3298F
Multimedia Display Tester
USER'S MANUAL

YOKOGAWA
Yokogawa Electric Corporation

IM 329802-01E
1st Edition
L4036AF

Foreward

Thank you for purchasing the 3298F Multimedia Display Tester.
This user's manual contains useful information about the functions, operating procedures, and handling precautions of the 3298F. To ensure correct use, please read this manual thoroughly before beginning operation.
After reading the manual, keep it in a convenient location for quick reference whenever a question arises during operation.

Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions. The figures given in this manual may differ from the actual screen.
- 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 nearest YOKOGAWA dealer.
- Copying or reproducing all or any part of the contents of this manual without the permission of Yokogawa Electric Corporation is strictly prohibited.

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Revisions

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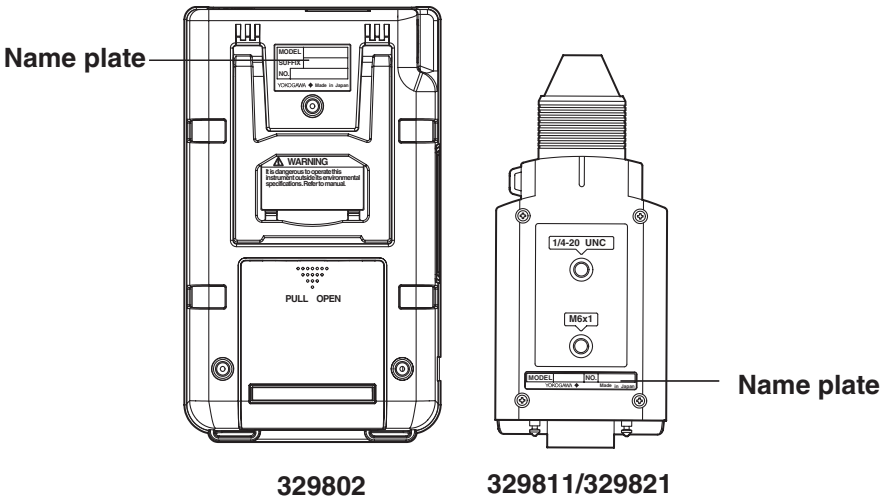
1st Edition : December 2003 (YK)

Checking the Contents of the Package

Unpack the box and check the contents before operating the 3298F. If some of the contents are incorrect, missing, or if there is physical damage, contact the dealer from which you purchased them.

3298F Main Unit and Sensor

Check that the model name and suffix code given on the name plate on the rear panel of the main unit and sensor match those on the order.



MODEL and SUFFIX Codes

Model	SUFFIX	Description
329802		Main unit with extension cable (1.5 m), AC adapter sold separately
	-J	Japanese display
	-E	English display
329811		Black and white sensor (sold separately)
329821		Color sensor (sold separately)

NO. (Instrument Number)

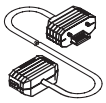
When contacting the dealer from which you purchased the 3298F, please give them the instrument number.

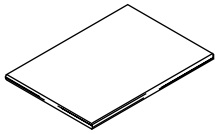
Standard Accessories

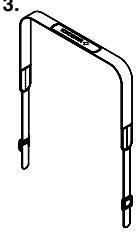
3298F Main Unit

The standard accessories below are supplied with the 3298F.

	Name	Model	Quantity	Note
1.	Extension cable	B8300LA	1	1.5 m
2.	User's manual	IM329802-01E (L4036AF)	1	This manual
3.	Strap		1	For the main unit
4.	AA batteries		4	Alkaline batteries

1. 

2. 

3. 

4. 

Sensor

The luminance sensor (329811) or the color sensor (329821) comes with the following accessories.

Name	Model	Quantity	Note
Rubber bumper	B8300LH	1	

Optional Accessories (Sold Separately)

The optional accessories below are available for purchase separately. For information and ordering, contact your nearest YOKOGAWA dealer.

Name	Model	Quantity	Description
AC adapter	A1020UP	1	For 100 VAC
AC adapter	A1022UP	1	For 120 VAC
AC adapter	B9108WB	1	For 220 to 240 VAC
Sensor cable	B8300LA	1	length: 1.5 m
Sensor cable	B8300LB	1	length: 3.0 m
Sensor cable	B8300LG	1	length: 5.0 m
RS-232 cable	B8300LC	1	D-Sub 9 pin on the PC side
RS-232 cable	B8300LD	1	D-Sub 25 pin on the PC side
Carrying case	329891	1	storage case
Recorder output plug	B8300LJ	1	Four plugs in a set
Rubber bumper	B8300LH	1	

Note

We recommend you keep the packing box. The box is useful when you need to transport the 3298F.

Safety Precautions

The general safety precautions described herein must be observed during all phases of operation. If the 3298F is used in a manner not specified in this manual, the protection provided by the 3298F may be impaired. Yokogawa Electric Corporation assumes no liability for the customer's failure to comply with these requirements.

The following symbols are used on the 3298F.

⚠ Handle with care. (To avoid injury, death of personnel, or damage to the 3298F, the operator must refer to the explanation in the user's manual or service manual.)

Make sure to comply with the precautions below. Not complying might result in injury or death.

⚠

WARNING

- **Use the proper power supply**
  Use the specified batteries or dedicated AC adapter.
- **Do not operate near flammable substances**
  Do not operate the 3298F in the presence of flammable liquids or vapors. Operation in such environments is very dangerous.
- **Do not remove covers**
  The cover should be removed by YOKOGAWA's qualified personnel only.
- **Ensure proper external connection**
  Do not short or apply voltage to the monitor output terminal or the DC luminance output terminal.
  Do not apply voltage that exceeds the allowable voltage to the GO/NOGO output terminal.

Structure of This Manual

This user's manual consists of the following sections.

Chapter 1 Explanation of Functions
Describes the system configuration and function configuration of the 3298F. Also describes the measurement principles. Operating procedures are not given in this chapter. However, reading this chapter will help you understand the operating procedures given in the chapters that follow.

Chapter 2 Names and Uses of Parts
Describes the names and uses of each part of the 3298F.

Chapter 3 Measurement Preparation and Common Operations
Describes preparations that are taken before making measurements such as handling precautions, how to install the 3298F, how to connect to the power supply, how to handle the batteries, how to turn ON/OFF the power switch, the procedure for entering numeric values, and other operations.

Chapter 4 Measurement Conditions and 3298F Setup
Describes parameters that should be specified before starting measurements such as the luminance, reference value, calibration coefficient, white balance, light source calibration coefficient, trigger mode, and 3298F settings. Describes how to set the measurement conditions.

Chapter 5 Measurement
Describes how to measure the luminance, contrast, flicker, and chromaticity.

Chapter 6 Serial (RS-232) Communications Function
Describes the communications function with a PC using the RS-232 interface.

Chapter 7 Specifications
Summarizes the main specifications of the 3298F main unit and the sensor in a table.

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Symbols Used in This Manual

Notes

The following symbols are used in this manual.

A symbol affixed to the 3298F. Indicates danger to personnel or the 3298F and the operator must refer to the user's manual. The symbol also appears in the user's manual to mark the corresponding page.

WARNING Describes precautions that should be observed to prevent injury or death to the user.

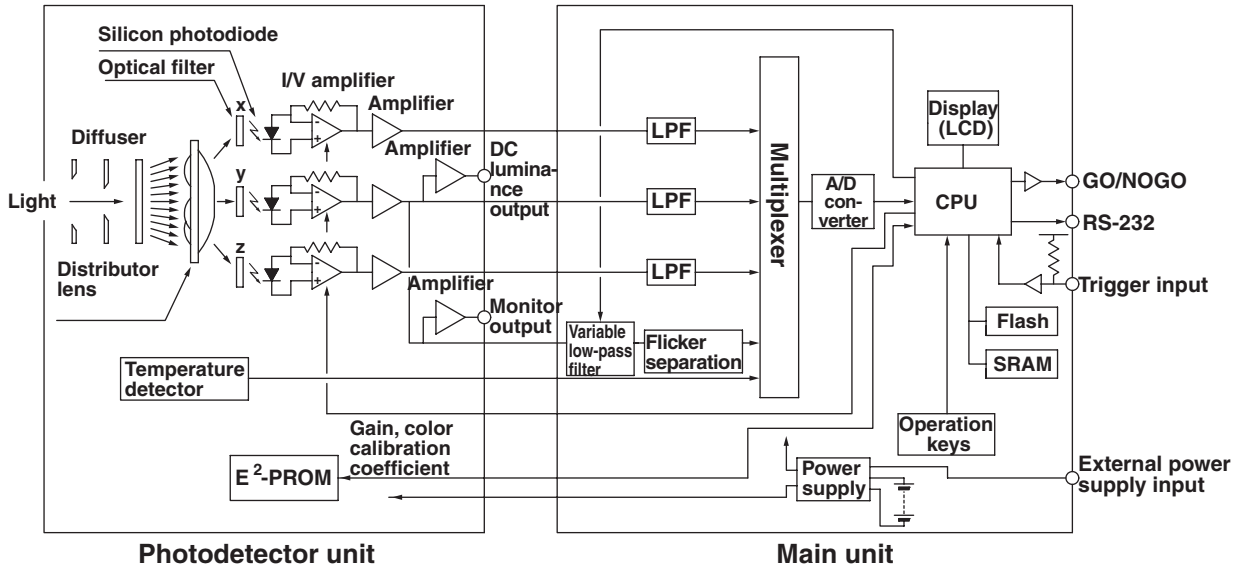
CAUTION Describes precautions that should be observed to prevent minor or moderate injury, or damage to the 3298F.

