

Display Color Analyzer CA-410

**Probe + PC Software
CA-S40 Ver. 1.8**

Instruction Manual



Please read before
using the instrument.



KONICA MINOLTA

■ Safety Symbols

The following symbols are used in this manual to prevent accidents that may occur because of incorrect use of the instrument.



Denotes an instruction regarding a safety warning or note.
Read the instruction carefully to ensure safe and correct use.



Denotes an instruction regarding the risk of electric shock.
Read the instruction carefully to ensure safe and correct use.



Denotes an instruction regarding the risk of fire.
Read the instruction carefully to ensure safe and correct use.



Denotes a prohibited operation.
The operation must never be performed.



Denotes an instruction.
This instruction must be strictly adhered to.



Denotes a prohibited operation.
Never disassemble the instrument.



This symbol indicates direct current (DC).

Notes on this Manual

- Copying or reproduction of all or part of the contents of this manual without the permission of KONICA MINOLTA is strictly prohibited.
- The contents of this manual are subject to change without prior notice.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your retailer or a KONICA MINOLTA-authorized service facility.
- KONICA MINOLTA will not accept any responsibility for consequences arising from the use of the instrument.
- The latest instruction manual can be downloaded from the following URL:
http://www.konicaminolta.com/instruments/download/instruction_manual/index.html

Formal designations of application software used in this manual

(Designation in this manual) (Formal designation)










Bluetooth	Bluetooth®
Windows, Windows 10	Microsoft® Windows® 10 Pro Operating System
Windows, Windows 11	Microsoft® Windows® 11 Pro Operating System
macOS, macOS Catalina	Apple® macOS® Catalina
macOS, macOS Big Sur	Apple® macOS® Big Sur
macOS, macOS Monterey	Apple® macOS® Monterey
Excel	Microsoft® Office Excel




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Safety Precautions

To ensure correct use of this instrument, read the following points carefully and adhere to them. After you have read this manual, keep it in a safe place where it can be referred to anytime a question arises.

	WARNING (Failure to adhere to the following points may result in death or serious injury.)
	Do not use the instrument in places where flammable or combustible gases (gasoline, etc.) are present. Doing so may cause a fire.
	Firmly push the cable plug completely into the outlet. Incomplete insertion may cause fire or electric shock.
	Always hold the plug itself when disconnecting the cable from an outlet. Pulling on the cable may damage it and cause a fire or electric shock. Also, do not insert or disconnect the plug with wet hands. Doing so may cause electric shock.
	Do not forcibly bend, twist, or pull the cords or cables. Also, do not scratch, or place heavy objects on the cables. Doing so may damage the cable and cause a fire or electric shock.
	Do not disassemble or modify the instrument. Doing so may cause a fire or electric shock.
	Take special care not to allow liquid or metal objects to enter the instrument. Doing so may cause a fire or electric shock. Should liquid or metal objects enter the instrument, turn the power OFF immediately, and contact the nearest KONICA MINOLTA-authorized service facility.
	The instrument should not be operated if it is damaged, or if smoke or odd smells occur. Doing so may cause a fire. In such situations, turn the power OFF immediately, and contact the nearest KONICA MINOLTA-authorized service facility.
	Do not insert or disconnect the plug with wet hands. Doing so may cause electric shock.

	CAUTION (Failure to adhere to the following points may result in injury or damage to the instrument or other property.)
	When cleaning the instrument, disconnect the cable. Failure to do so may result in electric shock.
	Do not place the instrument on an unstable or sloping surface. Doing so may result in the instrument dropping or overturning, causing injury. Be careful not to drop the instrument when carrying it as well.

Introduction

The CA-410 series is an instrument designed to measure the color, luminance, and flicker of various color displays. Please read this manual carefully before using the instrument.

Packing materials of the product

Be sure to keep all packing materials used for shipping the instrument (cardboard box, cushioning material, plastic bags, etc.). This instrument is a precision measuring instrument. When transporting the instrument to a service facility for maintenance or for other reasons, be sure to use the packing materials to minimize shock or vibration. If the packing materials are lost or damaged, contact a KONICA MINOLTA-authorized service facility.

Notes on Use

Operating Environment

- This instrument has been designed exclusively for indoor use. Outdoor use is prohibited.
- This instrument is composed of precision electronic components. Never disassemble the instrument.
- This instrument is a pollution level 2 product (equipment to be used primarily in manufacturing environments, laboratories, warehouses, and similar locations). This instrument should be used in environments where exposure to metallic dust or condensation is not a concern.
- This instrument is an overvoltage category I product (equipment for connection to circuits in which measures are taken to limit transient overvoltage to an appropriately low level).
- Do not use the instrument at altitudes higher than 2,000 m.
- Take care to prevent foreign matter from entering the instrument. Using the instrument while subjected to intrusion of water or metals is extremely dangerous.
- Using the instrument in direct sunlight or near heating equipment can cause the internal temperature of the instrument to become much higher than the ambient temperature, resulting in malfunction. Do not use the instrument in such areas. Also, use the instrument in a well-ventilated environment.
- Avoid subjecting the instrument to sudden temperature changes and condensation.
- Do not use the instrument in areas where dust, smoke, or chemical gases are present, or in extremely humid environments.
- This instrument should be used in an environment with an ambient temperature between 10 and 35°C and a relative humidity of 85% or less. Use of the instrument outside this range will result in unsatisfactory performance.

System

- Do not subject the instrument to strong vibrations or impacts.
- Do not pull, forcibly bend, or apply excessive force to the connected cables and cords. Doing so may cause the cable or cord to break.
- The instrument should be connected to a power source with as little noise as possible.
- The instrument may cause interference if used near a television, radio, transceivers, etc.
- When restarting the instrument, wait several seconds after turning the power OFF before turning the power ON again.
- Do not turn the power off during writing to the memory such as calibration and measurement.
- The instrument may not operate properly due to the compatibility with the equipment connected to it such as a PC. Please check whether the instrument operates properly by yourself.
- Make sure to disconnect the USB connection between the probe and the PC and to turn off the power when the instrument is not in use.
- Periodic backup of important data and settings to another storage medium is recommended.
- Should the instrument break down, do not try to disassemble and repair the instrument. Consult with your nearest KONICA MINOLTA-authorized service facility.

Lens

- Before measurement, make sure that the lens surface is not dirty. You may not be able to perform correct measurement if there is dirt, dust, or finger mark on it, or if stain remains after cleaning.
- Do not touch the lens surface with hands.
- Avoid subjecting the instrument to sudden temperature changes under a high-humidity environment. It may fog the lens and hinder correct measurement.

Storing the Instrument

- This instrument should be stored at a temperature between 0 and 45°C with a relative humidity of 85% or less and no condensation. Storing the instrument in an environment with high temperatures and high humidity will result in unsatisfactory performance. Storing the instrument at or near room temperature and humidity is recommended.
- Make sure that the instrument is not subjected to condensation when stored. In addition, take care to prevent rapid temperature changes to prevent condensation from occurring when transporting the instrument to the storage location.
- Storing the instrument in direct sunlight or near heating equipment can cause the internal temperature of the instrument to become much higher than the ambient temperature, resulting in malfunction. Do not store the instrument in such areas.
- Do not store the instrument in areas where dust, smoke, or chemical gases are present. Doing so may cause deterioration in performance or a malfunction.
- Do not leave the instrument inside the cab or trunk of a vehicle. Otherwise, the temperature and/or humidity during midsummer or midwinter may exceed the allowable range for storage, resulting in a malfunction.
- Before storing, make sure that the lens is attached with the cap supplied as a standard accessory.

Notes on Cleaning

- If the instrument becomes dirty, wipe it with a soft, dry cloth. Never use organic solvents (such as naphtha or thinner) or other chemicals for cleaning.
- If there is dust or dirt on the optical system of a probe, use a blower to blow it off and then gently wipe it with a soft, dry cloth or with a lens-cleaning cloth. Never use organic solvents (such as naphtha or thinner) or other chemicals for cleaning.
- If you are unable to remove dirt from the instrument or if the instrument becomes scratched, contact a KONICA MINOLTA authorized service facility.

Notes on Transporting

- When transporting the instrument, be sure to use the packing materials to minimize shock or vibration.
- When sending the instrument in for service, package and send the instrument and all accessories.

Maintenance and Inspection

- To maintain measurement accuracy, the instrument should be inspected once a year. For information on inspection, contact the nearest KONICA MINOLTA-authorized service facility.

Disposal Method

- Make sure that the instrument, its accessories, and the packing materials are either disposed of or recycled correctly in accordance with local laws and regulations.

About This Manual

This manual is designed for those who possess basic knowledge of displays and relevant equipment.

Please read this manual carefully before using the instrument.

In the descriptions about probes in this manual, probes are described as "probe" where the type of probe is not specified.

For Those Who Want to Purchase Optional Accessories for This Instrument

This manual also explains how to use optional accessories available for this instrument.

If an explanation of how to use an optional accessory is given in this manual, its product name is also given.

Please read the explanation together with the manual supplied with the accessory.

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Configuration of the CA-410 Series

1. Configuration

The CA-410 series consists of the following three systems:

● Probes

Sensor units for measuring displays.

Can be connected to a PC to perform measurement (using PC software).

Can be connected to a data processor to perform measurement.

● Data Processor CA-DP40

Can connect up to ten probes simultaneously to perform measurement.

Can be connected to a PC so that it can be controlled from the PC (using PC software).

Note: • Advanced high-sensitivity probes CA-VP427A and CA-VP410A cannot be controlled by the data processor.

● PC software CA-S40

Can control a probe connected to a PC to perform measurement.

Can control a data processor connected to a PC to perform measurement.

The instruction manual for probes and PC software (this manual) contains the following descriptions about probes and the standard PC software, PC Software for Color Analyzer CA-S40:

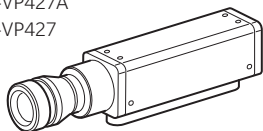
- Handling procedure and specifications of probes
- How to install the PC software
- How to measure when the probe(s) or the data processor are connected to a PC

2. System Configuration Diagram

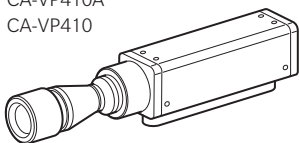
[Probe]

Advanced High Sensitivity Probe High Sensitivity Probe

CA-VP427A
CA-VP427

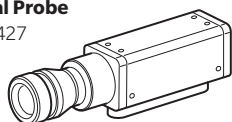


CA-VP410A
CA-VP410

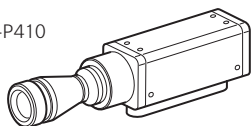


Normal Probe

* CA-P427

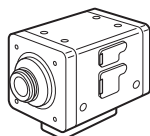


* CA-P410



Mini Probe

* CA-MP410

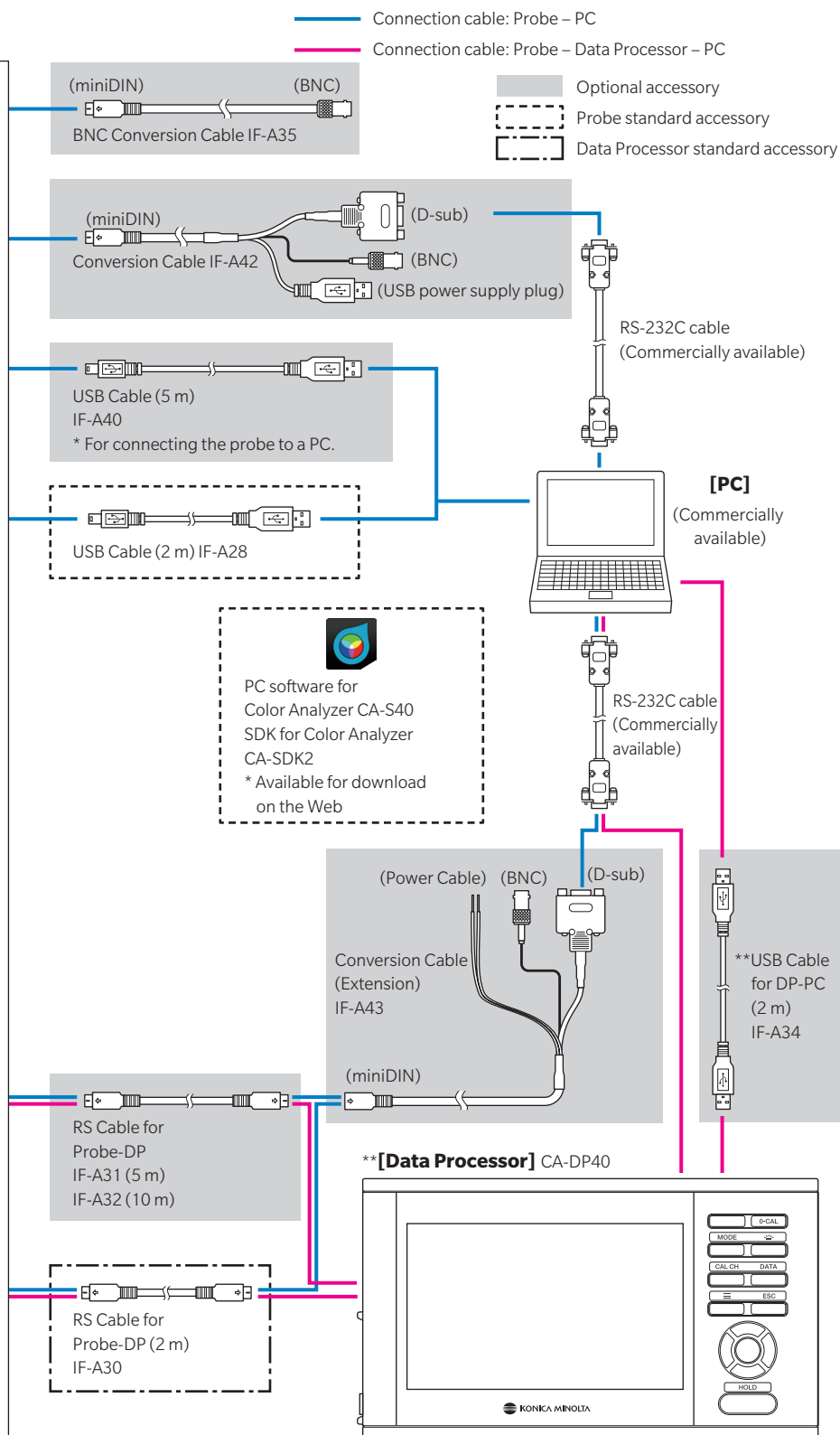


Other Probes

CA-P427C
CA-P410C
CA-VP402
CA-VP404
CA-VP410T

* High-luminance models capable of measurement even at luminance levels as high as 30,000 cd/m² are also available.

** Advanced high-sensitivity probes CA-VP427A and CA-VP410A cannot be controlled by the data processor.



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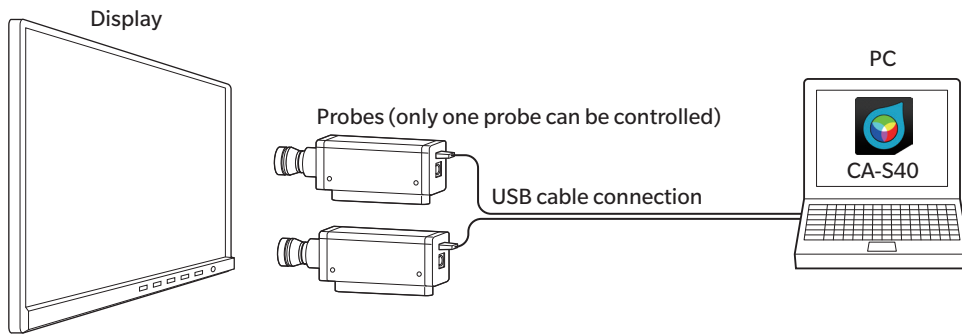
Probes

1. About Probes

A CA-410 series probe can be used to measure the luminance, chromaticity, and flicker values of displays.

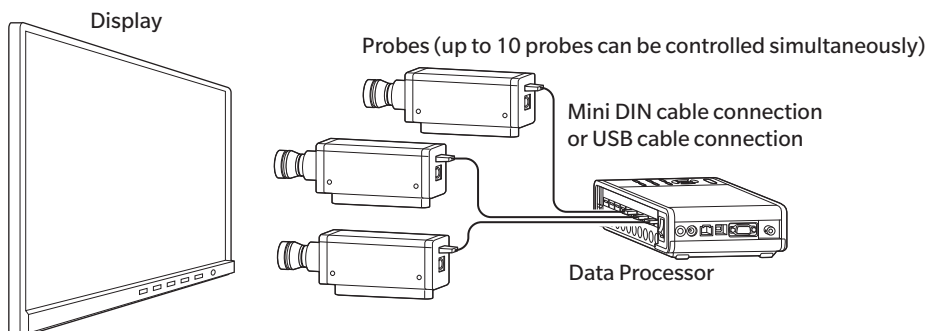
A probe can be controlled in the following three ways:

- You can connect a probe to a PC and control it from PC software to perform measurement. By using the standard software, PC Software CA-S40 For Color Analyzers, you can select one of the probes connected to a PC via USB and control it to perform measurement.



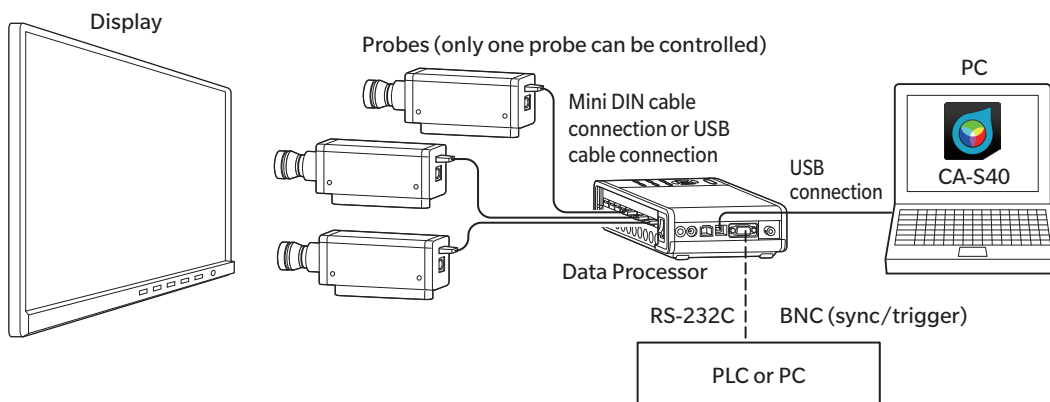
- You can connect a probe to a data processor and control it from the data processor to perform measurement. Multiple probes can be controlled simultaneously to perform measurement.

Note: • Advanced high-sensitivity probes CA-VP427A and CA-VP410A cannot be controlled by the data processor.



- You can connect a probe to a data processor, connect the data processor to a PC, and control it from PC software to perform measurement. By using the standard software, PC Software for Color Analyzer CA-S40, you can select one of the probes connected to the data processor and control it to perform measurement.

Note: • Advanced high-sensitivity probes CA-VP427A and CA-VP410A cannot be controlled by the data processor.



2. Probe Lineup (All Probes are Provided with Lens Caps)

The following probes are available according to the application.

Model	Name	Description
CA-P427	ø27 Probe	Probe with a measurement area of 27 mm
CA-P427H	ø27 Probe for high luminance	High-luminance probe with a measurement area of 27 mm
CA-P410	ø10 Probe	Probe with a measurement area of 10 mm
CA-P410H	ø10 Probe for high luminance	High-luminance probe with a measurement area of 10 mm
CA-MP410	ø10 mini Probe	Compact probe with a measurement area of 10 mm
CA-MP410H	ø10 mini Probe for high luminance	Compact high-luminance probe with a measurement area of 10 mm
CA-VP427	ø27 High Sensitivity Probe	High-sensitivity probe with a measurement area of 27 mm
CA-VP427A	ø27 Advanced High Sensitivity Probe	Advanced high-sensitivity probe with a measurement area of 27 mm
CA-VP410	ø10 High Sensitivity Probe	High-sensitivity probe with a measurement area of 10 mm
CA-VP410A	ø10 Advanced High Sensitivity Probe	Advanced high-sensitivity probe with a measurement area of 10 mm
CA-P427C	ø27 Probe (CIE 170-2:2015 compliant)	CIE 170-2:2015-compliant probe with a measurement area of 27 mm
CA-P410C	ø10 Probe (CIE 170-2:2015 compliant)	CIE 170-2:2015-compliant probe with a measurement area of 10 mm
CA-VP402	ø2 Small Spot Probe	Probe with a measurement area of 2 mm
CA-VP404	ø4 Small Spot Probe	Probe with a measurement area of 4 mm
CA-VP410T	ø10 LWD Probe (200 mm)	Probe with a measurement area of 10 mm and a measurement distance of 200 mm

Note:

- High-sensitivity probes CA-VP427 and CA-VP410, advanced high-sensitivity probes CA-VP427A and CA-VP410A, small spot probes CA-VP402 and CA-VP404, and LWD probe CA-VP410T cannot measure flicker in CA-310 Mode.
- Advanced high-sensitivity probes CA-VP427A and CA-VP410A cannot be controlled by the data processor.
- Use of a high-luminance probe is recommended for measuring a display that instantaneously shows high luminance, such as CRTs.
- The CA-VP402 probe is designed for measurement of displays with a high pixel density, such as micro OLED displays. The pixels within the measurement area may be insufficient when measuring smartphone displays or other displays, and measured values may be unreliable due to the influence of position reproducibility.

3. Standard Accessories

● Hoods and lens caps

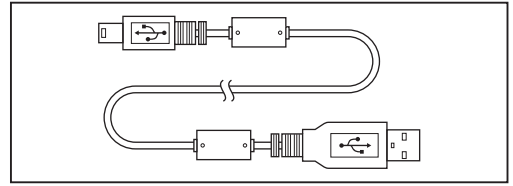
Use	Hood		Lens cap	
	Model	Name	Model	Name
For a ø27 probe	CA-H12	Hood for ø27 Probe	CA-H13	Lens Cap for ø27 Probe
For a ø10 probe	CA-H14	Hood for ø10 Probe	CA-H15	Lens Cap for ø10 Probe
For a ø10 mini probe	CA-H16	Hood for ø10 Mini Probe	CA-H17	Lens Cap for ø10 Mini Probe
For a ø27 high-sensitivity probe and ø27 advanced high-sensitivity probe	CA-H18	Hood for ø27 High Sensitivity Probe	CA-H19	Lens Cap
For a ø10 high-sensitivity probe and ø10 advanced high-sensitivity probe	CA-H20	Hood for ø10 High Sensitivity Probe	CA-H21	Lens Cap
For a ø2 Small Spot Probe	CA-H22	Hood for ø2 Small Spot Probe	CA-H19	Lens Cap
For a ø4 Small Spot Probe	CA-H23	Hood for ø4 Small Spot Probe	CA-H21	Lens Cap
For a ø10 LWD Probe	—	—	CA-H21	Lens Cap

Probes

● USB Cable (2 m) IF-A28

Connects a probe to a data processor or a PC via USB.

How to connect: Refer to page 15.



● PC Software for Color Analyzer CA-S40

Controls a probe or data processor connected to a PC via USB to perform measurement.

For how to use it, refer to the instruction manual for the PC software.



● SDK for Color Analyzer CA-SDK2

A library for users to create programs on their own.

* PC Software CA-S40 and SDK CA-SDK2 are available for download from the following product support webpage:

<https://www.konicaminolta.com/instruments/download/>

● Instruction Manual (this manual)

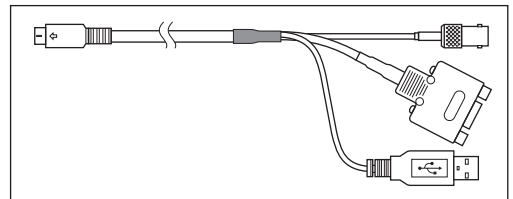
Please read before using the instrument.

4. Optional Accessories

● Conversion Cable IF-A42

Connects a probe to a PC or PLC (sequencer) via RS-232C and inputs synchronization signals to the probe.

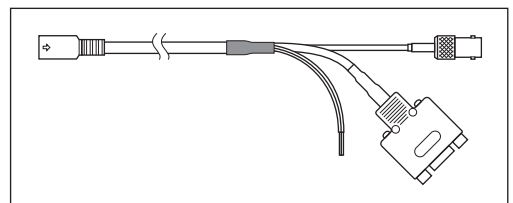
How to connect: Refer to page 15.



● Conversion Cable (Extension) IF-A43

Connects to a probe via a Probe-DP RS Cable IF-A30/A31/A32 for longer distance connections. Connects to a PC or PLC (sequencer) via RS-232C and inputs synchronization signals to the probe.

