MINOLTA

DISPLAY COLOR ANALYZER
CA-210
CRT COLOR ANALYZER
CA-100Plus

The essentials of imaging

www.minolta.com

For FPD (i.e . LCD, EL)

DISPLAY COLOR ANALYZER CA-210

Application
LCD Panel, LCD Monitor,
LCD TV Chromaticity Adjustment, Inspection
Quality Control of Chromaticity

For CRT

CRT COLOR ANALYZER CA-100Plus

Application
CRT, ITC
Chromaticity Adjustment, Inspection
Quality Control of Chromaticity

FASTER

- Max. 20 times / sec. High speed measurement of Luminance and Chromaticity

- Max. 20 times / sec. High speed measurement of Luminance and Chromaticity

LOW LUMINANCE

- Possible to measure as low as 0.1cd/m^2. Suitable for the measurement of gamma characteristic and adjustment. *1

- Possible to measure as low as 0.05cd/m^2. Suitable for the measurement of gamma characteristic and adjustment. *1

ACCURATE

- Accuracy of ±0.002 for White,±0.004 for R,G,B *2
- CIE 1931 Standard Observer XYZ Filter

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- CIE 1931 Standard Observer XYZ Filter

EASY TO USE

- Short measuring distance of 30 ±10 mm enables compact measuring system.
- Special optical design limits acceptance angle within ±2.5 degree. It eliminates the influence of viewing angle dependency of LCD.*3
- 4-digit display for the chromaticity enables more precise data readings.
- Flicker Measurement (Contrast Method,JEITA Method)*4
- Expandable up to 5 sensing probes. (Requires expansion board CA-B14)

- 4-digit display for the chromaticity enables more precise data readings.
- Expandable up to 5 sensing probes. (Requires expansion board CA-B04)

PC Software for Color Analyzer

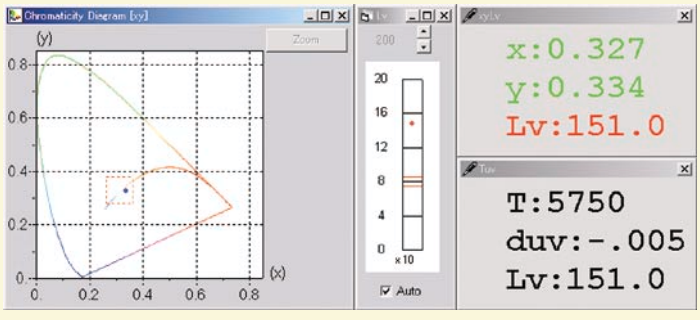
CA-SDK

(Standard accessory)

PC Software Development Kit for display color analyzer
Enables user programming by VBA or VisualC

Required system
OS Windows® 98,2000,ME
PC: COM Port support

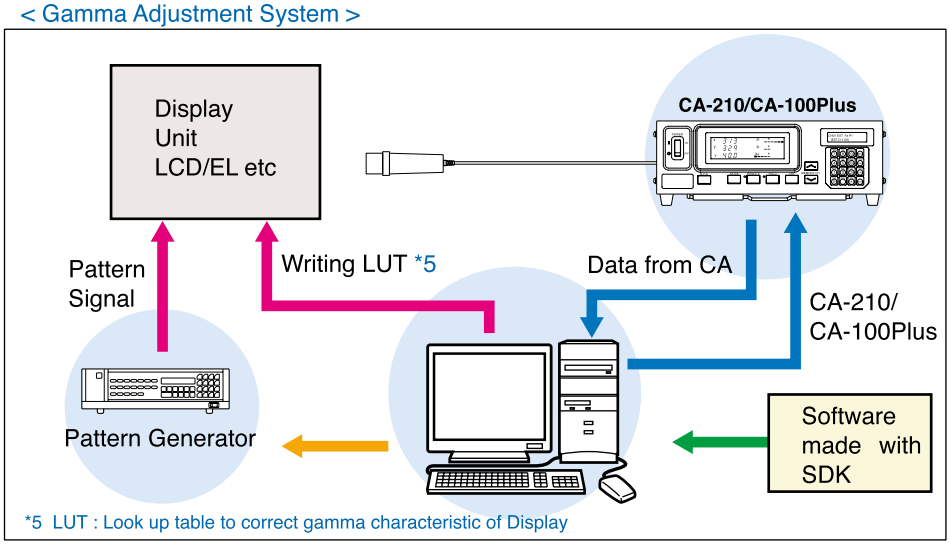
*Windows® is a trademark of Microsoft Corporation in the USA and other countries.



