



KONICA MINOLTA

Display Color Analyzer

CA-410

High-speed, high-accuracy color analyzer that meets the measurement needs of today's ever-evolving displays



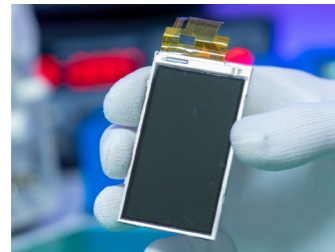
4 key features for measuring the latest displays

1 Accuracy guaranteed from super-low to high luminance

High-performance sensors and circuitry design combine to realize a wide accuracy-guaranteed luminance range that stretches from super-low to high emissions. This enables the CA-410 to meet the requirements for accurate measurement and tuning of chromaticity and gamma characteristics of OLED and HDR displays which require super-low luminance measurements. Moreover, the CA-410 can be paired with a lineup of high-luminance probes for measuring backlit modules equipped with new technologies like Mini-LEDs.

NEW The newly added CA-VP427A and CA-VP410A Advanced High-Sensitivity Probes offer a guaranteed accuracy range that begins from a super-low luminance of 0.0003 cd/m².

Measurable luminance range examples



OLED for mobile device: 0.001 - 500 cd/m²
 Ø27 CA-VP427 Advanced High Sensitivity Probe
 Accuracy-guaranteed luminance measurement range
 0.0003 - 5,000 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

Main probe lineup



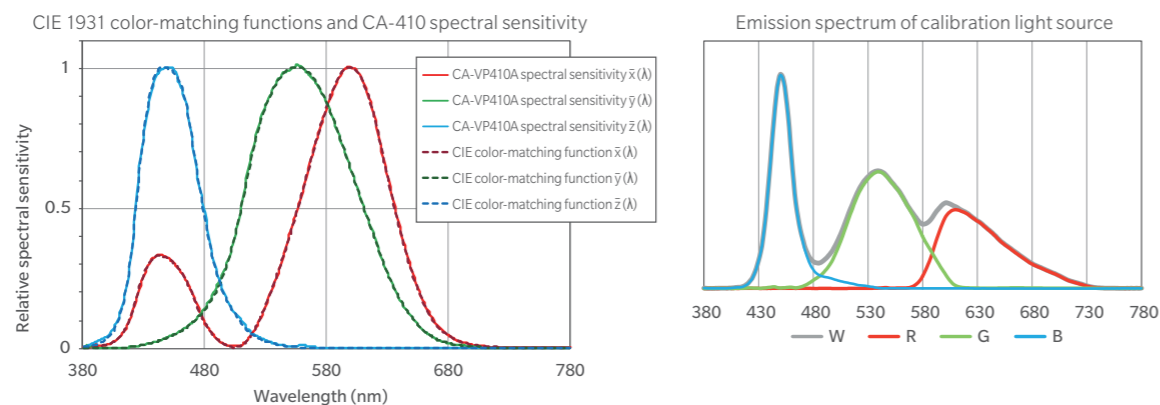
Recommended Measurement Instrument for DisplayHDR™ and Certification
 *Please contact us for further information about the recommended models.

2 High accuracy comparable to spectroradiometers in chromaticity measurements

The CA-410 features highly accurate XYZ filters that push its spectral sensitivity close to the CIE 1931 color-matching functions*. Moreover, because the calibration light source replicates the emission spectrum of LED displays, tristimulus chromaticity measurements can yield a high level of accuracy comparable to a spectroradiometer. This allows users to more accurately measure and tune the chromaticity and white balance of displays that have a wide color gamut.

*The spectral response of the CIE170-2: 2015 compatible probe CA-P427C is close to that standard's color-matching functions for the 2° observer.

