stray light suppression
- Integration times from 4ms to 65 s
- Lab & Production Software support
- High-precision measurement of CCT and CRI
- **Traceable measurement uncertainties of only +/-0.0015 on standard chromaticity coordinates**
- Available with high resolution sensor for increased sensitivity and for measurements of narrow band sources
- Lower spec system available for production level testing
- Pairs with optical probes for a wide range of application measurements:
 - Top 200 telescopic probe for radiance and luminance measurements
 - **Top 300 for AR/VR/MR radiance and luminance measurements**
 - EOP probes for irradiance measurement
 - LED Intensity probes



TOP300: Optical Probe that Matches The Human Eye

- **TOP 300** is an optical probe with a viewfinder for CAS dedicated for AR/VR applications
- Luminance and color spot measurements / Eye box scans/eye gaze scans
- **Features:**
 - Aperture at the tip of the probe that can be aligned with the designed eye relief
 - Robust, compact and lightweight design for manufacturing applications – can be integrated with automated test systems
 - High-accuracy luminance and color measurement in combination with CAS spectroradiometer
 - Optics mimic the human eye with a FOV of $\pm 1.2^\circ$
 - Configurable entrance pupil (3-5 mm) and focus distance
 - Binocular setup possible



- CoboTop is a combination of a cobot with TOP300.
- Is a cooperation with Cobosense (KM business unit).
- Allows automated measurement of luminance and color uniformity or contrast measurements with different eye positions.

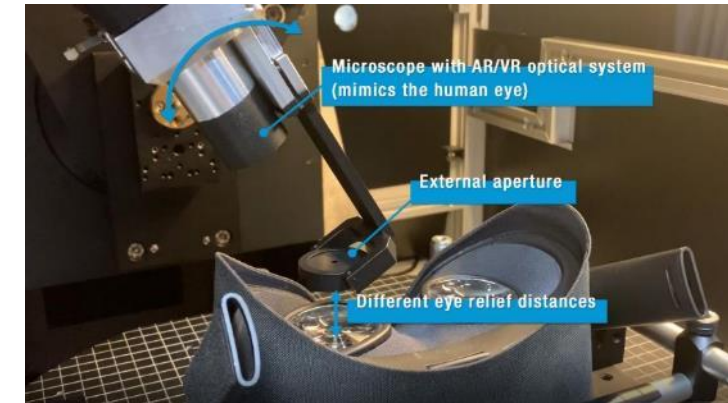
Problem solved: Automated solution for positioning the measurement device to match the human eye for product development and characterization.



DMS-803 Goniophotometer: Turnkey Reference System for Waveguide and System Level Characterization

6 motorized axes for automated measurements

- Fully automated spectral sampling
- Dedicated optics to mimic human visual system
- Variety of accessories for ambient, specular, and backlights are suitable for your angular measurement requirements.



Paired with CAS140D Spectroradiometer

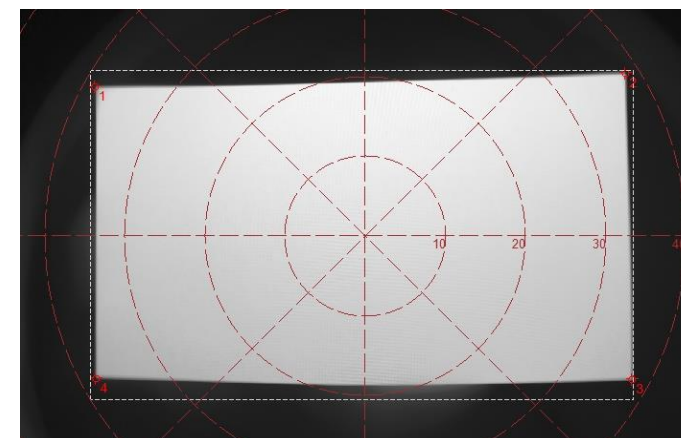
- Spectral spot information for accurate measurement value



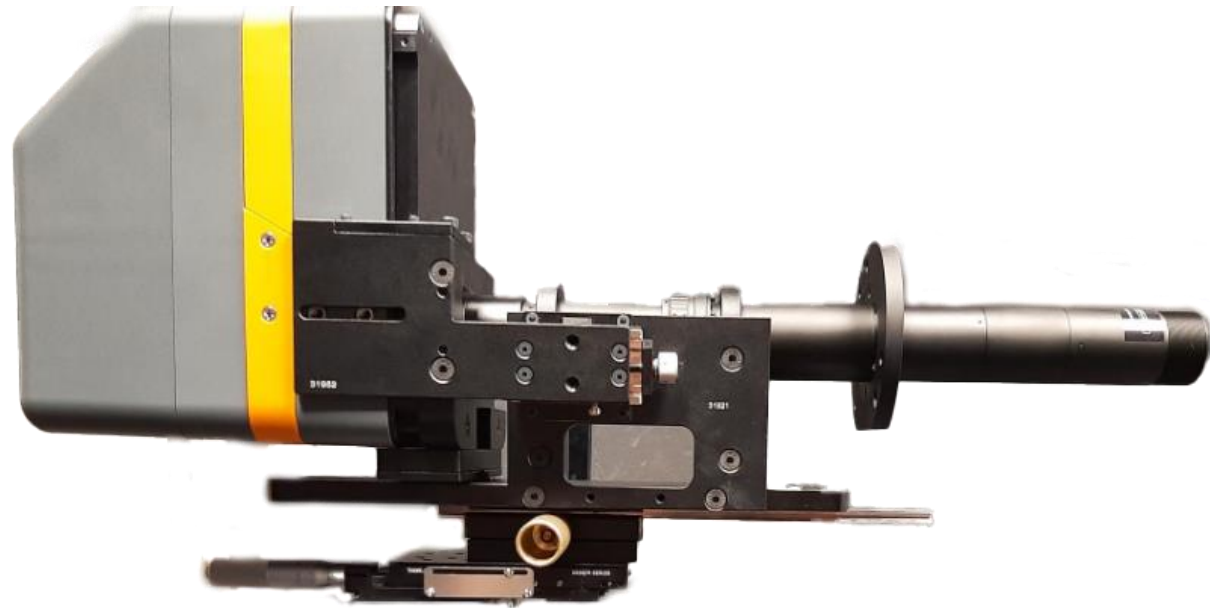
ProMetric® I Imaging Colorimeter + XRF-M30 Lens (Manual Focus)

