

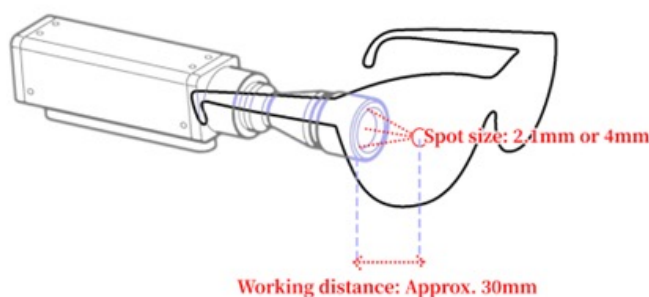
## Introducing Small Spot Display Measurements

### Highlighted topics include:

- Pupil-Size Measurement on Head-Mounted Displays using  $\varnothing 2.1\text{mm}$  &  $\varnothing 4\text{mm}$  Small Spot Probe
- Advancements in Measuring Under-Screen Camera Display Applications Using  $\varnothing 2.1\text{mm}$  Small Spot Probe
- Main Specifications of Small Spot Probes

### Pupil-Size Measurement on Head-Mounted Displays using $\varnothing 2.1\text{mm}$ & $\varnothing 4\text{mm}$ Small Spot Probes

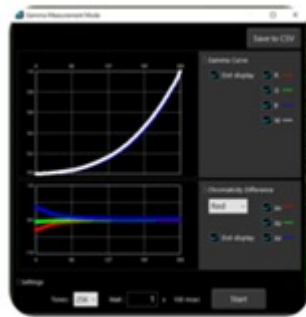
The measurement area of the CA-410 Small Spot Probe series corresponds to the typical size of the human pupil, and that its measurement distance is close to the eye relief. CA-VP402 measures a spot of  $\varnothing 2.1\text{mm}$  at a  $28(\pm 2)$  mm working distance of up to  $6,000\text{ cd/m}^2$  from  $0.002\text{ cd/m}^2$ . The CA-VP404 measures  $\varnothing 4\text{mm}$  at a  $30(\pm 2)$  mm working distance of up to  $12,000\text{ cd/m}^2$  from  $0.004\text{ cd/m}^2$ . Both probes measure luminance, chromaticity, and flicker at high speed with accuracy and repeatability, while easily and perfectly synchronizing the display frequency.



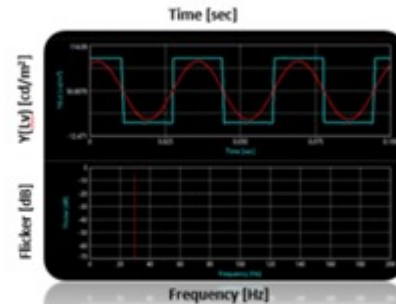
Application Example: Positioning CA-410 at Exit Pupil of AR Glasses

CA-410 Small Spot Probe series also provides a user-calibration feature. The user-calibration feature will allow probe calibration by specified correction coefficients based on the measurement data taken by other reference instruments\*. The focused measurement spot of the probe is the surface of the glasses, not the virtual image that is in a different focal length, which is on a different plane than the fixed working distance of the probe. If the reference data with a focus on the virtual image at the correct focal point can be obtained with other instruments, the CA-410 Small Spot Probe can be calibrated with the reference data and outputs the data corrected with the specified correction coefficients afterward.

\* Regarding the reference data, Konica Minolta also offers the CS-2000A spectroradiometer with its specialized attachment, as one of the solutions for the head-mounted display application, which allows measuring spectrum of virtual images corresponding to pupil size. This special attachment measures virtual images with different measurement spot sizes available from  $\varnothing 1\text{mm}$  to  $\varnothing 8\text{mm}$  in steps of  $1\text{mm}$ , which are also interchangeable. (See brochure of CS-2000A Pupil-Size Measurement)