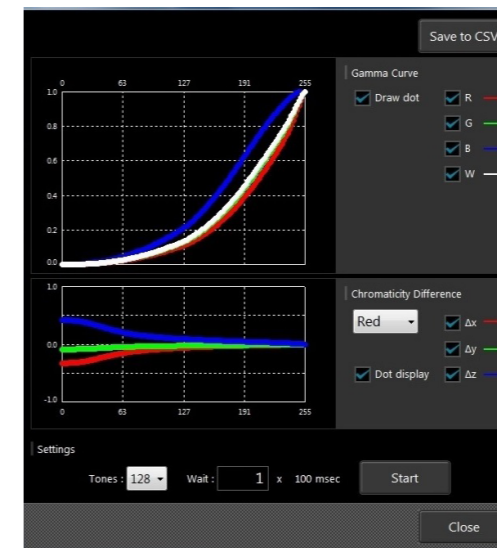
Spectral sensitivity of the CA-410 and calibration light source emission spectrum



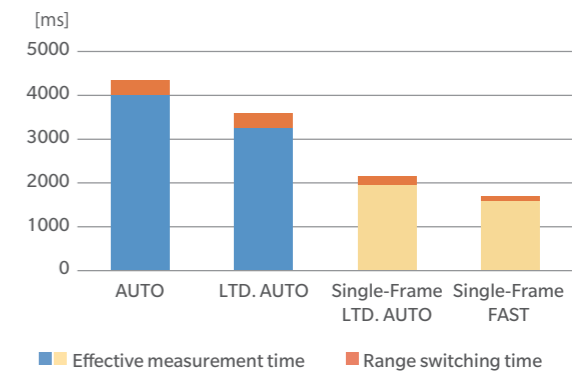
* Example using Advanced High Sensitivity Probe CA-VP410A (Typical for CA-VP410 Series)

3 High-speed measurements for enhanced productivity

Owing to high sensor sensitivity and high-speed computing, measurements with the CA-410 are fast in a way that shortens the time needed to conduct multiple measurements for luminance and chromaticity evaluation and adjustment such as for gamma testing. For even faster speed performance, the CA-410 offers LTD. AUTO mode that increases measurement speed while keeping the same or better accuracy than the predecessor CA-310. Also, Single-Frame mode which allows users to set the shortest integration time for synchronized measurements has been added. It is designed to improve productivity in processes where measurement speed is critical, such as inline color adjustments of OLEDs.



Gamma measurement time simulation



Probe: CA-P427
 Measurement synchronization: NTSC
 Integration time: Double-Frame, Single-Frame*
 Gamma measurement (64 tones) at 0.01 - 500 cd/m²
 Display drive time excluded
 * Accuracy and repeatability may be reduced when using Single-Frame in some cases.

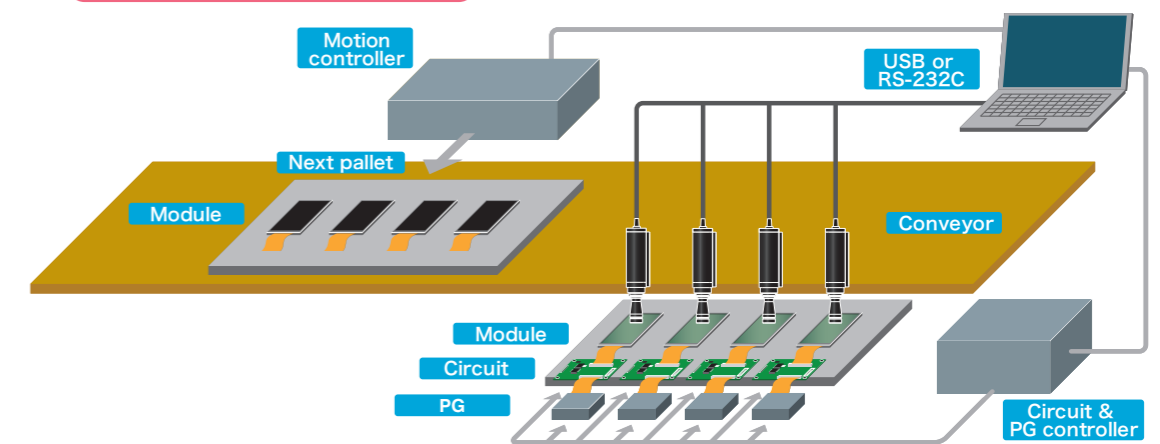
4 Designed for integration into automatic systems