- Flexible optical solution for replicating human vision in a broad range of XR devices & display test scenarios
- Utilizes Patent-pending Optical Technology Invented by Radiant
- **Key Specifications: Variable Aperture, Entrance Pupil Location, Field of View**

Parameter	XRF-M30 Specification
Primary Application	Light and color measurement for near-eye displays (NED) in headsets. Diffraction-Limited MTF Measurements
Aperture Sizes	1mm - 5mm
Focus Range	-4.0 D to +4.0 Diopters (0.25m to infinity)
Entrance Pupil Location	13mm in front of lens
Imaging System	ProMetric Y61 or I61 or I61-SC
Field of View (H)	$\pm 30^\circ$
Field of View (V)	$\pm 22^\circ$
Resolution	0.007° / sensor pixel
Luminance - Minimum	0.01 cd/m ²
Luminance - Maximum	10,000 cd/m ² (Y-series); 1,000,000 cd/m ² (I-series)
Lens Distortion	< 0.25 Degrees

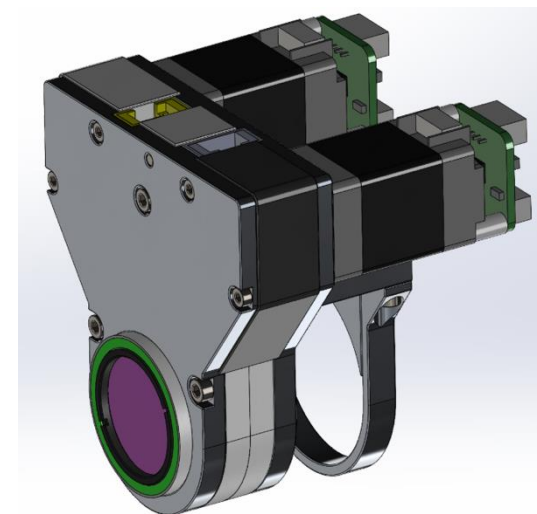


- **Coming Soon! ProMetric® I Imaging Colorimeter + XRF-E30 Lens (Electronic Focus)**
- Focus is achieved via +/- 5mm motion on rail/carriage system
- Electronic focus allows for full automation and testing at multiple focal planes
- Can be integrated with RX compensation

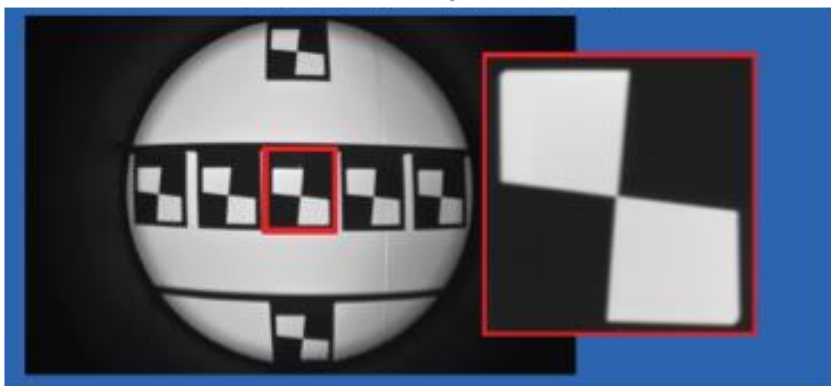


Problem solved: Automated focusing for Rx compensation and testing at multiple focal planes.

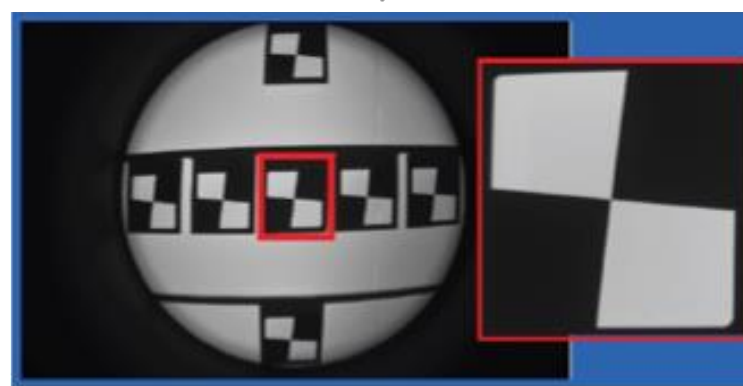
- **Coming Soon! Fully Integrated Rx Compensation Verification**
- Spherical and Cylindrical Rx compensation
- Rx compensation hardware mounts onto any XR lens
- Diopter range
 - -6D to +4 (first release)
 - -10D to 10D (later release)
- < 0.25 diopter resolution
- Electronic control and integration into testing software



Before Compensation



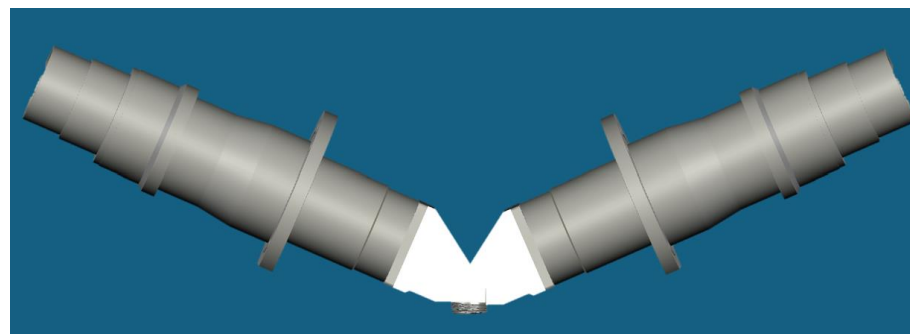
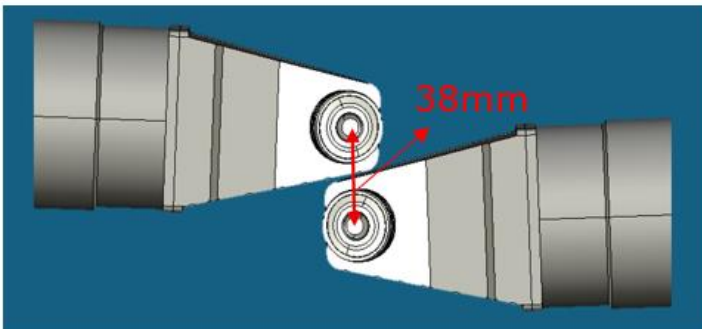
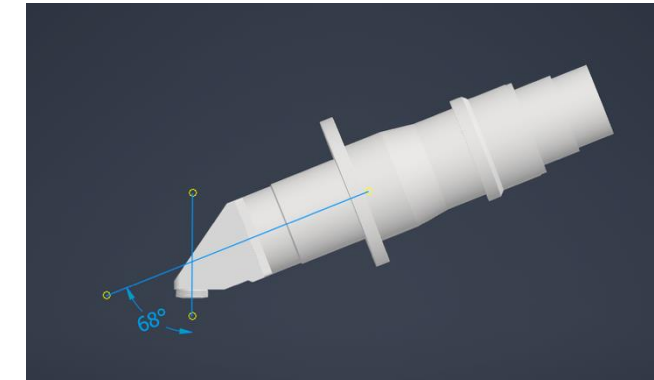
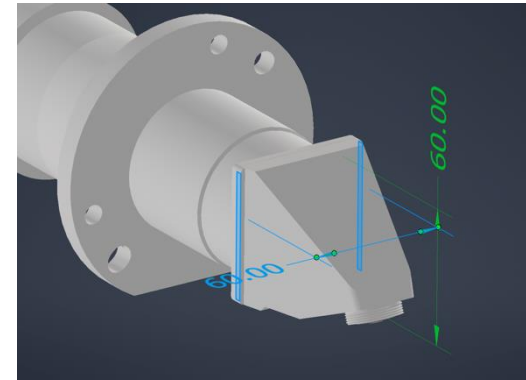
After Compensation