Note Provides important information for the proper operation of the 3298F.

Contents

1.1 Block Diagram and Functions

Block Diagram



The light incidence block of the 3298F employs a shading cylinder system that requires no focusing. It enables you to easily perform highly precise measurements regardless of whether the object is in contact.

The shading cylinder receives light emitted from a given solid angle and irradiates the transparent diffusing plate in the measuring instrument. The light that is transmitted through the diffusing plate passes through the distributor lens and optical filter and enters the silicon photodiode. The overall spectral responsivity of photoelectric sensors x, y, and z are designed to match color matching functions $\overline{x}(\lambda)$, $\overline{y}(\lambda)$, and $\overline{z}(\lambda)$.
The photodiode output is amplified by the high-precision I/V amplifier and connected to the main unit via a connector.
The temperature detector is installed near the photoelectric sensor. The detector corrects the minute sensitivity variation caused by changes in temperature.

Settings such as the calibration coefficients of the photo-detecting devices and the I/V amplifier gain are saved in the E^2-PROM of the light-receiving unit. This configuration allows correct measurements even if different light-receiving and main units are combined.

The main unit contains a multiplexer that switches the signal that is input to the A/D converter. The CPU receives the A/D converter output, performs computation according to the measurement items, and displays the result on the LCD.

Functions

Luminance Measurement
Displays the measured results numerically and in a bar graph.

Contrast Measurement
You can select Auto or Manual for the measurement mode.
- Auto: Performs the measurement twice. The greater of the two measured luminance values is displayed as the measured value for white.
- Manual: Performs a measurement after you specify white or black.

Flicker Measurement
The DC component (average luminance) and AC component (rms flicker value) are separated from the incident light containing the flicker, and their ratio (flicker ratio) is determined. The flicker ratio is displayed in terms of percentage and dB as well as using bar graphs.

Chromaticity Measurement
The tristimulus values are determined from the measured incident light, and the chromaticity is displayed using one of the following color systems.
- Chromaticity coordinates: x, y, L/u', v', L
- Tristimulus values: X, Y, Z/R, G, B/RGB ratio
- Correlated color temperature: Tc, duv, L

- **White balance adjustment**
  The 3298F allows you to set the x and y values of the target color temperature. Therefore, you can easily adjust the white balance by adjusting the level of the target display so that the measured values of R, G, and B are all 100%.
  Chromaticity measurement is not possible using the luminance sensor.

Trigger
The following two measurement triggers are available on the 3298F.
- Repeat: Repeats measurements. The measured value is held when you press the MEAS key. The measurement resumes when you press the MEAS key again.
- Single: Executes the measurement once when you press the MEAS key or when a signal is received from the external trigger input.

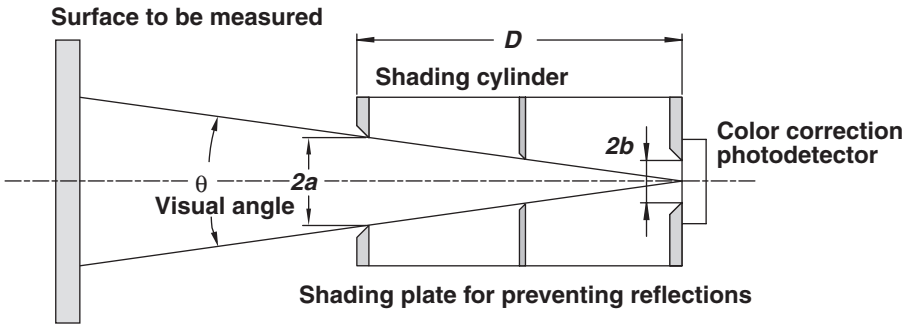
GO/NOGO Determination
In each measurement, a GO/NOGO determination is carried out according to the criteria that are specified beforehand, and the determination result can be displayed on the screen and output externally.

Memory Function
200 panels of data can be saved to the memory for each measurement. You can easily load and display the saved information.
The memory is cleared for each type of measurement.

1.2 Measurement Principles

Luminance Measurement

By setting up a light-shading solid angle by attaching a shading cylinder in front of the light-receiving unit, the average luminance on the surface contained in the solid angle is measured.
A shading cylinder is placed in front of the light-receiving unit of the 3928F. Only the light that enters within angle $\theta\{\cong 2\tan^{-1}(2a/D)\}$ is incident on the photo-detecting surface.



Contrast Measurement

Measures the luminance of the “bright” and “dark” and determines the ratio.

$$\text{Contrast ratio} = \frac{\text{Luminance of bright}}{\text{Luminance of dark}}$$

Flicker Measurement

The DC component (average luminance) and AC component (rms flicker value) are separated from the incident light containing the flicker, and their ratio (flicker ratio) is determined.

Flicker ratio

The ratio of the DC component and AC component that are separated from the incident light is displayed in terms of percentage and dB. The equations for calculating the ratios are given below.
In the equations, A and B are the flicker calibration coefficients. You can convert the ratio into flicker ratio as defined by the VESA Standard or JEITA Standard by setting the flicker calibration coefficients. For details on the flicker calibration coefficients, see section 1.5.

$$\text{Flicker ratio (\%)} = A \times \frac{\text{ACrms}}{\text{DC}} \times 100\ [\%]$$

$$\text{Flicker ratio (dB)} = B \times \log\left(A \times \frac{\text{ACrms}}{\text{DC}}\right)$$

Default value: A=1.0000, B: 10.000

ACrms: Rms value of the AC component of the incident light

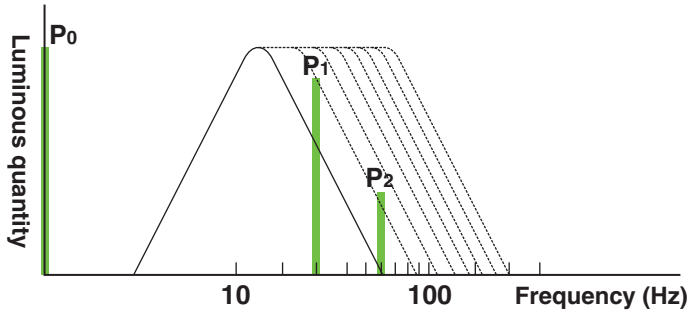
Bandwidth limit

In flicker measurements, you can select the flicker rate (flicker frequency) to limit the frequency bandwidth of the measurement. Below are the flicker frequencies (flicker rates) that can be measured, and the cutoff frequencies of the corresponding programmable low-pass filters.

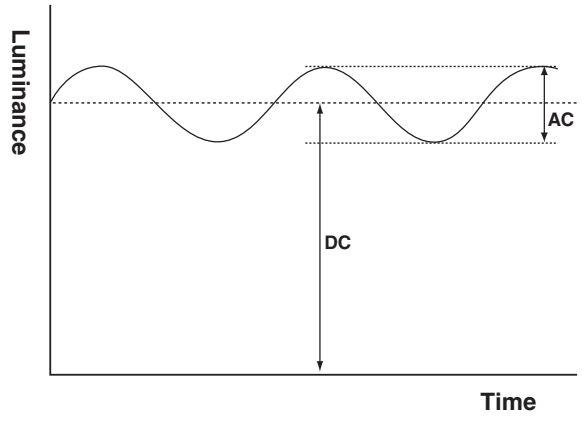
Flicker rate (Hz):	20	30	40	50	60	70	80	90
Cutoff frequency (Hz):	30	45	60	75	90	105	120	135

If the flicker rate is set to 30 Hz, the cutoff frequency is 45 Hz. Thus, high frequency components greater than or equal to P_2 in the figure below are cut. If the flicker rate is changed to 60 Hz, the frequency component at P_2 in the figure is also measured.

- **Incident light during flicker measurements (frequency domain)**



- **Incident light during flicker measurements (time domain)**



Note

VESA Standard and JEITA Standard

- JEITA (former EIAJ): ED-2522 Measuring Methods for Matrix Liquid Crystal Display modules
- VESA (Video Electronics Standards Association)
  Flat Panel Display Measurements Standard

Chromaticity Measurement

The color of light is determined by the correlation between the spectral radiation of the light source and the spectral luminosity of the person watching the light source. Commission Internationale de l'Eclairage (CIE) defines three color matching functions ($\overline{x}$ (λ), $\overline{y}$ (λ), and $\overline{z}$ (λ)) that correspond to the spectral responsivity of the human eye. The output obtained by measuring the light source through these functions is expressed in terms of X, Y, and Z. These values are called tristimulus values.

The 3298F uses photoelectric sensors whose frequency response is equivalent to the color matching functions to measure the incident light and determine the tristimulus values. A photoelectric tristimulus system is employed for measurements. In addition, the measured tristimulus values can be used to display the chromaticity in various coordinate systems. The 3298F is designed so that the overall spectral responsivity corresponds to the color matching functions by using a silicon photodiode, in the sensor (which excels in linearity and stability) and combining it with an optical filter. The current output from the sensor is proportional to the incident-luminous energy. Thus, the tristimulus values are determined by measuring the current. There are two types of color matching functions, 2° color matching functions (CIE 1931) and 10° color matching functions (CIE 1964).

The 3298F adopts the 2° color matching functions.