(Example of White Balance Adjustment Software made by SDK)

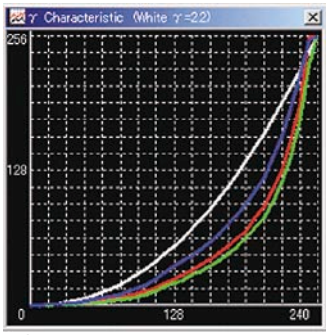
*1

< Gamma Adjustment System >



*5 LUT : Look up table to correct gamma characteristic of Display

This is an example of gamma adjustment system. User can create adjustment system by CA-SDK which comes as standard accessory. Software controls CA-210,100Plus and pattern generator to obtain color and chromaticity data with each out put level. After calculating correction factor of gamma curve, software will write the look up table of coefficient to monitor firmware.



(Gamma measurement example)

*2

<Matrix Calibration>

User's own matrix correction factor is set to the memory channels by measuring three monochrome colors (R, G and B) of known values and setting the obtained calibration values (xyLv) and emission characteristic to the instrument. Once this factor is set, the measured values will be displayed after correction by this factor and output each time measurement is taken.
Performing matrix calibration enables high-accuracy measurements of displays that provide colors through additive color mixing of three monochrome colors (R, G and B).
Since the matrix correction factor obtained from Minolta's calibration standard has been set, measured values calculated based on this factor will be acquired when this instrument is used for the first time since shipment from the factory.

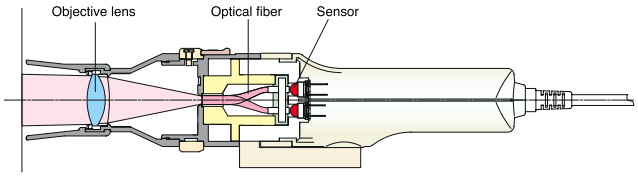
*3

<CA-210 Optical System>

The optical system consists of an objective lens and optical fiber.
Among the lights emitted from the LCD under measurement, only the lights that are emitted at within ±2.5 degrees perpendicular to the LCD are guided by the objective lens to the fiber. After being input to the fiber, the lights are divided into three portions, and each portion is received by a sensor that has a spectral sensitivity similar to the CIE 1931 color-matching function. (Three sensors in total).
IEC 61747-6 stipulates the following measuring requirements for LCD evaluation methods.

- Light receiving angle must be within 5 degrees.
- The measuring area must consist of 500 pixels or more.

This instrument satisfies the above requirements since it employs an optical system that receives only the lights emitted within ±2.5 degrees from a relatively wide measuring area (Ø27).

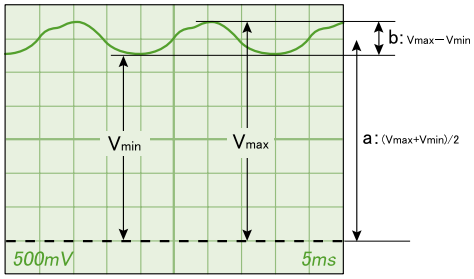


*4

<Principles of Flicker Measurement>

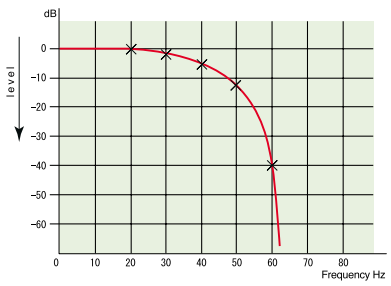
Two kinds of quantifying measurement methods are available: contrast method and JEITA method. With the CA-210 alone, the contrast method is possible. Use of the software supplied with the instrument also allows JEITA method. This section gives an outline of both quantifying measurement methods.