XRF-40 Lens: Optics to Support Next Generation AR Devices

Coming in 2027! The next generation AR lens

- Next Generation XRF lens to be paired with ProMetric imaging colorimeters
- Expanded field of view ($\pm 40^\circ$) to capture future AR devices
- Radiant proprietary prism design for better alignment to the device optics, while maintaining image quality
- New form factor to better fit in assembled headsets and alignment to waveguides
- Small minimum interpupillary distance (38 mm) to support binocular testing



LumiTop X30 + AR lens: High Speed AR/VR/MR measurement

- Camera-based solution tailored for **Augmented Reality (AR)** applications
- **Key features:**
 - Paired with XRF-M30 lens from Radiant product line for optimal testing setup
 - Fixed focus & fixed entrance pupil for consistent measurements
 - Straight lens design (periscope version coming soon!)
 - Spectrally corrected color measurements in < 1 sec

Problem solved: Fast, high-resolution color measurements paired with the XRF lens for production-level testing of waveguides



Waveguide IQ system for turnkey alignment and testing of Waveguides

- Waveguide IQ system is designed to support precise 6 degree of freedom alignment of both the camera and the projection unit
- Built inside a lightproof and safe enclosure with a proper operator user interface.
- Carousel-type waveguide feeders allows for testing of multiple waveguides autonomously
- Konica Minolta measurement devices are fully integrated into the system, including alignment, verification, and full software integration





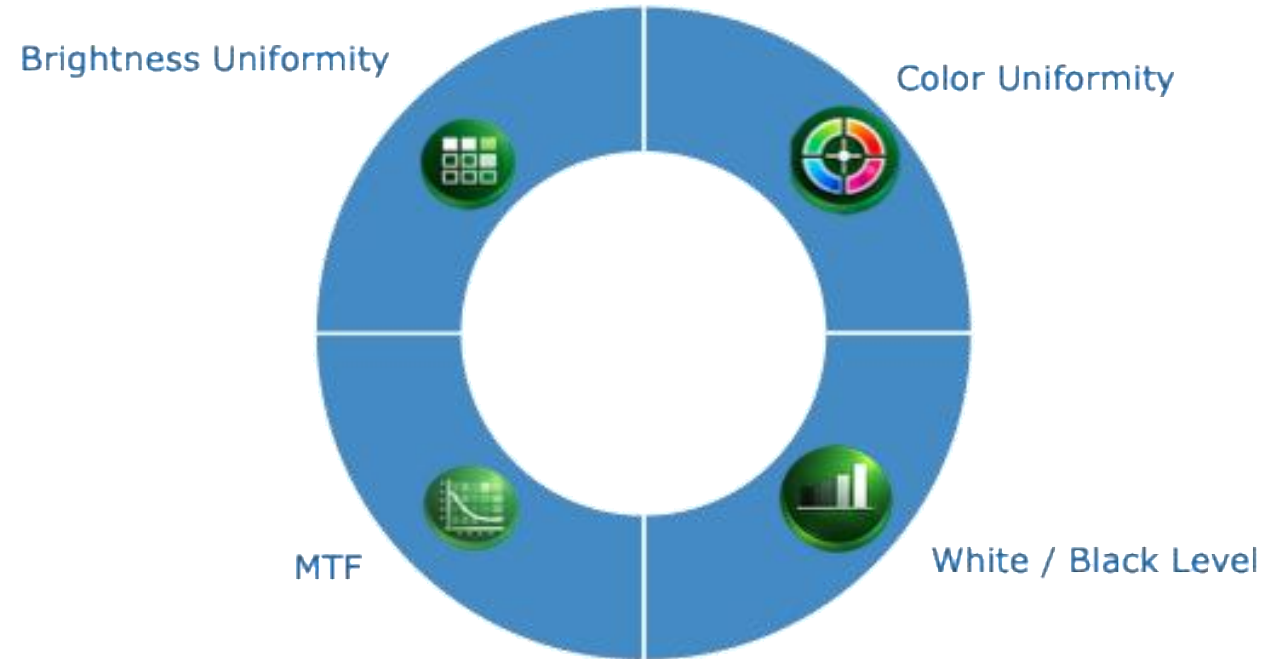
Final Device & Production Testing

Measurement device needs

- Speed: full-color measurements at speeds competitive with machine vision
- Small form factor that can fit inside a test fixture
- Many medical and aerospace applications require a higher level of testing requirements
- Similar device specifications as R&D tools
- Integration options into test fixtures

Medical & Aerospace Applications:

These applications require a higher level of testing and validation to match the critical nature of the applications they serve. A full test suite is often required.