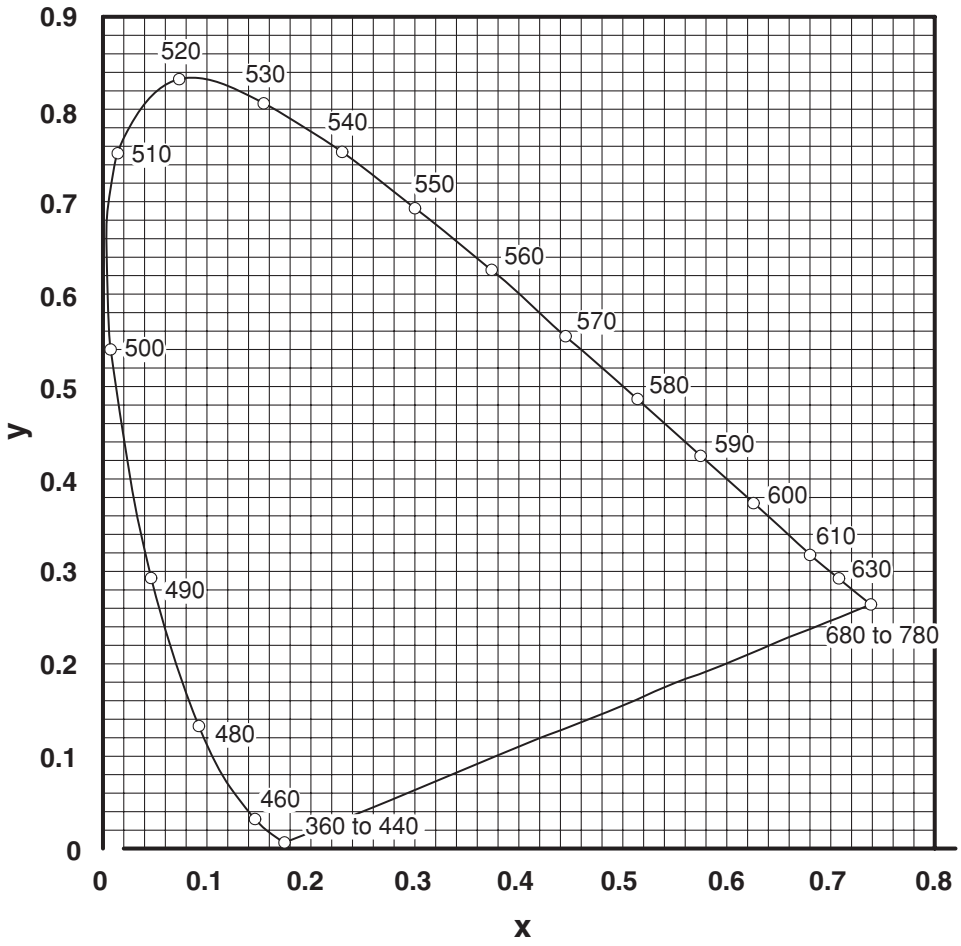
1.3 Calculation Methods of Color Systems

xyL Color System

Determines the x and y values according to the rules of the chromaticity coordinates of the CIE 1931 XYZ color system using the equations below.

$$x = \frac{X}{X+Y+Z}$$

$$y = \frac{Y}{X+Y+Z}$$

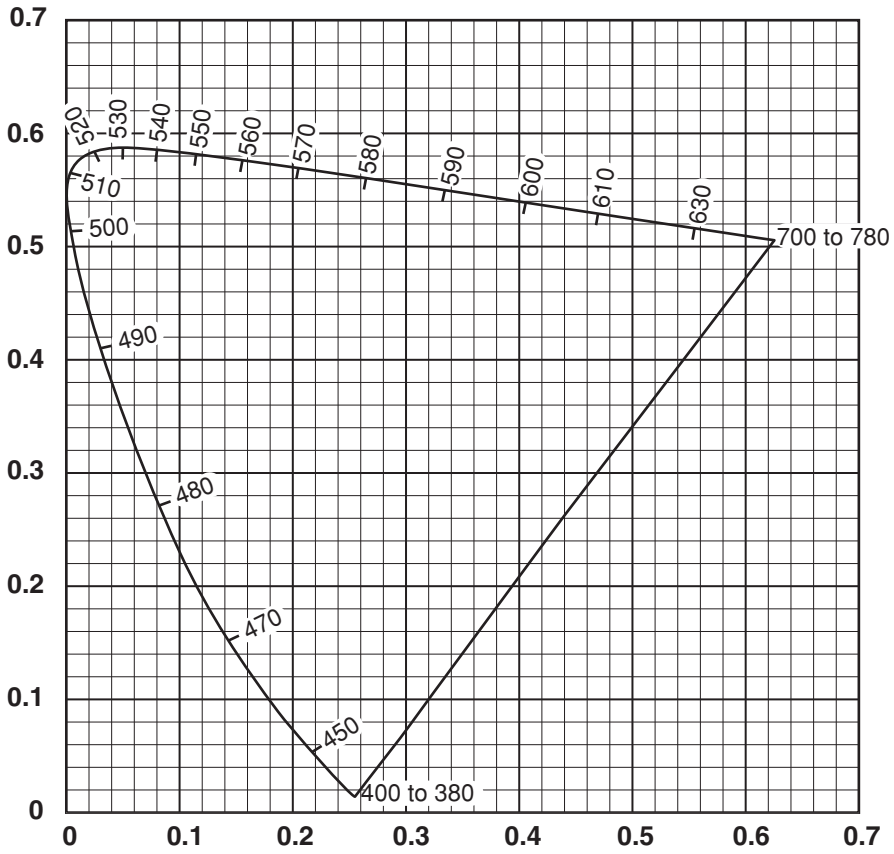


u' v' L Color System

Determines the u' and v' values according to the rules of the CIE 1976 UCS chromaticity coordinates using the equations below.

$$u' = \frac{4X}{X+15Y+3Z}$$

$$v' = \frac{9Y}{X+15Y+3Z}$$



RGB Color System

There are two types of RGB displays available on the 3298F.

- Relative RGB values
- rgb ratio

The values are calculated according to the following procedure.

1. Set the target color temperatures x and y and the target luminance Ls. Target RGB values (Rs, Gs, Bs) are calculated from the specified x, y, and Ls values.

$$Xs = \frac{x}{y} \times Ls$$

$$Ys = Ls$$

$$Zs = \frac{1-x-y}{y} \times Ls$$

$$\begin{bmatrix} Rs \\ Gs \\ Bs \end{bmatrix} = \underbrace{\begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix}}_{\text{Coefficients for converting tristimulus values XYZ into RGB}} \begin{bmatrix} Xs \\ Ys \\ Zs \end{bmatrix}$$

2. Tristimulus values Xm, Ym, and Zm are measured, and measured RGB values (Rm, Gm, Bm) are calculated.

$$\begin{bmatrix} Rm \\ Gm \\ Bm \end{bmatrix} = \begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix} \begin{bmatrix} Xm \\ Ym \\ Zm \end{bmatrix}$$

3. The relative RGB values (R, G, B) are calculated from the target RGB values (Rs, Gs, Bs) and measured RGB values (Rm, Gm, Bm).

$R = Rm/Rs \times 100$ (%)
$G = Gm/Gs \times 100$ (%)
$B = Bm/Bs \times 100$ (%)

4. One of the R, G, B colors are made the reference color (100%), and the ratios of the relative RGB values r, g, b are calculated (r, g, b ratio display mode).
The equations below are for the case when the reference color is set to G.

$r = R/G \times 100$ (%)
$g = G/G \times 100$ (%)
$b = B/G \times 100$ (%)

5. The ratio of the measured luminance Lm with respect to the target luminance Ls is calculated and displayed as a percentage.
$Lm = Ym$
$L = Lm/Ls \times 100$ (%)

Target Chromaticity x, y

The 3298F comes equipped with the target chromaticity values below. The target chromaticity values can also be defined by the user.

Color Temperature	Target Chromaticity	
	x	y
6504 K (D65 light source)	0.3127	0.3292
6774 K (C light source)	0.3101	0.3161
9304 K	0.2848	0.2934

A List of Coefficients

The 3298F provides RGB conversion coefficients for three broadcast systems below. Up to two sets of coefficients for other broadcast systems can also be defined by the user.

NTSC System		
a1 = 1.9106	b1 = –0.5326	c1 = –0.2883
a2 = –0.9843	b2 = 1.9984	c2 = 0.0283
a3 = 0.0584	b3 = –0.1185	c3 = 0.8985

PAL System		
a1 = 3.063	b1 = –1.393	c1 = –0.476
a2 = –0.969	b2 = 1.876	c2 = 0.042
a3 = 0.068	b3 = –0.229	c3 = 1.069

HDTV System		
a1 = 3.2479	b1 = –1.5428	c1 = –0.5014
a2 = –0.9733	b2 = 1.8788	c2 = 0.0430
a3 = 0.0569	b3 = –0.20427	c3 = 1.05616

Correlated Color Temperature and Error

The values are derived according to JIS Z 8725 “Methods for Determining Distribution Temperature and Color Temperature or Correlated Color Temperature of Light Sources.”