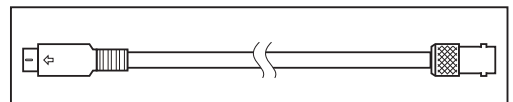
How to connect: Refer to page 15.



● BNC Conversion Cable IF-A35

Inputs synchronization signals to the probe.

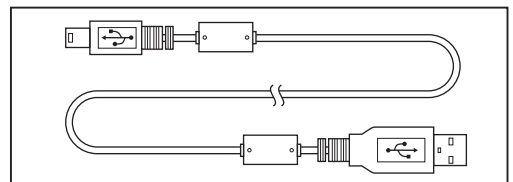
How to connect: Refer to page 16.



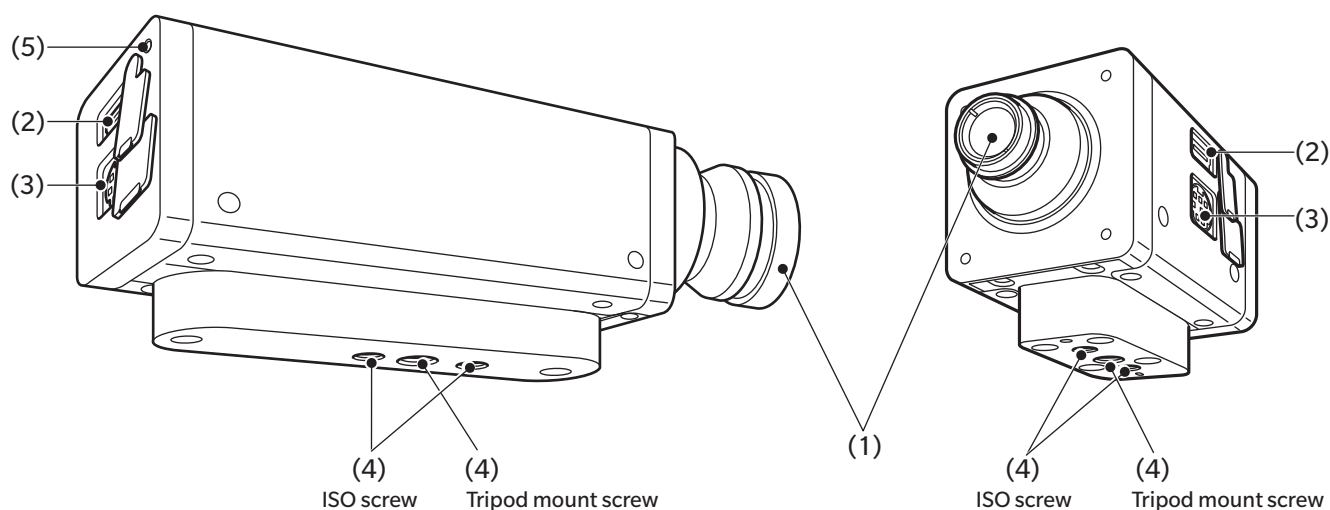
● USB Cable (5 m) IF-A40

For connecting the probe to a PC.

How to connect: Refer to page 15.



5. Description of Each Part of Probes



● Probe other than mini

Note: CA-P427, P427H, P410, and P410H have another tripod mount screw on the front side of the ISO screw. For details, refer to the dimensions.

● Mini probe

Note: Mini probes have screws for jigs and cable clamps. For details, refer to the dimensions.

(1) Receptor

Make this part face perpendicular to a display to perform measurement.

(2) USB connector

For USB connection with a data processor or a PC, connect the USB cable IF-A28 supplied as a standard accessory.

(3) RS-232C connector

For RS-232C connection to a data processor, connect the mini DIN cable IF-A30/31/32 for the data processor to the RS-232C connector.

Note: • Advanced high-sensitivity probes CA-VP427A and CA-VP410A cannot be controlled by the data processor.

For RS-232C connection with a PLC or PC, connect an optional conversion cable IF-A42.

Use a conversion cable IF-A42 or a BNC conversion cable IF-A35 to input the display's vertical synchronization signals, which are used for measurement in "EXT" measurement synchronization mode.

(4) Screw holes

There are two types of screws for securing a probe:

Tripod mount screw: Used for mounting the probe on a tripod. The depth is 6 mm.

ISO screw: Used for securing the probe to jigs. Use an ISO 5 mm screw and the depth is 6 mm.

- The distance from each screw to the end of the optical column is the same as that for a CA-310 series probe. (Excluding mini probes, the CA-VP402, the CA-VP404, and the CA-VP410T.)
- The position of the optical axis (in the height direction) is the same as that for a CA-310 series probe.

(5) Status indicator

Located on the rear of all probes to indicate the status of the probe.

No power supply: Off

During measurement or zero calibration: Off

Memory error: Blinking (On for 0.2 sec, then Off for 0.2 sec)

Zero calibration not performed: Blinking (On for 1 sec, then Off for 0.2 sec)

Measurement possible: On (even when measurement is not possible due to the setting of an invalid synchronization frequency or integration time in INT, EXT, or MANUAL sync mode, without displaying that state)

6. How to Set a Probe

1 Secure the display.

2 Secure the probe in a way to place its end 30 mm ^{*1} away from the display surface.

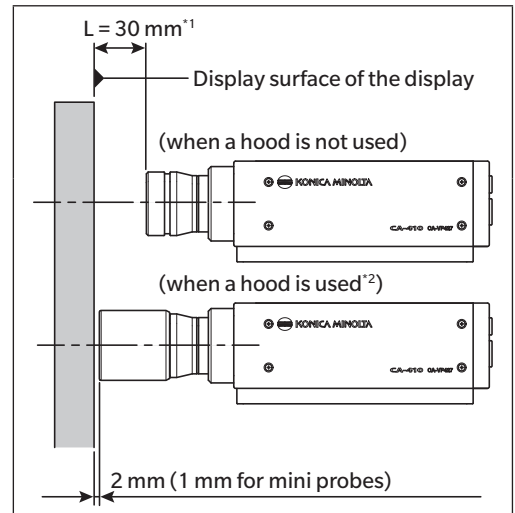
Be sure to set it perpendicular to the display.

*1: L = 10 mm for mini probes.

L = 28 mm for the CA-VP402.

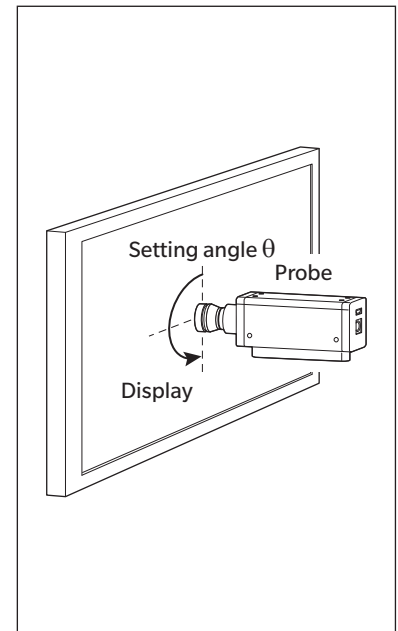
L = 200 mm for the CA-VP410T.

*2: No hood is used for the CA-VP410T.



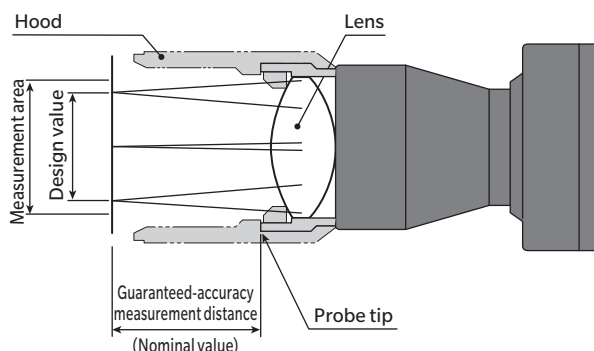
Notes on setting

- When measuring displays with high view angle dependence, you can obtain a higher measurement reproducibility by not changing the setting angle θ for every measurement. In particular, the CA-VP410 high-sensitivity probe, the CA-VP410A advanced high-sensitivity probe, and the CA-VP402 and CA-VP404 small spot probes have a large aperture angle, which has a greater effect on the viewing angle. When measuring displays with a high view angle dependence, run user calibration and use the probe without rotating it from the calibrated position.
- Use of the hood supplied as a standard accessory not only blocks ambient light but also makes it easier to achieve a proper measurement distance and an angle of 90° .
 - The guaranteed-accuracy measurement distance for a $\phi 27$ probe is $L = 30 \text{ mm} \pm 10 \text{ mm}$.
 - The guaranteed-accuracy measurement distance for a $\phi 10$ probe is $L = 30 \text{ mm} \pm 5 \text{ mm}$.
 - The guaranteed-accuracy measurement distance for a mini probe is $L = 10 \text{ mm} \pm 5 \text{ mm}$.
 - The guaranteed-accuracy measurement distance for the CA-VP402 is $L = 28 \text{ mm} \pm 2 \text{ mm}$.
 - The guaranteed-accuracy measurement distance for the CA-VP404 is $L = 30 \text{ mm} \pm 2 \text{ mm}$.
 - The guaranteed-accuracy measurement distance for the CA-VP410T is $L = 200 \text{ mm} \pm 2 \text{ mm}$.
- When strict low-luminance measurement is required, perform measurement in a dark room with no external light. Even when measuring in a dark room, the ambient light from the display itself may act as an external light. In such situations, light shielding using a hood is recommended. If strict limitations are required, compare measurement results from a general luminance meter such as the CS-2000, and verify whether using a hood has any effect.

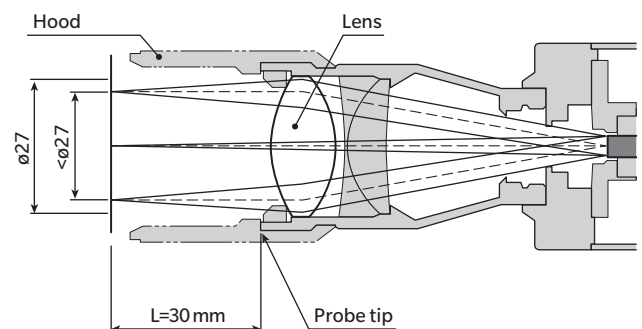


[Relationship between specification table measurement area and guaranteed-accuracy measurement distance]

The "measurement area" indicated in the specification table is a value that satisfies the design value at the nominal guaranteed-accuracy measurement distance.



Probe with a measurement area of $\phi 27$



7. How to Connect Cables

A probe has a USB connector for connecting a USB mini B plug and a connector for connecting an RS-232C mini DIN plug. Before connection, make sure that power is not supplied to the probe and the external device. Be sure to connect a cable plug to the specified connector. Be careful not to apply load to the cable connector during wiring. Fixing the cable with a steady load on the connector may result in a communication failure.

USB connection to PC

- Connect the USB mini B plug of the supplied USB cable IF-A28 to the USB connector of the probe. Connect the USB plug on the other side of the cable to the USB connector of the PC.

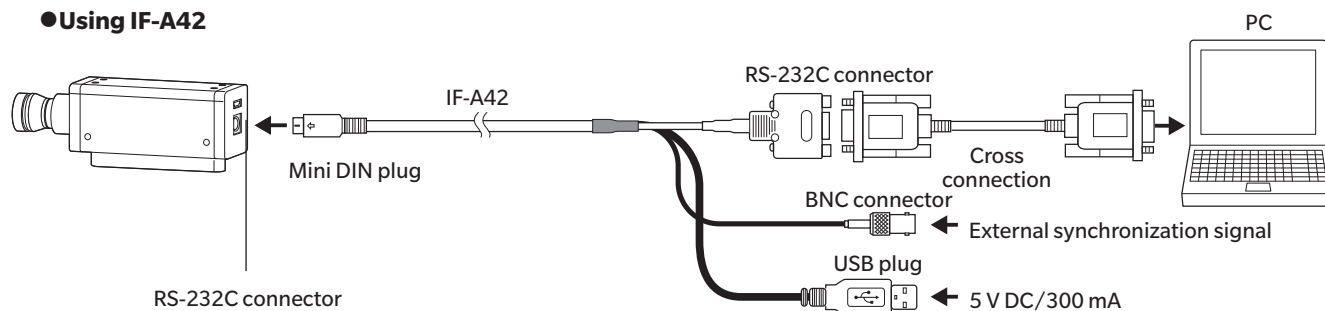
●Using IF-A28



RS-232C connection to PC or PLC

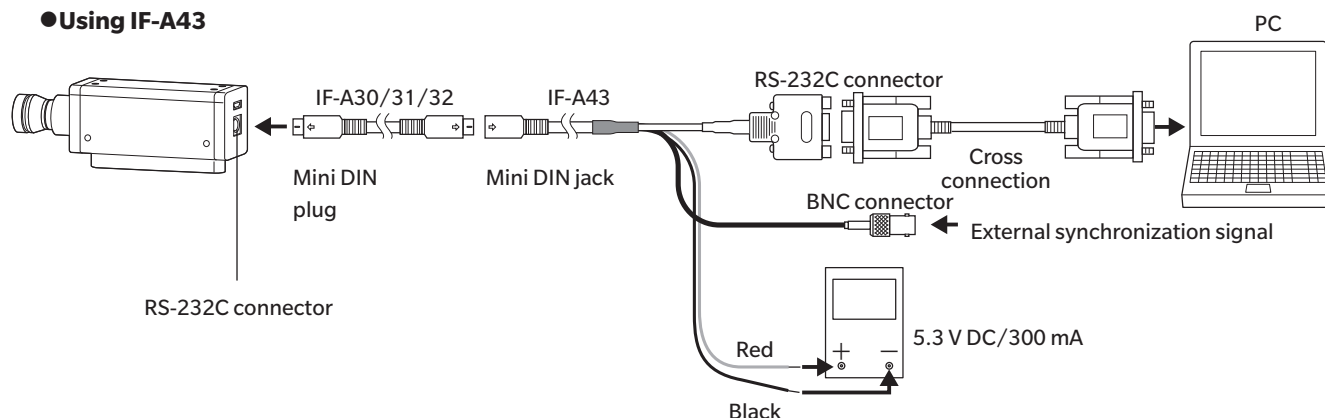
- Connect the mini DIN plug of an optional conversion cable IF-A42 to the RS-232C connector of the probe, and the D-sub plug to the RS-232C connector of the PC or PLC via a cross cable.

●Using IF-A42



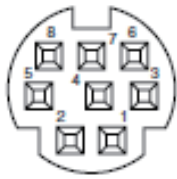
- Connect the mini DIN plug of the IF-A30 cable included with the data processor or an optional IF-A31/A32 cable to the RS-232C connector of the probe. Connect the mini DIN jack of an optional conversion cable IF-A43 to the IF-A30/A31/A32, and the D-sub plug to the RS-232C connector of the PC or PLC via a cross cable.

●Using IF-A43



- The baud rate of the probe is set to 38,400 bps. Power must be supplied from the USB plug when using an optional conversion cable IF-A42, or from the power cable when using an optional conversion cable IF-A43. To control a probe from a PC via RS-232C, use the supplied SDK (CA-SDK2). For the specifications of the SDK and how to use it, refer to the instruction manual for CA-SDK2.

RS-232C connector pin No. and functions



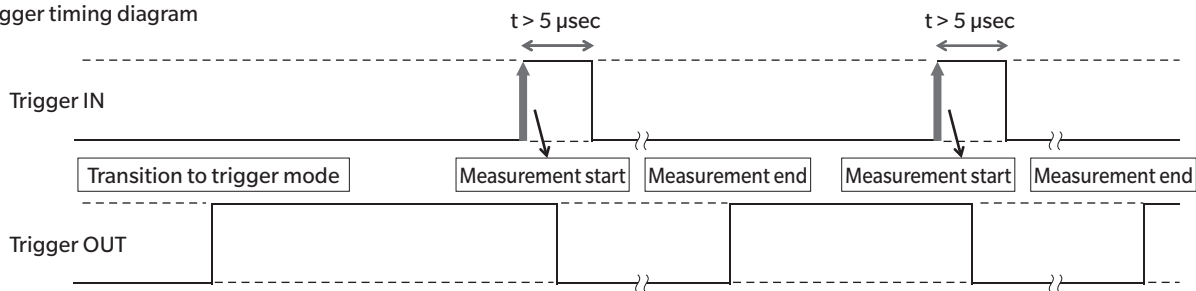
Mini-DIN 8-pin (female)

Pin No.	Pin function	Details
1	ExSync or Trigger IN	3.3 V CMOS input level (input up to 5 V) or 1.8 V CMOS input level (selectable)*, Max. 240 Hz
2	Trigger OUT	5 V CMOS output level
3	External power supply (5 V)	Min. 4.9 V to Max. 5.5 V
4	TxD	
5	GND	
6	RTS	
7	RxD	
8	CTS	

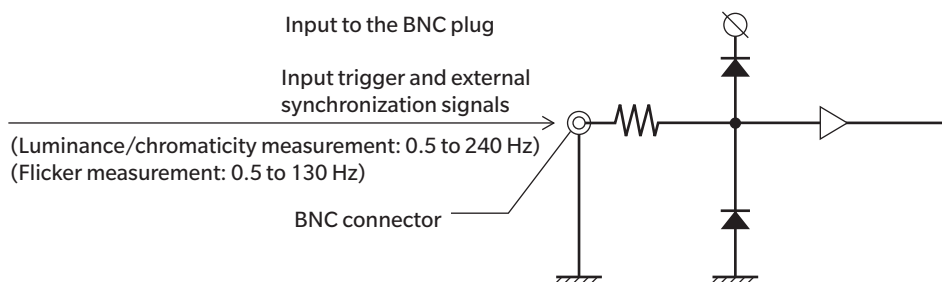
* The 1.8 V CMOS input level can be set for probes with a serial number for which the fourth digit from the left is 2 or higher (XXX2XXXX).

Inputting trigger and external synchronization signals to the probe

Trigger timing diagram



- Input the signals to the BNC plug of an optional conversion cable IF-A42/A43 or an optional BNC conversion cable IF-A35.

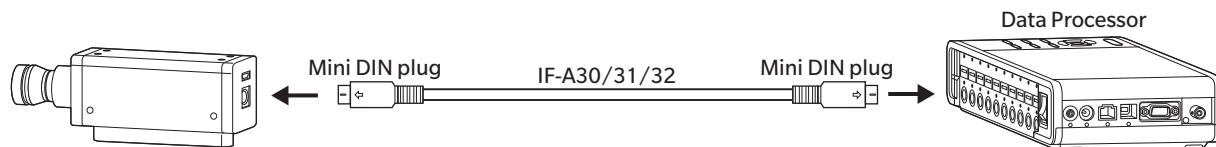


Connecting to a CA-DP40 data processor

Connect using a mini DIN cable or a USB cable.

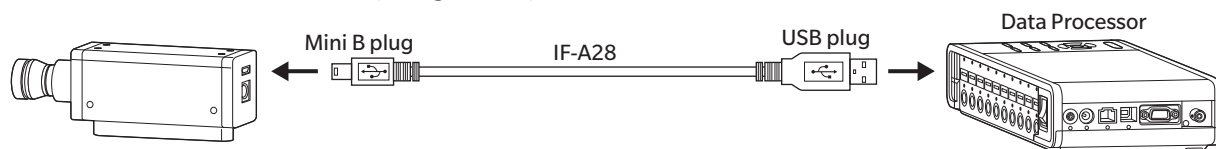
- For RS-232C connection, connect the mini DIN plug of the RS mini DIN cable IF-A30 (or IF-A31 or IF-A32) for the data processor to the RS-232C connector of the probe and the probe RS-232C connector of the CA-DP40 data processor.

● Connection via a mini DIN cable (using IF-A30/31/32)



- For USB connection, connect the USB mini B plug of the supplied USB cable IF-A28 to the USB connector of the probe. Connect the USB plug on the other side of the cable to the probe USB connector of the CA-DP40 data processor.

● Connection via a USB cable (using IF-A28)



Note: • Advanced high-sensitivity probes CA-VP427A and CA-VP410A cannot be controlled by the data processor.

About Zero Calibration

Zero calibration performs zero point adjustment while blocking entry of light into the probe's receptor. Be sure to perform zero calibration whenever the instrument is started.

Notes on zero calibration

- Perform zero calibration if the ambient temperature has changed.
- Do not direct the end of the probe toward an illuminant with high luminance during zero calibration.
- Zero calibration takes longer with the CA-VP427A, CA-VP410A or CA-VP402 than other probes.

1. How to Check Zero Calibration

To check whether zero calibration has been performed correctly, block entry of light into the end of the probe using a blackout curtain, etc. so that the receptor is not exposed to light.

- Zero calibration has been performed correctly if zero is displayed for the Lv section on the controller's measured value display. If a value other than zero is displayed, perform zero calibration again.

Measurement Functions of Probes

1. Measurement Speeds

A probe has the following four modes (measurement speeds), which are available according to the purpose. A probe outputs every measured value and a PC or data processor connected to it can retrieve all of them through communication. Generally, however, not all measured values are displayed but values are displayed at an appropriate interval.

FAST mode

Requires short measurement time, but may compromise measurement repeatability for low-luminance measurements.

SLOW mode

Repeats FAST mode measurements several times. Use this mode when you want to perform measurement with high repeatability.

AUTO mode

Switches FAST, SLOW, and setting with a further longer integration time automatically depending on the luminance level. Normally, this is the recommended setting.

LTD.AUTO mode

Switches between FAST and SLOW settings automatically depending on the luminance level.

Notes on selecting the measurement speed

- The currently selected measurement speed setting is stored in the probe. The set measurement speed will be used at the next start-up.

2. Measurement Synchronization Modes

Measurement synchronization modes are designed to select an integration time according to the vertical scanning frequency of a display. The time required for one measurement depends on the measurement speed setting, and is an integer multiple of the integration time plus the time required for communication, calculation, etc. Select a mode suitable for the type of the display to be measured.

Measurement synchronization mode	Description of mode	Integration time (Double-Frame)	Vertical scanning frequency	Display's vertical synchronization signal input
NTSC	Mode for measuring NTSC displays	33.3 ms	59.94 Hz	Not required
PAL	Mode for measuring PAL and SECAM displays	40.0 ms	50 Hz	Not required
EXT	Mode for measuring while synchronizing with the display's vertical synchronization signal input (refer to page 16 for how to input vertical synchronization signals)	(1 vertical scanning period) ×2	0.50 to 240.00 Hz (For FMA: 0.50 to 130.00 Hz)	Required
UNIV	Mode that allows measurement with an integration time of 100 ms Available when the display's vertical scanning frequency is unknown or when input of the vertical synchronization signal is not possible. (When the light source fluctuates sharply due to PWM control, etc., fluctuations in the measured values may increase.)	100 ms	—	Not required
INT	When the display's vertical synchronization signal is known, set that information so that it can be used for measurement.	(Set vertical scanning period) ×2	Settable range 0.50 to 240.00 Hz (For FMA: 0.50 to 130.00 Hz)	Not required
MANUAL	Mode that allows you to specify the integration time	Settable range 4.0 to 4000.0 ms (For FMA: 7.7 to 4000.0 ms)	—	Not required

Memo

- On a flickering LCD, the screen is fluctuating at half the frequency of the vertical scanning frequency. When you measure a display in this state, the luminance and the chromaticity vary if you set the same integration time as the vertical scanning frequency.
When measuring with the measurement synchronization mode set to MANUAL, set the integration time double (or another even multiple of) the vertical scanning frequency to ensure stable LCD measurement.
- The integration time can also be set to Single-Frame (half the integration time with Double-Frame) when the measurement mode is NTSC, PAL, EXT, or INT.
Note: Integration time is fixed to Double-Frame when using a data processor.

Relationship between measurement speed and measurement synchronization mode

The measurement time (integration time) is determined by the selected measurement synchronization mode.

Also, the measurement speed (number of measurements/outputs possible per second) is determined by the measurement synchronization mode and the following conditions:

- Luminance of the display to be measured
- Measurement mode
- Data output method (RS-232C or USB)
- Baud rate (for RS-232C)
- Number of probe to be used

Typical measurement speeds are described in the specifications.

3. Measurement Modes

A probe has the following measurement modes:

Measurement mode	Description of mode
xyLv mode	Mode for displaying and outputting chromaticity coordinates x, y and luminance Lv
TduvLv mode	Mode for displaying and outputting correlated color temperature T, color difference from blackbody locus duv, and luminance Lv
u'v'Lv mode	Mode for displaying and outputting u'v' chromaticity diagram coordinates (CIE 1976 UCS chromaticity diagram) and luminance Lv
Flicker mode	Displays the flicker amount in the contrast method (AC/DC). The unit is “%”.
	Displays the flicker amount in the JEITA/VESA method. The unit is “dB”.
XYZ mode	Mode for displaying and outputting tristimulus values XYZ
λ_d PeLv mode	Mode for displaying and outputting dominant wavelength λ_d , excitation purity Pe, and luminance Lv

* Under the initial settings, the mode is set to xyLv mode at the start-up.