The CA-410 is designed for integration and use in automatic systems. Features include a motorized zero-calibration shutter, synchronization detection function, and direct probe-PC connection which allows full functionality with USB bus power. Both RS-232C and USB ports are provided, and when using USB, the virtual COM port allows quick and easy connection to probes without the need to install drivers. For convenience when integrating the CA-410 into automatic systems developed for predecessor models CA-210/310, the basic communication commands of CA-410 are kept the same. Also, CA-SDK2 (Software development kit for the CA-410) includes as standard a COM registration tool which makes it possible to easily use the CA-410 with programs created for CA-210/310 using the previous CA-SDK. And various cables for incorporation into systems are available as optional accessories.

NEW Supports low-voltage external synchronization signal (1.8V) suitable for automatic synchronization measurement of small displays.

* From products produced after March 2021.

Example system configuration



Probes for measuring various kinds of displays

Ø27 mm measurement area

Applicable display size:
5 inches and above

High sensitivity CA-VP427A

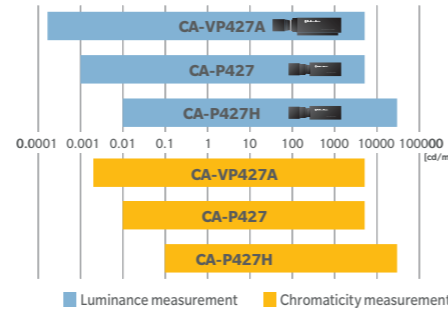


Normal CA-P427
High luminance CA-P427H



The measurement area of these probes is suitable for measuring large smartphones, in-vehicle displays, PC monitors, TVs and other large-size displays. Users can choose from the CA-VP427A Advanced High-Sensitivity Probe which offer high-speed measurements with accuracy guaranteed from super-low levels of luminance, or opt for the CA-P427H that can measure luminances as high as 30,000 cd/m².

<Specifications>
Measurement area: Ø27 mm
Acceptance angle: ± 2.5°
Accuracy guaranteed measurement distance:
30 mm ± 10 mm
Accuracy guaranteed range
for luminance measurements
CA-VP427A 0.0003 - 5,000 cd/m²
CA-P427 0.001 - 5,000 cd/m²
CA-P427H 0.01 - 30,000 cd/m²
Accuracy guaranteed luminance range
for chromaticity measurements
CA-VP427A 0.003 - 5,000 cd/m²
CA-P427 0.01 - 5,000 cd/m²
CA-P427H 0.1 - 30,000 cd/m²



Ø10 mm measurement area

Applicable display size:
Approx. 2 - 10 inches

High sensitivity CA-VP410A
High sensitivity CA-VP410H

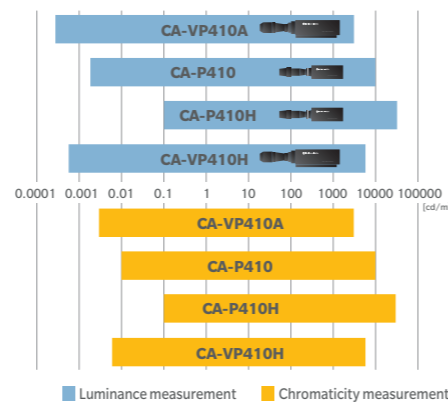


Normal CA-P410
High luminance CA-P410H



These probes have a measurement area suitable for measuring smart watches, small smartphones, in-vehicle displays and other small-size displays. There are three models to choose from, starting with the CA-VP410A Advanced High-Sensitivity Probe which offer high-speed measurements with accuracy guaranteed from super-low levels of luminance, the CA-P410 Normal Probe with its wide accuracy-guaranteed luminance range, or the CA-P410H that can measure luminance as high as 30,000 cd/m².