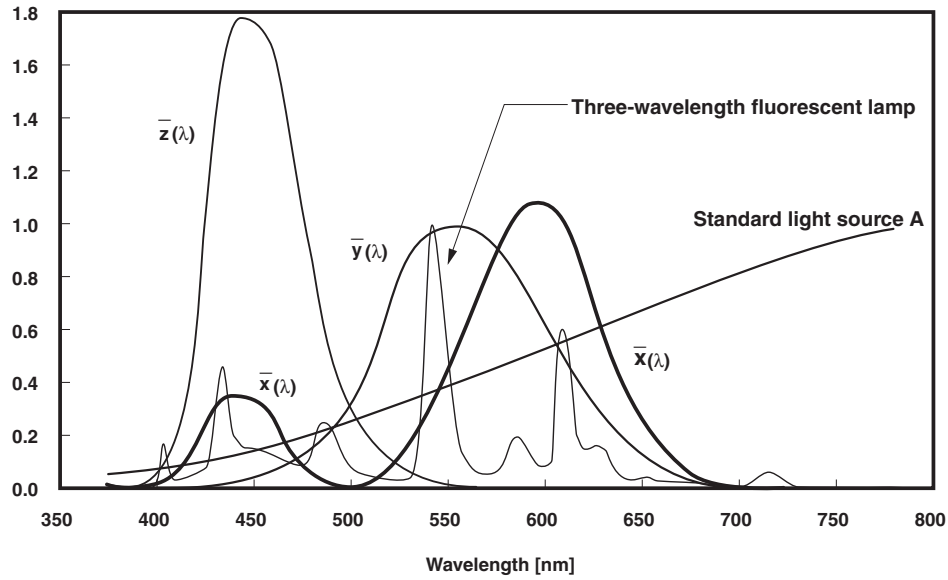
1.4 Light Source Calibration Coefficient

The 3298F has the following light source calibration coefficients.

- type-A: Type-A standard light source
- FL3: Three-wavelength fluorescent lamp
- CRT: CRT

Select the appropriate light source correlation coefficient according to the measured light source. For example, specify the light source calibration coefficient of Standard light source A for a tail lamp of a car that consists of a light bulb covered by a colored glass. Specify the light source calibration coefficient of three-wavelength fluorescent lamp for an LCD that uses a three-wavelength fluorescent lamp for its backlight.

The following figure is an example consisting of (1) the CIE color matching functions ($\bar{x}$ (λ), $\bar{y}$ (λ), $\bar{z}$ (λ)), (2) the spectral luminance of standard light source A, and (3) the distribution diagram of the relative spectral luminance of the three-wavelength fluorescent lamp.



In the case of a photoelectric tristimulus colorimeter, the spectral luminance of the measured light source is measured using a spectral responsivity of sensors that are analogous to the color matching functions. This means that the sum of the products of the spectral luminance and the spectral responsivity at each wavelength over all wavelengths is equal to the stimulus value of the sensor.
This is given by the following equations.

$$\begin{cases} X = k\sum_{380}^{780} S_t(\lambda)\bar{x}(\lambda)\Delta\lambda \\ Y = k\sum_{380}^{780} S_t(\lambda)\bar{y}(\lambda)\Delta\lambda \\ Z = k\sum_{380}^{780} S_t(\lambda)\bar{z}(\lambda)\Delta\lambda \end{cases}$$

where $S_t(\lambda)$ is the spectral luminance distribution of the light source, $\Delta\lambda$ is the wavelength interval, and k is the coefficient used to match the value to the photometric value.
With actual sensors, implementing the spectral response of $\bar{x}(\lambda)$ using a single sensor is difficult. Therefore, in some cases, the spectral response is divided into $\bar{x}_1(\lambda)$ for the short wavelength and $\bar{x}_2(\lambda)$ for the long wavelength. A coefficient is multiplied to $\bar{z}(\lambda)$ to obtain x1 (λ).
When a light source with such composition is measured and the output from the sensors with spectral responsivity equivalent to $\bar{x}_2(\lambda)$, $\bar{y}(\lambda)$, $\bar{z}(\lambda)$ are taken to be Vx2, Vy, and Vz, the tristimulus values are expressed as

$$\begin{cases} X = \alpha Vz + \beta Vx2 \\ Y = \gamma Vy \\ Z = \varepsilon Vz \end{cases}$$

where α, β, γ, and ε are coefficients used when the output of each sensor is summed. In this case, if an error exists between the spectral response of each sensor and the color matching functions, a measurement error results. However, achieving a complete match between the spectral response and color matching function is difficult, and in general, minimal errors cannot be avoided. The 3298F employs a function that minimizes the influence resulting from such errors.

This section describes the method in which the influence resulting from this error is minimized using an LCD as an example. The optical system of an LCD is a complex system consisting of a polarizer. For simplicity, we assume a simple light source that combines three RGB filters in front of the three-wavelength fluorescent lamp used for a backlight. This light source consists of a high line spectrum as indicated in the luminance distribution of a three-wavelength fluorescent lamp on the previous page. This line spectrum greatly affects the chromaticity measurement. However, because the wavelength at which the line spectrum appears is fixed, only the height of the line spectrum changes even when the RGB ratio changes due to the changes in the transmission factor of the optical shutter composed of liquid crystals and a polarizing plate. (The wavelength does not change.) By focusing on this point and suppressing the error between the color matching functions and the spectral response at the wavelength containing the line spectrum, the measurement error can be minimized.
Conventionally, the coefficients (α, β, γ, and ε) that are multiplied to the sensor output were determined so that the error is minimized for either a white light source or Standard light source A. However, on the 3298F, the coefficients that are multiplied to the sensor output are switched according to the measured light source, so that the error is minimized for each light source.

The light source calibration is set using the calibration coefficient configuration screen in system settings. For details on the operation, see section 4.5, “Setting the Light Source Calibration.”

1.5 User-Calibration Coefficients

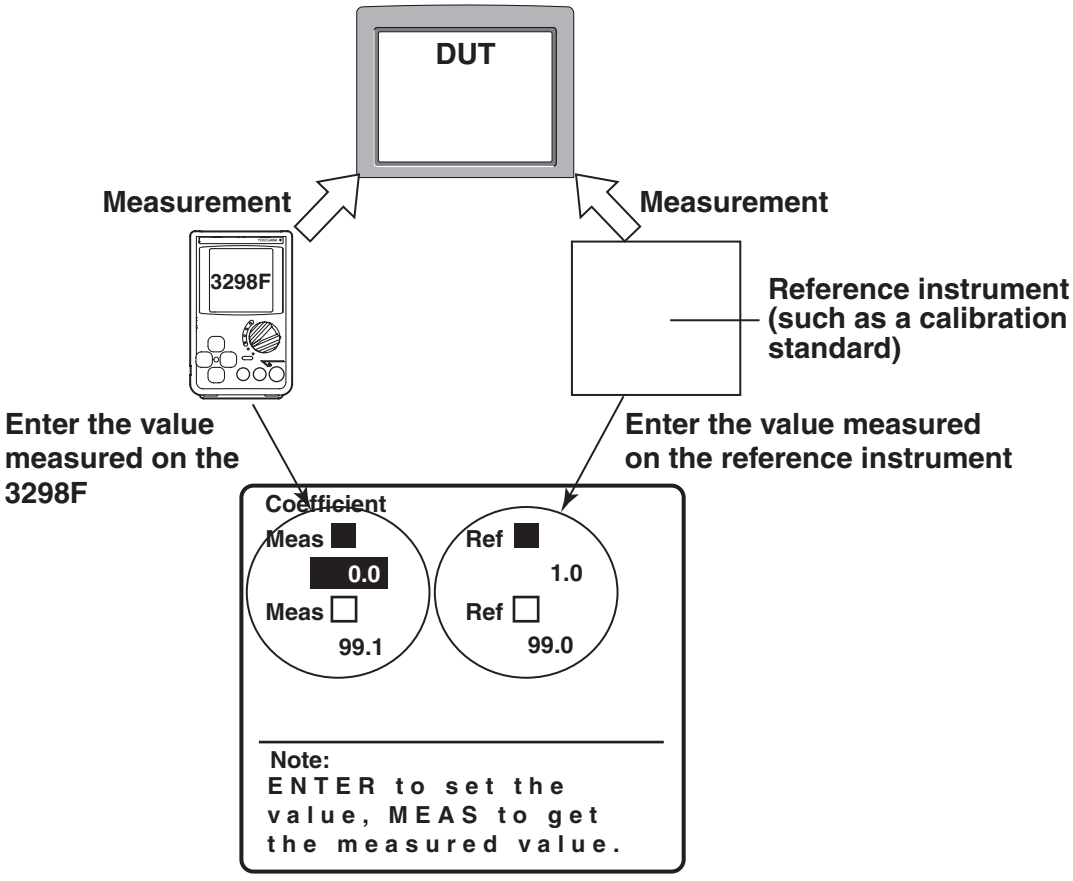
You can set user-calibration factors on the 3298F. By setting the user-calibration factors, you can display the measured values according to the reference values that the user specified.
The type of user-calibration coefficients that can be specified are as follows:

- Luminance calibration coefficient (when using the luminance sensor)
- Flicker calibration coefficient
- Chromaticity calibration coefficient (when using the color sensor)

The user-calibration coefficients are set on the calibration coefficient screen on the SET menu. For details of the operation, see section 4.3, "Setting the Calibration Coefficients." The following two methods are available for setting the user-calibration coefficients.

- Key input
- Measurement input (Luminance calibration coefficient and chromaticity calibration coefficient)

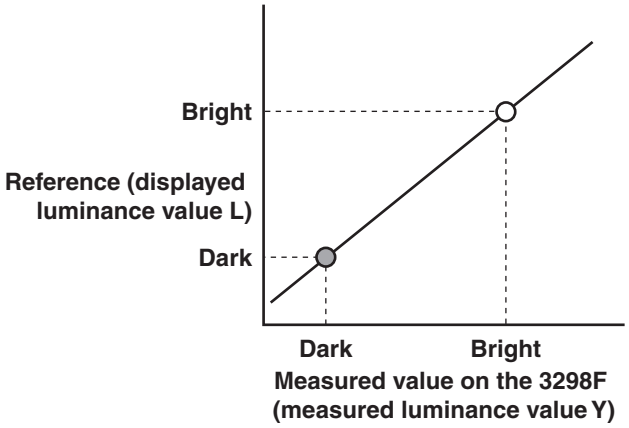
Luminance Calibration Coefficient (when using the luminance sensor)
Set the white and black values measured on the 3298F and the reference instrument as luminance calibration coefficients.