User Memory

1. About Calibration Channels

A probe has calibration channels from CH00 to CH99 (100 channels in total).

The following can be set for each of CH00 to CH99:

- (1) Correction coefficient for user calibration
- (2) Target
- (3) ID

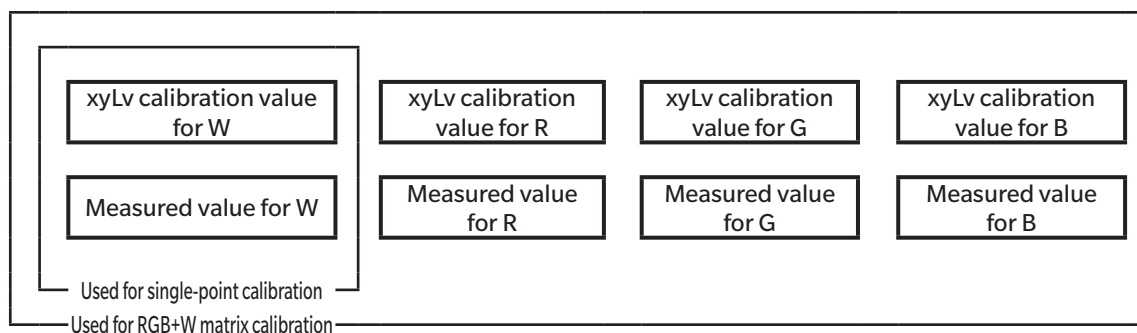
CH00 is a channel for calibration in accordance with the Konica Minolta calibration standard. It can only be used for setting targets or IDs.

Users can use CH01 to CH99 for calibration or saving targets.

Under the initial settings, CH01 to CH99 are also provided with the same Konica Minolta calibration value as with CH00.

Each channel can also be assigned with an ID.

How the memory is used during user calibration



2. About Targets

Targets become the base color for measuring how different another measurable color is, which is required for color difference display. Targets can be set for each probe of each calibration channel.

Targets are set after the following operations:

- (1) User calibration: After user calibration, the calibration value is set as a target at the same time.
 - (2) Setting/changing a target: To be performed in the following cases:
 - To set a target in calibration channel CH00
 - To set a different color from user calibration as a target in a user-calibrated calibration channel
 - To perform measurement without performing user calibration but in accordance with the Konica Minolta calibration standard and to use color difference display
- If a correction coefficient for user calibration is input, a target is set at the same time, which erases the previously set target.
 - To change a set target, set/change a target. Changing a target does not change the correction coefficient set for user calibration.

In a same calibration channel, the target is saved to common channel, irrespective of measurement mode.

As a result, the target set last is saved, irrespective of measurement mode.

For one calibration channel and one probe number:

- The correction coefficient for user calibration is common to xyLv mode, TduvLv mode, u'v'Lv mode, and XYZ mode.
- The target is common to all measurement modes.

3. About User Calibration

- User calibration allows users to set their own correction coefficients to the calibration channel of the probe by measuring any display colors and setting calibration values (x, y, Lv) to the instrument.
Afterward, the value corrected with the specified correction coefficients will be displayed/output for every measurement.
- Two types of user calibration can be performed for a CA-410 series probe: single-point calibration and RGB+W matrix calibration.
- RGB+W matrix calibration has been performed when the instrument is shipped from the factory.
- User calibration is performed independently for each probe.
- User calibration can be performed for every calibration channel (except for CH00).
- When a probe is used for the first time after being shipped from the factory, measurement is performed in accordance with the Konica Minolta calibration standard in all calibration channel. You can use user calibration to apply the following corrections to measurements based on the specified correction coefficients.
 - (1) Corrects the difference in the reading due to the deviation of spectral response from the CIE 1931 color-matching function.
 - (2) Corrects the difference in the readings between probes when multiple probes are used for measurement.
- When user calibration is performed, the color is set to the same calibration channel as its target at the same time.
Targets become the base color for displaying how different another measurable color is, which is used as the base for color difference display.

When multiple probes are used

When using multiple probes for measurement, you can correct the difference in the readings by performing user calibration as follows:

When the target color value for the display to be measured is known

Make a standardized color display on a standard display and perform user calibration for all probes.

When the target color value for the display to be measured is not known

- (1) Determine one master probe.
- (2) Set the measurement mode to xyLv mode, make the master probe face perpendicular to the display on which the target color is displayed, and perform measurement.
- (3) Record the measured value.
- (4) Using the display on which the target color is displayed and the value displayed in (3), perform user calibration for other probes.

PC Software

CA-S40

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PC Software CA-S40



Safety Precautions

Before using the software, please read this manual as well as the instruction manuals of your instrument and personal computer (PC) carefully to ensure safe and correct use.

Introduction

PC Software CA-S40 For Color Analyzers is software that loads and saves measurements and data on a computer connected with the probe or data processor of Display Color Analyzer CA-410 via a USB cable.

Please note that this manual assumes that the reader is familiar with the basic operations of Windows.

Software License Agreement

The terms of the license agreement for this software are provided in the [Software License Agreement] dialog box displayed during the installation process. This software can be used only if you agree to all the terms of the agreement.

KONICA MINOLTA holds the copyrights to the CA-410 USB driver and this manual.

Notes on Use

- This software is application software for use with Windows 10, Windows 11, macOS Catalina, macOS Big Sur, and macOS Monterey. Please note that this software does not include any OS.
- One of the above OS must be installed on the PC in order to use this software.
- To connect the CA-410 series probe or data processor to a PC, you need the dedicated USB driver.
- This software only controls the CA-410 series probe or data processor connected to the PC with a USB cable. It is not possible to control the probe or data processor of the CA-410 series connected by anything other than USB with this software. It does not support the CA-210 or CA-310 series.
- Make sure that the connector is oriented correctly and connected securely.
- Do not touch or otherwise dirty the terminal portion of the connector or subject the terminals to unreasonable force.
- Use a cord with a suitable length. Putting tension on the cable may cause connection failure or wire breakage.
- Disconnect the connection cord only by holding the plug or the connector. Also, do not pull the cord itself or bend it with unreasonable force.

Every effort has been made in the preparation of this product to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your retailer or a KONICA MINOLTA-authorized service facility.

About this manual

The screen capture shots in this manual are examples and may be slightly different from actual screen images. Windows screens are shown in most cases. Menu items, button names, etc. and their respective functions are the same under macOS even if their position on the screen is slightly different.

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System environment

Operating requirements

OS	Windows® 10 Pro 32bit Windows® 10 Pro 64bit Windows® 11 Pro macOS® Catalina macOS® Big Sur macOS® Monterey
	<ul style="list-style-type: none">The PC's system configuration must be either that recommended for the above OS or have the following specifications, whichever is higher.
PC	Computer equipped with Intel Core i series, or equivalent or higher processor Computer equipped with an Apple Silicon M1 chip, or equivalent or higher processor (Apple silicon native support)
RAM	4 GB or more
Hard disk	More than 100 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	1280 x 768 or higher, 16-bit color or higher
Other	USB 2.0 or above required to connect the instrument

Instruments controlled

CA-410 data processor: CA-DP40

CA-410 probe: CA-P427 / P427H / P410 / P410H / MP410 / MP410H / VP427 / VP427A / VP410 / VP410A / P427C / P410C / VP402 / VP404 / VP410T

Language

Display language English

Setup

1. Installing the software (Windows)

Double-click [setup.exe] in the Windows folder where the file was downloaded. Proceed as instructed on the screen. When you agree to the license agreement, the installation process starts and the following folders are created under the [Program Files (x86)] folder. The program and manual are installed, and the CA-S40 startup menu is registered in the Start menu.
[Program Files (x86)] – [KONICA MINOLTA] – [CA-S40]

2. Uninstalling the software (Windows)

Open [Control Panel] - [Uninstall a program], select CA-S40 from the list, and double-click it or click [Uninstall].

3. Installing the software (macOS)

Double-click [setup.pkg] in the Mac folder where the file was downloaded. Proceed as instructed on the screen. When you agree to the license agreement, the installation process starts and the following folders are created under the [Application] folder. The program and manual are installed, and the CA-S40 startup menu is registered in the Launchpad.
[Application] – [KONICA MINOLTA] – [CA-S40]

4. Uninstalling the software (macOS)

Right-click the CA-S40 application and click [Move to Trash].

Major functions

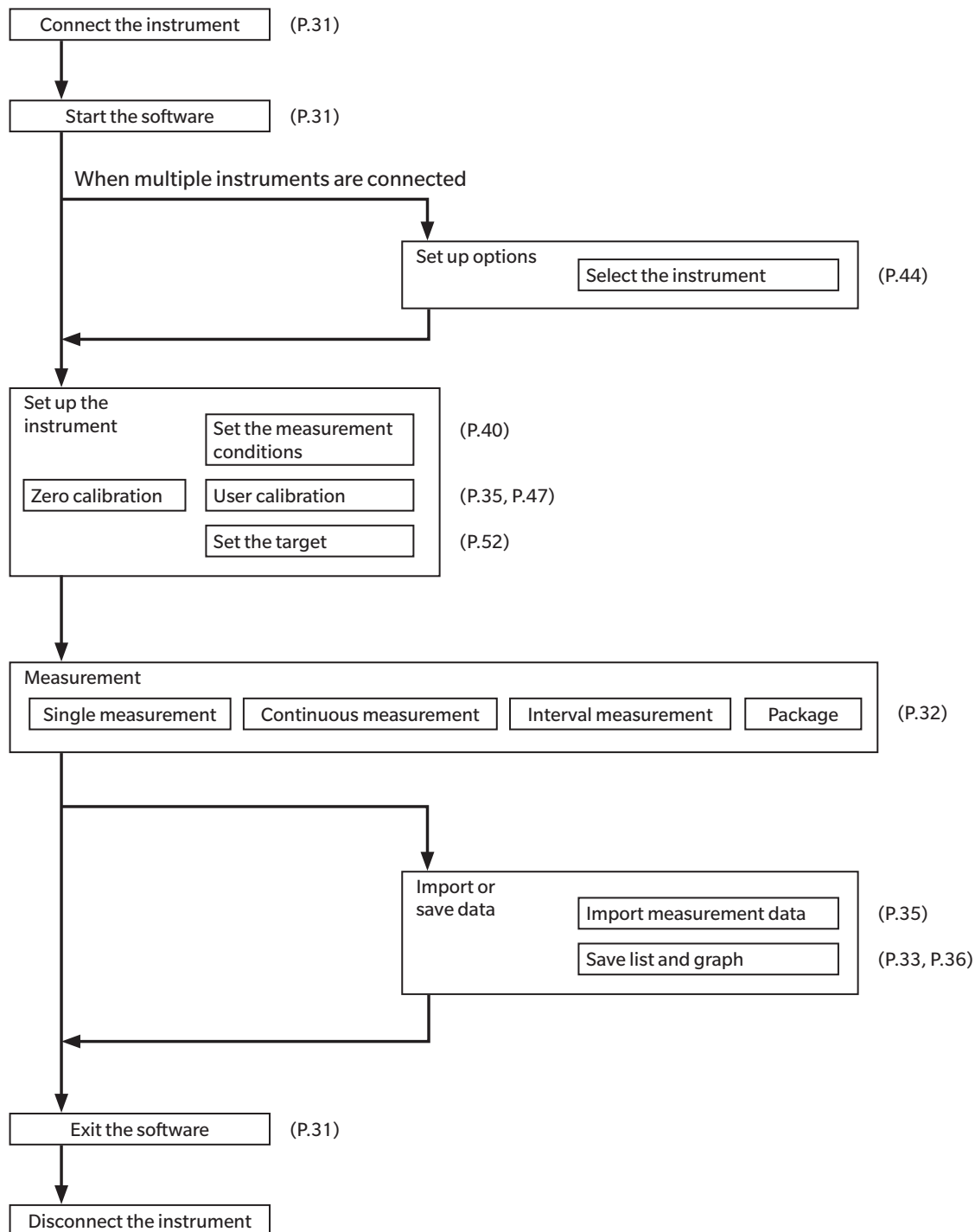
Display	(Color)	Lv, x, y, Lv, u', v', Lv, Tcp, duv, X, Y, Z, Lv, λ_d , and Pe values, chromaticity diagram, and trend graph
	(JEITA/VESA)	Flicker value (dB); frequency and trend graph; spectral intensity value and graph; and waveform graph
	(FMA)	Flicker value (%) and trend graph
	(Waveform)	Flicker value MAX (dB) and frequency; waveform graph; and power spectrum graph

About displayed values

- Although the CA-S40 offers a higher calculation accuracy through internal calculations using more decimal places than found in the displayed values, some calculations, such as rounding, and those during color space conversion may result in a different minimum decimal place from the output of the instrument by one digit. In addition, plotted positions may also differ from those obtained from the displayed values for the same reason.

Instrument control	Single measurement Continuous measurement Interval measurement Color and FMA Number of measurements: 1 to 4,000 times/Measurement interval: 0 to 7,259 sec Number of measurements: 4,001 to 40,000 times/Measurement interval: 1 to 7,259 sec JEITA/VESA Number of measurements: 1 to 4,000 times/Measurement interval: 0 to 7,259 sec Instrument settings Retrieval of data stored in the instrument User calibration Data processors cannot be connected when using ver. 1.1 or earlier of the CA-S40 for macOS.
Target	Writing of a target to the instrument
Data list	Listing of measurement data Edit (delete, copy)
External input/output	Saving in text/CSV format, copying lists to the clipboard

Operation flow



Notes on measurement

1. Notes on hardware operation

- Use the USB cable to connect the instrument. This software can only control probes or data processors of the CA-410 series connected by USB. It is not possible to control the probe or data processor of the CA-410 series connected by anything other than USB with this software. Also, the CA-210/310 series can not be used with this software.
- The CA-VP410 high-sensitivity probe, the CA-VP410A advanced high-sensitivity probe, and the CA-VP402 and CA-VP404 small spot probes have a large aperture angle, which creates a higher dependence on panel directivity. When measuring panels with high directivity, run arbitrary calibration and use the probe without rotating it from the calibrated position.

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Preparing and starting the software

1. Connect the instrument and start the software

Connect the instrument

- (1) Connect the instrument (CA probe or data processor) to the PC's USB port. When connecting the instrument, connect it to a USB port that can supply power to the probe. When a message appears prompting for the installation of the USB driver, install the USB driver in the [Driver] folder.
- (2) Check whether the probe's LED indicator blinks.
- (3) Go to [Start menu] - [KONICA MINOLTA] - [CA-S40] and click CA-S40 to start the software.
 - When only one instrument is connected, the measurement screen appears. (See 1-1. Screen layout on P.32)
 - When multiple instruments are connected, the instrument selection screen appears. Select one instrument. (See 2-2. Instrument selection CA Info. on P.44)
 - When no instrument is connected, the error screen appears.
 - When the software starts and the instrument to be used has been chosen, the information of the instrument is displayed in the status bar, indicating that it is ready to be operated from the PC.
 - If a probe that has not been calibrated to its zero point is directly connected to the PC, the internal shutter closes automatically to start zero calibration.
 - When zero calibration is completed, the LED indicator changes from blinking to lighting up steadily.

Notes: The probe operates on USB bus power and requires 5 V and 300 mA. It is recommended that an AC power supply is used for the PC as necessary. It is also recommended that the instrument be disconnected whenever it is not in use.

- (4) Click [Settings] and set the measurement conditions.

Disconnect the instrument

Exit the software and disconnect the instrument from the PC.

Precautions for connecting the instrument

- When the instrument's communication is controlled by another PC or other software, CA-S40 cannot control its communication.

Make sure that the instrument's communication is not controlled by other software. If it is, exit that software as necessary. If the instrument is connected to another PC, disconnect that connection to ensure that it is only connected to the intended controlling PC.
- Connection-related problems (*) may occur and an error message such as "CA device not connected" may be displayed even after an instrument has been connected successfully and proper communication has been established. In this case, restart CA-S40 after checking that the cable is connected and that the instrument (if a data processor is connected) is turned on. Also, the instrument (data processor or probe) may not operate if the operating system on your PC is started (or restarted) after the PC is connected to the instrument using a cable. In this case, exit CA-S40 and, if the instrument is a data processor, turn it off and then on again, and if the instrument is a probe, disconnect and reconnect it to the PC before restarting CA-S40.
 - * Ex. • When CA-S40 is operated after one of the probes is disconnected from the data processor while the CA-S40 is running with one or more probes connected to the data processor
 - When the [ESC] key of the data processor is pressed while CA-S40 is running
- If your PC enters power-saving mode while connected to a measurement instrument (such as a probe or data processor) via USB, communication operations, such as for continuous measurement, may stop, or a forced termination of Windows (blue screen) may occur. When using the PC in a high communication load situation, such as with continuous measurement, change the power-saving mode settings in the PC control panel to prevent Windows from entering power-saving mode.
- A Firewall alert may be displayed when CA-S40 is started for the first time after installation. In this case, click "Allow access" to grant access because CA-S40 does not connect to an external network.
- If you start the CA-S40 while the data processor startup screen is displayed, connection may not be possible. Please start up the CA-S40 after the data processor starts up and zero calibration is completed.

Measurement

1. Chromaticity measurement

Click the [Color] tab to display the following screen. On this screen, you can measure chromaticity and display the results in the selected color space. User calibration and gamma measurement can also be performed.

1-1. Screen layout



- (1) Function selection
Chromaticity measurement (Color), Flicker (JEITA/VESA), Flicker (FMA), Waveform
- (2) Instrument information
Information about the instrument that is connected to the PC is displayed.
- (3) Probe information
Probe information is displayed when a data processor is connected. Click here to select the probe.
- (4) Measurement information
This section displays the synchronization mode, measurement speed, calibration mode, and measurement status.
- (5) Help function
The instruction manual, saved on the PC when the software was installed, opens.
- (6) License information
Click here to open a screen that shows the software name and version along with copyright information.
- (7) Individual functions (pop-up)
Zero calibration, settings, data import from data processor, user calibration, gamma measurement
- (8) Measurement start/pause/stop button (Operation with shortcut keys of Windows: Ctrl + M, macOS: Command + M is possible)
- (9) Color space selection tab
- (10) Latest data display
This area shows the latest data in the color space specified in the color space selection tab above.

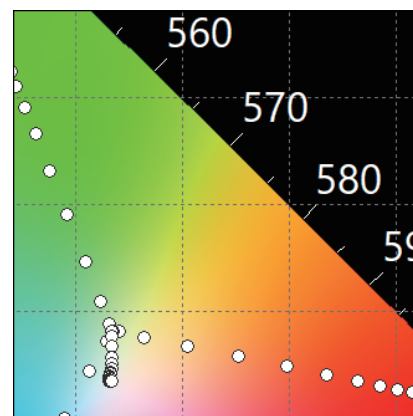
(11) Chromaticity diagram

After selecting a graph area,

- Use the mouse wheel to zoom in and zoom out.
- Drag to move the display area.
- Double-click to return to the original scale.
- Right-click on the graph to display the following menu, which allows you to copy the graph to the clipboard or a file.

Right-click → to Clipboard → Background Color: Black
 Background Color: White
 to File → Background Color: Black
 Background Color: White

* When the chromaticity diagram is enlarged or reduced during a continuous measurement or interval measurement, the plotting may momentarily stop. (Measurement is continuing)



(12) Data display toggling

Toggles between showing both the data list and trend graph, data list only, and trend graph only

(13) Data list (displayed when [List+Trend Graph] or [List] is selected for data display)

- Right-click on the list to display the following menu, which allows you to copy items and selected data to the clipboard or delete selected measurements.

Right-click → Title to Clipboard
 to Clipboard
 Line Clear

- [Δt] in the list shows the temperature change inside the probe from when zero calibration was performed.
- [ErrCode] in the list shows the following statuses: [ErrCode] in the list shows the following statuses: (Refer to page 62 for information on other error codes.)
 - 0: Successfully processed.
 - 1: The currently selected calibration channel uses user calibration data or target data that has been set using a different probe.
 - 2: The temperature inside the probe has changed 6°C or more since zero calibration. It is recommended that zero calibration be performed because an error has occurred due to shift of the zero point.
 - 3: 1 and 2 have occurred simultaneously.
 - 4: The brightness of the measurement target is lower than the measurable range of the instrument.
 - 5: 2 and 3 have occurred simultaneously.
 - 6: 2 and 4 have occurred simultaneously.
 - 7: 1, 2, and 4 have occurred simultaneously.

(14) Trend graph (displayed when [List+Trend Graph] or [Trend Graph] is selected for data display)

Measured values are plotted on the graph in chronological order.

- Right-click on the graph to display the following menu, which allows you to copy the graph to the clipboard or a file.

Right-click → to Clipboard → Background Color: Black
 Background Color: White
 → to File → Background Color: Black → Image Size: 50%
 Image Size: 100%
 Image Size: 150%
 Image Size: 200%
 Background Color: White → Image Size: 50%
 Image Size: 100%
 Image Size: 150%
 Image Size: 200%

(15) Color display window settings

Displays the RGB-specified color window

(16) Data save and clear

Click [Save to CSV] to save the data to a file. Click [Clear] to clear data. The data is saved in CSV format.

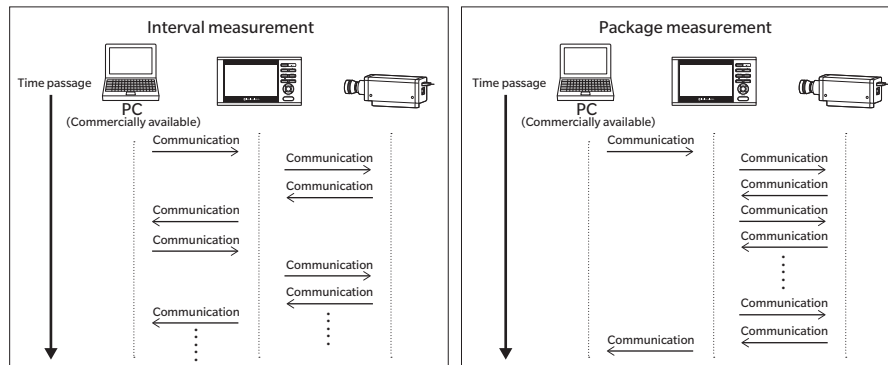
Measurement

1-2. Measurement type

- 1) Select the measurement type.



- ☐ Single: Single measurement
- ☐ Continuous: Continuous measurement (graph scrolls)
* Displays up to 100 data sets and deletes data from the oldest.
- ☐ Interval: Interval measurement, which performs the specified number of measurements at the specified interval.
- ☐ Package: Package measurement minimizes the communications time between PC and data processor and maximizes the measurement function when data processor is used. The times of measurements can be set up to 20.

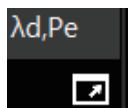


- 2) Click  to start measurement.

* When using continuous measurement or interval measurement, the button display changes to “Hold”, which you click to pause or stop the measurement.

1-3. Data display

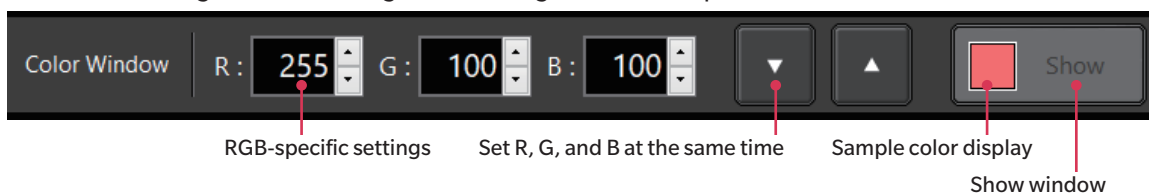
The most recent measurement results are displayed in the [Current Data] field and added to the data list and trend graph. Use the tab in (9) to select the color space to be used for display.



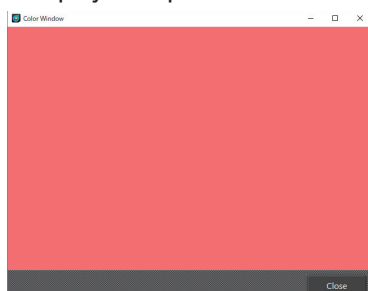
The trend graph is also displayed in the selected color space. Click the pop-up mark as shown on the left to display an enlarged view of “Current Data” in a pop-up window.

1-4. Color display window

You can display the color that you defined using the RGB levels in a pop-up window to be measured using the instrument. You can also change the RGB settings while having this window open.