(1) Contrast Method
If the intensity level of the display changes as Fig.1, it is considered that AC component (b) overlaps on the DC component(a).With the contrast method, the ratio of AC component to DC component is defined as the flicker amount.
AC component (a) is defined as Vmax + Vmin and DC component (b) as (Vmax + Vmin)/2, and the flicker amount is calculated by the following formula.
Flicker amount = AC component / DC component
= (Vmax – Vmin)/{(Vmax + Vmin)/2} x 100 [%]

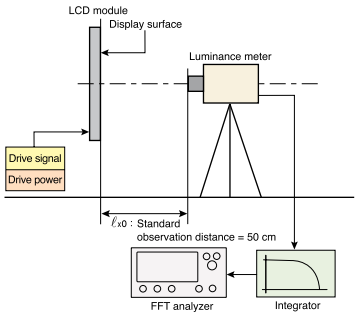


(Fig. 1)

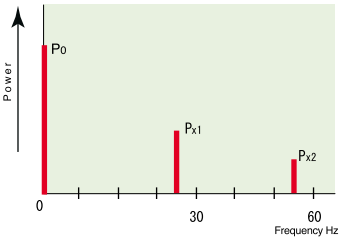
(2)JEITA Method
With the JEITA method, the amount of flicker does not depend on its frequency, and is calculated based on the AC and DC components of the measured luminance.
However, human sensitivity to flickering starts to drop gradually at about 30 Hz, and when the frequency exceeds 60 Hz, it is no longer possible for humans to sense it.
From this, it is possible that even if a flicker of a large amplitude and frequency of 60 Hz or higher exists the human eye cannot recognize it as a flicker.
Thus, with the JEITA method of flicker measurement, it is very important to know the exact amplitude and frequency of flicker energy, in addition to the AC /DC component ratio, that is defined by the contrast method.
With the JEITA method, the measuring devices shown below are required for measurement.
Fig. 3 shows that the output signal (Fig. 1) from the luminance meter (used to measure the LCD) is guided to the integrator.
To reconstruct what is seen by the human eye, the integrator sends the signal through a filter that decreases the sensitivity because of frequency difference, and then outputs it to the FFT analyzer.
The signal is processed by the FFT analyzer (Fast Fourier Transform Analyzer), and is displayed in a form of energy distribution of frequency components (Fig. 4).
As shown in Fig. 4, when two or more frequency components (P0, Px1, Px2) exist, the maximum value among all the frequency components (Px1, Px2 in the case of Fig. 4) except for P0, that is the component of frequency 0, will be set as Px. With the JEITA method, the flicker amount in this example is calculated by the following formula.
Flicker amount = 10 x log (Px/P0) [dB]



(Fig. 2)

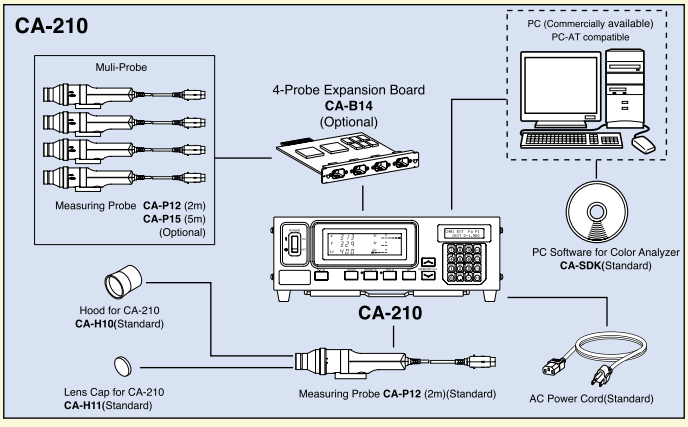


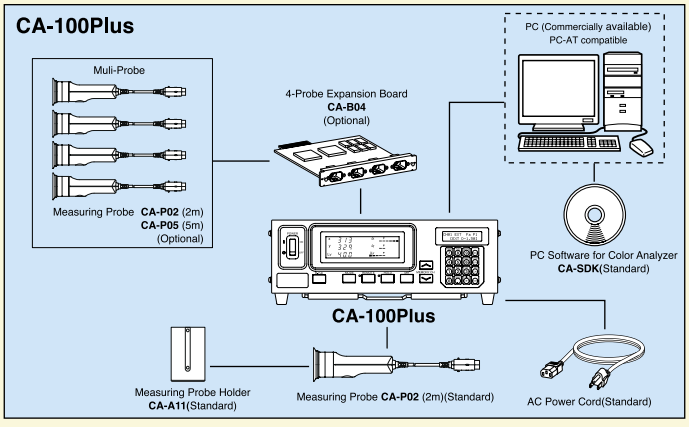
(Fig. 3)