- **Display after calibration**
  When you set the luminance calibration coefficients, constants a and b below are automatically calculated, and the corrected measured value is displayed on the screen.
  Luminance readout L (value after calibration)
  = a × measured luminance Y + b
  Where Y is the measured tristimulus values (X, Y and Z).

$$\mathbf{a} = \frac{\text{Bright reference} - \text{dark reference}}{\text{Measured bright value} - \text{measured dark}}$$

$$\mathbf{b} = \text{bright reference} - \mathbf{a} \times \text{measured bright value}$$



Note

- If you set the luminance calibration coefficient, the coefficient applies to all measured luminance.
- Enter the value measured on a calibration standard or a reference instrument that you specified in Meas of the luminance calibration coefficient. Enter the value measured on the 3298F in Ref.

Flicker Calibration Coefficients

The 3298F determines the flicker ratio as described below. You can arbitrary set constants A and B (calibration coefficients) in the equation. By setting the calibration coefficients, the flicker ratio measured on the 3298F can be matched to the value measured on the standard or converted into values conforming to JEITA Standard, VESA Standard, or other standards.

$$\text{Flicker ratio (\%)} = A \times \frac{ACrms}{DC} \times 100\ [\%]$$

$$\text{Flicker ratio (dB)} = B \times \log\left(A \times \frac{ACrms}{DC}\right)$$

Default value: A = 1.0000, B: 10.000

ACrms: Rms value of the AC component of the incident light

Note

Conversion into the JEITA Standard

- **JEITA Standard (ED-2522)**

  The incident light L(t) from the LCD can be expressed as a sum of the DC (luminance) component and the AC (flicker) component. The AC (flicker) component can be expanded into the fundamental wave of the frame fundamental frequency f and its harmonics.

  $L(t) = DC + P_1\sin 2\pi ft + P_2\sin 4\pi ft + P_3\sin 6\pi ft...$

  The signal obtained by applying a photoelectric conversion on the incident light L(t) is analyzed using an FFT analyzer. The flicker value is defined as the value obtained from the DC component P_0 and the frequency components other than the DC component P_X using the following equation.

  $$\text{Flicker ratio} = 10 \bullet \log \frac{P_X}{P_0}\ [\text{dB}]$$

- **Setting calibration coefficients**

  $$\text{Flicker ratio as defined by the JEITA Standard} = 10 \bullet \log \frac{P_X}{P_0}$$

  $$= 10 \bullet \log \bullet A \frac{ACrms}{DC}\ [\text{dB}]$$

  Here, P_0 is equal to DC. If the P_X components of incident light L(t) can be approximated using a sine wave of the fundamental frequency f, we can set $A = \sqrt{2}$ and B = 10 to obtain ($P_1 = \sqrt{2} \times$ ACrms), allowing a conversion into a value conforming to the JEITA Standard.

Conversion into the VESA Standard

- **VESA Standard**

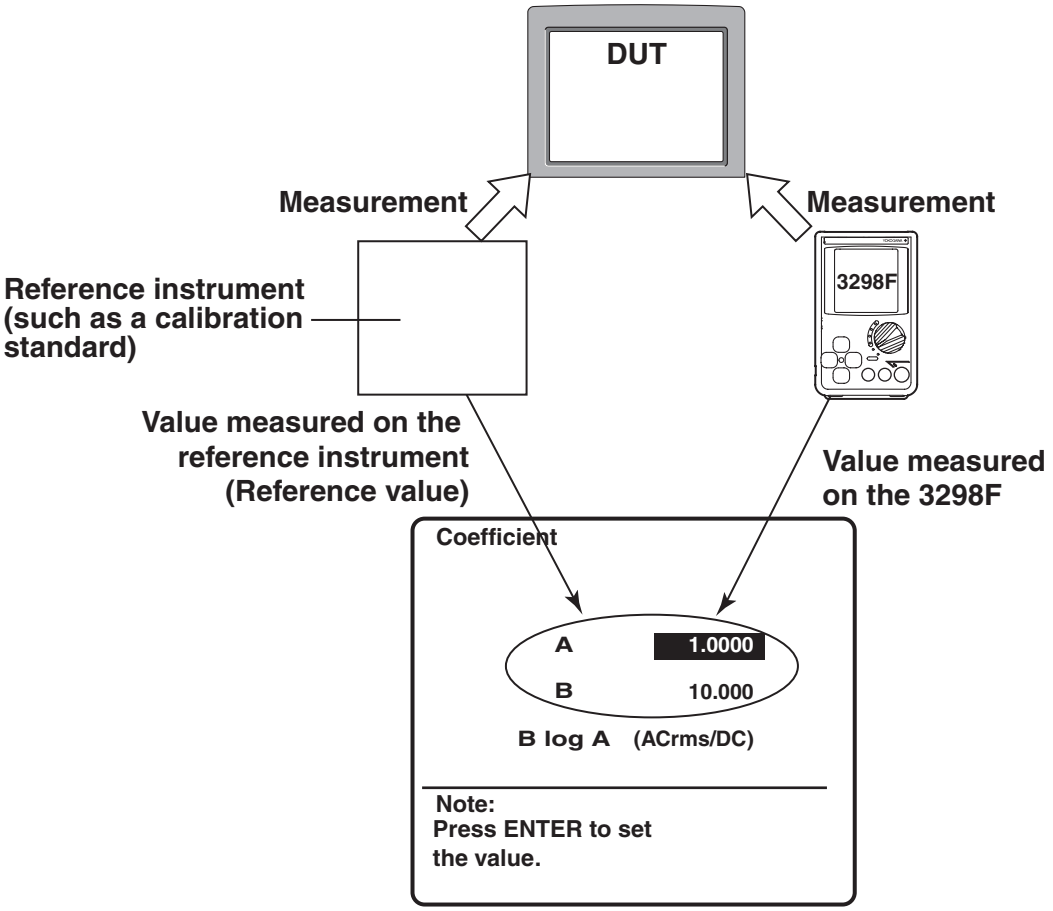
  The signal obtained by applying a photoelectric conversion on the incident light L(t) is applied to an oscilloscope, and the flicker amplitude and average luminance are measured. The flicker ratio is defined as the value obtained using the following equation.

  $$\text{Flicker ratio} = \frac{\text{flicker amplitude}_{\text{p-p}}}{\text{average luminance}} \times 100[\%]$$

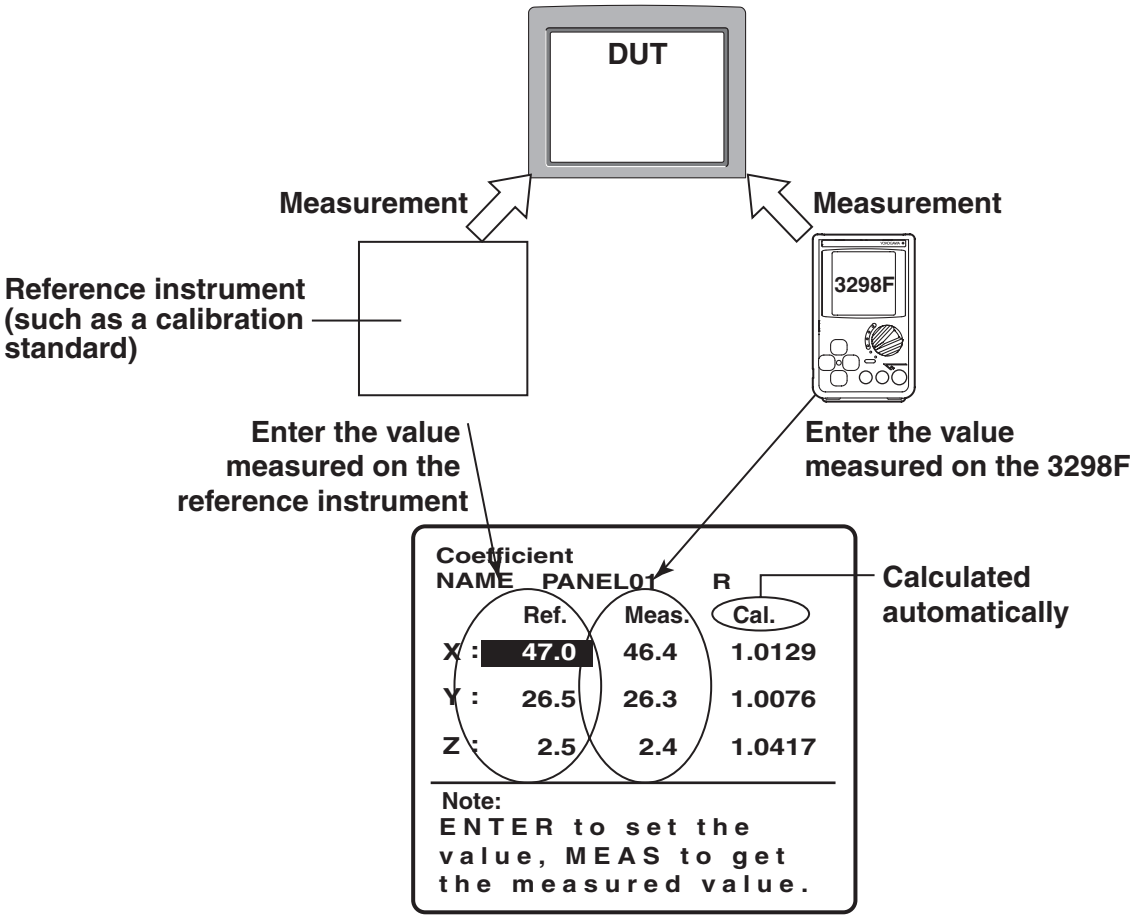
- **Setting calibration coefficients**

  $$\text{Flicker ratio as defined by the VESA Standard} = \frac{\text{flicker amplitude}_{\text{p-p}}}{\text{average luminance}} \times 100[\%] = A \times \frac{ACrms}{DC}$$

  Here, the average luminance is equal to DC. If the flicker amplitude can be approximated by a sine wave of the fundamental frequency f, we can set A = 2 to obtain (flicker amplitude $_{\text{p-p}} = \sqrt{2} \times$ ACrms), allowing a conversion into a value conforming to the VESA Standard.