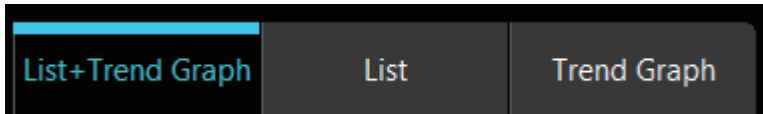



* Display example



2. Common operations

- 1) On each measurement screen, you can toggle between “Data List” display and “Trend Graph” display.



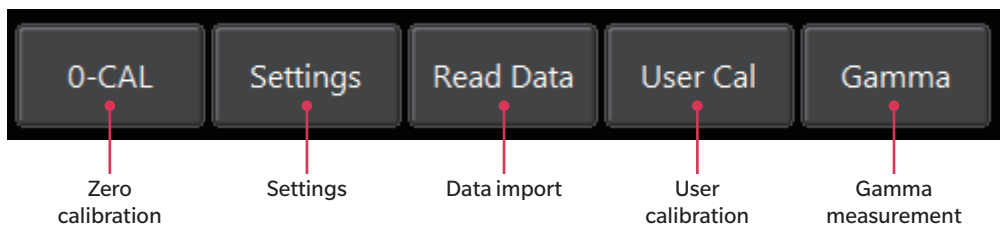
- 2) Click  to start the measurement with the settings applied.
- 3) Click [Save to CSV] to save the data to a file. Click [Clear] to clear data.



* The data is saved in CSV format.

- 4) “Right-click” functions
Right-click on the data list or graph to display a pop-up menu from which you can copy the data or graph to the clipboard.
<Example>
You can also specify the background color (B/W) and size for the graph that you want to save.

3. Individual functions



Zero calibration [0-CAL]

- When you click [0-CAL], the shutter inside the probe automatically closes, and zero calibration starts.
- It is recommended that zero calibration be used after start-up or whenever there is a change in ambient temperature or a temperature change inside the instrument due to using it for long periods.

Settings [Settings]

- The pop-up window for setting the measurement conditions appears.
- You can set the measurement speed and the calibrated channel.

Data import [Read Data]

- This function imports the data from the data processor.

User calibration [User Cal] (only for chromaticity measurement)

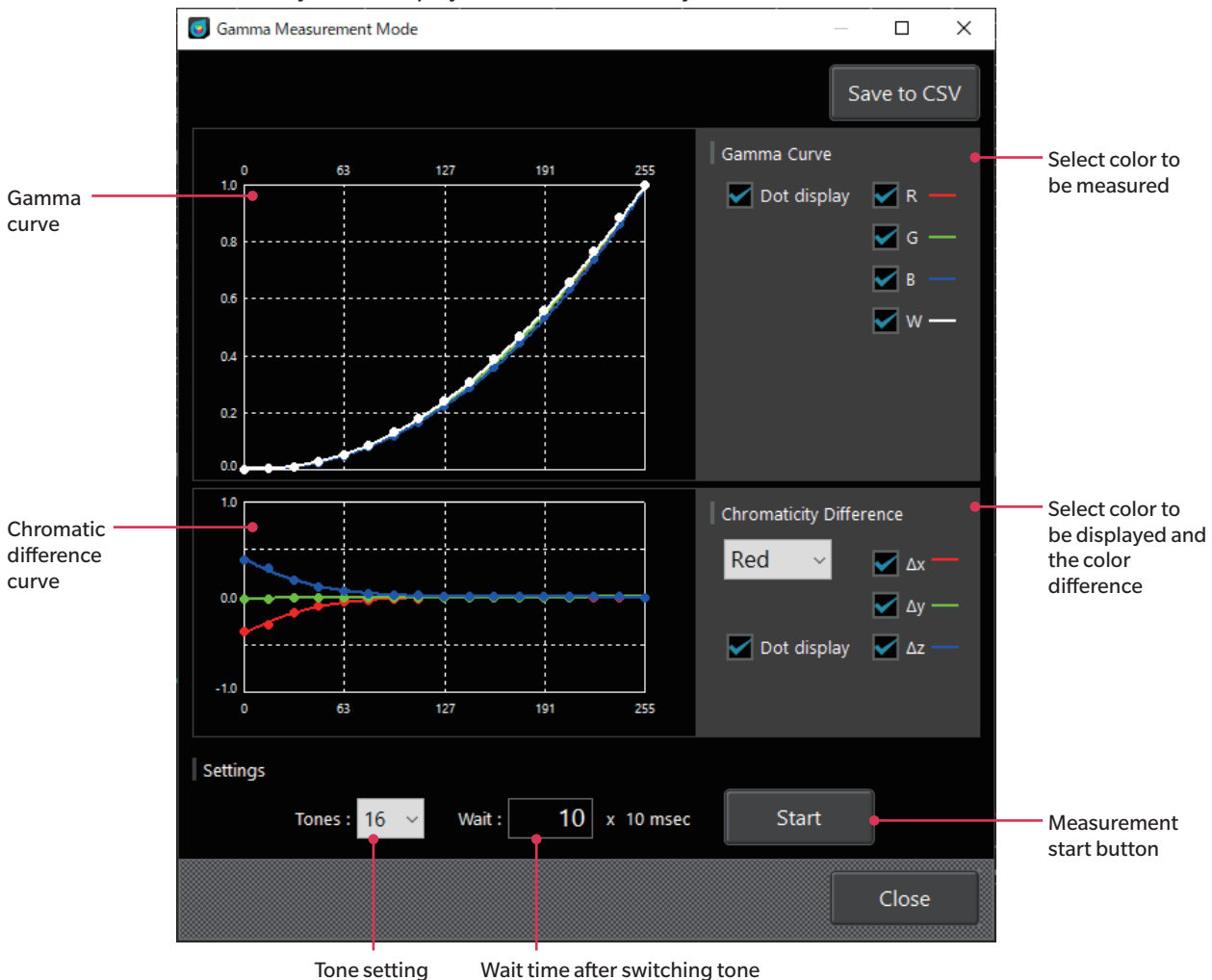
- The pop-up window for user calibration appears. (See User calibration on P.47)
- The calibration channel (CH00 to CH99) data is read before displaying the pop-up window.

Gamma measurement [Gamma] (only for chromaticity measurement)

- The pop-up window for gamma measurement appears. (See 3-1. Gamma measurement (only for chromaticity measurement) on P.36.)

3-1. Gamma measurement (only for chromaticity measurement)

- Click [Gamma] among the individual functions to bring up the pop-up window for gamma measurement. Here, you can measure the color output intensity for each color's input tone.
- When measuring, configure the settings related to the color and tone to be measured.
- Click the measurement start button. The measurement results are displayed in the graph as gamma curve and chromatic difference curve.
- The obtained chromaticity data is displayed on the chromaticity measurement screen and can be saved.



Right-click on the gamma curve or chromatic difference curve (chromatic difference for each tone when the 255 gradation value is set to 0) graph to display the following menu, which allows you to copy the graph and data to the clipboard or a file.

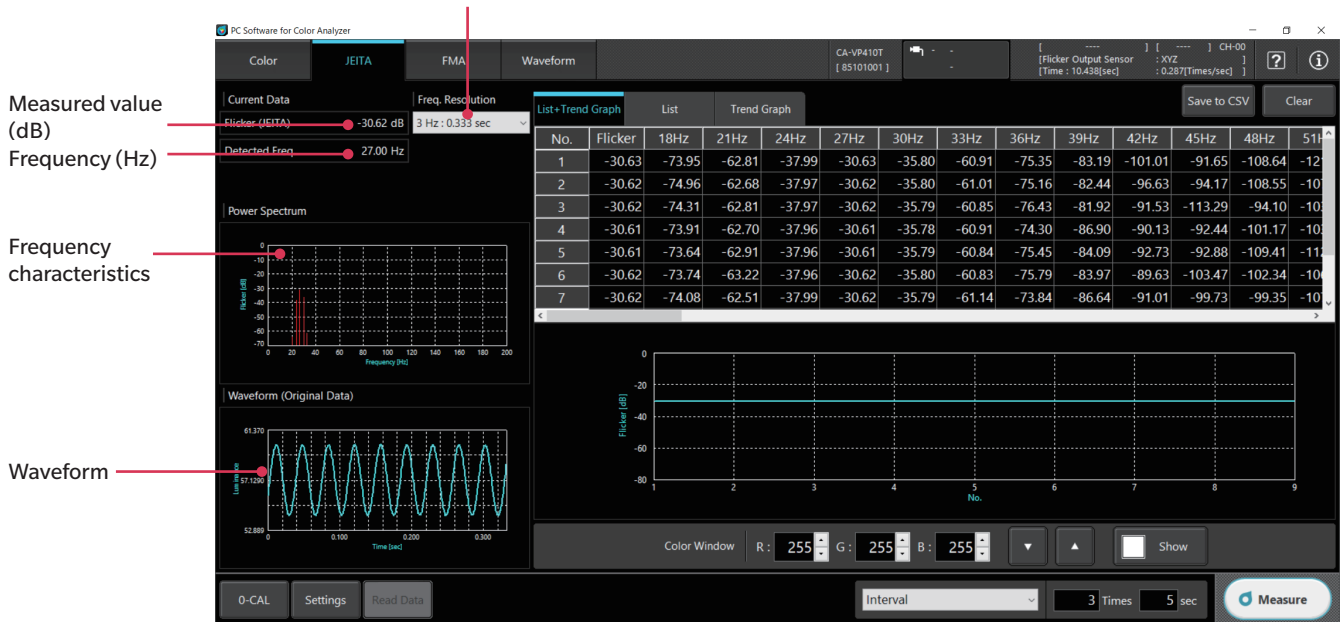
- Right-click on a graph → to Clipboard → Plot data (for Excel)
 Background Color: Black
 Background Color: White
- to File → Plot data (for Excel)
 Background Color: Black → Image Size: 50%
 Image Size: 100%
 Image Size: 150%
 Image Size: 200%
 Background Color: White → Image Size: 50%
 Image Size: 100%
 Image Size: 150%
 Image Size: 200%

4. Flicker measurement (JEITA/VESA)

(Refer to "1. Measurement condition settings <Setting> tab" for information on switching between JEITA and VESA.)

Click the [JEITA] or [VESA] tab to bring up the following screen, where you can set the JEITA/VESA frequency resolution. Click [Measure] to start measurement. The JEITA/VESA flicker measurement values, frequency and frequency characteristics, and waveform are displayed.

JEITA/VESA frequency resolution



Right-click on the graph to display the following menu, which allows you to copy the graph and data to the clipboard or a file. You can also change the scale on the Waveform graph.

The right-click functions accessible by right-clicking over the list or trend graph are the same as those for chromaticity measurement.

Power Spectrum graph

- Right-click → to Clipboard → Background Color: Black
- Background Color: White
- to File → Background Color: Black → Image Size: 50%
- Image Size: 100%
- Image Size: 150%
- Image Size: 200%
- Background Color: White → Image Size: 50%
- Image Size: 100%
- Image Size: 150%
- Image Size: 200%

Waveform graph

- Right-click → Change Scale
- to Clipboard → to Excel
- Background Color: Black
- Background Color: White
- to File → CSV
- Background Color: Black → Image Size: 50%
- Image Size: 100%
- Image Size: 150%
- Image Size: 200%
- Background Color: White → Image Size: 50%
- Image Size: 100%
- Image Size: 150%
- Image Size: 200%

Aliasing Noise

During JEITA/VESA flicker measurement, when measuring a light source that includes a harmonic component such as a rectangular wave light source, aliasing noise may occur in the low-frequency range, which can be displayed as the JEITA/VESA flicker value. Peaks that vary greatly on the Power Spectrum graph when changing the JEITA/VESA frequency resolution setting by one step likely are being influenced by aliasing noise.

Set the sampling frequency for JEITA/VESA flicker measurement as follows (typical examples).

JEITA/VESA frequency resolution	Sampling frequency	
	Flicker (CA-310 Mode)*	XYZ (Wide Frequency Mode)*
0.1 Hz	409.6 Hz	1638.4 Hz
0.5 Hz	1024 Hz	1024 Hz
1 Hz	1024 Hz	1024 Hz

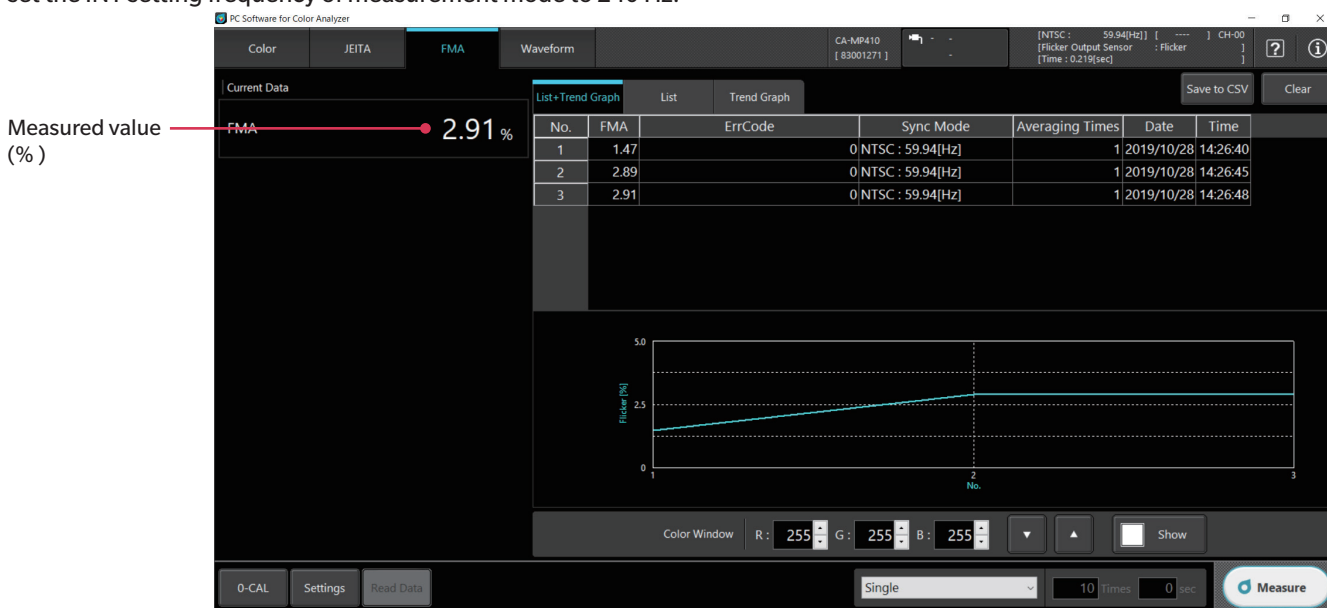
* “Flicker (CA-310 Mode)” and “XYZ (Wide Frequency Mode)” are mode names for PC Software CA-S40. “XYZ (Wide Frequency Mode)” can only be used when no CA-DP40 data processor is connected.

5. Flicker measurement (FMA)

Click the [FMA] tab to bring up the following screen and click [Measure] to start measurement. The FMA flicker measurement values are displayed.

When performing flicker measurement (FMA), make sure the measurement mode is set correctly (refer to page 41).

To measure waveforms with a vertical synchronization frequency that exceeds 240 Hz (flicker frequency exceeds 120 Hz), set the INT setting frequency of measurement mode to 240 Hz.



Right-click on the list or graph to copy the graph and data to the clipboard or a file. The right-click menu is the same as that for chromaticity measurement.

6. Waveform measurement (Also refer to “1. Measurement condition settings <Setting> tab”)

Click the [Waveform] tab to bring up the following screen where you can set various parameters. Click [Measure] to start measurement. The flicker measurement values and other measurement results will be displayed in a waveform graph and power spectrum graph.

Graph display settings



Measurement result

○ Set Waveform sampling conditions according to Sync Mode

: When checked, sampling will be performed according to the input Sync Mode (refer to page 41). As such, configuration of Sampling Number or Decimation Interval will not be possible.

○ Sampling Number : Sets the number of measurements to perform.

○ Decimation Interval : Sets the number of intervals for measurement.

The measurement time is defined as follows.

Measurement time = Flicker measurement speed × Sampling number × Decimation interval

The possible range of calculating the flicker value differs depending on the measurement time while adhering to the following.

(1 / measurement time) to 200 Hz

○ Weighting Factor : Sets a filter for the measured value. (None/JEITA/ LowPass/User)

- No filter will be applied if “None” is selected. The graph will display original data only.
- When “JEITA” is selected, a filter adjusted to the frequency response characteristics of the human eye is used.
- When “LowPass” is selected, the user can set the LowPass filter to between 0 to 1500.
- When “User” is selected, the user can load a custom filter to be used for measurement from the [Weighting Factor] tab in the [Settings] tab.

The data will be displayed as weighted data with the filter applied. Users can select to display the graph using the check box in the graph display settings.

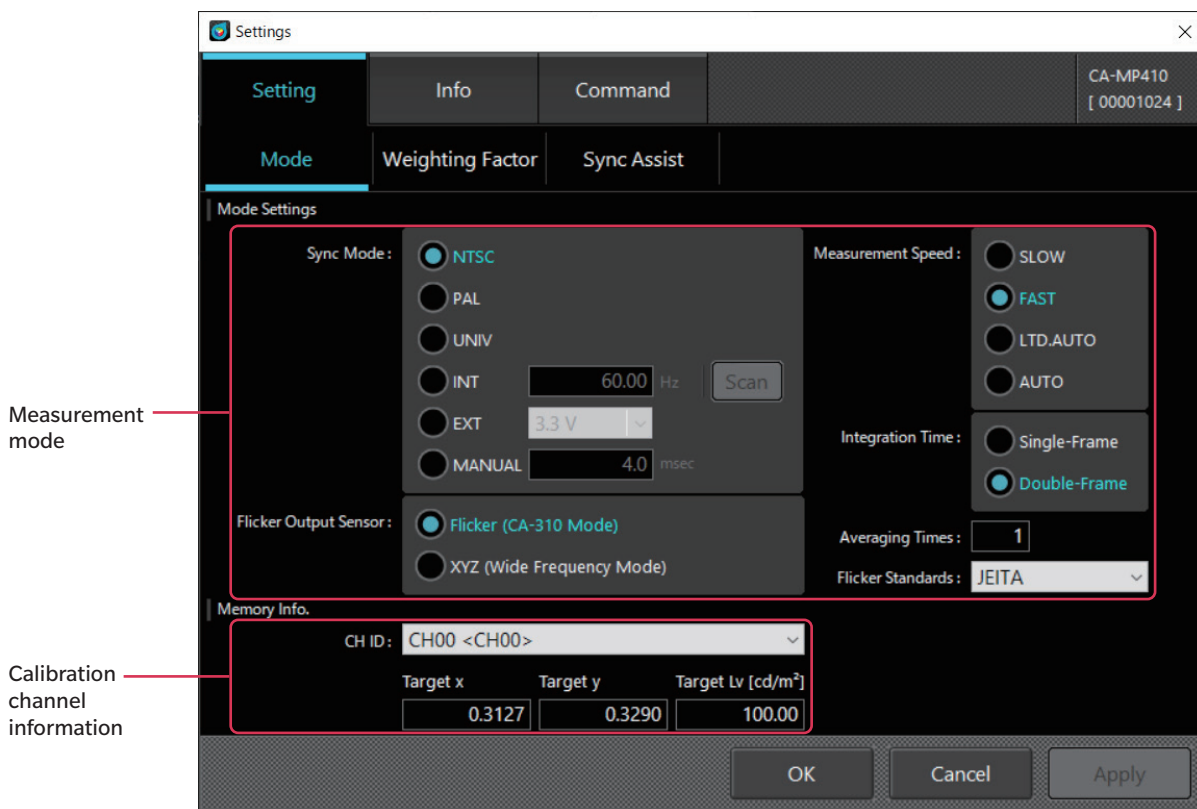
○ Sensor : Sets the sensor when “XYZ (Wide Frequency Mode)” is selected for the flicker measurement operation mode. (X/Y(Lv)/Z)

When “Flicker (CA-310 Mode)” is selected, only sensor Y can be used.

Measurement results such as flicker measurement values and Power Spectrum graph data are subject to a filter and considered Weighted Data.

Click [Settings] among the individual functions to bring up the following pop-up window for setting the measurement conditions and optional items.

1. Measurement condition settings <Setting> tab



1-1. Measurement mode settings [Mode tab - Mode Settings]

○ Sync Mode : Select the mode for synchronized measurement. (NTSC/PAL/UNIV/INT/EXT/MANUAL)

Measurement synchronization mode	Description of mode	Integration time		Vertical scanning frequency	Vertical synchronization signal input
		Single-Frame	Double-Frame		
NTSC	Mode for measuring NTSC displays	16.7 ms	33.3 ms	59.94 Hz	Not required
PAL	Mode for measuring PAL and SECAM displays	20.0 ms	40.0 ms	50 Hz	Not required
EXT	Mode for measuring while synchronizing with the display's vertical synchronization signal input	1 vertical scanning period	(1 vertical scanning period) x 2	0.50 to 240.00 Hz*1	Required
UNIV	Mode that allows measurement with an integration time of 100 ms Available when the display's vertical scanning frequency is unknown or when input of the vertical synchronization signal is not possible. (When the light source fluctuates sharply due to PWM control, etc., fluctuations in the measured values may increase.)	—	100 ms	—	Not required
INT	When the display's vertical synchronization signal is known, set that information so that it can be used for measurement.	Set vertical scanning period	(Set vertical scanning period) x 2	Settable range (Flicker mode for FMA: 0.50 to 130.00 Hz) Use the [Scan] button*2 to measure frequency, or use the [SYNC Assist] tab to search for the optimum frequency.	Not required
MANUAL	Mode that allows you to specify the integration time	—	Settable range 4.0 to 4000.0 ms (For FMA, 7.7 to 4000.0 ms)	—	Not required

*1 For waveform measurement: 0.50 to 400.00 Hz. The frequency varies for FMA depending on the operation mode.
Flicker mode: 0.50 to 130.00 Hz, XYZ mode: 0.50 to 400.00 Hz.

*2 The [Scan] button is enabled when INT is selected.

The Scan function measures the display to detect the light emission frequency (10.00 to 240.00 Hz). When the [Scan] button is pressed, a white window and a dialog confirming the start of measurement are displayed. Set the probe to a position where the white window can be measured, and then press the [Yes] button.

Note: The probe firmware version must be Ver. 1.3 or higher.

Note: This function cannot be used when using a data processor.

○ Measurement Speed : Select the measurement speed. (SLOW/FAST/LTD.AUTO/AUTO)

- Selecting FAST can shorten measurement time, but may compromise measurement repeatability for low-luminance measurements.
- Selecting SLOW repeats FAST measurements several times to ensure measurement with high repeatability.
- When AUTO is selected, measurements are automatically selected between SLOW, FAST, and setting with a further longer integration time depending on the luminance level.
- When LTD.AUTO is selected, measurements are automatically selected between SLOW and FAST depending on the luminance level.

Notes: For the first measurement or when the brightness of the measurement target changes from the that in the previous measurement, the switching of ranges may result in longer measurement time.

○ Averaging Times : Set the number of measurements taken to average for obtaining a single measurement value. (1 to 20)

○ Flicker Output Sensor : Select the operation mode for flicker measurement.

(Flicker (CA-310 Mode) / XYZ (Wide Frequency Mode))

- "Flicker (CA-310 Mode)" is the same operation mode as flicker measurement (JEITA/VESA screen, Waveform screen) in conventional CA-310 and CA-S40 (up to Ver. 1.2) products. In this mode, the measurement range for the measurement target (flicker frequency) is 0.25 to 65 Hz, and the flicker measurement speed is 33.333 μ s. This mode is selectable only when probes other than CA-VP427, CA-VP427A, CA-VP410, CA-VP410A, CA-VP404, CA-VP402 or CA-VP410T are connected.
- In "XYZ (Wide Frequency Mode)" operation mode, the measurement range for the measurement target (flicker frequency) is 0.25 to 200 Hz. The flicker measurement speed is 333.333 μ s. This mode can be selected when any probe is connected.

○ Integration Time : Select the shortest measurement time for synchronized measurement.

- When Single-Frame is selected, measurement takes half the normal amount of time (Double-Frame).
- When Double-Frame is selected, measurement takes the normal amount of time.

Note: The probe firmware version must be Ver. 1.2 or higher.