CA-S40 Quick Gamma Measurement Mode



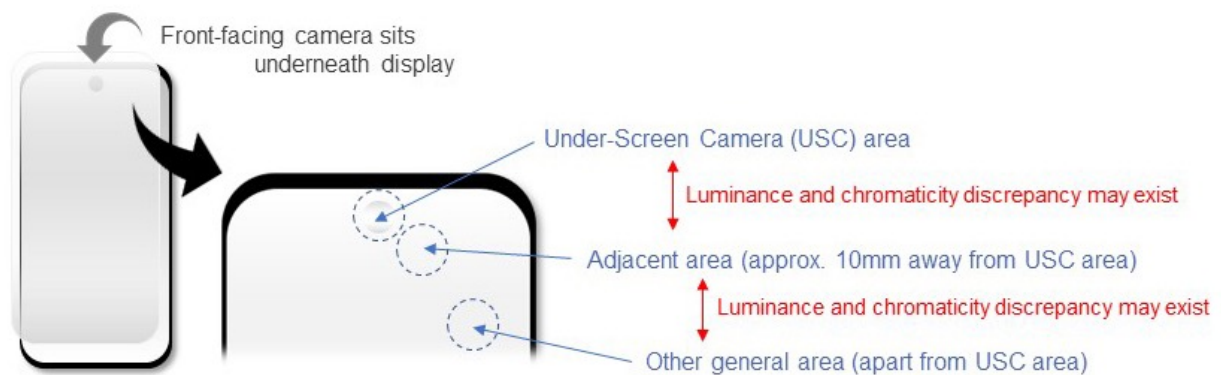
CA-S40 Waveform checking feature

Our PC Software CA-S40 comes standard with all probes and supports both Windows and macOS.

It provides the special features of fast gamma measurements (see [video](#) for demo) and display waveform measurements (see [video](#) for demo)

### Advancements in Measuring Under-Screen Camera Display Applications Using ø2.1 mm Small Spot Probe

Today, many smartphones use front-facing cameras as part of the full-screen display, positioning the camera behind the screen. This configuration requires two different pixel configurations to exist on the same display, making display gamma correction more complicated. This new positioning can cause a discrepancy in the brightness and color between the area in which the camera sits behind the screen and the other display area in question. Konica Minolta Sensing addresses this challenge with its Display Color Analyzer CA-410 Small Spot Probe. When used in conjunction with a fixture assisting accurate measurement, it can measure the ø2.1 mm spot area directly in front of the camera and compare it to the adjacent area approximately 10 mm away at the same time.



### Challenges with Under-Screen Camera Applications

The challenge of the under-screen camera (USC) display application exists with the uniformity issue between the screen located above the front-facing camera area and the rest of the screen. Pixel configurations are different between the two locations, and this will lead to a discrepancy between the two locations on the same screen for luminance and chromaticity.

To correct this discrepancy, you need to perform the gamma correction for the USC area separately from the rest of the screen on the same smartphone. To keep the USC area and the rest of the screen seamless with no color discrepancy, you need a gamma correction for the USC area to allow the color to match the adjacent area. Keeping a consistent color is more complex considering that the OLED displays have color non-uniformity in general, depending on the screen areas. If the display is not uniform between the USC area and the center screen area of the smartphone. In that case, the color difference will make the boundary between the two areas conspicuous, leading to a less than ideal appearance.

### What are the Challenges in Creating this Uniformity Between these Two Areas of the Display

To measure the screen area above the USC is the first challenge; this requires an instrument that can measure a minimal area. Secondly, finding the correct center point is key in measuring the USC area. Taking a measurement off-center can skew the results. Finally, simultaneous measurements and distance between these measurements should be as close as possible. Simultaneous measurement with dual probes saves operation time, one of the most critical factors considered on the production line. Seamless displays require instruments that can measure and accommodate this new technology. Konica Minolta Sensing offers instruments that can assist in this application.

### New Developments

In addition, Konica Minolta Sensing can also discuss the concept of our USC display application measurement system with the use of two CA-VP402 probes integrated into a fixture, which enables the measurement of the USC area and its adjacent area side by side at the same time. (See exhibit A).

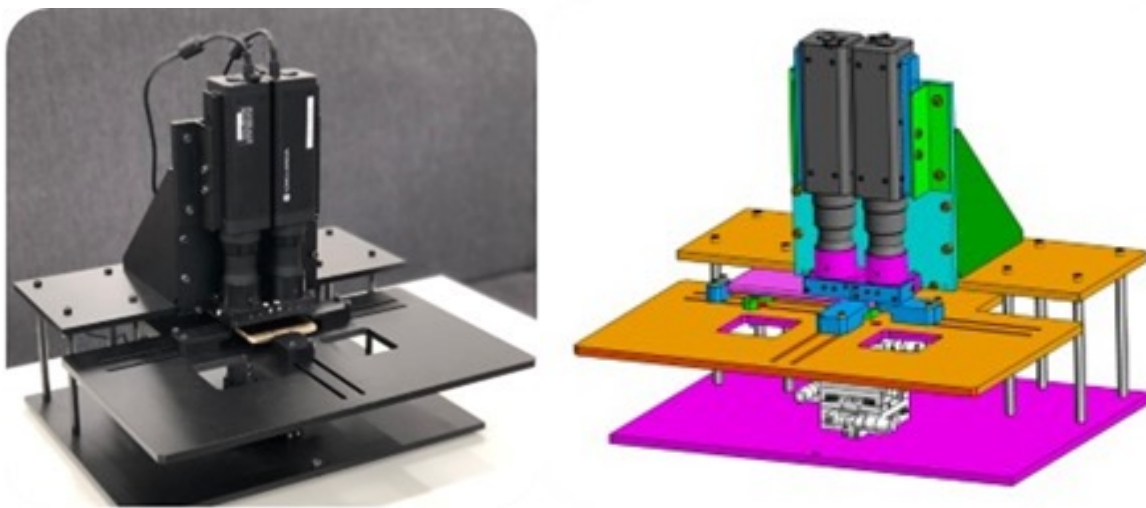


Exhibit A. Concept of USC Display Application Measurement System  
(Application example only - fixture is not for sale rather used for illustrative purposes only)

This fixture has a unique optical system applied to realize the simultaneous measurement for both areas at a 10 mm distance. The optional software for this system helps with positioning the probe at the right place on the center point of the area where the camera sits underneath the display by finding each peak luminance of the X-axis and the Y-axis. (See exhibit B).