DUT
Measurement
Measurement
Reference instrument
(such as a calibration
standard)
3298F
Value measured on the
reference instrument
(Reference value)
Value measured
on the 3298F
Coefficient
A
1.0000
B
10.000
B log A (ACrms/DC)
Note:
Press ENTER to set
the value.

Color Calibration Coefficients (When Using the Color Sensor)
The 3298F displays values that are calibrated using the calibration coefficients (reference value/measured value) calculated from the tristimulus values (X, Y, and Z) measured on the 3298F and the standard.



- **Display after calibration**
  When you set the chromaticity calibration coefficient (1 by default), the following calculated result is displayed as a chromaticity value.
  Displayed chromaticity value = Calibration coefficient × measured chromaticity value

1.6 Other Functions

External I/O Function

The following I/O functions are available. For details and handling of each function, see section 3.6. For details on the serial (RS-232) communication, see chapter 6.

- Serial (RS-232) communication
- Trigger (contact) input
- GO/NOGO determination
- Monitor output
- DC luminance output

Turning ON/OFF the Back light

The back light can be turned ON/OFF on the 3298F. For the procedure, see section 4.7.

The backlight operation when using an AC adapter and the operation when using batteries are as follows:

- When using an AC adapter: The backlight is always ON in the ON setting.
- When battery-driven: The backlight is ON for approximately 20 seconds in the ON setting and turns OFF automatically.
  The backlight turns back ON when a key is pressed. The backlight is always OFF in the OFF setting.

Power Down

When the 3298F is battery-driven, the auto power down time can be set to one of the following. For the procedure, see section 4.7.

- OFF, 1 min, 2 min, 5 min, 10 min, and 20 min

Trigger

The 3298F has the following two trigger modes. For the procedure, see section 4.6.

- Repeat: Performs continuous measurements.
  The measured value is held when you press the MEAS key. Continuous measurement is resumed when you press the MEAS key again.
- Single: A single triggered measurement is made in the following cases.
  - When the MEAS key is pressed.
  - Each time a signal is input through the external trigger input terminal.

Average Count

If you set the average count, the average value is calculated and displayed after executing the measurement the specified number of times. You can select the average count from the following:

- None: Does not perform averaging of measured values.
- 2 to 20: Repeats the measurement the specified number of times and displays the average value.

Note

If you set the measurement mode to AUTO in the contrast measurement (section 5.2), the trigger mode is switched to single even if the trigger mode is set to repeat.

Communication Functions

You can remotely control the 3298F using the serial (RS-232) interface.

Initialize

You can set the 3298F settings to factory default.
You can select the settings to be initialized from the items below.

- Setting values
- Reference values
- Calibration coefficients
- All settings

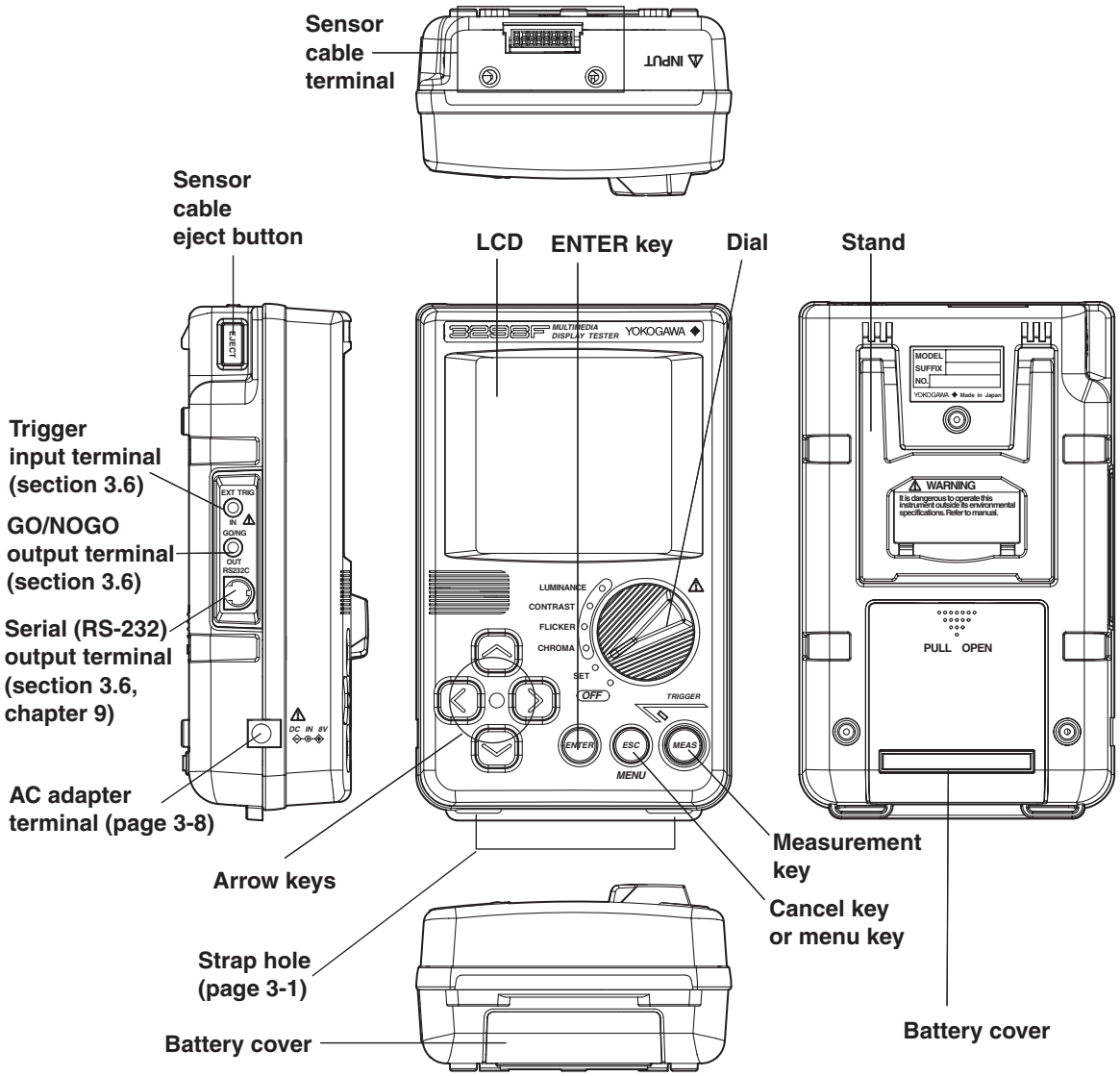
See Appendix 1 for the initialized items and factory default values for each type of initialization.

Version

You can check the ROM version of the 3298F.

2.1 3298F Main Unit

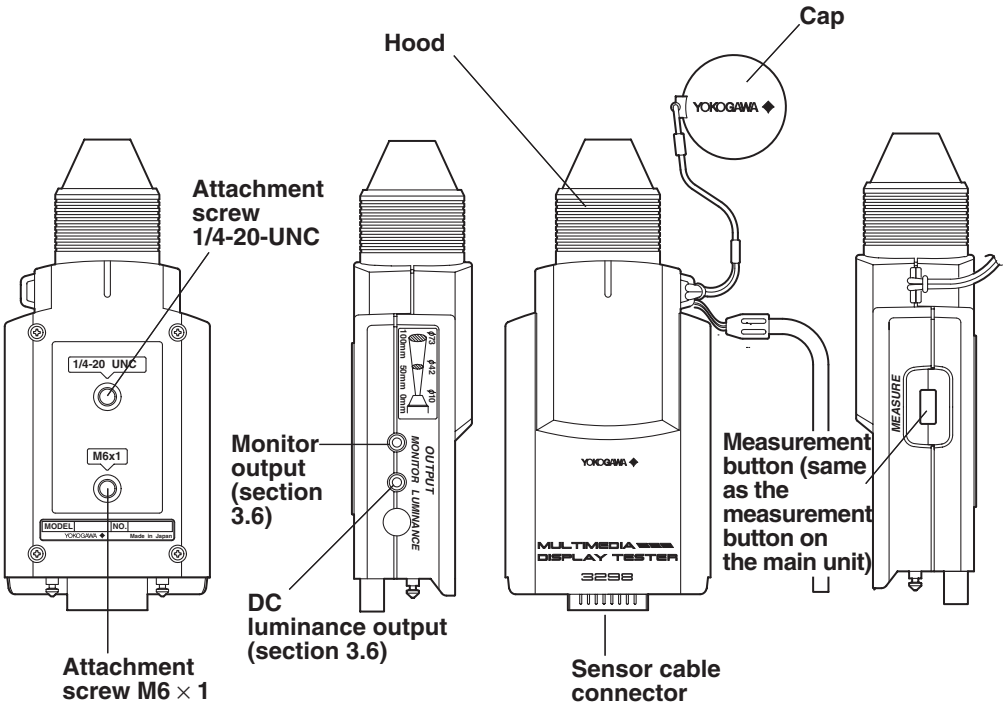
The names and functions of the sections of the 3298F main unit are as follows:



2.2 Sensor and Sensor Cable

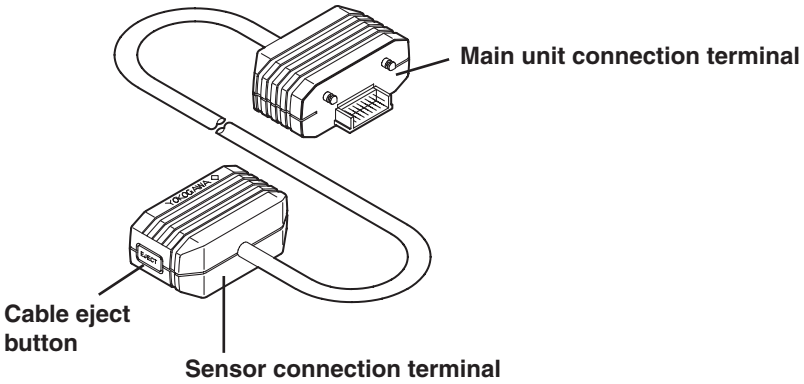
Sensor

There are two types of sensors: for black and white (329811) and for color (329821). Their shape and handling are the same.