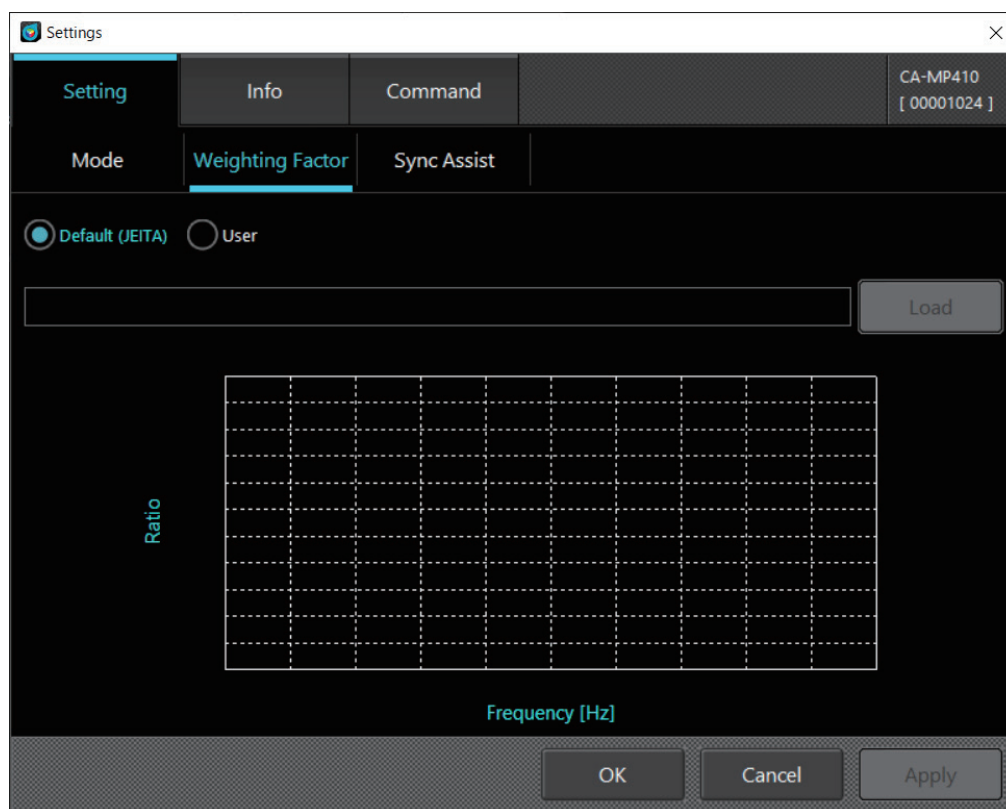
Note: Integration time is fixed to Double-Frame when using a data processor.

○ Flicker Standards : Select either JEITA or VESA for the flicker measurement standard.

1-2. Calibration channel selection [Mode tab - Memory Info.]

- CH ID : Select a calibrated channel. Measurement values are corrected using the calibration coefficient of the selected calibration channel. If you do not need such correction, select CH00. The target saved to the selected calibration channel is displayed.

1-3. JEITA/VESA frequency characteristics settings [Weighting Factor tab]



- Weighting Factor : Specify the frequency characteristics for JEITA/VESA flicker measurements.
- When Default (JEITA/VESA) is selected, a CA-310-compatible filter compliant with JEITA/VESA standards and adjusted to the human eye is used.
 - When "User" is selected, the filter created by the user is used. In the text file (.txt) for the filter, include the starting frequency, end frequency, frequency pitch, number of data sets, and the respective gains in tab-delimited format. Click [Load] to navigate to the reference folder and load the created filter file to draw the graph. This user-created filter will be applied to flicker measurement (JEITA/VESA) results and Waveform measurement results when "User" is selected under Weighting Factor. Note that 0 Hz (DC component) will be calculated as 1.0.
- * For reference, a file with the frequency response characteristics of the human eye (IEC 62341-6-3.txt) is stored in [KONICA MINOLTA] – [CA-S40] – [Template].

The tables from IEC 62341-6-3:2017/COR1:2019

Text file content:

```
<Starting frequency> <End frequency>
<Frequency pitch> <Number of data sets>
<Frequency> <Value>
. .
. .
. .
. .
. .
```

Example of text file content:

```
0.01 65 0.01 6500
0.01 1.0
0.02 1.0
. .
. .
. .
65 0.0
```

Upper/lower limits:

```
Starting frequency: 0.01 Hz - 999.99 Hz
End frequency: 0.02 Hz - 1000.00 Hz
Frequency pitch: 0.01 Hz - 10.00 Hz
Number of data sets: 2 - 100000
Value: 0.0000 - 10.0000
```

Click [OK] to confirm the settings or click [Cancel] to cancel the edit and close the pop-up.

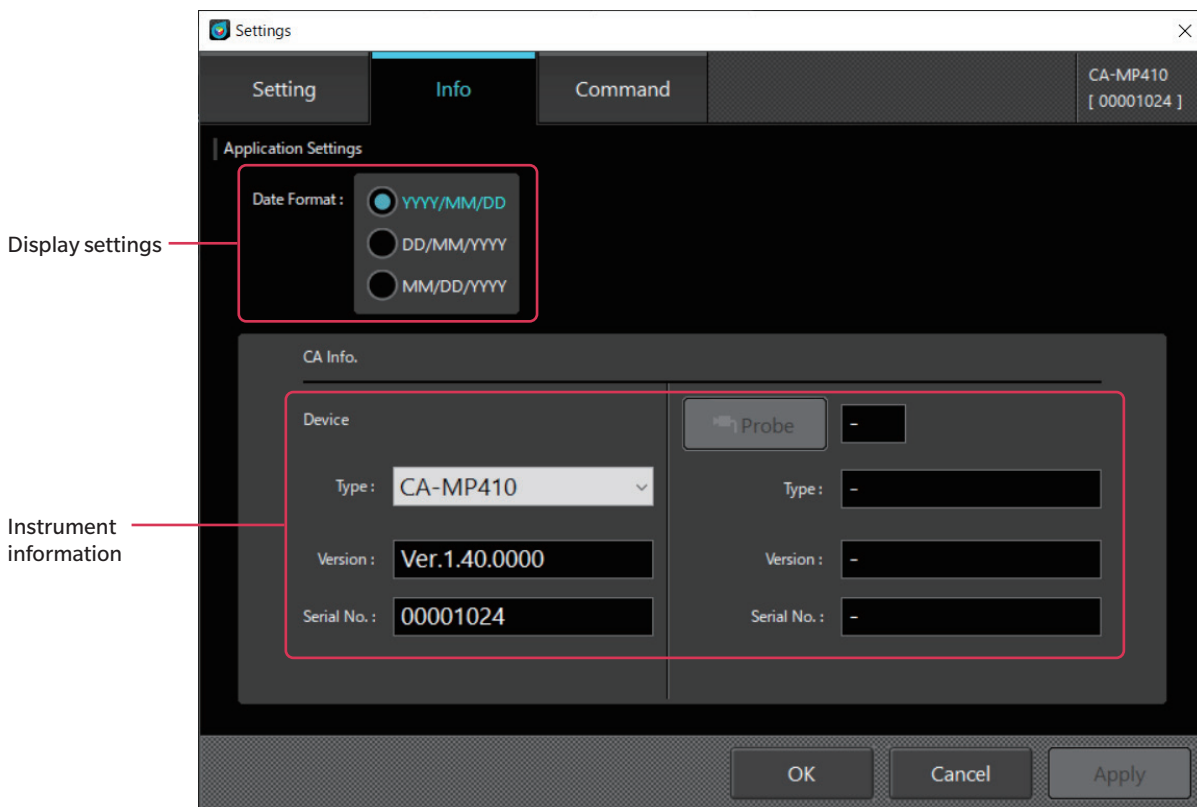
1-4. Frequency search [SYNC Assist tab – Settings]

If "INT" is selected as the sync mode, and if the user has some idea of vertical synchronization frequency of the display (measurement target), using the following procedure to set the internal synchronization frequency correctly up to the second decimal place makes it possible to perform measurement with good repeatability.



- (1) Set the number of measurements to perform for Sampling Number.
- (2) Set the known vertical synchronization frequency for the display (measurement target) for Frequency, and click [Measure]. During measurement, the standard deviation $2\sigma_{Lv}$ is calculated from the measured values obtained from the number of measurements for Sampling Number, and the results are plotted on the graph. The most recent $2\sigma_{Lv}$ value is also displayed as the Current Value.
It is possible to change Frequency during measurement.
- (3) While changing Frequency, watch the graph to determine which frequency shows the smallest $2\sigma_{Lv}$ value.
- (4) When the optimum frequency has been found, stop measurement and return to the [Mode] tab. The obtained vertical synchronization frequency will be displayed in the [INT] column of [Sync Mode].
If [Measurement Speed] in the [Mode] tab has been changed, it will be necessary to obtain the optimum frequency again in the [SYNC Assist] tab after confirming the setting by clicking [OK].

2. Option settings <Info> tab



2-1. Selecting the date display format and luminance unit

Application Settings

- Date Format : Select a date display format.
- Luminance Unit : Select a luminance unit.

If the selection of [Luminance Unit] is not displayed on the screen, exit the software, and restart the software after adding “/u” as the startup option for the software execution file “CA-S40.”

2-2. Instrument selection CA Info.

This screen appears first when the software is started with multiple instruments connected to the PC. Information about the selected instrument is displayed.

Device:

Among the instruments connected to the PC, select the one to be used in the drop-down menu. Information about the selected instrument (firmware version and serial number) is displayed.

If a data processor is selected as the instrument to be used, then also select the probe connected to the data processor in the [Probe] field on the right.

Information about the selected probe (firmware version and serial number) is displayed.

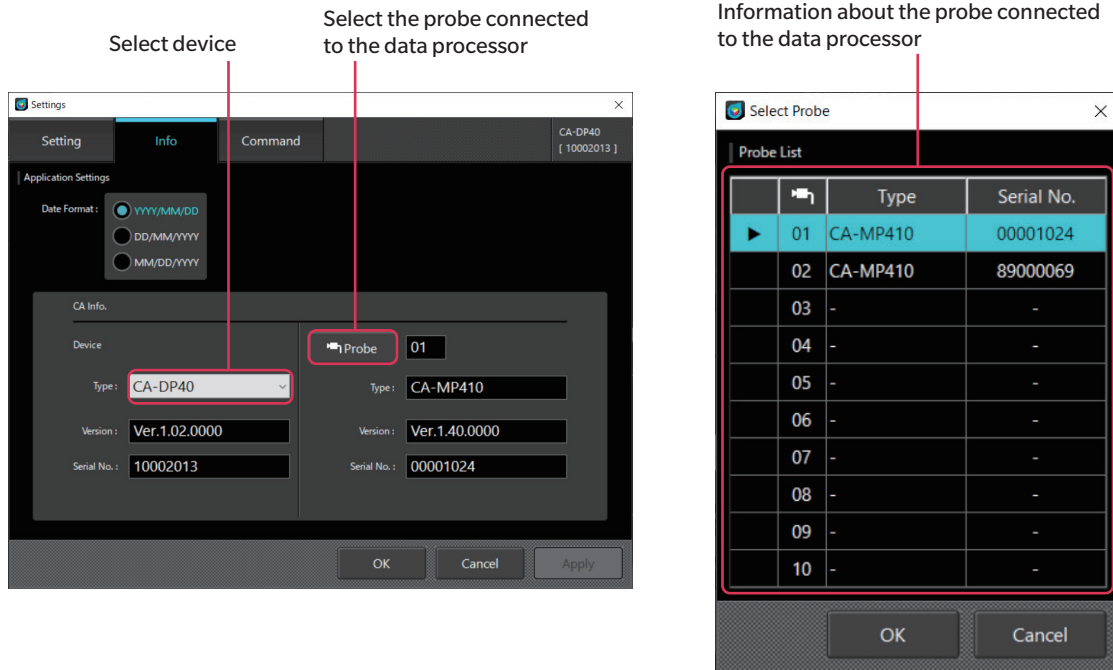
- Type : Displays the type of instrument connected.
- Version : Displays the firmware version of the selected instrument.
- Serial No. : Displays the serial number of the selected instrument.

Click [OK] to confirm the settings or click [Cancel] to cancel the edit and close the pop-up.

2-3. Switching between data processor and probe

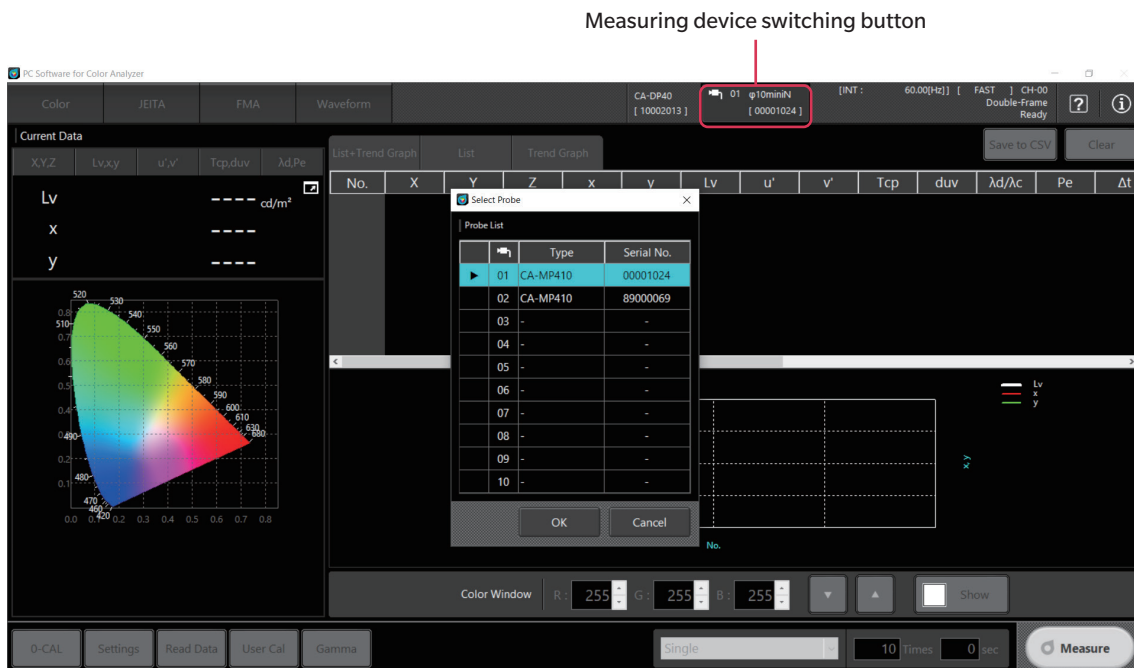
How to switch from "Type" on the Settings-Info screen

- (1) Select the data processor in "CA Info" - "Device" - "Type".
- (2) Click the [Probe] button on the "CA Info". (Select the device connected to the data processor.)
- (3) Select an area that is not any probe on the Select Probe screen and click [OK] to switch to the data processor.
Select the probe you want to connect to on the Select Probe screen and click [OK] to switch to the probe.



How to switch on the status bar

- (1) Select the measuring device switching button on the status bar.
- (2) Select an area that is not any probe on the Select Probe screen and click [OK] to switch to the data processor.
Select the probe you want to connect to on the Select Probe screen and click [OK] to switch to the probe.

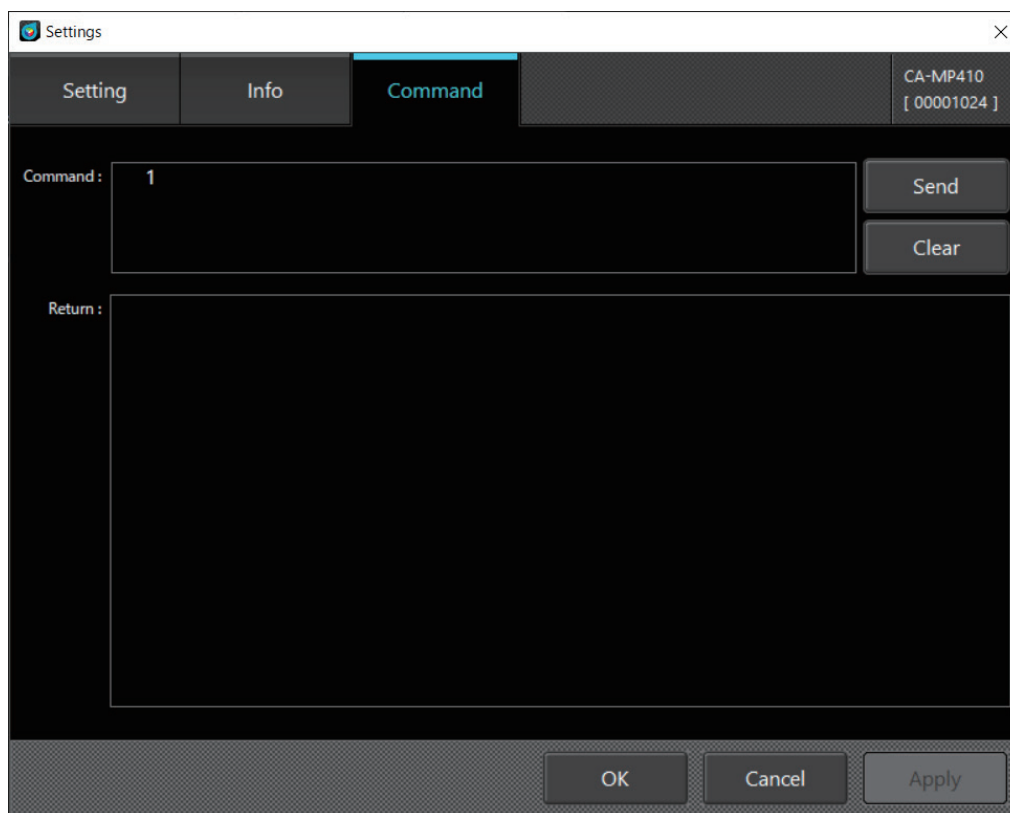


3. Command communication <Command> tab

The user can check the operations of communication commands when developing original software.

The specifications of communication commands are available for download from the following webpage:

<https://www.konicaminolta.com/instruments/download/>



○ Command : Enter a command to be sent and click [Send] to send it to the instrument.

○ Return : Displays the command reception result from the instrument.

* This function is used for checking command communication operation. Restart CA-S40 after executing command communication to update the CA-S40 settings to reflect the changes from command communication.

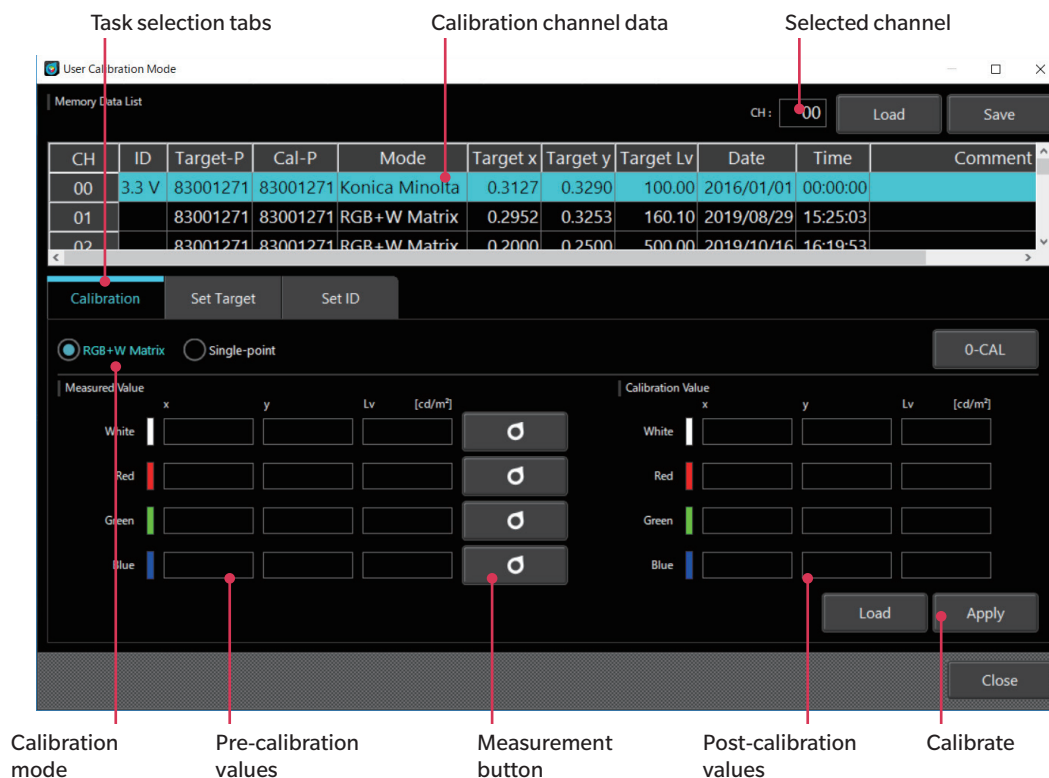
User calibration

1. About user calibration <User Calib> tab

- User calibration allows users to set their own correction coefficients to the calibration channel of the probe by measuring any colors and setting calibration values to the probe. After setting, the values corrected with the specified correction coefficients can be displayed and output for every measurement.
- As user calibration, you can select single-point calibration or RGB+W matrix calibration.
- User calibration can be performed for every calibration channel (except for CH00).
- User calibration cannot be performed for CH00 because it is calibrated in accordance with the Konica Minolta calibration standard.
- You can use user calibration to apply the following corrections to measurements based on the specified correction coefficients.
 - Correct the difference in the reading due to the inconsistencies in the spectral response of the light-receiving element of the probe.
 - Correct the difference in the readings between probes used simultaneously.

2. User calibration procedure

- Click the [User Cal] button on the chromaticity measurement screen to open the [User Calibration Mode] dialog and the [Color Window].
- The calibration channel (CH00 to CH99) data is read from the probe and displayed in the dialog.
- As calibration channel data, the ID, target probe, calibration probe, calibration mode, Lv,x,y, calibration date/time, and comments are displayed.
- A user calibration coefficient is written to the specified calibration channel. If a coefficient is already written in that calibration channel, it is overwritten.
- The target value used is written to a calibration channel as its target. If target data is already written in that calibration channel, it is overwritten.
- Performing zero calibration by clicking the [0-CAL] button is recommended before running a calibration.
- Data written to the calibration channel can be saved and read as a file using the [Load] and [Save] buttons next to the selected channel display.

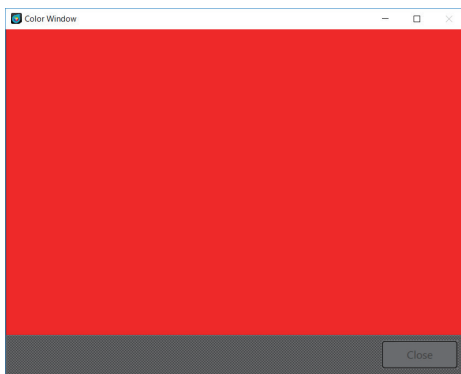
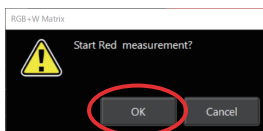


2-1. RGB+W matrix calibration / Single-point calibration

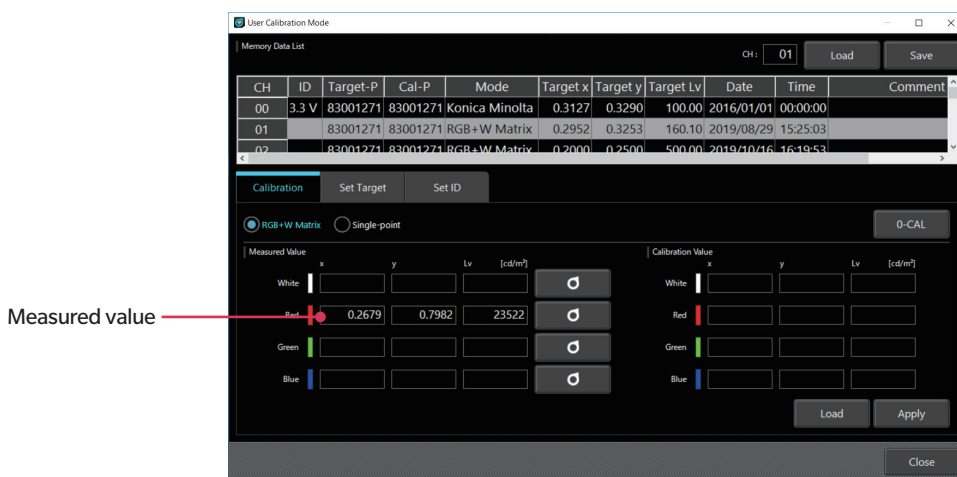
- (1) Select the [Calibration] tab.
- (2) Select the calibration channel to be calibrated. (CH01 to CH99)
 - Click over the calibration channel data.
- (3) Select [RGB+W Matrix] or [Single-point] as the calibration mode.
 - When [RGB+W Matrix] is selected, White, Red, Green, and Blue are measured (in no particular order). When [Single-point] is selected, only White is measured.
- (4) When the measurement button to the right of each color in the [Measured Value] area is clicked, the [Color Window] changes to the target color, and a dialog confirming the start of measurement is displayed.



- (5) Place the probe on the color display dialog and press the [OK] button.