<Specifications>
Measurement area: Ø10 mm
Acceptance angle: ± 5° (CA-VP410A and CA-VP410H is ± 8.5°)
Accuracy guaranteed measurement distance:
30 mm ± 5 mm
Accuracy guaranteed range
for luminance measurements
CA-VP410A 0.0003 - 3,000 cd/m²
CA-P410 0.002 - 10,000 cd/m²
CA-P410H 0.1 - 30,000 cd/m²
CA-VP410H 0.0006 - 6,000 cd/m²
Accuracy guaranteed luminance range
for chromaticity measurements
CA-VP410A 0.003 - 3,000 cd/m²
CA-P410 0.01 - 10,000 cd/m²
CA-P410H 0.1 - 30,000 cd/m²
CA-VP410H 0.0006 - 6,000 cd/m²



<0-point calibration time>
0-point calibration with CA-VP427A, CA-VP410A, CA-VP410H and CA-VP402 takes about 10 sec.
With all other probes, it is about 3 sec.

Probe specification tables can be downloaded from the below address.
<https://www.konicaminolta.com/instruments/download/catalog/display/index.html>



Ø2, Ø4 mm measurement area

Applicable display size:
2 inches and below

Small spot CA-VP402



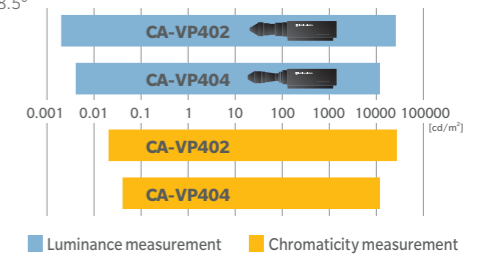
Small spot CA-VP404



These probes have small measurement areas which are suitable for measurement of micro OLEDs, smart watches, etc. Although the measurement area is small, the probes can take display measurements from low luminance levels at high speed and high accuracy, suitable for applications like gamma adjustments. The lineup consists of 2 models: CA-VP402 Small Spot Probe with Ø2 mm measurement area and CA-VP404 Small Spot Probe with Ø4 mm measurement area.

* Since CA-VP402 has an imaging optical system, when measuring devices with large pixel pitch, interference between the sensor fiber and the display pixels may adversely affect measurement repeatability.

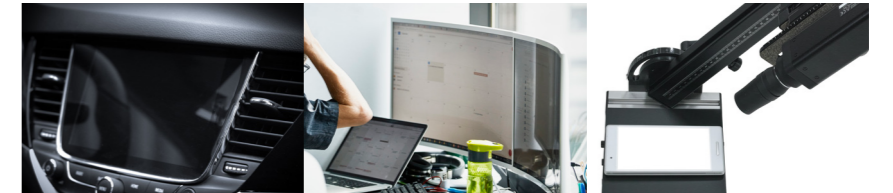
<Specifications>
Measurement area: CA-VP402 Ø2.1 mm; CA-VP404 Ø4 mm
Acceptance angle: CA-VP402 ± 10°; CA-VP404 ± 8.5°
Accuracy guaranteed measurement distance:
CA-VP402 28 mm ± 2 mm
CA-VP404 30 mm ± 2 mm
Accuracy guaranteed range
for luminance measurements
CA-VP402 0.002 - 25,000 cd/m²
CA-VP404 0.004 - 12,000 cd/m²
Accuracy guaranteed luminance range
for chromaticity measurements
CA-VP402 0.02 - 25,000 cd/m²
CA-VP404 0.04 - 12,000 cd/m²



Long working distance probe

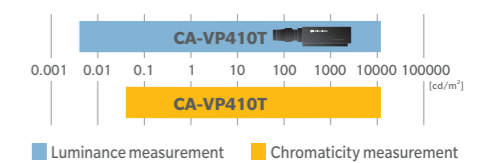
Multiple angle measurements, evaluation of angular viewing characteristics

LWD CA-VP410T



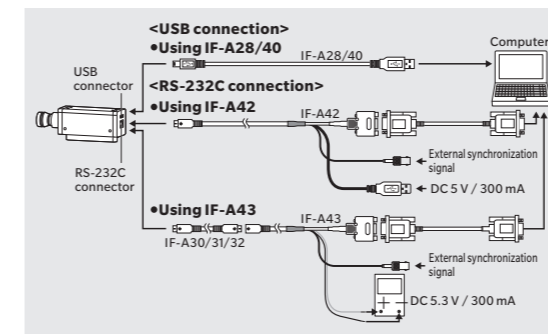
CA-VP410T Ø10 mm LWD probe (200mm) is suitable for multi-angle measurements of OLED for smartphones and in-vehicle displays, and also evaluation of viewing angle characteristics of curved displays. It is also a viable choice when distances must be kept from measurement targets to avoid collisions in automatic measuring systems.