Sensor Cable

The same sensor cable is used for the black and white sensor (329811) and the color sensor (329821).



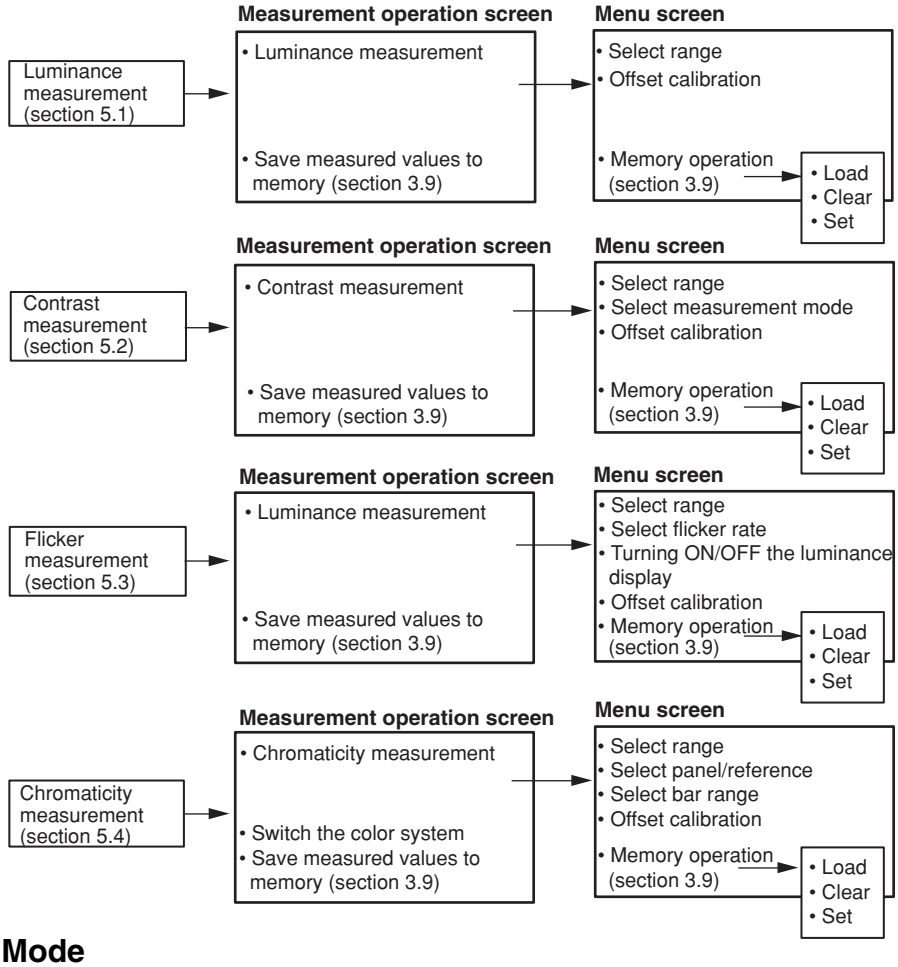
2.3 A List of Operations

The 3298F has two operation modes: measurement operation mode and setup operation mode. The mode is switched using the dial.

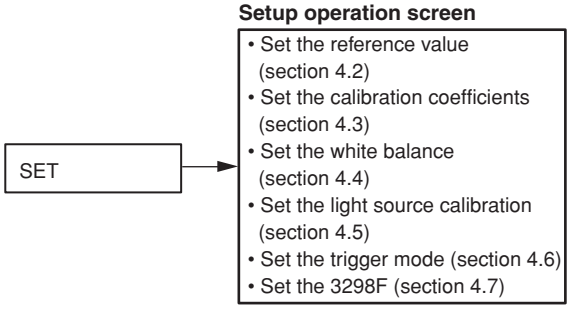
- **Measurement operation mode**
  In addition to making measurements, you can select the range of the measurement item (luminance, contrast, flicker, or chromaticity) that you selected using the dial, execute offset calibration, manage the memory, and perform other operations.
- **Setup operation mode**
  You can set the conditions that are used when measuring the items.

For details on each operation mode, see chapters 4 and 5.

Measurement Operation Mode



Setup Operation Mode



3.1 Before Starting Measurements

Safety Precautions

When using the 3298F for the first time, make sure to read “Safety Precautions” on page iv.

Do not remove the case from the 3298F.
For internal inspection or adjustment, contact your nearest YOKOGAWA dealer.

Do not operate if you detect abnormal behavior.
Stop using the 3298F if there are any symptoms of trouble such as strange odors or smoke coming from the 3298F. If these symptoms occur, immediately turn OFF the power and, if you are using an AC adapter, unplug the AC adapter from the outlet. In addition, turn OFF the power to the device that is connected to the input terminal. In such case, contact your nearest YOKOGAWA dealer.

Use the proper AC adapter.
Use only the AC adapter provided for the 3298F. Do not place objects on top of the AC adapter and keep it away form heat sources. When unplugging the AC adapter from the outlet, never pull by the cord itself. Always hold and pull by the plug. If the cord is damaged, contact your dealer for replacement. Refer to page iii for the part number when placing an order.

General Handling Precautions

Unplug before carrying the 3298F.
First, turn OFF the power to the target display. Then, turn OFF the power switch of the 3298F. If you are using an AC adapter, remove the plug from the outlet. Remove the connected cables. When carrying the 3298F, attach the strap that came with the package to prevent it from being dropped.

Do not bring charged objects near the 3298F.
Do not bring charged objects near the input connector. Doing so could damage the internal circuitry.

Do not let volatile solutions, rubber, or PVC products contact the 3298F.
Do not pour volatile substances on the case or operation panel, or leave them in contact with rubber or PVC products for extended time. The operation panel is made of thermoplastic resin. Make sure heating elements such as soldering bits do not come in contact with the operation panel.

Unplug before wiping off dirt.
When wiping off dirt from the case or operation panel, turn OFF the power switch of the 3298F. If you are using an AC adapter, remove the plug from the outlet. Then, wipe with a dry, soft, clean cloth. Do not use volatile chemicals as this may cause discoloring and deformation.

Unplug when not using the AC adapter for an extended time.
If you are using an AC adapter and plan not to use it for an extended time, remove the AC adapter plug from the outlet.

Handle the batteries correctly.
For information about the handling of batteries, see section 3.3, "Connecting the Power Supply and Turning ON/OFF the Power." Never use the 3298F with the battery cover opened.

Do not stack the 3298F.
The 3298F is not designed to be stacked. Never stack the 3298F as this will cause unstable installation leading to accidents and malfunction.

Do not place objects on top of the 3298F.
Never place any objects containing water on top of the 3298F. Doing so could lead to malfunction.

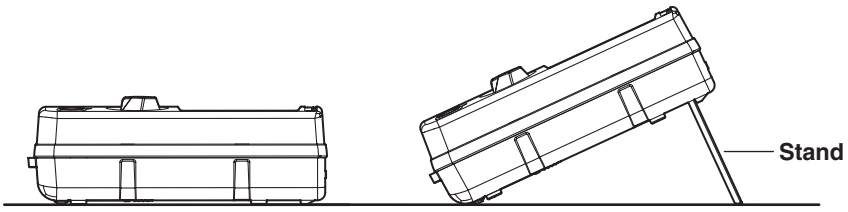
Do not apply shock or vibration.
Do not apply shock or vibration. Doing so could lead to malfunction. In addition, applying shock to the input/output terminal or the connected cable can cause electrical noise to enter or output from the 3298F.

Protect the sensor's optical aperture.
Do not insert sharp objects, foreign objects, or liquids into the sensor's optical aperture. Doing so could lead to malfunction.

3.2 Installation

Installation Location and Installation Procedure

Place the 3298F in a horizontal position or inclined position using the stand as shown in the figure below.



Ambient Temperature and Humidity

Use the 3298F in the following environment:

- Ambient temperature: 5°C to 40°C
  In order to obtain highly accurate measurements, operate the 3298F in the 23±3°C temperature range.
- Ambient humidity: 20% to 80%RH
  No condensation should be present. However, in order to obtain highly accurate measurements, operate the 3298F in the 50±10%RH range.

Note

Condensation may occur if the 3298F is moved to another place where the ambient temperature is higher, or if the temperature changes rapidly. In this case, let the 3298F adjust to the new environment for at least an hour before using it.

Do not install the 3298F in the following places.