- (6) Measurement is performed, and the measured value is displayed in the [Measured Value] area.



- (7) Enter the target values to correct and display in the [Calibration Value] field.
To load target values saved to a tab-delimited text file, click the [Load] button.

The screenshot shows the 'Calibration Value' section of the interface. It has two columns: 'Measured Value' and 'Calibration Value'. Each column has rows for White, Red, Green, and Blue. The 'Red' row in the 'Calibration Value' column has the values 0.625, 0.333, and 20, which are circled in red. The 'Load' button is also circled in red.

Text file content:

<White x value>	<White y value>	<White Lv value>
<Red x value>	<Red y value>	<Red Lv value>
<Green x value>	<Green y value>	<Green Lv value>
<Blue x value>	<Blue y value>	<Blue Lv value>

Text file content (Example):

0.3130	0.3230	99.6200
0.6520	0.3460	21.3200
0.3070	0.6380	74.0000
0.1500	0.0340	4.3000

* Use only "." for decimal points.

* Digit separators are not supported.

Reading will be successful even if a blank exists in the 4 × 3 format, but an error will occur if anything other than a numeric value is included.

When a 4 × 3 format file is loaded with single-point calibration, only the first row (white values) will be used.

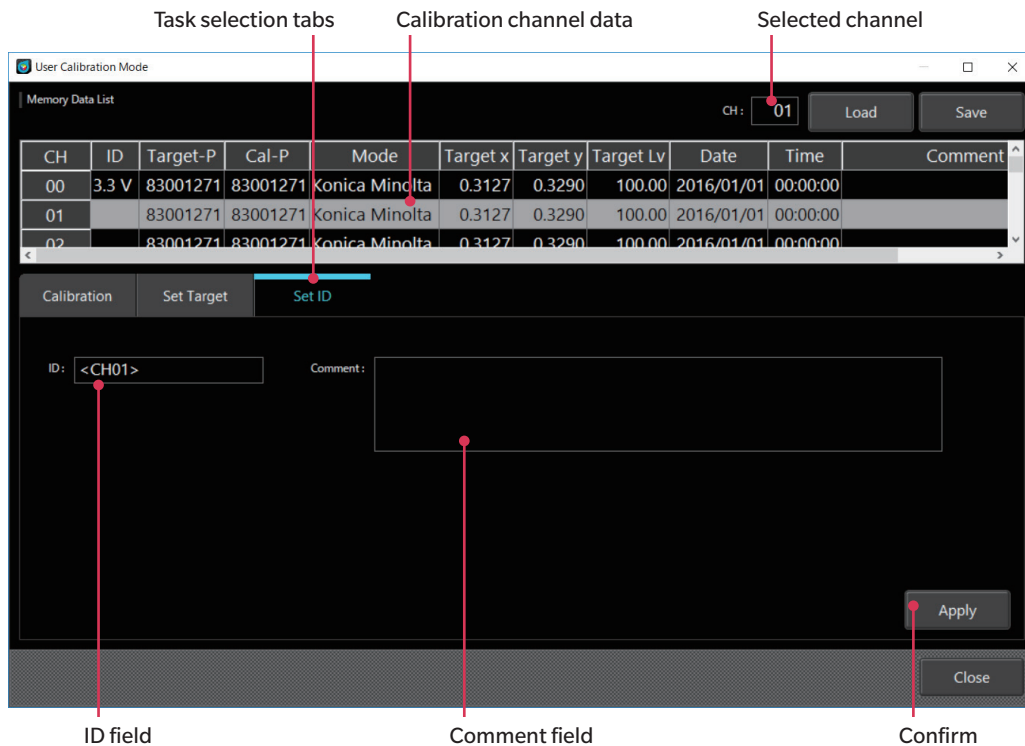
- (8) After performing measurement and entering targets for all of Red, Green, Blue, and White, click the [Apply] button.
- To stop calibration, click [Close]. The change is not applied until the [Apply] button is clicked.

The screenshot shows the 'User Calibration Mode' window. It has a 'Memory Data List' table at the top with columns: CH, ID, Target-P, Cal-P, Mode, Target x, Target y, Target Lv, Date, Time, and Comment. Below this is the 'Calibration' section with 'Set Target' and 'Set ID' buttons. The 'Calibration Value' section has two columns: 'Measured Value' and 'Calibration Value'. Each column has rows for White, Red, Green, and Blue. The 'Apply' button is circled in red.

2-2. ID setup

You can add an ID and comment to a calibration channel to make it easier to distinguish.

- (1) Select the [Set ID] tab.
- (2) Select a calibration channel. (CH00 to CH99)
 - Click over the calibration channel data.
- (3) Enter an ID in the ID text box. You can enter a comment in the Comment text box.
 - You can enter up to 10 alphanumeric characters for an ID and up to 50 alphanumeric characters as a comment.
- (4) Click [Apply]. The change is not applied until you click [Apply].
- (5) The entered ID and comment are applied.



<Notes on user calibration>

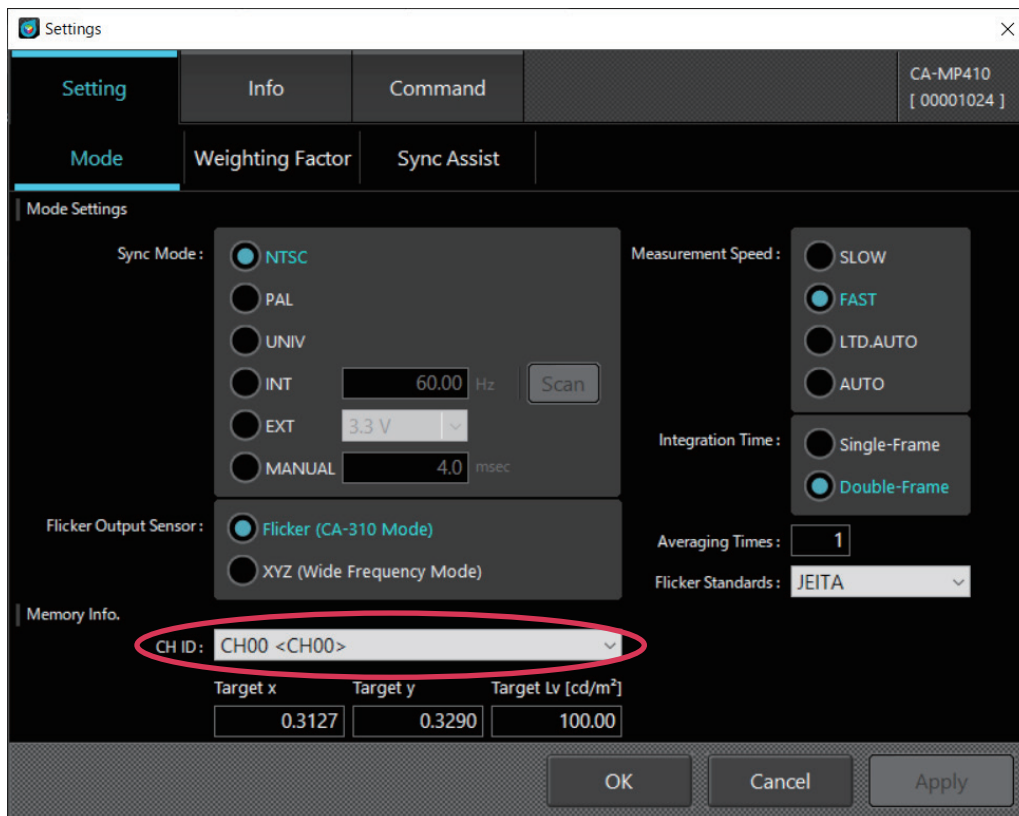
- Correction coefficients are used for all measurement modes (Lv xy, Lv u' v', Lv Tcp duv, XYZ, and Lvλd Pe).
- You cannot perform user calibration for channel CH00.
(CH00 is a channel for performing measurement in accordance with the Konica Minolta calibration standard.)
- Performing RGB+W matrix calibration for a preset channel erases the last-set value.
- Performing RGB+W matrix calibration for a single-point-calibrated channel erases the correction coefficients for the last single-point calibration and sets correction coefficients for RGB+W matrix calibration.
- The target value used is written to a calibration channel as its target. If target data is already written in that calibration channel, it is overwritten.

3. Specifying the calibration coefficients <Settings> window

To perform measurement using your own correction coefficients, specify which calibration channel's correction coefficients you want to use. Specify [CH00] to perform measurement without performing correction but in accordance with the Konica Minolta standard.

3-1. Selecting a calibrated channel

- (1) Click [Settings] to bring up the following pop-up window for setting the measurement conditions and optional items.
- (2) In the [CH ID:] field under [Memory Info.] in the [Setting] tab, select a calibrated calibration channel.
The target saved to the calibration channel is displayed in the pane below for your review.
- (3) Click [OK] to confirm the calibration channel for which the correction coefficients are to be used. The pop-up closes.
Click [Cancel] to close the pop-up without confirming the calibration channel.



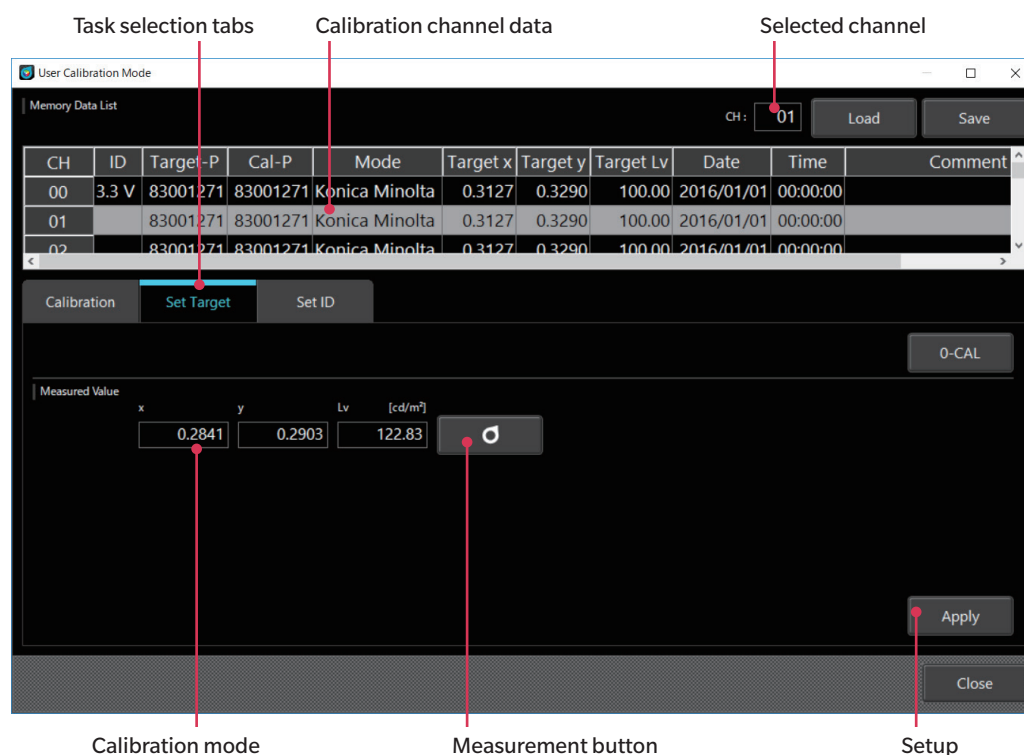
Target settings

The target values used for user calibration are written as the target in a calibration channel. If you want to set a separate target for color difference assessment (this function is available with a data processor), you can set a target in a calibration channel using [Set Target]. While any target data already written in that calibration channel is overwritten, the set correction coefficients remain the same.

If you do not want to lose the target values used for user calibration, it is recommended that you set them in a channel different from the one you used for user calibration.

- Click the [User Cal] button on the chromaticity measurement screen to open the pop-up window for user calibration.
- The calibration channel (CH00 to CH99) data is read before displaying the pop-up window.
- As calibration channel data, the ID, target probe, calibration probe, calibration mode, Lv,x,y, calibration date/time, and comments are displayed.

1. Setting the target



(1) Setting the target

- (1) Select the [Set Target] tab.
- (2) Select the calibration channel in which the target is set. (CH01 to CH99)
 - Click over the calibration channel data or select from the channel selection drop-down menu.
- (3) Enter the target values in the [Measured Value] field or obtain the value by clicking the measurement button on the right side. The values can be rewritten after measurement. Performing zero calibration by clicking the [0-CAL] button is recommended before running a measurement.
- (4) Click [Apply] to complete setting the target. The change is not applied until you click [Apply].

(2) Setting the ID

To set the ID or enter a comment, follow the same procedure as for setting the ID and entering a comment for user calibration. See 2-2 on P.50 for instructions on how to set the ID. (ID is set for a calibration channel.)

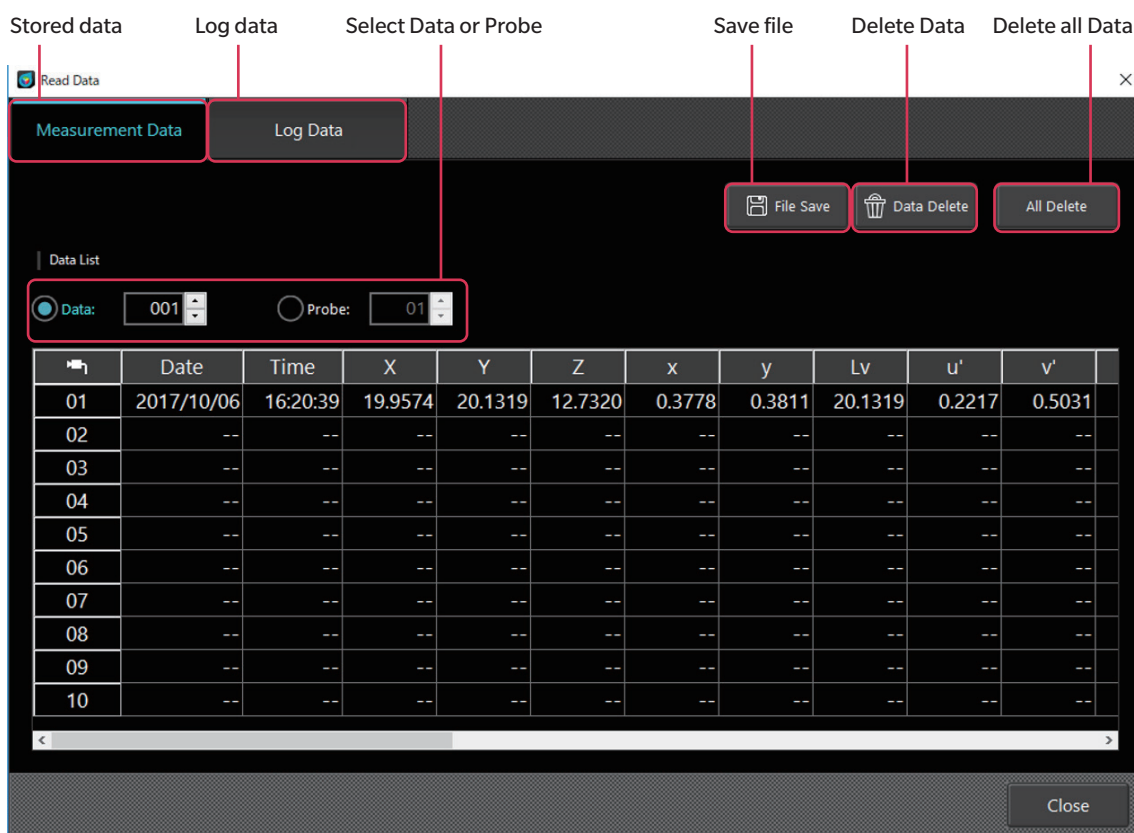
Data processor data

1. Handling of stored data

The stored data are the measurement results stored in the data processor.

You can measure a single data using up to 10 probes and 100 Data can be registered.

- (1) When Data is selected in the Data list on the [Measurement Data] tab
 - When you click the [File Save] button, all the measurement results of the probe used for measurement in the selected Data are saved.
 - Click [Data Delete] to erase all measurement results of the selected Data.
 - Click [All Delete] to erase all Data.
- (2) When Probe is selected in the Data list on the [Measurement Data] tab
 - When you click the [File Save] button, the measurement results of all Data measured with the selected probe are saved.
 - Click [Data Delete] to erase Data on the selected probe.
 - When you click [All Delete], all data will be deleted on the screen and in the data processor.



2. Handling of Log data

One Log Data has the Data of the number of probes for the measured times.

Log No. / date and time measurement started / date and time measurement stopped / data number tabs are displayed on the Log Data screen.

- Select the Log No. you want to save and click the [File Save] button to save the measurement result of the selected Log No.
- When you click [All Delete], all data will be deleted on the screen and in the data processor.

Stored data Log data Save file Delete all Data

Read Data Measurement Data Log Data File Save All Delete

Data List

Log No.	Start Date Time	Stop Date Time	Data Num
001	2017/10/05 19:02:24	2017/10/05 19:02:34	2
002	2017/10/06 16:20:39	2017/10/06 16:20:39	1
003	2017/10/06 16:24:19	2017/10/06 16:24:49	4
004	2017/10/11 10:52:03	2017/10/11 10:52:23	3
005	--	--	--
006	--	--	--
007	--	--	--
008	--	--	--
009	--	--	--
010	--	--	--
011	--	--	--
012	--	--	--
013	--	--	--

Close

Appendix

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Error message

The operation is not correct. Follow the instructions displayed immediately.

Message	Details
--failed to write or read on memory --reconnect the probe	A memory error has occurred inside the probe. If this condition persists after reconnecting, contact a service center to deal with the possible malfunction.
--System error --restart and application and a device	A program operation error has occurred inside the probe or SDK. If this condition persists after restarting, contact a service center to deal with the possible malfunction.
--SDK has problem --restart SDK	A program operation error has occurred inside the SDK. If this condition persists after restarting, contact a service center to deal with the possible malfunction.
Unknown error.	An unknown error code has been returned from the SDK. Due to the possibility of having an incompatible version, re-installation is recommended.
Cannot calibrate selected channel.	The selected channel cannot be calibrated. If the channel in question is not CH00, that channel may be locked. Contact a service center.
Cannot set target on selected channel.	Target cannot be set for the selected channel. The channel may be locked. Contact a service center.

Caution

The setting or operation is not correct.

Message	Details
Cannot open the manual Make sure that a PDF reader is installed and it is set as the default app for PDFs.	PDF viewer software for displaying the instruction manual cannot be opened. Check whether PDF viewer software is installed and set to default.
Cannot find the manual Please check your app installation.	The instruction manual is not found. The manual may have been moved from the correct folder path. Re-install CA-S40.
Failed to connect to selected probe. Please check probe connection.	This message appears when connection to a probe fails while a data processor is connected. Check the connection with the probe, and establish the connection again after restarting CA-S40.
CA device not connected. Please connect device.	This message appears when CA-S40 is started without connecting a probe/ data processor. Restart CA-S40 after checking the connection.
Y(Luminance) [Max] input value error. Please input -99999999999.0 to 99999999999.0.	This is an error in the manual setting of the vertical axis scale in the Waveform graph. The maximum value must be greater than -99999999999.0, but less than 99999999999.0.
Y(Luminance) [Min] input value error. Please input -99999999999.0 to 99999999999.0.	This is an error in the manual setting of the vertical axis scale in the Waveform graph. The minimum value must be less 99999999999.0, but greater than -99999999999.0.
[Max] and [Min] cannot be the same.	The maximum and minimum values may not be the same.
Failed to re-connect to device. Please disconnect and connect the device again.	Reconnection to the device failed. The device must be reconnected.
Failed to connect to device. Please check device connection.	Reconnection of the device failed. Check the device connection status.
Cannot complete measurement. (ERROR: [SDK error message])	Measurement failed. Follow the instructions in the error message.
Device connection failed. Please check selected device.	Reconnection of the device failed. Check the device connection status.
Cannot calibrate CH00. Select other CH.	CH00 cannot be calibrated. Specify a different channel for calibration.
[WHITE/RED/GREEN/BLUE Lv] has input value error. Please input 0.0001 to 99999.0	True value input of Lv for one of the RGBW colors is out of range. Input a value between 0.0001 and 99999.0.
[WHITE/RED/GREEN/BLUE x] has input value error. Please input 0.0001 to 0.9999.	True value input of x for one of the RGBW colors is out of range. Input a value between 0.0001 and 0.9999.
[WHITE/RED/GREEN/BLUE y] has input value error. Please input 0.0001 to 0.9999.	True value input of y for one of the RGBW colors is out of range. Input a value between 0.0001 and 0.9999.
[WHITE/RED/GREEN/BLUE x] or [WHITE/RED/GREEN/BLUE y] has input value error. Make sure $x+y \leq 1$.	True value input of x or y for one of the RGBW colors is out of range. Check whether $x + y$ is 1 or less.
Invalid memory channel ID. ID is too long (Max of 10 characters only).	Memory ID input character count exceeds character limit.
Invalid memory channel comment. Comment is too long (Max of 50 characters only).	Comment input character count exceeds character limit.
Loaded file is invalid. Please select .dat file.	Loaded calibration data file has incorrect data format.

Caution

Message	Details
[Times] has input value error. Please input a valid number.	A non-numeric value is entered for the number of measurements for interval measurement. Use only numeric values.
[Times] has input value error. Please input 0 - 40000 measurements.	An out-of-range value is entered for the number of measurements for interval measurement. Use a value within the specified range.
[sec] has input value error. Please input a valid number.	A non-numeric value is entered for the measurement interval time for interval measurement. Use only numeric values.
[sec] has input value error. Please input 0 - 7259 sec.	The measurement time interval input is out of range when the interval count is specified within 1 to 4000. Enter a value within 0 to 7259 seconds.
[sec] has input value error. Please input 1 - 7259 sec.	The measurement time interval input is out of range when the interval count is specified within 4001 to 40000. Enter a value within 1 to 7259 seconds.
[Wait] has input value error. Please input a valid number.	A non-numeric value is entered for the inter-tone wait time for gamma measurement. Use only numeric values.
[Wait] has input value error. Please input 0 - 36000 x 100 msec.	An out-of-range value is entered for the inter-tone wait time for gamma measurement. Enter a value within 0 to 36000.
INT Sync Mode setting is invalid. Please go to Settings and set INT value to 0.50 - 130.00 Hz.	Sync Mode INT out of range is entered for FMA measurement. Enter a value within 0.50 Hz to 130.00 Hz.
MANUAL Sync Mode setting is invalid. Please go to Settings and set MANUAL value to 7.7 - 4000.0 msec.	Sync Mode INT out of range is entered for FMA measurement. Enter a value within 7.7 to 4000.0 msec.
[INT] has input value error. Please input a valid number.	A non-numeric value is entered for Sync Mode INT. Use only numeric values.
[INT] has input value error. Please input 0.50 - 240.00 Hz.	An out-of-range value is entered for Sync Mode INT for colorimetry. Use a value within the specified range.
[INT] has input value error. Please input 0.50 - 130.00 Hz.	An out-of-range value is entered for Sync Mode INT for FMA measurement. Use a value within the specified range.
[MANUAL] has input value error. Please input a valid number.	A non-numeric value is entered for Sync Mode MANUAL. Use only numeric values.
[MANUAL] has input value error. Please input 4.0 - 4000.0 msec.	An out-of-range value is entered for Sync Mode MANUAL for colorimetry. Use a value within the specified range.
[MANUAL] has input value error. Please input 7.7 - 4000.0 msec.	An out-of-range value is entered for Sync Mode MANUAL for FMA measurement. Use a value within the specified range.
[Averaging Times] has input value error. Please input a valid number.	A non-numeric value is entered for averaging times. Use only numeric values.
[Averaging Times] has input value error. Please input 1 - 255.	An out-of-range value is entered for the number of averaging measurements. Use a value within the specified range.
File has incorrect format. Please input a valid file.	Weighting factor data could not be read. Check the file format.
Cannot get the saved weighting factor data.	Weighting coefficient data for flicker that has been read cannot be acquired. Load the weighting coefficient data file again.
Filepath does not exist. Please input a valid path.	File path is incorrect. Specify the correct path.
User-defined weighting factor data was not loaded. The previous setting will be retained. Do you want to proceed?	File cannot be loaded because of an error in the file format. Use the current settings or try applying the settings again.
The weighting factor setting will be reverted to the previous setting Do you want to proceed?	Settings reverted to the original setting.