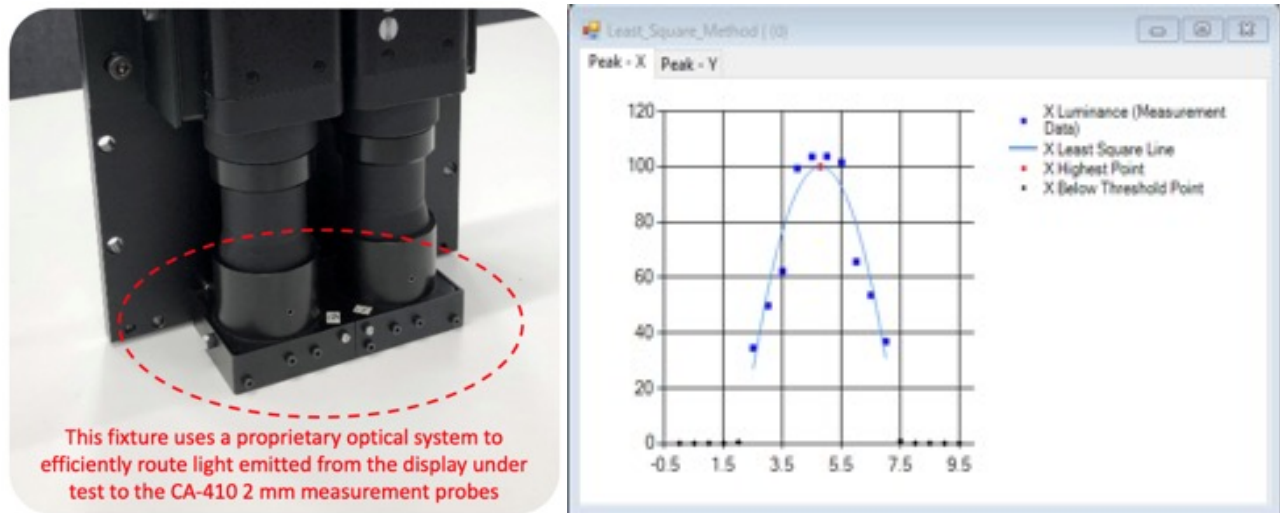


Exhibit B. Concept of USC Display Application Measurement System  
 (Application example only - fixture is not for sale rather used for illustrative purposes only)

### Konica Minolta's CA-VP402 and CA-VP404 Small Spot Probe Address the Need of:

- Measuring extremely small areas with its  $\varnothing 2.1$  mm (CA-VP402) and  $\varnothing 4$ mm (CA-VP404) spot measurements
- Provides a wide luminance measurement range covering 0.002 up to 6000 cd/m<sup>2</sup> ( $\varnothing 2.1$ mm) and 0.004 up to 12000 cd/m<sup>2</sup> ( $\varnothing 4$ mm probe) with high accuracy and repeatability performance for xy chromaticity
- Initiates gamma measurement quickly (see [video](#) for demo)
- Capable of FMA /JEITA/ VESA flicker measurements with a wide frequency measurement range of 0.25 up to 200 Hz
- The ability to display waveform measurements through flicker measurement results in a waveform graph and power spectrum graph with detailed measurement information, including maximum flicker value (dB), detected frequency (Hz), and luminance max/min/average values. This feature helps test and realize the low-consumption performance of the PWM-driven display, as shown in OLEDs. (see [video](#) for demo).

## About Konica Minolta Sensing

Konica Minolta Sensing is 'The Standard in Measuring Color, Light & Display'. Konica Minolta provides advanced optical technology that precisely measures the elements of color and light. Our products are a staple in research and manufacturing environments, helping organizations to meet product quality and operational goals with less waste, time, and effort. This commitment to creating value for customers is the core principle behind the Konica Minolta brand. It's also the driving force behind the high level of quality and precision built into each of our products and why we're the technological leader in color and light measurement solutions today.

To learn more, please visit us online at: <https://sensing.konicaminolta.us/light-measurement>

Or email us at: [marketing.sus@konicaminolta.com](mailto:marketing.sus@konicaminolta.com)