(Fig. 4)

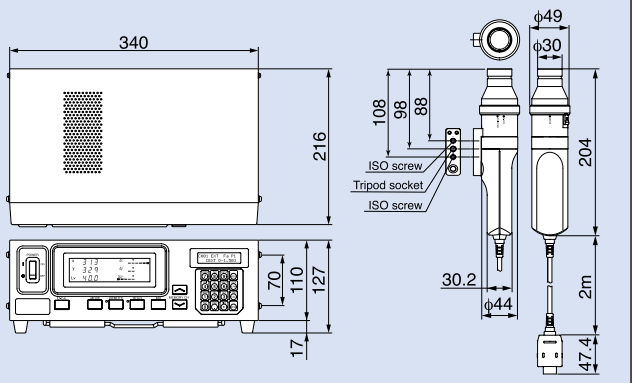
<System Diagram>



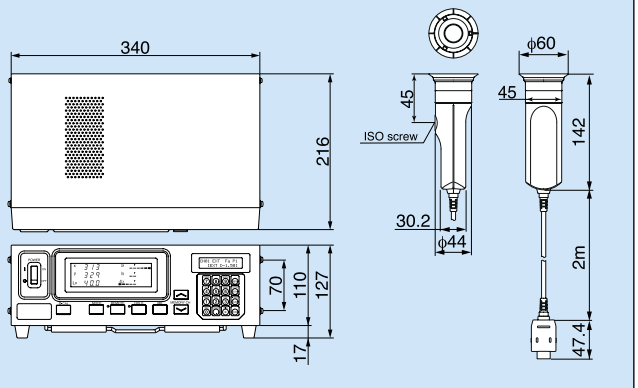


<Dimensions (Units : mm)>

CA-210



CA-100Plus



<Specifications>

		CA-210	CA-100Plus
Receptor		Detector : Silicon photo cell	Detector : Silicon photo cell
Measurement area		ϕ27mm	ϕ21mm
Angle of aperture		±2.5°	- - - - -
Measurement distance		30±10mm	- - - - -
Display range	Luminance	0.01 to 999.9cd/m²	0.01 to 999.9cd/m²
	Chromaticity	Displayed in 4 or 3-digit value (Can be chosen)	Display in 4 or 3-digit value (Can be chosen)
Luminance	Measurement range	0.10 to 999.9cd/m²	0.05 to 999.9cd/m²
	Accuracy	±2%±1digit (Calibration LCD 6500K,9300K) *1	±2%±1digit (Calibration CRT 6500K(D_{65})) *1
	Repeatability	0.10 to 0.99cd/m² 0.2%+1digit (2σ) 1.00 to 999.9cd/m² 0.1%+1digit (2σ) (6500K,9300K)	0.2%+1digit (2σ) (6500K (D_{65}))
Chromaticity	Measurement range	0.10 to 999.9cd/m²	0.05 to 999.9cd/m²
	Accuracy	0.10 to 4.99cd/m² ±0.005 (for white) 5.00 to 19.99cd/m² ±0.004 (for white) 20.00 to 999.9cd/m² ±0.003 (for white) 160cd/m² ±0.002 (for white), ±0.004 (for monochrome) (Calibration LCD 6500K,9300K)	0.05 to 0.19cd/m² ±0.006 (for white) 0.20 to 0.49cd/m² ±0.004 (for white) 0.50 to 999.9cd/m² ±0.003 (for white) 40cd/m² ±0.002 (for white), ±0.004 (for monochrome) (Calibration CRT 6500K (D_{65}))
	Repeatability	0.10 to 0.19cd/m² 0.010 (2σ) 0.20 to 0.49cd/m² 0.005 (2σ) 0.50 to 0.99cd/m² 0.002 (2σ) 1.00 to 999.9cd/m² 0.001 (2σ) (6500K,9300K)	0.05 to 0.19cd/m² 0.006 (2σ) 0.20 to 0.49cd/m² 0.002 (2σ) 0.50 to 999.9cd/m² 0.001 (2σ) (6500K (D_{65}))
Flicker Contrast method	Measurement range	5cd/m² or higher	- - - - -
	Display range	0.0 to 100.0%	- - - - -
	Accuracy	±1% (30Hz AC/DC 10% sine wave) ±2% (60Hz AC/DC 10% sine wave)	- - - - -
	Repeatability	±1% (2σ) (AC/DC 10% sine wave)	- - - - -
Flicker JEITA method*4	Measurement range	5cd/m² or higher	- - - - -
	Accuracy	±0.5 (30Hz AC/DC 10% sine wave)	- - - - -
	Repeatability	0.3 (2σ) (30Hz)	- - - - -
Measurement speed (Single-point probe, Use USB (RS-232C*2))	xyLv	0.10 to 1.99cd/m² 5 measurements/sec. (4.5 measurements / sec.) 2cd/m² or higher 20 measurements/sec. (17 measurements / sec.)	0.05 to 0.99cd/m² 5 measurements/sec. (4.5 measurements / sec.)*5 1cd/m² or higher 20 measurements/sec. (17 measurements / sec.)*5
	Flicker Contrast	16 measurements/sec. (16 measurements / sec.)	- - - - -
	Flicker JEITA *4	0.5 measurements/sec. (0.3 measurements / sec.) *3	- - - - -
Display	Digital	xyLv, TΔuvLv, RGB analyze, XYZ, u'v'Lv Flicker (Contrast method)	xyLv, TΔuvLv, RGB analyze, XYZ, u'v'Lv
	Analog	Δx,ΔyΔLv, R/G, B/G, ΔG, ΔR, B/R, G/R, Flicker (Contrast method)	Δx,ΔyΔLv, R/G, B/G, ΔG, ΔR, B/R, G/R