Principle

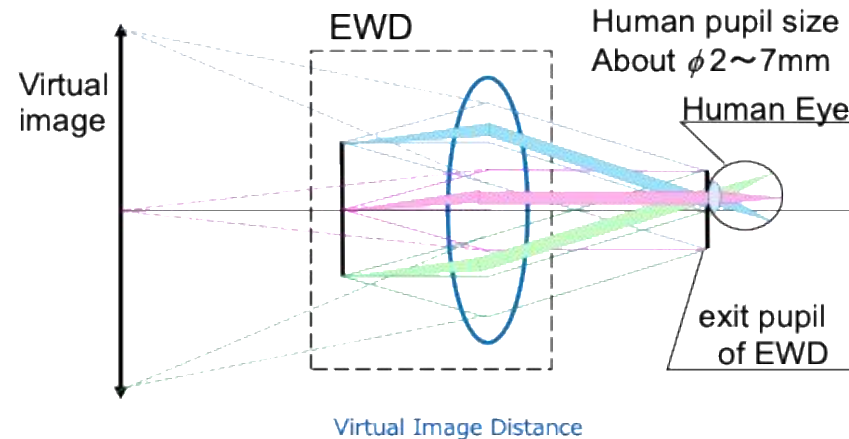
1. For accurate measurement, the entrance pupil of a measuring instrument needs to be smaller than the Exit Pupil of the eye wear device.
2. More accurate data is captured when instruments with apertures that match the human eye.
 - EWD Exit Pupil > Instrument Entrance Pupil
 - Instrument Entrance Pupil = 2mm-7mm

Instrument Entrance Pupil Size

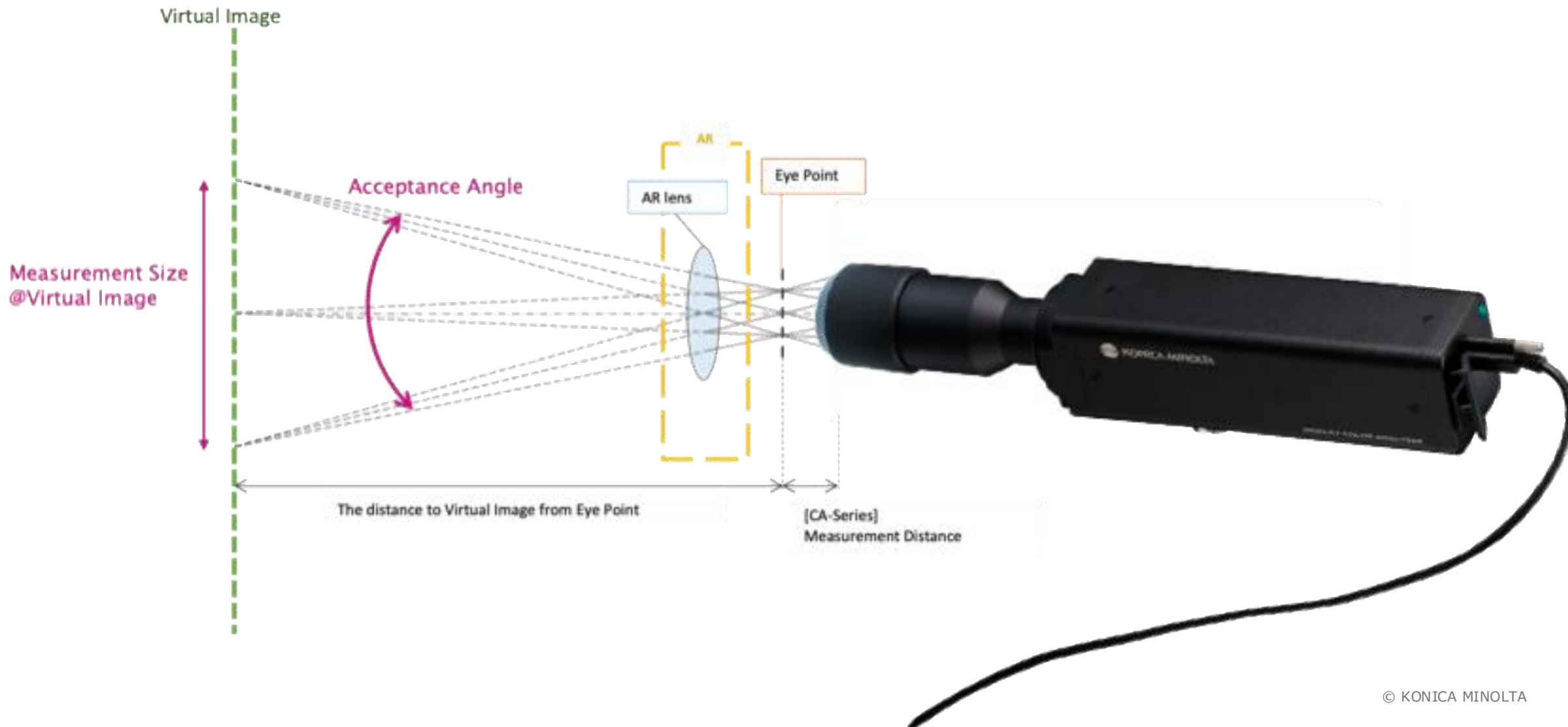
- Many spectrometers and luminance meters have entrance pupils larger than the human eye, leading to measurement inaccuracies
- The CS-3000 solves this by a fixed aperture at the front of the lens



