

Evaluating the latest technological displays using progressive **Display Color Analyzer CA-410**

Konica Minolta Sensing Americas, Inc.

Agenda

- I. Benefits of Color Analyzer CA-410 Series
- II. Small Spot Probe's specifications
- III. Unique applications
 - Head-mounted Display (for AR/VR) application
 - Under-Screen Camera application



Color Analyzer CA-410 Series

► **Benefits**

- High-speed, high accuracy measurements for luminance & chromaticity of HDR displays
- Easy to integrate into automatic-measurement systems
- Flicker measurement with wide-frequency measurement range that covers any types of displays
- High-Speed Gamma testing is approximately 1.5 times faster than previous generation CA-310 probe

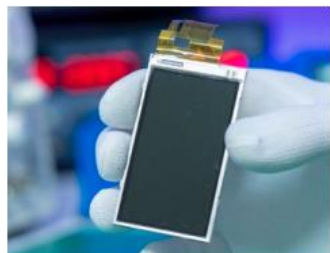
► **Applications**

- High-Sensitivity Probe ($\Phi 27\text{mm}$, $\Phi 10\text{mm}$) for OLED displays with best xy repeatability on lower-level luminance
- Regular Probe ($\Phi 27\text{mm}$, $\Phi 10\text{mm}$) as direct successor of CA-310 series with LCD flicker measurement function
- **Small-Spot Probe ($\Phi 4\text{mm}$, $\Phi 2\text{mm}$) for Micro & Small Display's evaluation needs**
- Long-Working Distance Probe ($\Phi 10\text{mm}$) for viewing angle measurement

High-Speed Measurement with High Accuracy & Repeatability

► Accuracy guaranteed from low to high luminance:

- 0.001 – 30,000 cd/m² depending on probe type



OLED for mobile device: 0.001 - 500 cd/m²

Ø27 CA-VP427 high-sensitivity probe

Accuracy-guaranteed luminance measurement range
0.001 - 3,000 cd/m²



HDR display: 0.01 - 2,000 cd/m²

Ø27 CA-P427 probe

Accuracy-guaranteed luminance measurement range
0.001 - 5,000 cd/m²



Backlight module: 20,000 cd/m²

Ø27 CA-P427H high-luminance probe

Accuracy-guaranteed luminance measurement range
0.01 - 30,000 cd/m²

► High-speed measurement:

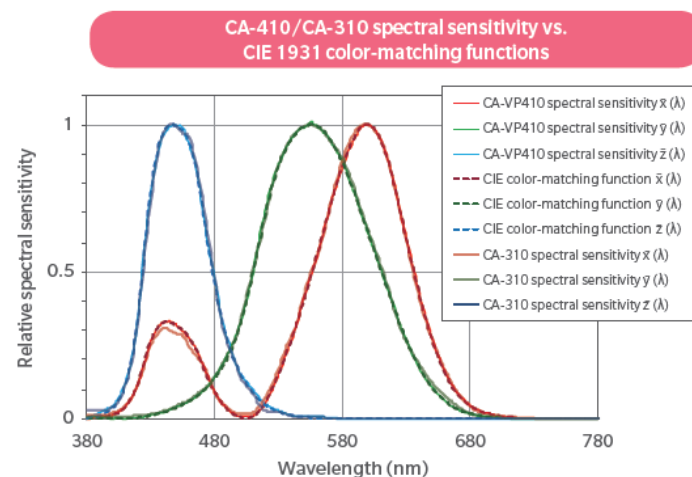
- Improvement of measurement circuit operation sequence
- Processing speed increased by improvement of CPU performance

*25x measurement per sec**

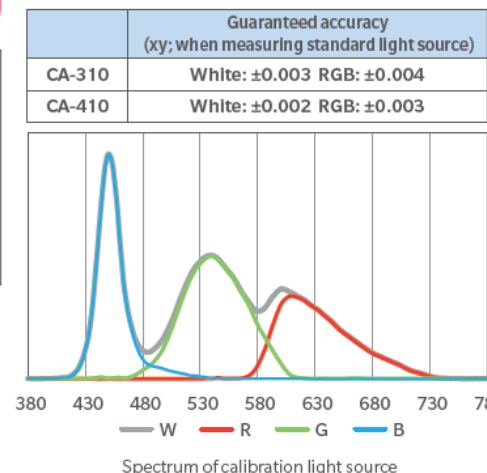
*In case of NTSC, Fast Mode, 2 cd/m² or over

► High-accurate spectral responsivity:

- Spectral sensitivity close to CIE1931
- Konica Minolta original calibration light source similar to general OLED's spectral characteristics



• High Sensitivity Probe CA-VP410's spectral sensitivities are shown above as typical.