<Specifications>
Measurement area: Ø10 mm
Acceptance angle: ± 4°
Accuracy guaranteed measurement distance:
200 mm ± 2 mm
Accuracy guaranteed range
for luminance measurements:
0.004 - 12,000 cd/m²
Accuracy guaranteed luminance range
for chromaticity measurements:
0.04 - 12,000 cd/m²



Cables

Cables for connecting probes with PC are available as accessories.



- <USB connections>
USB cable (2 m) IF-A28 (Communication + Power) Included with probe as a standard accessory
- USB cable (5 m) IF-A40 (Communication + Power)
- BNC conversion cable IF-A35 (External synchronization signal)
- <RS-232C connections>
Conversion cable IF-A42 (Communication + USB Power + External synchronization signal)
- Conversion cable (Extension) IF-A43 (Communication + Power line + External synchronization signal)
- IF-A43 is used together with RS cable for probe-DP connection IF-A30 (2m) / IF-A31 (5m) / IF-A32 (10m)

Full software support

PC Software CA-S40 can be downloaded from Konica Minolta website free of charge. The software connects the CA-410 series connects to a computer for measurement, allowing you to check measurement data, trend graphs, and waveforms.

* Click the link below to download CA-S40/CA-SDK2 free of charge.
Software downloads require input of customer information.
<https://www.konicaminolta.com/instruments/download/software/display/index.html>



Luminance and chromaticity measurement

- Synchronization frequency can be detected and set.
- Listed measurement results can be saved in .csv format or copied and pasted into a spreadsheet.
- Data can be displayed on graphs in various color spaces such as xy and u'v'
- Even low-luminance data below 0.1 cd/m² can be observed on trend graphs.



(Luminance and chromaticity measurement screen)

Gamma measurement

- The Color Window can be controlled by CA-S40 to automatically perform gamma measurements.
- An ideal gamma curve (gamma value) can be set as a target for comparison with actual measurement results.
- Approximate gamma values can be calculated from actual measurement results and displayed.

Flicker measurement

- In addition of FMA (contrast) and JEITA methods, flicker measurement align with IEC 62341-6-3 can also be performed by combining various weighting factors.
 - VRR-Flicker, a new flicker evaluation index, can be measured.
 - Specific parts of the waveform of VRR-Flicker can be zoomed in on for detailed observation.
 - VRR-Flicker measurement function is added not only to CA-527 but also to the CA-410 series.
- *For details on VRR-Flicker, please refer to page 7 of this catalog.



(Waveform measurement screen)

Waveform measurement

- The number of samples to measure for showing the display emission waveform can be set as desired.
- Waveforms can be converted and displayed by applying weighting factors.

* : CA-S40 Ver.2.1 New Features

<System requirements for CA-S40 (Ver.2.1)>

OS	Windows® 10 Pro 32bit, Windows® 10 Pro 64bit, Windows® 11 Pro macOS® Ventura, macOS® Sonoma * The required PC system configuration is the recommended configuration for the operating system above or the specifications below (whichever is more advanced).
Computer	Computer equipped with Intel Core i series, or equivalent processor, or a computer equipped with an Apple Silicon M1 chip, or equivalent processor (Apple silicon native support)
Memory	More than 4 GB
Hard disk	More than 500 MB of available space Out of the above, there must be at least 50 MB of available space on the system drive (drive where the OS is installed)
Display resolution	Display that supports at least 1,440 × 900 pixels and 16-bit colors
Other	USB 2.0 or above required to connect the instrument
Display languages	Display: English only

Flicker measurement for VRR displays

With the growing adoption of Variable Refresh Rate (VRR) technology and advancements in power-saving, there is an increasing need to evaluate flicker that occurs during frequency switching, as well as discrete and complex flicker with longer occurrence intervals. Traditional flicker measurement methods, such as the contrast (FMA) method and the JEITA method designed for LCDs, may not accurately capture flicker phenomena specific to VRR displays as perceived by the human eye.