External Pupil Adapters
(ARVR Adapters)
for CS-2000A/CS-3000 Series

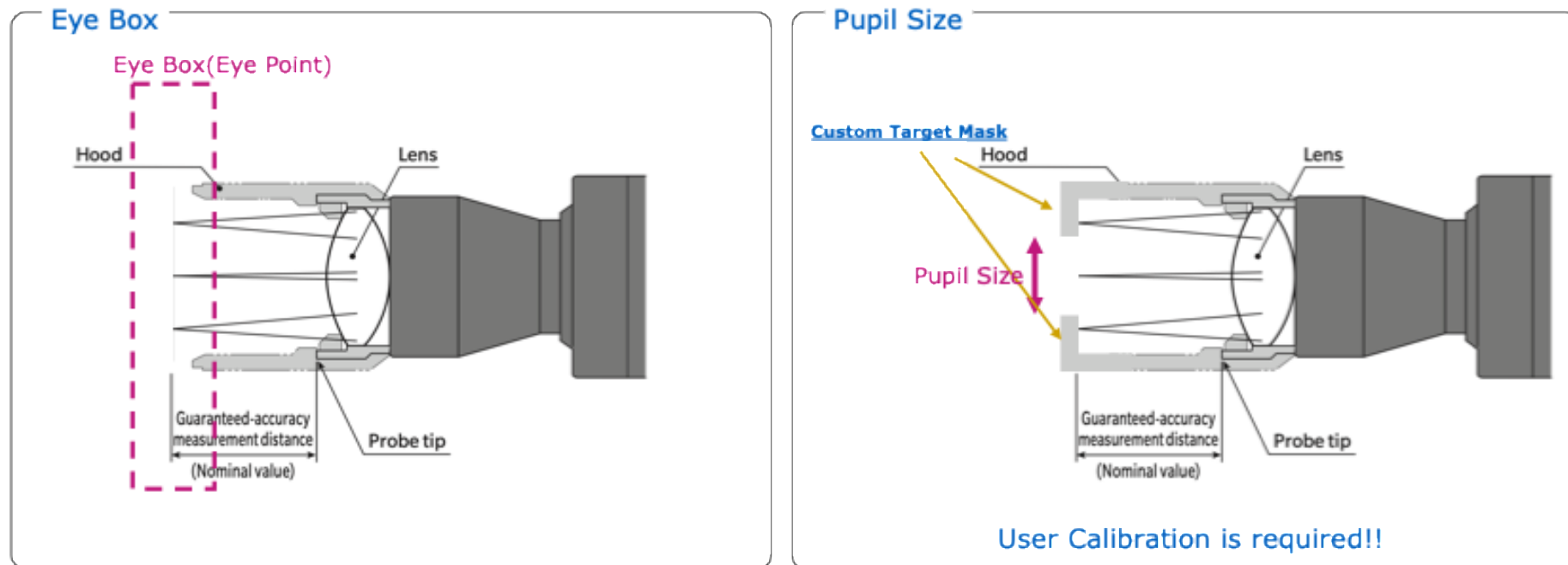


AR/VR Measurement with the CA-527



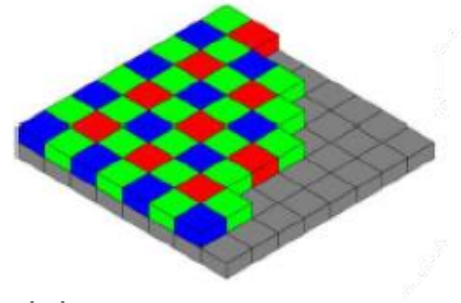
Custom Target Mask

1. The instrument measurement point is placed in the eye box.
2. A custom mask can be applied that matches the human eye and is smaller than the device exit pupil.



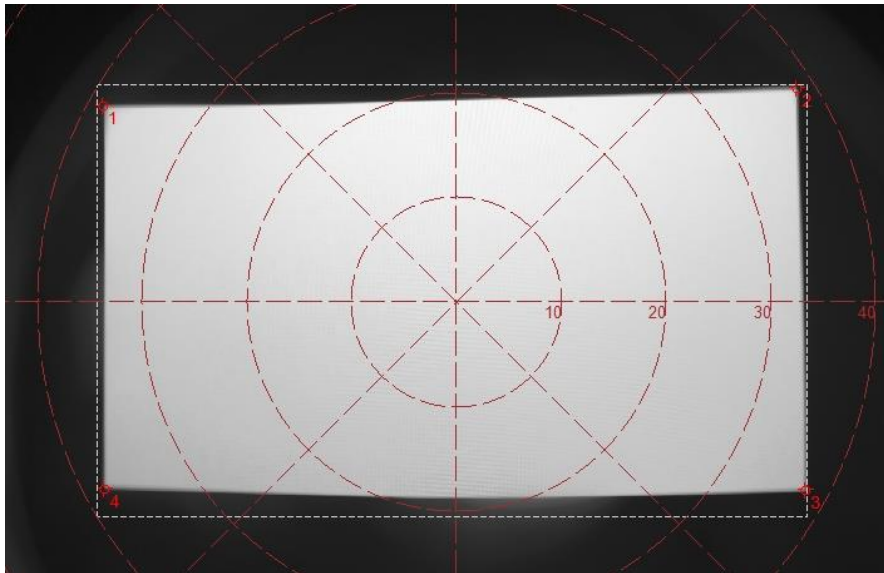
YC31 & YC61: Fast Measurement to Support Mass Production Cycles

- Bayer pattern RGB sensor for full color measurements in one acquisition
- **YC31 (8 MP)** – Luminance and Color in 1 sec
- **YC61 (15 MP)** – Luminance and Color in 1 sec
- Paired with the XRF-M30 for full color measurements of the final assembled headset, using the same technology end of line as in the lab
- Correlation to a spot spectrometer provides accurate color measurement in production
 - Luminance = +/-5% or less
 - Color = +/- 0.006 or less
- **Benefits of the YC systems**
 - New calibration platform
 - Faster acquisition times
 - Smaller form factor
 - No moving parts
 - More cost effective than filter based solutions



Key Features

- Aperture (entrance pupil) located on the front of the lens
- 3.6 mm aperture
- **Wide field of view (FOV): 120° horizontal**

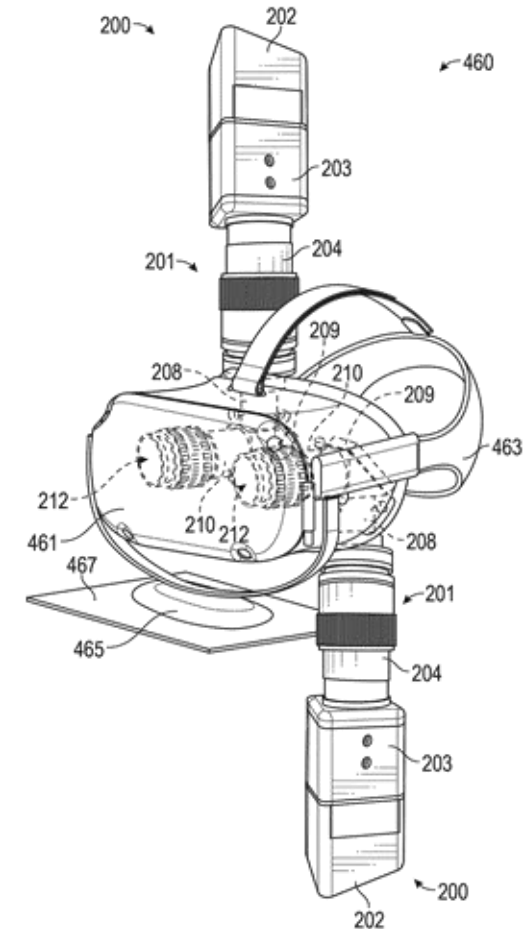


Binocular Measurement: Increased Device Production Throughput

- Folded optics provide more angles of approach to the desired imaging position
- Dual-eye (stereoscopic) measurement of left- and right-eye positions
- Two systems fit in the headset at once while continuing to avoid headgear
- Interpupil Distance (IPD) of < 55mm available