Message	Details
Cannot overwrite existing file. Check that it is not in use.	Data cannot be saved to file due to reasons such as the save file is currently in used. Check the file.
--no sync_signal --input an external synchronization signal	Vertical synchronization signals are not input in external synchronization mode. Check the signal transmitter and the connection status.
--data value is too high --set a color within CA's measuring range	The brightness of the measurement target exceeds the upper limit. Either adjust the brightness so that it is within the measurable range or use a high-luminance probe.
--failed to calculate color temp --Retry the measurement	Retry the measurement.
--FMA Flicker Value is out of range	Retry the measurement.
X(Time) [Max] is invalid. Please set it to [Min] - 300000.0	This is an error in the manual setting of the horizontal axis scale in the Waveform graph. The maximum value must be greater than the minimum value, but less than 300000.0.
X(Time) [Min] is invalid. Please set it to 0.0 - [Max]	This is an error in the manual setting of the horizontal axis scale in the Waveform graph. The minimum value must be less than the maximum value, but greater than 0.0.
Y(Luminance) [Min] cannot be greater than [Max].	This is an error in the manual setting of the vertical axis scale in the Waveform graph. The minimum value must be less than the maximum value.
X(Time) [Min] cannot be greater than [Max].	This is an error in the manual setting of the horizontal axis scale in the Waveform graph. The minimum value must be less than the maximum value.
EXT Sync Mode setting is invalid. Please input a VSYNC signal of 0.50 - 240.00 Hz at the 1.8 V CMOS input level.	The external synchronization signal is invalid. (The external synchronization signal is set to less than 0.5 Hz or greater than 240 Hz.) Input a VSYNC signal between 0.50 and 240.00 Hz using the 1.8 V CMOS input level.
EXT Sync Mode setting is invalid. Please input a VSYNC signal of 0.50 - 240.00 Hz at the 3.3 - 5.0 V CMOS input level.	The external synchronization signal is invalid. (The external synchronization signal is set to less than 0.5 Hz or greater than 240 Hz.) Input a VSYNC signal between 0.50 and 240.00 Hz using the 3.3 to 5.0 V CMOS input level.
EXT Sync Mode setting is invalid. Please input a VSYNC signal of 0.50 - 130.00 Hz at the 1.8 V CMOS input level.	The external synchronization signal is invalid. (The external synchronization signal is set to less than 0.5 Hz or greater than 130 Hz.) Input a VSYNC signal between 0.50 and 130.00 Hz using the 1.8 V CMOS input level.
EXT Sync Mode setting is invalid. Please input a VSYNC signal of 0.50 - 130.00 Hz at the 3.3 - 5.0 V CMOS input level.	The external synchronization signal is invalid. (The external synchronization signal is set to less than 0.5 Hz or greater than 130 Hz.) Input a VSYNC signal between 0.50 and 130.00 Hz using the 3.3 to 5.0 V CMOS input level.
EXT Sync Mode setting is invalid. Please input a VSYNC signal of 0.50 - 400.00 Hz at the 1.8 V CMOS input level.	The external synchronization signal is invalid. (The external synchronization signal is set to less than 0.5 Hz or greater than 400 Hz.) Input a VSYNC signal between 0.50 and 400.00 Hz using the 1.8 V CMOS input level.
EXT Sync Mode setting is invalid. Please input a VSYNC signal of 0.50 - 400.00 Hz at the 3.3 - 5.0 V CMOS input level.	The external synchronization signal is invalid. (The external synchronization signal is set to less than 0.5 Hz or greater than 400 Hz.) Input a VSYNC signal between 0.50 and 400.00 Hz using the 3.3 to 5.0 V CMOS input level.
--Device not found. --Check Device.	No device could be found. Check the device connection status.
There is no periodicity. Please use the reference frequency (20.00 Hz) when you cannot find the frequency by Waveform measurement.	No periodicity could be detected. If the frequency cannot be determined using Waveform measurement, please use the reference value (UNIVERSAL: 20.00 Hz).
The detected frequency is out of the specification range.	No periodicity could be found within the range of detection. Use Waveform measurement to determine the frequency.
Loaded file is invalid. Please check the contents of the file.	The file format is incorrect.
Failed to load memory data.	The file may be corrupted.

Instruction

The flow of operation is displayed. Perform the operation according to the information displayed.

Message	Details
Please wait for a moment.	A task is running. Please wait until the task is completed.
Transferring to Datalist...	Continuous/Interval measurement data is being transferred from the buffer to the list. Please wait until the task is completed.
Please perform 0-CAL.	This message appears when zero calibration is required. Perform zero calibration according to the information displayed.
Continuous measurement in progress. Please stop measurement first.	This message appears when you try to exit the application while Continuous measurement is running. Exit the application after stopping the measurement.
Interval measurement in progress. Please stop measurement first.	This message appears when you try to exit the application while Interval measurement is running. Exit the application after stopping the measurement.
Closing the application will clear all measurement data. Do you want to proceed?	This message appears when you try to exit the application when there is still measurement data. If the measurement data needs to be saved, use the [Save to CSV] button to save the data before exiting the application.
Device was changed. Do you want to apply previous probe settings to the new device?	This message appears when a new device has been connected to the application. If you want to use the settings for an existing device, click [Yes]. If you want to use the settings in the new device, click [No].
Start 0-CAL?	This message appears when the zero calibration button is pressed. Press [No] if you are not running the zero calibration.
Please input a valid number.	This message appears when an invalid value (such as characters) is entered for true value input for calibration. Enter a numeric value.
Start [WHITE/RED/GREEN/BLUE] measurement?	A message is displayed prompting whether or not to perform monochromatic measurement for calibration. While this message is displayed, you can change the position of the Color Window for measurement.
Start Target setting?	This message prompts whether or not to set the target.
The work is processing. Switch to other tab?	Switching to another tab results in the loss of edits and measurement data. If necessary, finish the tasks before switching tabs.
Delete CH data from all probes?	This message asks for confirmation whether to delete the data in the selected channel that saves measurement data.
Delete all data?	This message asks for confirmation whether to delete all data in the channels that save measurement data.
Overwrite [file name]?	This message asks for confirmation whether to overwrite the file for channels that save measurement data.
Executing continuous measurement will clear previous measurement data. Do you want to proceed?	This message appears when you try to run a continuous measurement while there is measurement data. If the measurement data is necessary, save it before running the measurement.
Executing interval measurement will clear previous measurement data. Do you want to proceed?	This message appears when you try to run an interval measurement while there is measurement data. If the measurement data is necessary, save it before running the measurement.
Executing package measurement will clear previous measurement data. Do you want to proceed?	This message appears when you try to run a package measurement while there is measurement data. If the measurement data is necessary, save it before running the measurement.
Executing Gamma measurement will clear previous measurement data. Do you want to proceed?	This message appears when you try to run a gamma measurement while there is measurement data. If the measurement data is necessary, save it before running the measurement.
Executing measurement will clear gamma measurement data. Do you want to proceed?	This message appears when you try to run another measurement while there is gamma measurement data. If the measurement data is necessary, save it before running the measurement.

Message	Details
Entering gamma measurement mode will clear previous measurement data. Do you want to proceed?	This message appears when you try to open the gamma measurement window while there is measurement data. If the measurement data is necessary, save it before running the measurement.
Closing the window will clear Gamma measurement data and graphs. Do you want to proceed?	This message appears when you try to close the gamma window while there is gamma measurement data. If the measurement data is necessary, save it before running the measurement.
Changing frequency resolution will clear previous flicker measurement data. Do you want to proceed?	This message appears when trying to change the JEITA/VESA frequency resolution conditions while there is JEITA/VESA measurement data. If the measurement data is necessary, save it before running the measurement.
Data are over capacity. Max capacity = 40000	This message appears when the number of measurements reaches the maximum limit. Save the data first, and then clear it.
Delete data?	This message appears when deleting list data. If you need the data, save it first.
Start Gamma Measurement? Tone: [User specified tone] Wait Time: [User specified time] msec	Start gamma measurement? Tone: [User-specified tone] Wait time: [User-specified time] msec
The device was changed. Do you want to apply current settings to the new device?	The settings from the previously connected device can be applied to the newly connected device.
Please specify image format	Specify the image format.
Cannot save current data in file **	Measurement values cannot be saved.
Trigger measurement will be performed. In this application, commands up to the line where "TMS, 1" is entered will be sent. After that, reception of trigger measurement results will be performed repeatedly.	Perform trigger measurement. In this application, commands up to the line where "TMS, 1" is entered will be transmitted (commands entered after that line will be invalid). After that, the trigger measurement results are received repeatedly.
The amount of data that can be received in trigger mode has been exceeded. Instrument will exit from trigger mode.	The amount of data that can be received in trigger mode has been exceeded. The device will exit trigger mode.

Information

Updated information is provided.

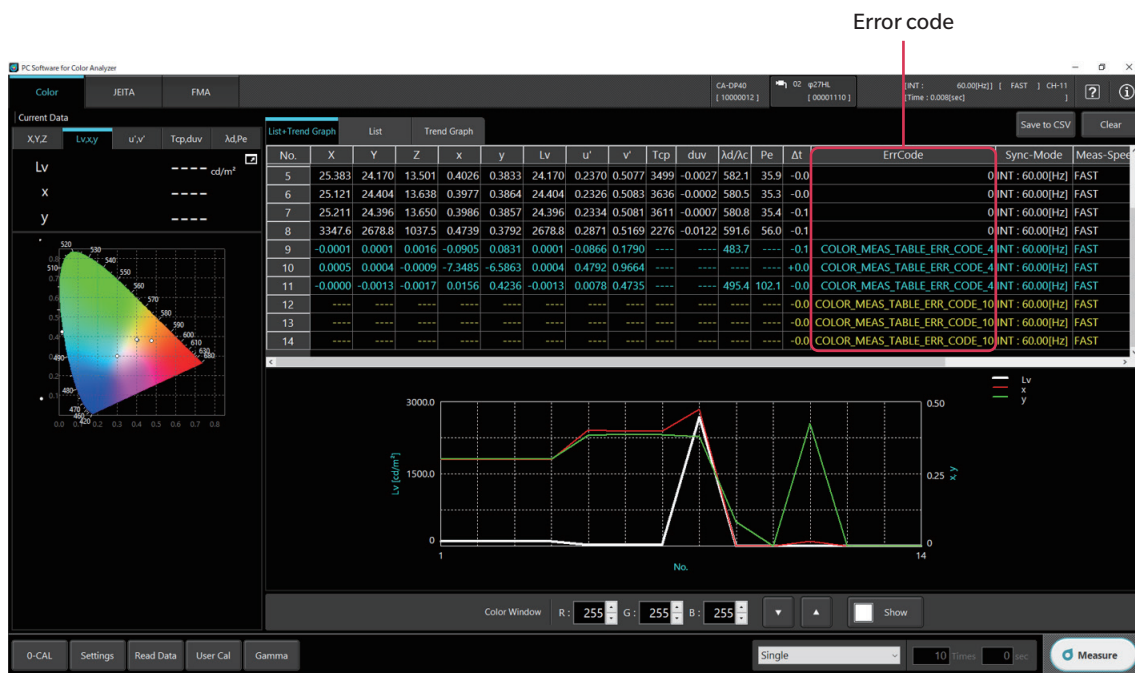
Message	Details
New CA device is connected.	This message appears when a different device is connected after the USB connection has been disconnected or when there is a device switchover from the Settings screen.
New probe is connected.	This message appears when a separate probe is selected while a data processor is connected.
Another PC Software for Color Analyzer instance is already running.	This message indicates a repeated launch attempt. Multiple copies of the software cannot run simultaneously.
Re-connection to device in progress...	Re-connection to the device is in progress. Wait without unplugging the USB flash drive.
0-CAL in progress. . .	Zero calibration is in progress.
Measurement is cancelled.	The measurement has been canceled.
RGB+W Matrix is successfully applied.	RGB+W matrix calibration has been successfully completed.
Single-point is successfully applied.	Single-point calibration has been successfully completed.
Set Target is successfully applied.	Color difference target has been successfully set.
ID and Comment are successfully applied.	ID and comment have been successfully set.
Calibration measurement failed.	Measurement for calibration failed.
Target measurement failed.	Measurement for setting the target failed.
Read data in progress. . .	Data processor data is being read.
Saving data for Log No. [No.]...	Log data is being saved.
No data selected.	Data has not been selected.
No available data.	There is no operable data.
Cannot delete measurement data.	Measurement data cannot be deleted.
No data to save.	There is no data to be saved.
Gamma measurement cancelled.	Gamma measurement has been canceled.
Interval measurement in progress...	Interval measurement is in progress.
Package measurement in progress...	Package measurement is in progress.
JEITA flicker measurement in progress...	JEITA measurement is in progress.
Reading memory...	Memory is being read.
Please check the boxes corresponding to the colors to be measured.	No color has been selected to be measured. Check the check boxes of the colors to be measured.
Color measurement in progress...	Color measurement is in progress.
FMA measurement in progress...	FMA measurement is in progress.
VESA measurement in progress...	VESA measurement is in progress.
Waveform measurement in progress...	Waveform measurement is in progress.
Updating lists might take a few minutes.	It may take several minutes for the list to refresh.

List display color, error code: List color displayed on data processor, error code

List display color	Error Code	Meaning
White	—	—
Blue	1:Different from cal Probe	The probe(s) being used are different from when user calibration / target setting and measurement was performed.
Blue	2:Δt out of range	The temperature inside the probe has changed more than the specified amount since zero calibration.
Blue	3:Δt out of range	Error code 1 and error code 2 occurred at the same time.
Blue	4:Below measurement range	Measurement is out of measurement range.
Blue	5:Out of measurement range	Error code 1 and error code 4 occurred at the same time.
Blue	6: Δ t out of range	Error code 2 and error code 4 occurred at the same time.
Blue	7: Δ t out of range	Error code 1, error code 2, and error code 4 occurred at the same time.
Yellow	10:Problem with CA-410 device	There is a problem with CA-410.
Yellow	20:Out of EXT range	External synchronization signal is invalid. (External synchronization signal is set to less than 0.5 Hz or over 240 Hz.)
Yellow	50:FMA value over 999.9%	The measured value in flicker mode exceeds 999.9%.
Yellow	51:Out of EXT range for FMA	Synchronization signal is invalid in FMA flicker mode. (The synchronization signal is set at less than 0.5 Hz or over 130 Hz.)
Yellow	53:Not flicker probe	CA-VP 410 , CA-VP410A, CA-VP427, CA-VP427A, CA-VP404, CA-VP402 or CA-VP410T is connected in flicker mode.
White	64:Low Battery	Battery level is low.
Blue	65:Low Battery + other errors	Error code 1 and error code 64 occurred at the same time.
Blue	66:Low Battery + other errors	Error code 2 and error code 64 occurred at the same time.
Blue	67:Low Battery + other errors	Error code 1, error code 2, and error code 64 occurred at the same time.
Blue	68:Low Battery + other errors	Error code 4 and error code 64 occurred at the same time.
Blue	69:Low Battery + other errors	Error code 1, error code 4, and error code 64 occurred at the same time.
Blue	70:Low Battery + other errors	Error code 2, error code 4, and error code 64 occurred at the same time.
Blue	71:Low Battery + other errors	Error code 1, error code 2, error code 4, and error code 64 occurred at the same time.

* If correlated color temperature or dominant wavelength cannot be calculated, "----" is displayed as measured value.

* If there is a colorimetric value that has not been measured when reading the data of the data processor, its colorimetric value will be displayed as "-9999", "- 99999999", etc.



For the error code displayed on the List in yellow, the error message shown in the table below is displayed after measurement is completed.












Error message	Meaning
CA410 device has problem. Please check configurations or device conditions	There is a problem with CA-410. Check the setting and CA-410 status.
An invalid external synchronization signal (set an external synchronization signal when less than 0.5 Hz, over 240 Hz)	External synchronization signal is invalid. (External synchronization signal is set to less than 0.5 Hz or over 240 Hz.)
Over the measurement range.	The tristimulus value of the measurement subject is too large.
Measurement value is over 999.9% in the flicker mode.	The measured value exceeds 999.9% in FMA measurement.
External synchronizing signal is over 130 Hz in the FMA flicker mode.	Frequency input exceeded 130 Hz in FMA measurement.
Flicker measurement is being attempted using a Probe CA-VP410, CA-VP410A, CA-VP427, CA-VP427A, CA-VP404, CA-VP402, or CA-VP410T.	CA-VP 410, CA-VP410A, CA-VP427, CA-VP427A, CA-VP404, CA-VP402 or CA-VP410T is connected in flicker mode.

< CAUTION >





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KONICA MINOLTA

<div><div><div>Main Specifications of CA-410 Probes</div></div></div>			CA-VP427A	CA-VP427	CA-P427	CA-P427H	CA-VP410A	CA-VP410	CA-VP410T	CA-P410	CA-P410H	CA-VP404	CA-VP402	
			Advanced High Sensitivity Probe	High Sensitivity Probe	Normal Probe	High Luminance Probe	Advanced High Sensitivity Probe	High Sensitivity Probe	LWD Probe	Normal Probe	High Luminance Probe	Small Spot Probe	Small Spot Probe	
														
Measurement area			Ø 27 mm	Ø 27 mm	Ø 27 mm	Ø 27 mm	Ø 10 mm	Ø 10 mm	Approx. Ø 10 mm	Ø 10 mm	Ø 10 mm	Ø 4 mm	Ø 2.1 mm	
Acceptance angle			± 2.5°	± 2.5°	± 2.5°	± 2.5°	± 8.5°	± 8.5°	± 4°	± 5°	± 5°	± 8.5°	± 10°	
Accuracy guaranteed measurement distance			30 ± 10 mm	30 ± 10 mm	30 ± 10 mm	30 ± 10 mm	30 ± 5 mm	30 ± 5 mm	200 ± 2 mm	30 ± 5 mm	30 ± 5 mm	30 ± 2 mm	28 ± 2 mm	
Display range	Luminance ^{*1}		0.0001 to 5,000 cd/m ²	0.0001 to 3,000 cd/m ²	0.0001 to 5,000 cd/m ²	0.0001 to 30,000 cd/m ²	0.0001 to 3,000 cd/m ²	0.0001 to 3,000 cd/m ²	0.0001 to 12,000 cd/m ²	0.0001 to 5,000 cd/m ²	0.0001 to 30,000 cd/m ²	0.0001 to 12,000 cd/m ²	0.0001 to 6,000 cd/m ²	
	Chromaticity		Displayed in 4 digits	Displayed in 4 digits	Displayed in 4 digits	Displayed in 4 digits	Displayed in 4 digits	Displayed in 4 digits	Displayed in 4 digits	Displayed in 4 digits	Displayed in 4 digits	Displayed in 4 digits	Displayed in 4 digits	
Luminance	Accuracy guaranteed range ^{*2}		0.0003 to 5,000 cd/m ²	0.001 to 3,000 cd/m ²	0.001 to 5,000 cd/m ²	0.01 to 30,000 cd/m ²	0.0003 to 3,000 cd/m ²	0.001 to 3,000 cd/m ²	0.004 to 12,000 cd/m ²	0.01 to 5,000 cd/m ²	0.1 to 30,000 cd/m ²	0.004 to 12,000 cd/m ²	0.002 to 6,000 cd/m ²	
	Accuracy (for white) ^{*1, *3}		> 0.0003 cd/m ²	± 9 %	---	---	± 9 %	---	---	---	---	---	---	
			> 0.001 cd/m ²	± 4 %	± 9 %	± 9 %	± 4 %	± 9 %	± 9 % (0.004 to cd/m ²)	---	---	± 9 % (0.004 to cd/m ²)	± 9 % (0.002 to cd/m ²)	
			> 0.01 cd/m ²	± 2 %	± 2 %	± 2 %	± 2.5 %	± 2.5 %	± 9 %	± 2.5 %	---	± 9 %	± 9 %	
			> 0.1 cd/m ²	± 1.5 %	± 1.5 %	± 1.5 %	± 2 %	± 2 %	± 3 %	± 2 %	± 2.5 %	± 3 %	± 3 %	
			> 1 cd/m ²	± 1.5 %	± 1.5 %	± 1.5 %	± 2 %	± 2 %	± 3 %	± 2 %	± 2 %	± 3 %	± 3 %	
			> 10 cd/m ²	± 1.5 %	± 1.5 %	± 1.5 %	± 1.5 %	± 1.5 %	± 2.5 %	± 1.5 %	± 2 %	± 2.5 %	± 2.5 %	
			> 100 cd/m ²	± 1.5 %	± 1.5 %	± 1.5 %	± 1.5 %	± 1.5 %	± 2 %	± 1.5 %	± 1.5 %	± 2 %	± 2 %	
	Repeatability (2σ) ^{*1}	AUTO	> 0.0003 cd/m ²	10 %	---	---	7 %	---	---	---	---	---	---	
			> 0.001 cd/m ²	4 %	10 %	10 %	3 %	7 %	10 % (0.004 to cd/m ²)	---	---	10 % (0.004 to cd/m ²)	10 % (0.002 to cd/m ²)	
			> 0.01 cd/m ²	1 %	1 %	1 %	10 %	1 %	5 %	2 %	---	5 %	10 %	
			> 0.1 cd/m ²	0.25 %	0.25 %	0.40 %	0.25 %	0.25 %	0.50 %	0.60 %	2 %	0.50 %	1 %	
			> 1 cd/m ²	0.10 %	0.10 %	0.10 %	0.40 %	0.10 %	0.20 %	0.20 %	0.60 %	0.20 %	0.25 %	
			> 10 cd/m ²	0.10 %	0.10 %	0.10 %	0.10 %	0.10 %	0.10 %	0.10 %	0.20 %	0.10 %	0.10 %	
			> 100 cd/m ²	0.10 %	0.10 %	0.10 %	0.10 %	0.10 %	0.10 %	0.10 %	0.10 %	0.10 %	0.10 %	
			> 100 cd/m ²	0.10 %	0.10 %	0.10 %	0.10 %	0.10 %	0.10 %	0.10 %	0.10 %	0.10 %	0.10 %	
Chromaticity	Accuracy guaranteed luminance range ^{*3}		0.003 to 5,000 cd/m ²	0.01 to 3,000 cd/m ²	0.01 to 5,000 cd/m ²	0.1 to 30,000 cd/m ²	0.003 to 3,000 cd/m ²	0.01 to 3,000 cd/m ²	0.04 to 12,000 cd/m ²	0.01 to 5,000 cd/m ²	0.1 to 30,000 cd/m ²	0.04 to 12,000 cd/m ²	0.02 to 6,000 cd/m ²	
	Accuracy (for white) ^{*1, *3}		> 0.003 cd/m ²	± 0.003	---	---	± 0.003	---	---	---	---	---	---	
			> 0.01 cd/m ²	± 0.002	± 0.003	± 0.003	± 0.002	± 0.003	± 0.004 (0.04 to cd/m ²)	± 0.006	---	± 0.004 (0.04 to cd/m ²)	± 0.004 (0.02 to cd/m ²)	
			> 0.1 cd/m ²	± 0.002	± 0.002	± 0.002	± 0.003	± 0.002	± 0.002	± 0.002	± 0.006	± 0.004	± 0.004	
			> 1 cd/m ²	± 0.002	± 0.002	± 0.002	± 0.002	± 0.002	± 0.003	± 0.002	± 0.002	± 0.003	± 0.003	
			> 10 cd/m ²	± 0.002	± 0.002	± 0.002	± 0.002	± 0.002	± 0.003	± 0.002	± 0.002	± 0.003	± 0.003	
			> 100 cd/m ²	± 0.002	± 0.002	± 0.002	± 0.002	± 0.002	± 0.002	± 0.002	± 0.002	± 0.002	± 0.002	
	At 100 cd/m ² (for monochrome) ^{*2}		100 cd/m ²	± 0.003	± 0.003	± 0.003	± 0.003	± 0.003	± 0.003	± 0.003	± 0.003	± 0.003		
	Repeatability (2σ) ^{*1}	AUTO	> 0.003 cd/m ²	0.0030	---	---	0.0020	---	---	---	---	---	---	
			> 0.01 cd/m ²	0.0030	0.0030	0.0035	0.0020	0.0020	0.0030 (0.04 to cd/m ²)	0.0070	---	0.0030 (0.04 to cd/m ²)	0.003 (0.02 to cd/m ²)	
			> 0.1 cd/m ²	0.0008	0.0008	0.0015	0.0008	0.0008	0.0015	0.0020	0.0070	0.0015	0.003	
			> 1 cd/m ²	0.0003	0.0003	0.0004	0.0015	0.0003	0.0005	0.0008	0.0020	0.0005	0.0008	
			> 10 cd/m ²	0.0002	0.0002	0.0003	0.0004	0.0002	0.0003	0.0005	0.0008	0.0003	0.0003	
			> 100 cd/m ²	0.0002	0.0002	0.0002	0.0003	0.0002	0.0002	0.0003	0.0005	0.0002	0.0002	
			> 100 cd/m ²	0.0002	0.0002	0.0002	0.0003	0.0002	0.0002	0.0003	0.0005	0.0002	0.0002	
Flicker (CA-310 Mode) ^{*5}	Flicker (Contrast)	Measurement luminance range ^{*8}		---	---	5 to 1,500 cd/m ²	30 to 9,000 cd/m ²	---	---	---	15 to 3,000 cd/m ²	90 to 18,000 cd/m ²	---	
		Measurement target (Flicker frequency)		---	---	0.25 to 65 Hz	0.25 to 65 Hz	---	---	---	0.25 to 65 Hz	0.25 to 65 Hz	---	
		Accuracy		30 Hz, AC/DC 10% sine wave	---	± 0.4 %	± 0.4 %	---	---	± 0.4 %	± 0.4 %	---	---	
				60 Hz, AC/DC 10% sine wave	---	± 0.7 %	± 0.7 %	---	---	± 0.7 %	± 0.7 %	---	---	
	Repeatability (2σ)			20-65 Hz, AC/DC 10% sine wave	---	0.3 %	0.3 %	---	---	0.3 %	0.3 %	---	---	
	Measurement luminance range ^{*8}			---	---	5 to 1,500 cd/m ²	30 to 9,000 cd/m ²	---	---	---	15 to 3,000 cd/m ²	90 to 18,000 cd/m ²	---	
	Measurement target (Flicker frequency)			---	---	0.42 to 65 Hz	0.42 to 65 Hz	---	---	---	0.42 to 65 Hz	0.42 to 65 Hz	---	
	Accuracy		30 Hz, AC/DC 4% sine wave	---	± 0.35 dB	± 0.35 dB	---	---	---	± 0.35 dB	± 0.35 dB	---	---	
			30 Hz, AC/DC 1.2% sine wave	---	± 0.35 dB	---	---	---	---	± 0.35 dB	---	---	---	
			30 Hz, AC/DC 4% sine wave	---	0.1 dB	0.1 dB	---	---	---	0.1 dB	0.1 dB	---	---	
	Repeatability (2σ)		30 Hz, AC/DC 1.2% sine wave	---	0.3 dB	---	---	---	---	0.3 dB	---	---	---	
Measurement luminance range ^{*8}			1 to 3,000 cd/m ²	1 to 3,000 cd/m ²	1 to 5,000 cd/m ²	6 to 30,000 cd/m ²	1 to 2,500 cd/m ²	1 to 2,500 cd/m ²	4 to 12,000 cd/m ²	1 to 5,000 cd/m ²	6 to 30,000 cd/m ²	4 to 12,000 cd/m ²	7 to 6,000 cd/m ²	
Sampling frequency			3 kHz	3 kHz	3 kHz	3 kHz	3 kHz	3 kHz	3 kHz	3 kHz	3 kHz	3 kHz		
Accuracy guaranteed measurement speed ^{*4}	Lvxy	AUTO	Measurement luminance range ^{*8}		0.16 times/sec (> 0.0003 cd/m ²)	---	---	---	0.16 times/sec (> 0.0003 cd/m ²)	---	---	---	0.16 times/sec (> 0.002 cd/m ²)	
					1 times/sec (> 0.01 cd/m ²)	1 times/sec (> 0.001 cd/m ²)	1 times/sec (> 0.001 cd/m ²)	1 times/sec (> 0.01 cd/m ²)	1 times/sec (> 0.001 cd/m ²)	1 times/sec (> 0.004 cd/m ²)	1 times/sec (> 0.01 cd/m ²)	1 times/sec (> 0.004 cd/m ²)	1 times/sec (> 0.05 cd/m ²)	1 times/sec (> 0.05 cd/m ²)
					5 times/sec (> 0.15 cd/m ²)	5 times/sec (> 0.15 cd/m ²)	5 times/sec (> 0.15 cd/m ²)	5 times/sec (> 0.9 cd/m ²)	5 times/sec (> 0.15 cd/m ²)	5 times/sec (> 0.15 cd/m ²)	5 times/sec (> 0.6 cd/m ²)	5 times/sec (> 0.9 cd/m ²)	5 times/sec (> 0.6 cd/m ²)	5 times/sec (> 1.5 cd/m ²)
			20 times/sec (> 2 cd/m ²)	20 times/sec (> 2 cd/m ²)	20 times/sec (> 2 cd/m ²)	20 times/sec (> 12 cd/m ²)	20 times/sec (> 2 cd/m ²)	20 times/sec (> 2 cd/m ²)	20 times/sec (> 8 cd/m ²)	20 times/sec (> 2 cd/m ²)	20 times/sec (> 12 cd/m ²)	20 times/sec (> 8 cd/m ²)	20 times/sec (> 25 cd/m ²)	20 times/sec (> 25 cd/m ²)
	Flicker (Contrast)		20 times/sec	20 times/sec	20 times/sec	20 times/sec	20 times/sec	20 times/sec	20 times/sec	20 times/sec	20 times/sec	20 times/sec	20 times/sec	
	Flicker (JEITA)		0.5 times/sec (at 1 HzPitch), 2.5 times/sec (at 10 HzPitch)	0.5 times/sec (at 1 HzPitch), 2.5 times/sec (at 10 HzPitch)	0.5 times/sec (at 1 HzPitch), 2.5 times/sec (at 10 HzPitch)	0.5 times/sec (at 1 HzPitch), 2.5 times/sec (at 10 HzPitch)	0.5 times/sec (at 1 HzPitch), 2.5 times/sec (at 10 HzPitch)	0.5 times/sec (at 1 HzPitch), 2.5 times/sec (at 10 HzPitch)	0.5 times/sec (at 1 HzPitch), 2.5 times/sec (at 10 HzPitch)	0.5 times/sec (at 1 HzPitch), 2.5 times/sec (at 10 HzPitch)	0.5 times/sec (at 1 HzPitch), 2.5 times/sec (at 10 HzPitch)			