To address this, Konica Minolta developed the VRR-Flicker measurement method and integrated it into our Color Analyzers to enable evaluations highly correlated with visual perception.

Effectiveness Comparison with Conventional Methods

Purpose	Method		
	VRR-Flicker	JEITA	FMA
Conventional Use			
LCD Vcom Adjustment			✓
Periodic Waveform Flicker (20-65 Hz)	✓	✓	
New Use			
Periodic Waveform Flicker (Low to High Frequency)	✓		
Aperiodic Flicker	✓		
Flicker Due to Complex Waveforms	✓		

New method - VRR-Flicker

The JEITA method, which enables measurements based on the TCSF of the human eye, has been widely used in applications requiring high visual correlation. However, due to its methodological characteristics—(1) reliance on Fourier transforms (e.g., FFT), (2) limited sensitivity to low-frequency components in TCSF, and (3) calculation of flicker values based only on the highest frequency component—it is only suitable for measuring simple and periodic waveforms in the 20–65 Hz range, as shown in the table above. The VRR-Flicker method overcomes these limitations by incorporating an updated TCSF and advanced calculation method. While maintaining the ability to accurately measure traditional periodic and static flicker, it also enables precise evaluation of newly emerging flicker patterns that require assessment.

Conference Presentation

We delivered a presentation on VRR-Flicker technology at IDW'21*.
Paper "Flicker Calculation Method for Dynamic Refresh Rate Display"
URL: <https://doi.org/10.36463/idw.2021.0690>

*The 28th International Display Workshops



VRR-Flicker Measurement

The PC Software CA-S40 enables the emission waveform of the target display ("Original data"), the perceived luminance waveform ("Weighted data"), and the VRR-Flicker value to be easily measured and obtained.



Additionally, "VRR-Flicker Trend," which represents the variation of the VRR-Flicker value over time, can be acquired. This provides insight into how flicker is perceived by the human eye and serves as a useful tool for evaluating flicker quality.