XRE Lens: Sample dual-eye configuration



Patent pending; Radiant Vision Systems LLC

System Level IQT for end of line inspection of fully assembled devices

- System Level IQT station is designed to perform 6 degree of freedom alignment of the measurement camera to the AR glasses eye box
- The instrumentation is built inside a lightproof and safe enclosure with a dedicated operator interface and a configurable device holder
- System executes the full measurement sequence autonomously — luminance, color uniformity, contrast, CTF, FOV, and ghost — across 9 eyebox positions and 3 eye reliefs
- Support both 100% inspection and statistical sampling modes
- Completely autonomous alignment and measurement





Software Options

Measurements and analyses :

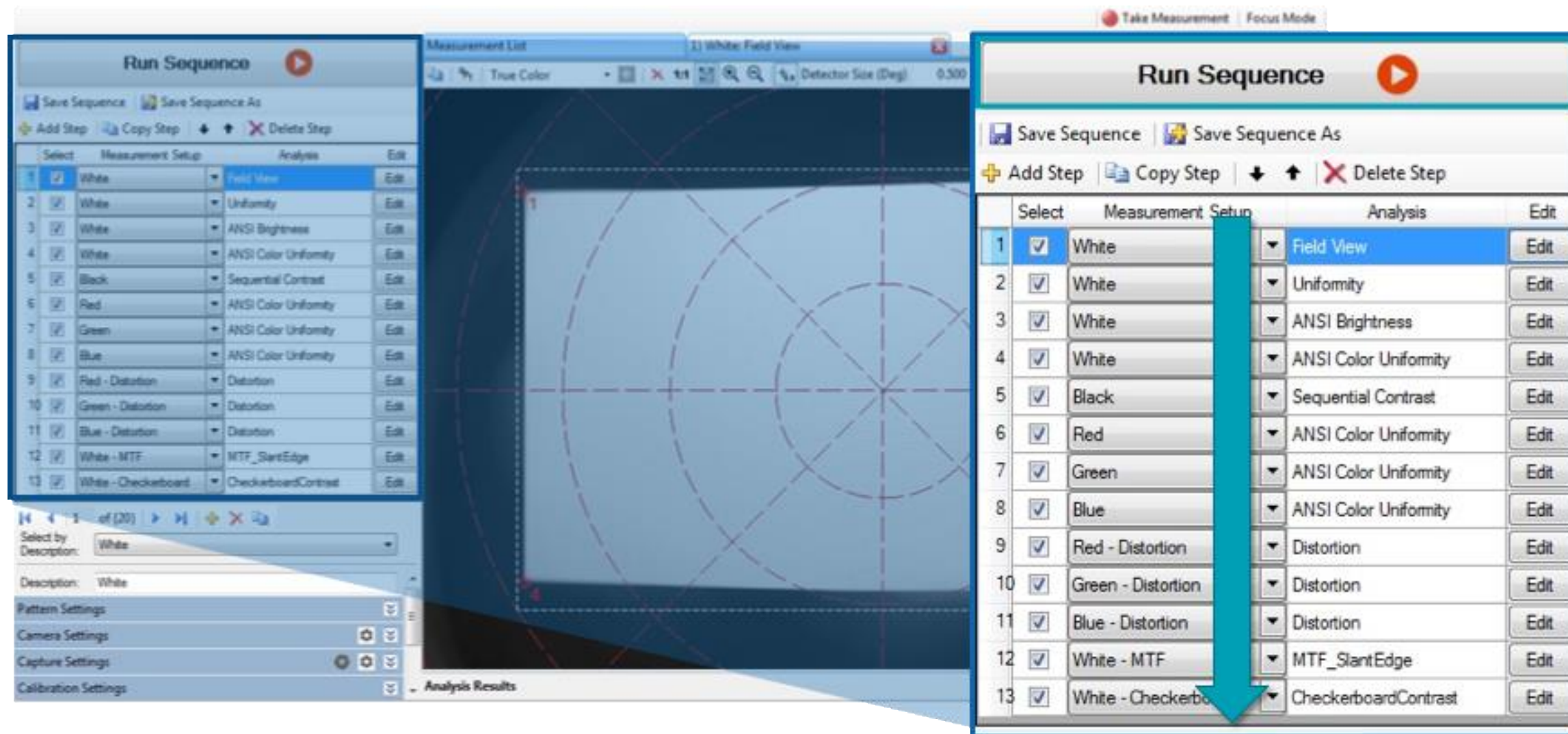
- Luminance
- Chromaticity
- Uniformity
- Contrast
- Distortion
- Focus Uniformity
- MTF (Line Pair, Slant Edge, LSF)
- Through Focus MTF
- Mura & defects
- Eyebow (req robot)
- Display FOV



Software Features:

- ✓ Controls test images on headset
- ✓ Synchronizes tests with images
- ✓ Rapid, automated evaluation of all visual qualities with pass/fail results
- ✓ API and SDK for integration with fixtures and control systems

Automated Test Sequencing



The screenshot displays the 'Run Sequence' software interface. The main window shows a sequence of 13 test steps. A large blue arrow points from the 'Field View' step to the 'CheckerboardContrast' step.