Easy to integrate into automatic-measurement systems

- ▶ Light weight & small size
 - ▶ **Probe can be connected to PC directly (supports both USB / RS interface)**
 - ▶ **Automatic dark calibration (electric shutter is built in)**
 - ▶ Wider operation temperature / humidity (10 to 35°C / Under 85%)
 - ▶ Software Development Kit CA-SDK is provided as standard
- *PC Software CA-S40 is also available

Data Processor CA-DP40

- ▶ Portability with data memory function & Rechargeable battery
- ▶ Supports connection of up to 10 probes and simultaneous measurement



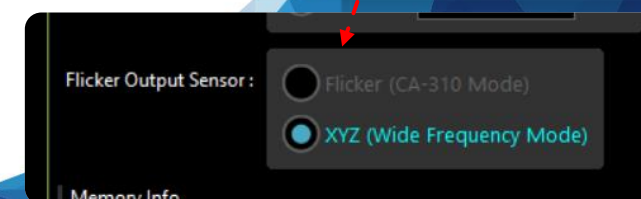
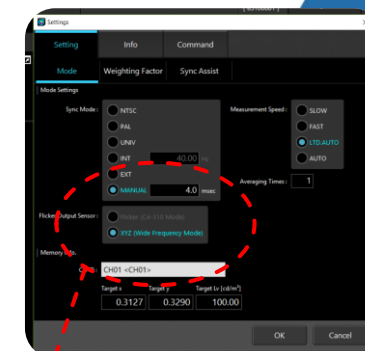
Flicker measurement with wide-frequency measurement range

- All the CA-410 probes can measure flicker (*in JEITA, VESA & FMA methods*)

CA-410 flicker meas spec. (φ27mm)		CA-P427		CA-VP427
Flicker Output Sensor ->		Flicker (CA-310 Mode)	XYZ (Wide Frequency Mode)	
Contrast (FMA)	Lv range	5 to 1500 cd/m ²	5 to 5000 cd/m ²	5 to 3000 cd/m ²
	Frequency range	0.25-65Hz	0.25-200Hz	0.25-200Hz
	Accuracy 30Hz, AC/DC 4% & 1.2% sine wave	±0.4% (at 30Hz) ±0.7% (at 60Hz)	±1.2% (at 30Hz) ±1.7% (at 60Hz)	±1.1% (at 30Hz) ±1.7% (at 60Hz)
	Repeatability (2σ) between 20-65Hz	0.3% (at AC/DC 10% sine wave)	1.7% (at AC/DC 10% sine wave)	1.6% (at AC/DC 10% sine wave)
JEITA	Lv range	5 to 1500 cd/m ²	5 to 4500 cd/m ²	5 to 3000 cd/m ²
	Frequency range	0.42-65Hz	0.42-200Hz	0.42-200Hz
	Accuracy 30Hz, AC/DC 4% & 1.2% sine wave	±0.35dB	±0.35dB	±0.35dB
	Repeatability (2σ) 30Hz	0.1dB (at AC/DC 4% sine wave) 0.3dB (at AC/DC 1.2% sine wave)	0.4dB (at AC/DC 4% sine wave) 1.5dB (at AC/DC 1.2% sine wave)	0.4dB (at AC/DC 4% sine wave) 1.4dB (at AC/DC 1.2% sine wave)

- **CA-310 Mode:** Measures FMA/JEITA flicker value using a dedicated flicker sensor with a low-pass filter cutting over 65Hz off (compatible with CA-310 flicker data)
*To remove high-frequency noise before sampling, that could cause aliasing

 PC Software CA-S40
Settings' window:



Small-Spot Probe Specifications

DATASHEET		CA-VP404	CA-VP402
Measurement area		Φ 4 mm	Φ 2.1 mm
Luminance range <small>*Supported frequency range: 0.5 to 240 Hz</small>	Luminance	0.004 to 12,000 cd/m ²	0.002 to 6,000 cd/m ²
	Chromaticity	0.04 to 12,000 cd/m ²	0.02 to 6,000 cd/m ²
Lv performance <small>*At 1 cd/m²</small>	Accuracy	± 3%	± 3%
	Repeatability (2σ)	0.20%	0.25%
xy performance <small>*At 1 cd/m²</small>	Accuracy	± 0.003	± 0.003
	Repeatability (2σ)	0.0005	0.0008
Flicker measurement		JEITA, VESA (dB), FMA (%) <small>Frequency range: 0.42 to 200 Hz Luminance range: 20 to 12000 cd/m²</small>	JEITA, VESA (dB), FMA (%) <small>Frequency range: 0.42 to 200 Hz Luminance range: 35 to 6000 cd/m²</small>

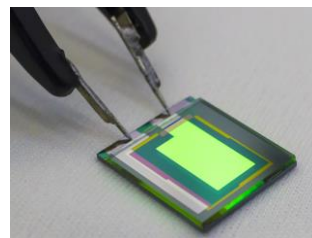
CA-VP404



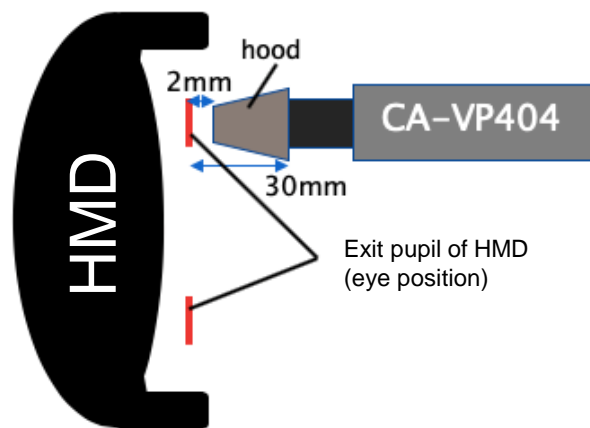
CA-VP402



For Micro & Small Display Applications



Small-Spot Probe CA-VP404 for AR/VR application (measuring area $\Phi 4\text{mm}$)



*HMD: Head-Mounted Display

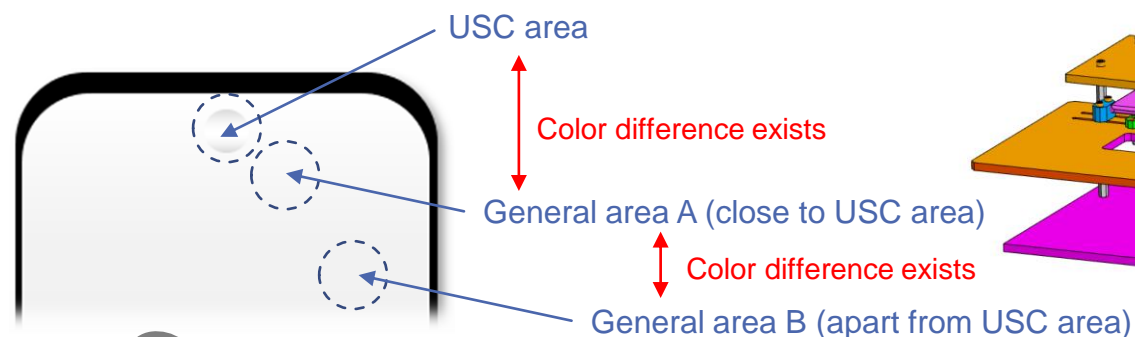
- Measuring area: $\varnothing 4 \text{ mm}$ (cf. human pupil size)
- Focal distance: $30 \pm 2 \text{ mm}$ (fixed)
- Measurement target:
 - Exit pupil w/ KM factory calibration channel (CH00)
 - Corresponding to virtual image measurement w/ additional user calibration channel (CH01-99)
- Suitable for routine measurement, Quality Control on production line, etc.