SYNC mode		NTSC, PAL, EXT, UNIV, INT	NTSC, PAL, EXT, UNIV, INT
Object under measurement		Vertical syncronizing frequency : 40 to 200Hz (Flicker : 40 to 130Hz)	Vertical syncronizing frequency : 40 to 200Hz
Memory channel		100 channels	100 channels
Analyzer function		Standard function	Standard function
Interface		USB (1.1 conformity) , RS-232C (38,400bps or below)	USB (1.1 conformity) , RS-232C (38,400bps or below)
Multi-point expansion		Max. 5 points (with 4-Probe Expansion Board CA-B14)	Max. 5 points (with 4-Probe Expansion Board CA-B04)
Operating environment conditions		Temperature : 0 to 40°C (32 to 104°F) ; relative humidity 85% or less (at 35°C / 95°F) with no condensation, Installation category : II, Pollution degree : 2	Temperature : 0 to 40°C (32 to 104°F) ; relative humidity 85% or less (at 35°C / 95°F) with no condensation, Installation category : II, Pollution degree : 2
Storage temperature range		-20 to 55°C (-4 to 131°F) ; relative humidity 85% or less (at 35°C / 95°F) with no condensation	-20 to 55°C (-4 to 131°F) ; relative humidity 85% or less (at 35°C / 95°F) with no condensation
Input voltage range		100 to 240V~, 50/60Hz 50VA	100 to 240V~, 50/60Hz 50VA
Size	Main body, Probe	340 (W) × 127 (H) × 216 (D), ϕ49 × 204	340 (W) × 127 (H) × 216 (D), ϕ45 × 142
Weight	Main body, Probe	3.58kg, 520g	3.58kg, 285g

*1 Based on Minolta Standard LCD or CRT *2 Baud rate : 38,400bps *3 Measured by Minolta's PC (PIII-600MHz)
*4 Measurement of flicker (JEITA method) is supported by SDK software *5 At the CA-200 mode

● Specifications are subject to change without notice.

SAFETY PRECAUTIONS

To ensure correct use of the instrument, please adhere to the following.

- Before using the instrument, be sure to read the instruction manual.
- Always use the specified power. Use of inappropriate power may result in afire or electric shock.

ISO 9001 CERTIFIED

Toyokawa Administrative Center (Aichi Pref., Japan) of Minolta Co., Ltd. was approved by the British certification organization Lloyd's Register Quality Assurance for certification under the ISO 9001:1994 international quality assurance standards on March 3, 1995. Since the Center's establishment in 1990, Instrument Systems Company in Toyokawa Administrative Center has carried out the development and production of precision instruments for the measurement of color, light, and temperature. The ISO 9001:1994 certification was awarded to the Instrument Systems Company quality control system, including the design, development, production, calibration, and servicing of the measuring instruments described above.

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