Run Sequence

Save Sequence | Save Sequence As

+ Add Step | Copy Step | Delete Step

Select	Measurement Setup	Analysis	Edit
1 ☒	White	Field View	Edit
2 ☒	White	Uniformity	Edit
3 ☒	White	ANSI Brightness	Edit
4 ☒	White	ANSI Color Uniformity	Edit
5 ☒	Black	Sequential Contrast	Edit
6 ☒	Red	ANSI Color Uniformity	Edit
7 ☒	Green	ANSI Color Uniformity	Edit
8 ☒	Blue	ANSI Color Uniformity	Edit
9 ☒	Red - Distortion	Distortion	Edit
10 ☒	Green - Distortion	Distortion	Edit
11 ☒	Blue - Distortion	Distortion	Edit
12 ☒	White - MTF	MTF_SlantEdge	Edit
13 ☒	White - Checkerboard	CheckerboardContrast	Edit

Select by Description: White

Description: White

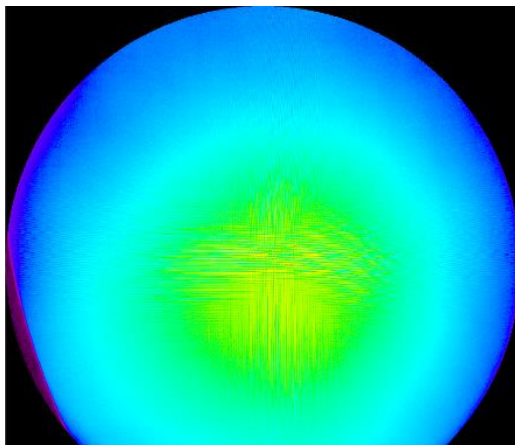
Pattern Settings

Camera Settings

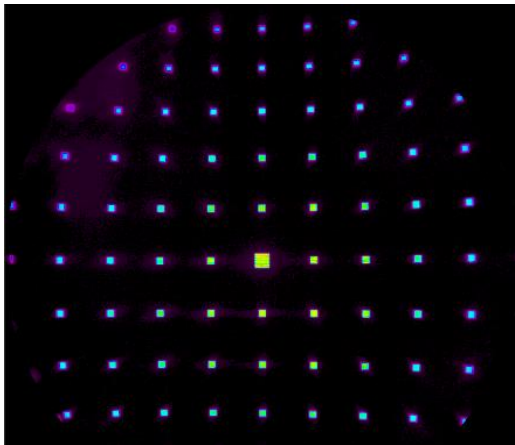
Capture Settings

Calibration Settings

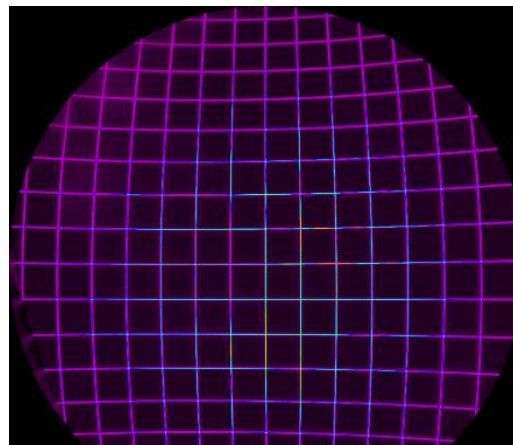
Analysis Results



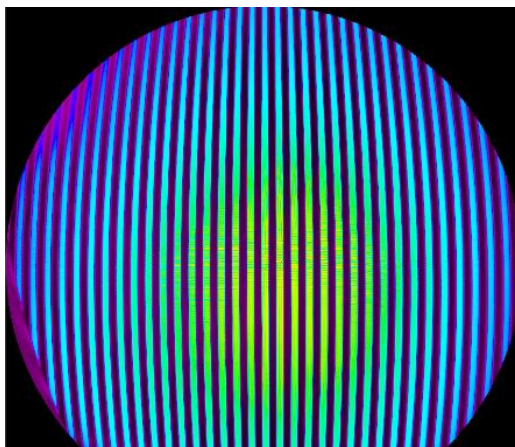
ANSI Brightness



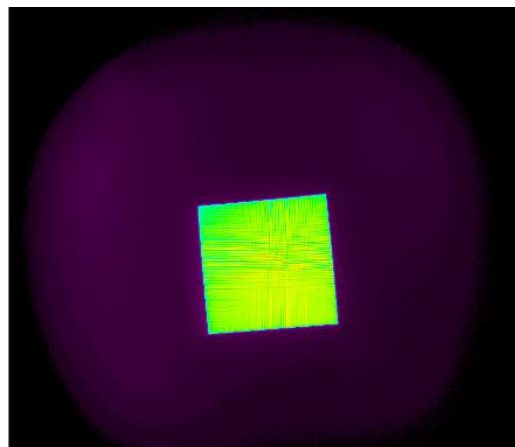
Distortion Dot Grid



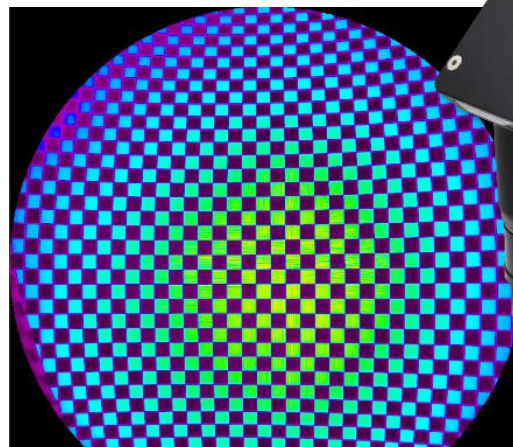
Distortion Line Grid



MTF Line Pairs

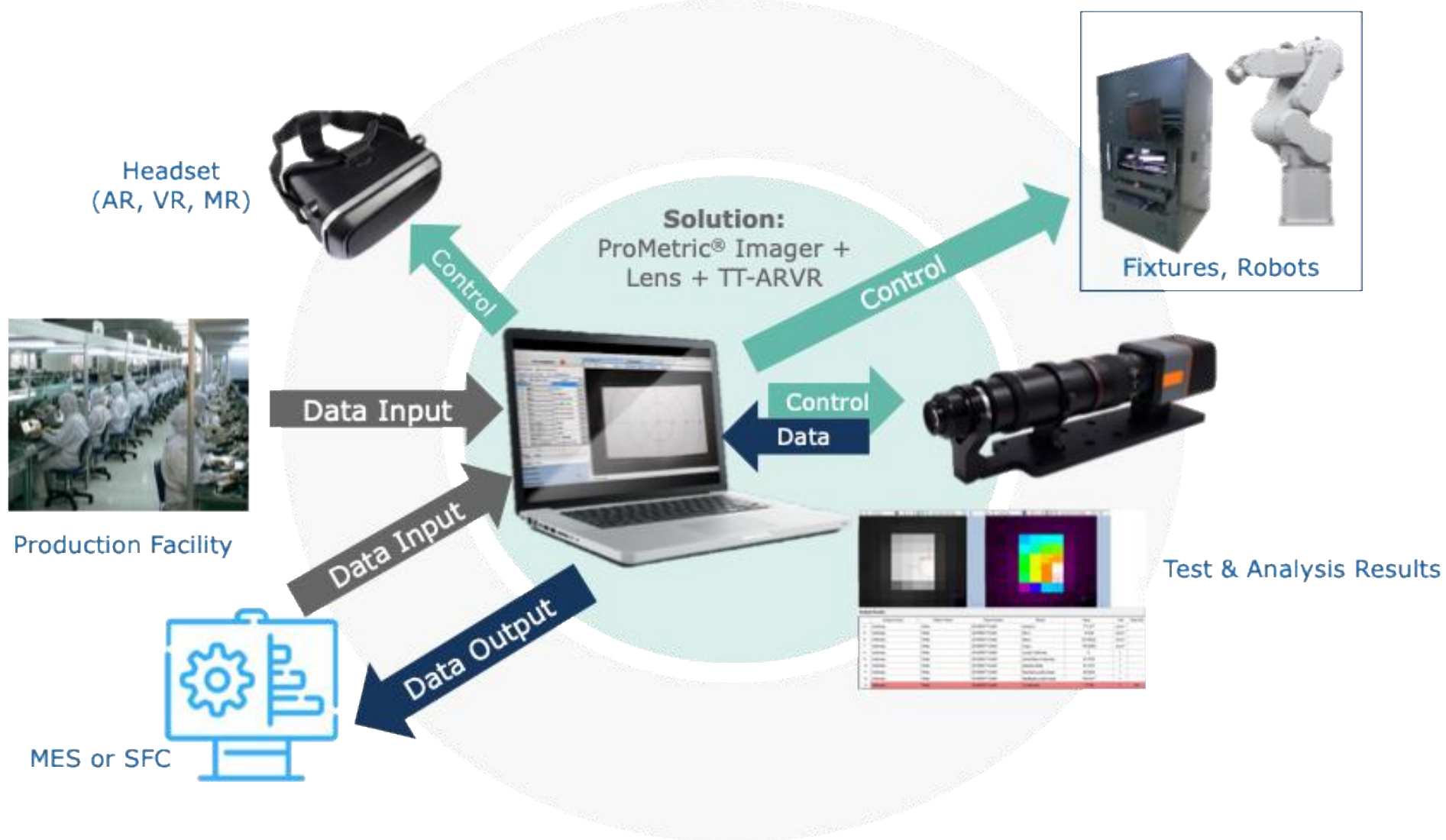


MTF Slant Edge



Focus Uniformity



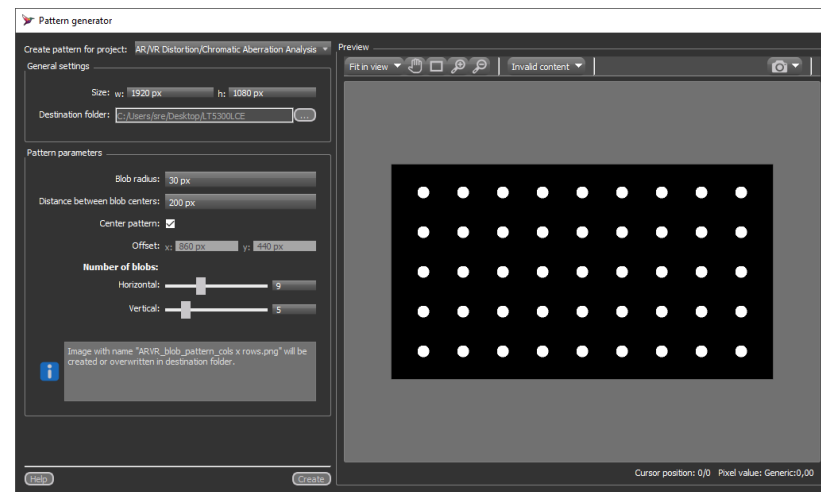


AR/VR analysis features

- Michelson Contrast (SDK)
- Slanted edge analysis (SDK/GUI)
- Distortion analysis (SDK)
- Chromatic aberration analysis (SDK)
- Luminance uniformity (SDK/GUI)