► Spectroradiometer CS-2000A Human Pupil Measurement for HMD applications

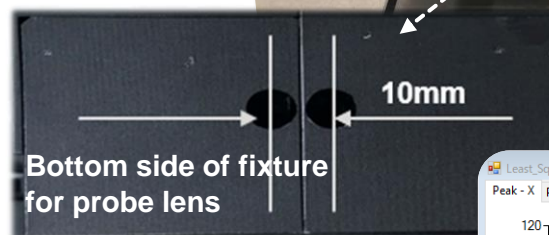
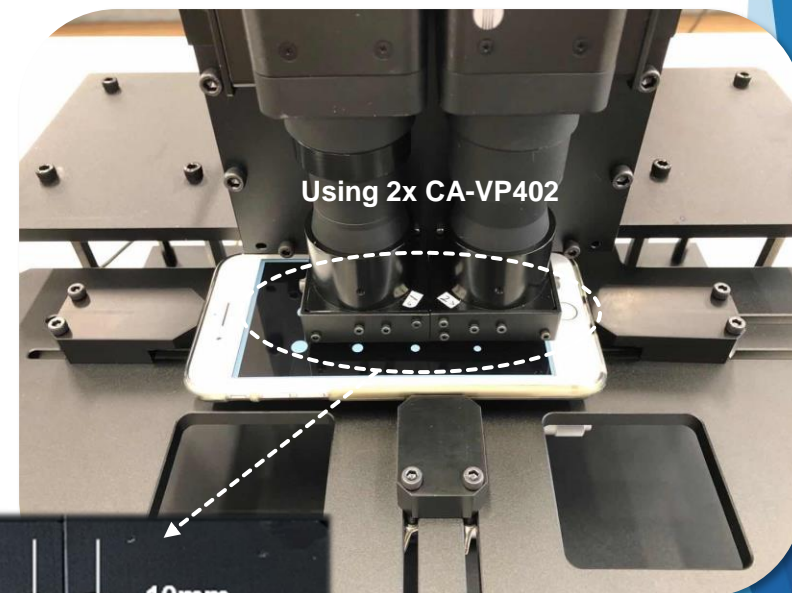
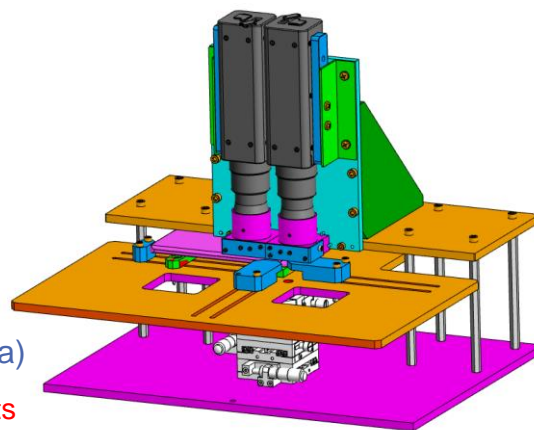


- $\Phi 1$ to 8 mm apertures in steps of 1 mm
- Focal distance: $350\text{mm} \sim \infty$
- Measurement target: Virtual image
- Suitable for R&D spectral data verification

Small-Spot Probe CA-VP402 for Under-Screen Camera application (measuring area Φ 2.1mm)

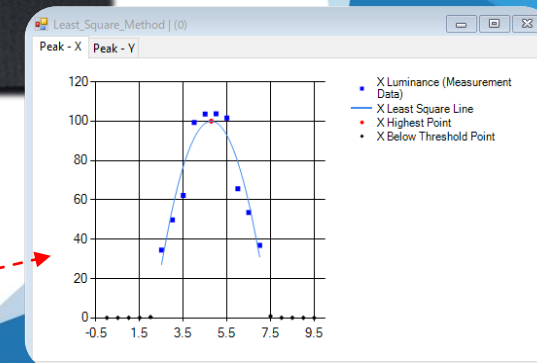


Front-facing camera sits underneath display



What are challenging on this application?

- I. Needs to measure both USC area and general area side by side as close as possible
 > Can measure both areas simultaneously at close distance (approx. 10mm)
- II. Needs to measure exact position of USC area
 > Special jig software helps to find center position of USC area



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Thank you!