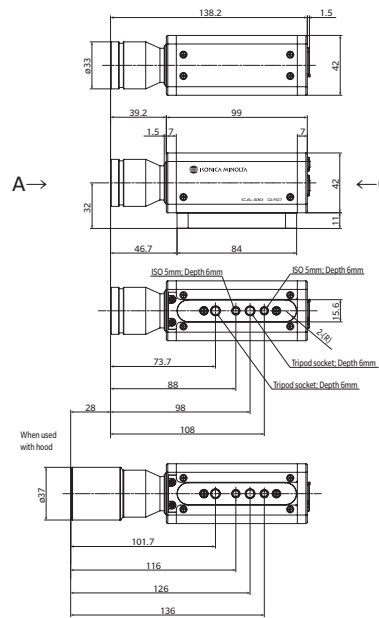
Main Specifications of CA-410 Probes

Main Specifications of CA-410 Probes				CA-P427C		CA-P410C		CA-MP410		CA-MP410H			
				CIE 170-2: 2015 Supported Probe ⁷⁾				Mini Probe					
													
Measurement area				Ø 27 mm		Ø 10 mm		Ø 10 mm		Ø 10 mm			
Acceptance angle				± 2.5°		± 5°		± 5°		± 5°			
Accuracy guaranteed measurement distance				30 ± 10 mm		30 ± 5 mm		10 ± 5 mm		10 ± 5 mm			
Display range	Luminance ^{*)}			0.0001 to 5,000 cd/m ²		0.0001 to 5,000 cd/m ²		0.0001 to 5,000 cd/m ²		0.0001 to 30,000 cd/m ²			
	Chromaticity			Displayed in 4 digits		Displayed in 4 digits		Displayed in 4 digits		Displayed in 4 digits			
Luminance	Accuracy guaranteed range ^{*)}			0.001 to 5,000 cd/m ²		0.01 to 5,000 cd/m ²		0.01 to 5,000 cd/m ²		0.1 to 30,000 cd/m ²			
	Accuracy (for white) ^{*)1, 3)}		> 0.0003 cd/m ²	---		---		---		---			
			> 0.001 cd/m ²	± 9 %		---		---					
			> 0.01 cd/m ²	± 2 %		± 2.5 %		---					
			> 0.1 cd/m ²	± 1.5 %		± 2 %		± 2.5 %					
			> 1 cd/m ²	± 1.5 %		± 2 %		± 2 %					
			> 10 cd/m ²	± 1.5 %		± 1.5 %		± 2 %					
			> 100 cd/m ²	± 1.5 %		± 1.5 %		± 1.5 %					
	Repeatability (2σ) ^{*)1}	AUTO	> 0.0003 cd/m ²	---		---		---		---			
			> 0.001 cd/m ²	10 %		---		---					
			> 0.01 cd/m ²	1 %		2 %		2.40 %					
			> 0.1 cd/m ²	0.4 %		0.6 %		0.70 %					
			> 1 cd/m ²	0.10 %		0.20 %		0.25 %					
			> 10 cd/m ²	0.10 %		0.10 %		0.12 %					
> 100 cd/m ²			0.10 %		0.10 %		0.12 %						
Chromaticity	Accuracy guaranteed luminance range ^{*)}			0.01 to 5,000 cd/m ²		0.01 to 5,000 cd/m ²		0.01 to 5,000 cd/m ²		0.1 to 30,000 cd/m ²			
	Accuracy (for white) ^{*)1, 3)}		> 0.003 cd/m ²	---		---		---		---			
			> 0.01 cd/m ²	± 0.003		± 0.006		± 0.006					
			> 0.1 cd/m ²	± 0.002		± 0.002		± 0.002					
			> 1 cd/m ²	± 0.002		± 0.002		± 0.002					
			> 10 cd/m ²	± 0.002		± 0.002		± 0.002					
			> 100 cd/m ²	± 0.002		± 0.002		± 0.002					
	At 100 cd/m ² (for monochrome) ^{*)2}		100 cd/m ²	± 0.003		± 0.003		± 0.003		± 0.003			
			Repeatability (2σ) ^{*)1}	AUTO	> 0.003 cd/m ²	---		---		---			
					> 0.01 cd/m ²	0.0035		0.007		0.0085			
					> 0.1 cd/m ²	0.0015		0.0020		0.0025			
					> 1 cd/m ²	0.0004		0.0008		0.0010			
					> 10 cd/m ²	0.0003		0.0005		0.0010			
					> 100 cd/m ²	0.0002		0.0003		0.0006			
Flicker (CA-310 Mode) ^{*)}					Flicker (Contrast)		Measurement luminance range ^{*)}		5 to 1,500 cd/m ²		15 to 3,000 cd/m ²		15 to 3,000 cd/m ²
	Measurement target (Flicker frequency)		0.25 to 65 Hz				0.25 to 65 Hz		0.25 to 65 Hz		0.25 to 65 Hz		
	Accuracy	30 Hz, AC/DC 10% sine wave	± 0.4 %				± 0.4 %		± 0.4 %				
		60 Hz, AC/DC 10% sine wave	± 0.7 %				± 0.7 %		± 0.7 %				
	Flicker (JEITA)			Repeatability (2σ) 20-65 Hz, AC/DC 10% sine wave		0.3 %		0.3 %		0.3 %			
				Measurement luminance range ^{*)}		5 to 1,500 cd/m ²		15 to 3,000 cd/m ²		15 to 3,000 cd/m ²		90 to 18,000 cd/m ²	
				Measurement target (Flicker frequency)		0.42 to 65 Hz		0.42 to 65 Hz		0.42 to 65 Hz		0.42 to 65 Hz	
				Accuracy	30 Hz, AC/DC 4% sine wave	± 0.35 dB		± 0.35 dB		± 0.35 dB			
30 Hz, AC/DC 1.2% sine wave	± 0.35 dB		± 0.35 dB		---								
XYZ (Wide Frequency Mode) ^{*)}	Flicker (Contrast)			Measurement luminance range ^{*)}		5 to 5,000 cd/m ²		15 to 5,000 cd/m ²		15 to 5,000 cd/m ²		90 to 30,000 cd/m ²	
				Measurement target (Flicker frequency)		0.25 to 200 Hz		0.25 to 200 Hz		0.25 to 200 Hz		0.25 to 200 Hz	
				Accuracy	30 Hz, AC/DC 10% sine wave	± 1.2 %		± 0.7 %		± 0.9 %		± 0.9 %	
					60 Hz, AC/DC 10% sine wave	± 1.7 %		± 1.1 %		± 1.3 %		± 1.3 %	
	Flicker (JEITA)			Repeatability (2σ) 20-65 Hz, AC/DC 10% sine wave		1.7 %		1.3 %		1.3 %			
				Measurement luminance range ^{*)}		5 to 4,500 cd/m ²		15 to 5,000 cd/m ²		15 to 5,000 cd/m ²		90 to 30,000 cd/m ²	
				Measurement target (Flicker frequency)		0.42 to 200 Hz		0.42 to 200 Hz		0.42 to 200 Hz		0.42 to 200 Hz	
				Accuracy	30 Hz, AC/DC 4% sine wave	± 0.35 dB		± 0.35 dB		± 0.35 dB		± 0.35 dB	
30 Hz, AC/DC 1.2% sine wave	± 0.35 dB		± 0.35 dB		± 0.35 dB		---						
Waveform				Repeatability (2σ) 30 Hz, AC/DC 4% sine wave		0.4 dB		0.3 dB		0.3 dB			
				30 Hz, AC/DC 1.2% sine wave		1.5 dB		0.9 dB		1.2 dB			
				Measurement luminance range ^{*)}		1 to 5,000 cd/m ²		1 to 5,000 cd/m ²		1 to 5,000 cd/m ²		6 to 30,000 cd/m ²	
				Sampling frequency		3 kHz		3 kHz		3 kHz		3 kHz	
Accuracy guaranteed measurement speed ^{*)4}	Lvxy	AUTO	---		---		---		---				
			1 times/sec (> 0.001 cd/m ²)		1 times/sec (> 0.01 cd/m ²)		1 times/sec (> 0.01 cd/m ²)		1 times/sec (> 0.1 cd/m ²)				
			5 times/sec (> 0.15 cd/m ²)		5 times/sec (> 0.15 cd/m ²)		5 times/sec (> 0.15 cd/m ²)		5 times/sec (> 0.9 cd/m ²)				
	Flicker (Contrast)		20 times/sec (> 2 cd/m ²)		20 times/sec (> 2 cd/m ²)		20 times/sec (> 2 cd/m ²)		20 times/sec (> 12 cd/m ²)				
			20 times/sec		20 times/sec		20 times/sec		20 times/sec				
			Flicker (JEITA)		0.5 times/sec (at 1 HzPitch), 2.5 times/sec (at 10 HzPitch)		0.5 times/sec (at 1 HzPitch), 2.5 times/sec (at 10 HzPitch)		0.5 times/sec (at 1 HzPitch), 2.5 times/sec (at 10 HzPitch)		0.5 times/sec (at 1 HzPitch), 2.5 times/sec (at 10 HzPitch)		
Measurement synchronization mode				NTSC, PAL, EXT, UNIV, INT, MANU(4 ms to 4 s)									
Measurement speed mode				AUTO, LTD. AUTO, SLOW, FAST									
Measurement target (Vertical synchronization frequency)				0.5 to 240 Hz (luminance and chromaticity), 0.5 to 130 Hz (flicker)		0.5 to 240 Hz (luminance and chromaticity), 0.5 to 130 Hz (flicker)		0.5 to 240 Hz (luminance and chromaticity), 0.5 to 130 Hz (flicker)		0.5 to 240 Hz (luminance and chromaticity), 0.5 to 130 Hz (flicker)			
Interface	User calibration memory channel			99 channels									
	Communication			USB2.0, RS-232C									
	Trigger ^{*)9}			IN: 1.8 V/3.3 to 5 V switching Out: 5 V									
Size (mm)				42 x 42 x 139.7		42 x 42 x 173.5		42 x 42 x 77		42 x 42 x 77			
Weight				270 g (including mount)		280 g (including mount)		200 g (including mount)		200 g (including mount)			
Power supply				DC 5 V (input from USB bus power line or RS communication connector)									
Operation temperature/humidity range ^{*)5}				10 to 35°C, relative humidity 85% or less with no condensation									
Storage temperature/humidity range				0 to 45°C, relative humidity 85% or less (at 35°C) with no condensation									

Probe Dimensions (unit: mm)

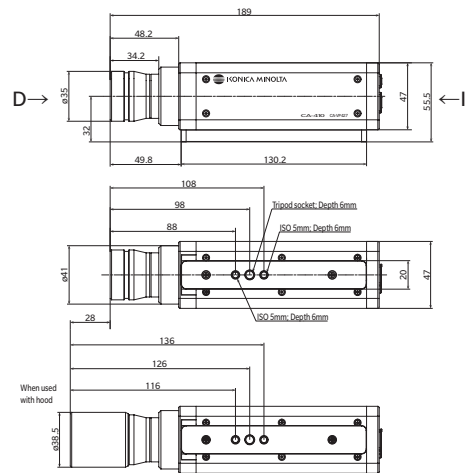
CA-P427
CA-P427H
CA-P427C

Ø27 Normal Probe
Ø27 High Luminance Probe
Ø27 Normal Probe



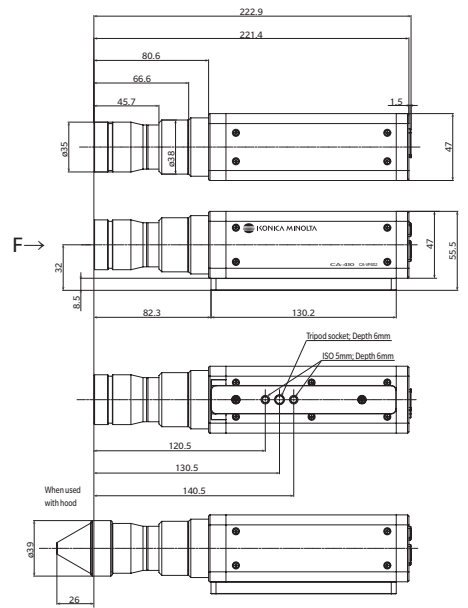
CA-VP427
CA-VP427

Ø27 High Sensitivity Probe
Ø27 Advanced High Sensitivity Probe



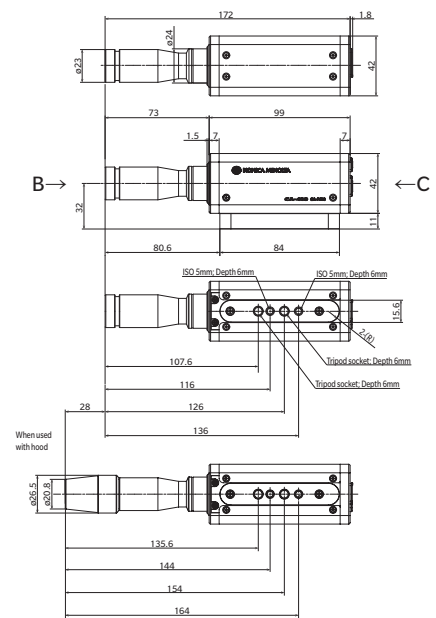
CA-VP402

Ø2 Small Spot Probe



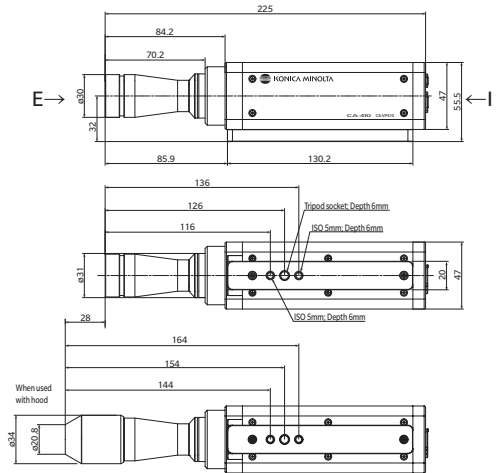
CA-P410
CA-P410H
CA-P410C

Ø10 Normal Probe
Ø10 High Luminance Probe
Ø10 Normal Probe



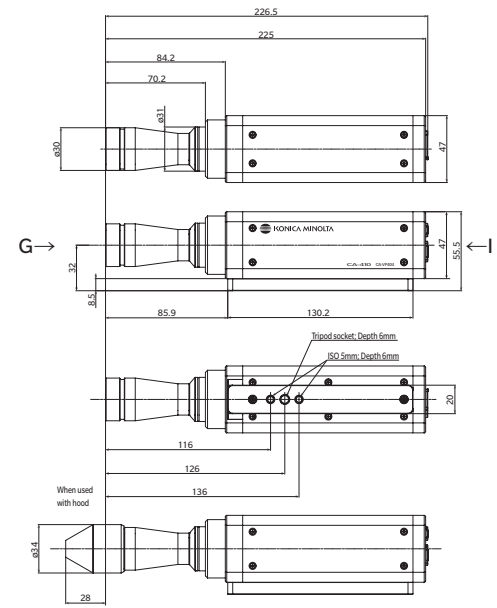
CA-VP410
CA-VP410A

Ø10 High Sensitivity Probe
Ø10 Advanced High Sensitivity Probe



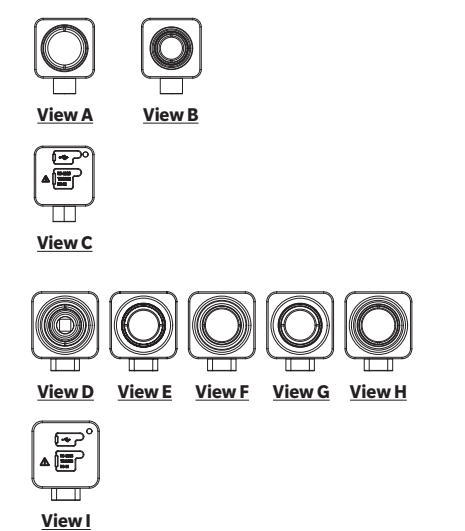
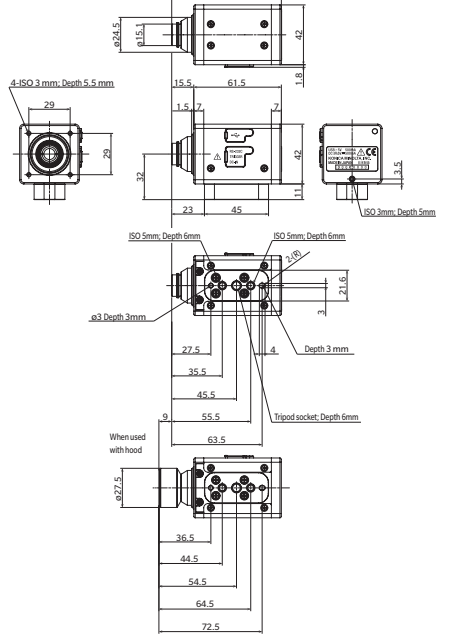
CA-VP404

Ø4 Small Spot Probe



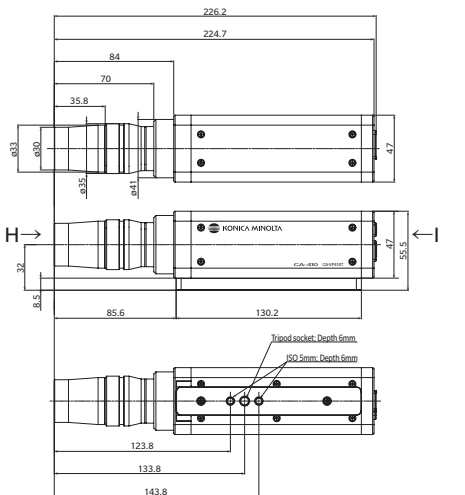
CA-MP410
CA-MP410H

Ø10 Mini Probe
Ø10 Mini High Luminance Probe



CA-VP410T

Ø10 LWD Probe (200 mm)



*1: Measured under Konica Minolta's standard light source (6,500K).

*2: Luminance for monochrome is measured when reading of luminance for white is 100 cd/m²

*3: Temperature 23°C/±2°C, relative humidity 40%±10%

*4: In NTSC synchronization mode using USB with one probe

*5: Reading fluctuation (compared to reference reading at 23°C, 40% RH): Luminance: $\pm 2\%$ for white; Chromaticity (at 100 cd/m²): ± 0.002 for white, ± 0.003 for monochrome

*6: "Flicker (CA-310 Mode)" and "XYZ (Wide Frequency Mode)" are mode names for PC Software CA-S40. "XYZ (Wide Frequency Mode)" can only be used when no CA-DP40 data processor is connected.

*7: The spectral sensitivities of probes conforming to CIE 170-2:2015 are different from those defined for the CIE 1931 color-matching functions; therefore, displayed values for luminance and chromaticity will be different from those calculated based on the CIE 1931 color-matching functions.

*8: Measured under Konica Minolta's standard light source (constant light). If the luminance momentarily greatly exceeds the upper limit, such as with a PWM light source with a small duty cycle, luminances below the upper limit may be shown as too high.

*9: Supports 1.8V switching from products produced in March 2021.

* Unless otherwise specified, specifications are given for conditions established by Konica Minolta.