- Test pattern generator (GUI)
- Contrast ratio (SDK)
- Chromatic aberration (SDK)

AR/VR visualization

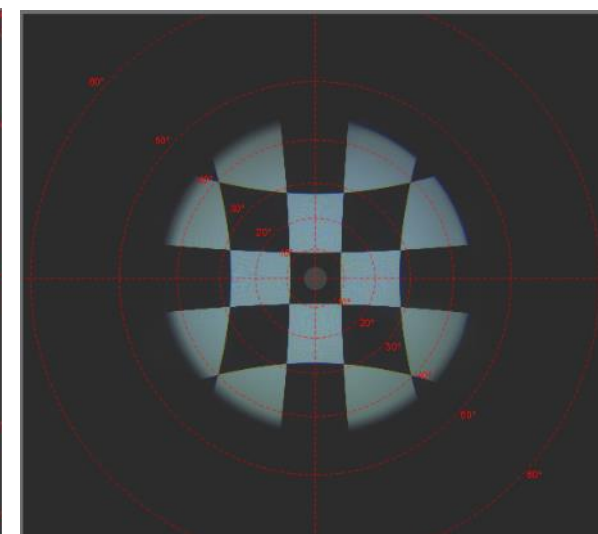
- Cartesian coordinates (x,y)
- Polar coordinates (azimuth (phi), elevation (theta))



Polar



Cartesian



Accurate measurement at every stage helps translate XR innovation into **consistent visual performance**.

1

XR Is Evolving Rapidly

Growth in AR, VR, and emerging display technologies is creating increasingly demanding performance and measurement requirements.



Market Growth

2

Measurement Must Reflect the User Experience

Accurate XR evaluation requires more than measuring the display alone—it requires measurement approaches that account for optics, viewing position, focus, and the way the human eye interacts with the device.



Display & Human Vision

3

Metrology Is Needed Throughout Development & Production

From display and sub-pixel characterization to waveguide evaluation and final-device testing, different stages of the XR ecosystem require specialized measurement approaches.



Display/Optics/Waveguide

4

A Comprehensive Approach Enables Better XR Quality

Konica Minolta Sensing brings together spectral, imaging, optical, and automated measurement capabilities to address XR testing needs from R&D through production.



Final Device



KONICA MINOLTA

Thank you!



KONICA MINOLTA