Probes Supporting the Function

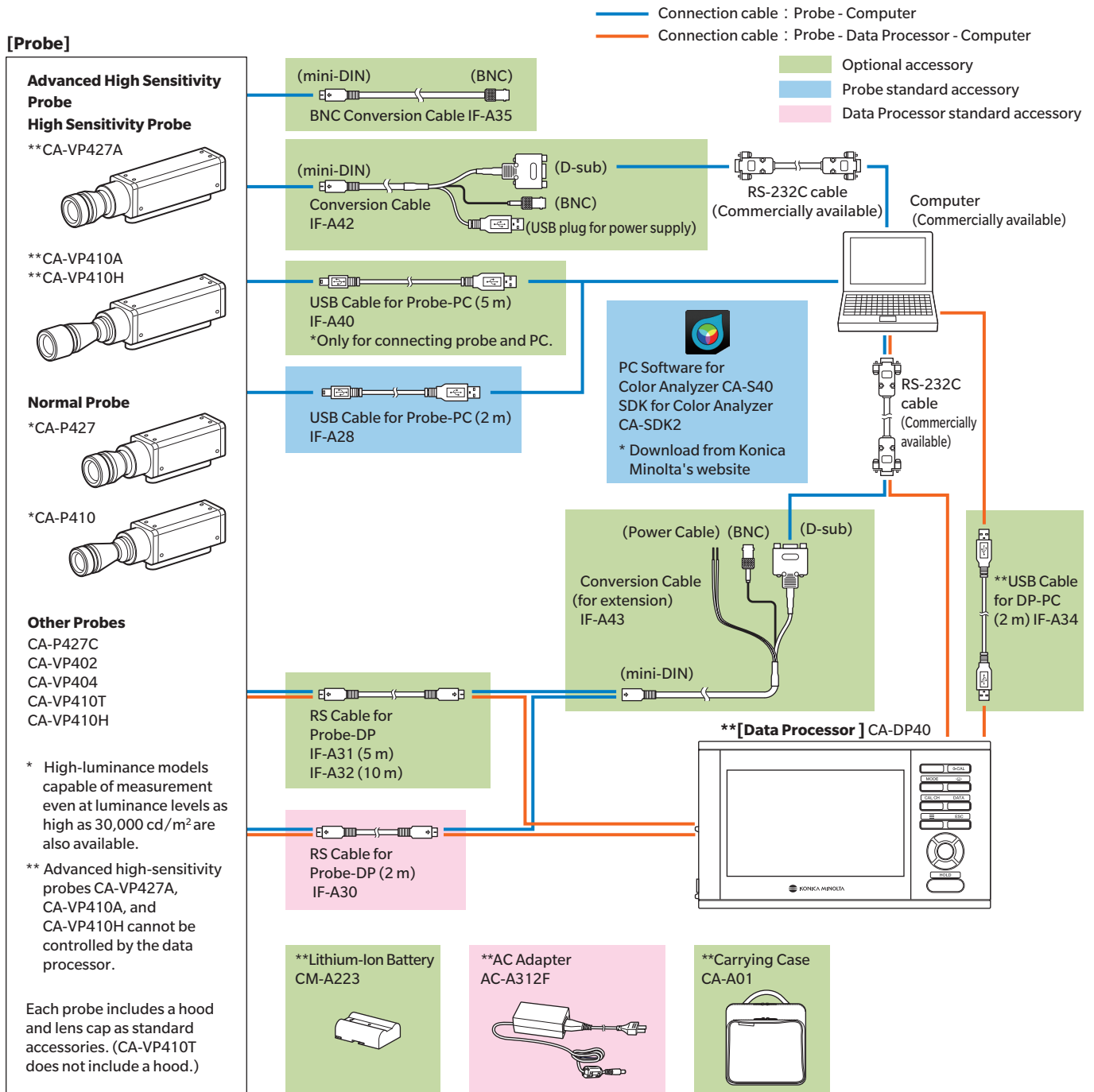
This feature is available for all CA-410 series* and CA-527 probes. CA-410 series probes provide sufficient performance for evaluating flicker as perceived by the human eye. The CA-527 probe goes further, enabling accurate measurement of emission waveforms and flicker even for OLED displays at low luminance, where emission waveforms change rapidly.

* The CA-410 firmware must be version 1.4 or later.

	CA-527	CA-VP427A
VRR-Flicker measurement luminance range	≥ 0.5 cd/m ²	≥ 5 cd/m ²
Sampling frequency	Up to 200 kHz	3 kHz
Aliasing prevention function	Yes	No

CA-SDK2 can be used to obtain the same data as CA-S40 for seamless integration of VRR-Flicker measurement and inspection into production lines.

System Diagram



- Windows® is a trademark or registered trademark of Microsoft Corporation in the USA and other countries.
- macOS® is a registered trademark of Apple Inc. in the USA and other countries.
- Intel® Core™ is a trademark or registered trademark of Intel Corporation in the USA and other countries.
- Other company names and product names used herein are trademarks or registered trademarks of their respective companies.
- Bluetooth® is a registered trademark of Bluetooth SIG, Inc. and is used under license agreement.
- Screens shown are for illustration purposes only.
- The specifications and appearance shown herein are subject to change without notice.

SAFETY PRECAUTIONS

For correct use and for your safety, be sure to read the instruction manual before using the instrument.

- Always connect the instrument to the specified power supply voltage. Improper connection may cause a fire or electric shock.

ISO Certifications of KONICA MINOLTA, Inc., Sakai Site

ISO 9001
 JQA-QMA15888
 Design, development, manufacture/
 manufacturing management, calibration, and
 service of measuring instruments

ISO 14001
 JQA-E-80027
 Design, development,
 manufacture, service and sales
 of measuring instruments

CONTACT US-Global Network

<https://www.konicaminolta.com/instruments/network/index.html>