- In direct sunlight or near heat sources.
- Where the level of mechanical vibration is high.
- Near noise sources such as high-voltage equipment and power lines.
- Near strong magnetic field sources.
- Where an excessive amount of soot, steam, dust, or corrosive gas is present.
- In an unstable location.
- A place with flammable gas or other substances that can lead to ignition, explosion, etc.

Storage Location

When storing the 3298F, avoid the following locations.

- A place with a relative humidity of 80% or more.
- Where mechanical vibration is high.
- In direct sunlight.
- A place with corrosive gases or flammable gases.
- A hot place with a temperature of 60°C or more.
- A place with a lot of dust, trash, salt, or iron powder.
- Near a high humidity or heat source.
- A place where water, oil, or chemicals may splash.

We strongly recommend you store the 3298F in an environment with a temperature between 5°C and 40°C and a relative humidity between 20% to 80%RH.

3.3 Installing the Sensor

CAUTION

When connecting or disconnecting the sensor cable from the 3298F, be sure to turn OFF the power to the 3298F. Connecting or disconnecting the sensor cable with the power turned ON can damage the 3298F or the sensor.

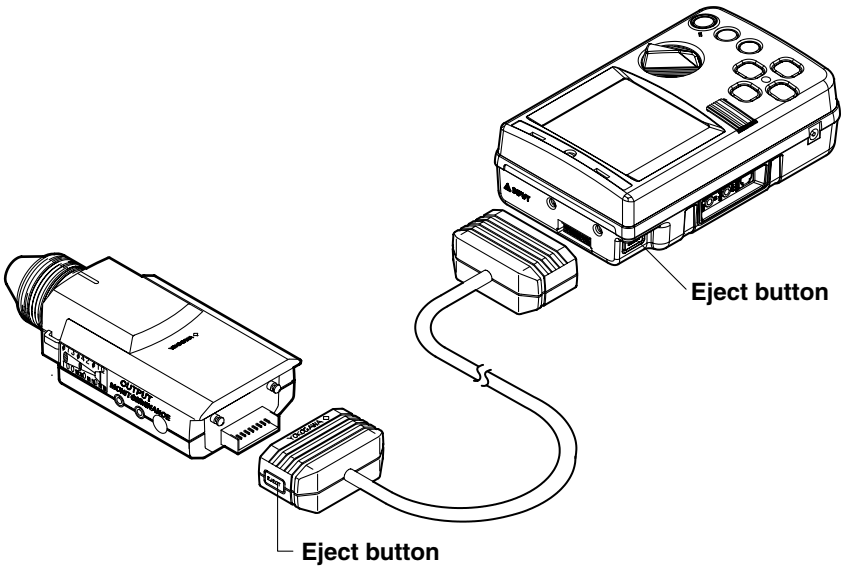
Connecting the Sensor

Connect the 3298F and the sensor (sold separately) using the dedicated cable. Connect the connector with the eject button to the sensor and the other end to the 3298F.

You can press the eject button to remove the cable.

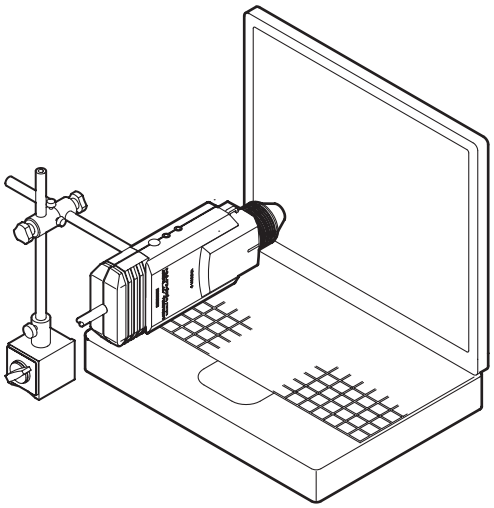
- **Connecting the sensor cable**
  While holding down the eject button, press the connector into the 3298F or the sensor.

- **Removing the sensor cable**
  While holding down the eject button, pull the connector out from the 3298F or the sensor.



Installation against the DUT

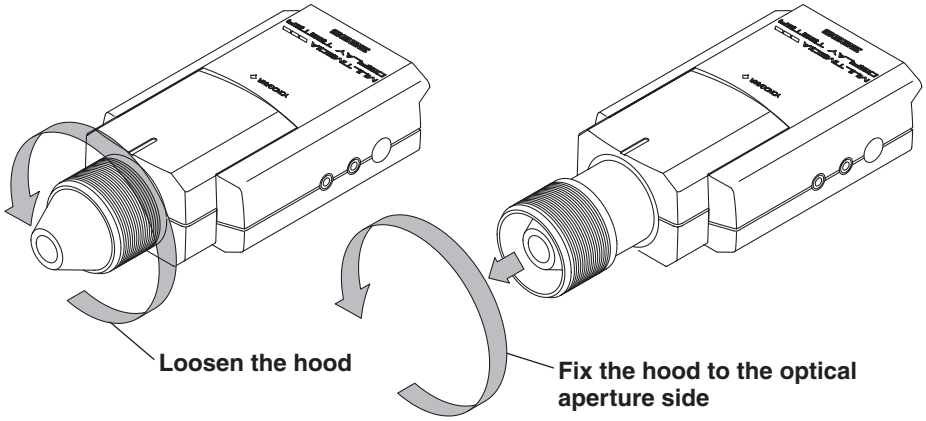
To make accurate measurements, install the sensor section perpendicular to the DUT as shown in the following figure.



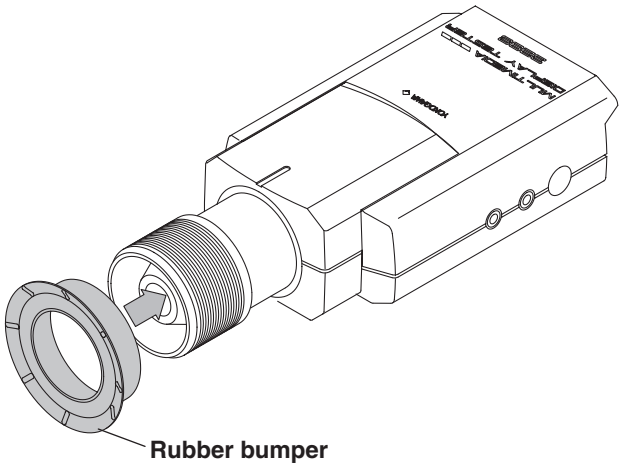
Using the Hood and Rubber Bumper

The hood is threaded on the inside. You can turn the hood to fix the hood to the optical aperture side or the light-receiving unit side. If you set the hood to the optical aperture side and make measurements by bringing the sensor section close to the illuminant, the effects from the ambient light can be reduced.

- **Moving the hood from the optical aperture side to the light-receiving unit side**
  Turn the hood in the direction indicated in the figure, move the hood to the optical aperture side, and turn the hood in the same direction to fix it in place.



- **Using the rubber bumper**
  When measuring a target display by bringing the sensor in contact with the display, you can attach a rubber bumper that came with the sensor to the tip of the sensor as shown in the figure for protecting the display. The hood must be fixed to the optical aperture side when attaching the rubber bumper.



Note

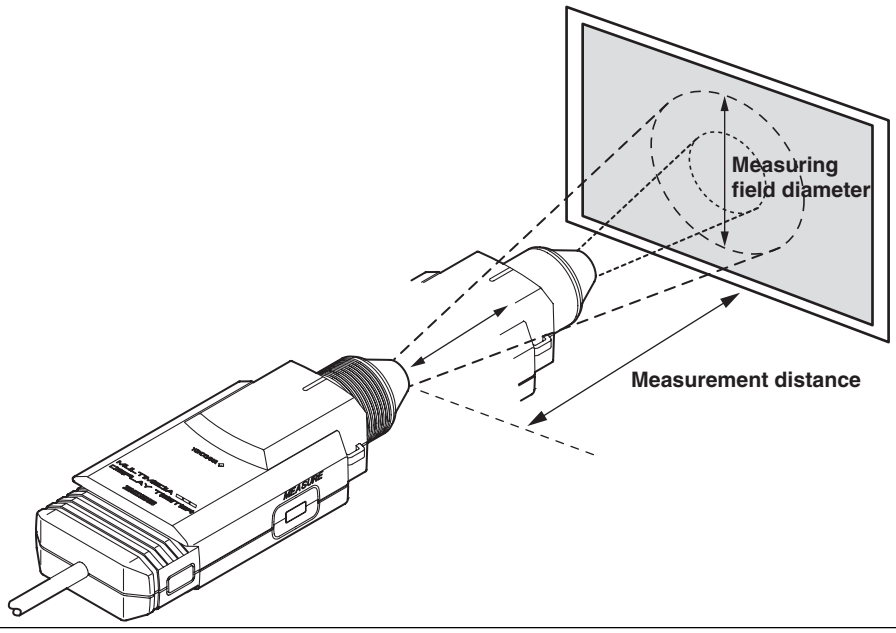
If the sensor is not brought in contact with the target display, the ambient light cannot be blocked completely even when the hood is fixed to the optical aperture side. If you need accurate measurements, it is recommended that the measurement be performed in a dark room.

Distance to the DUT and the Measurement Range (Measuring Field Diameter)

Because the 3298F is a shading cylinder meter, the measuring field diameter varies depending on the distance between the DUT and the sensor.

Measuring field diameter (mm) = 0.6 × (21.1 + measurement distance)

Measurement distance (mm)	In contact	10	20	50	100
Measuring field diameter (mm)	10	19	25	42	73



3.4 Connecting the Power Supply and Turning ON/ OFF the Power

Installing the Batteries

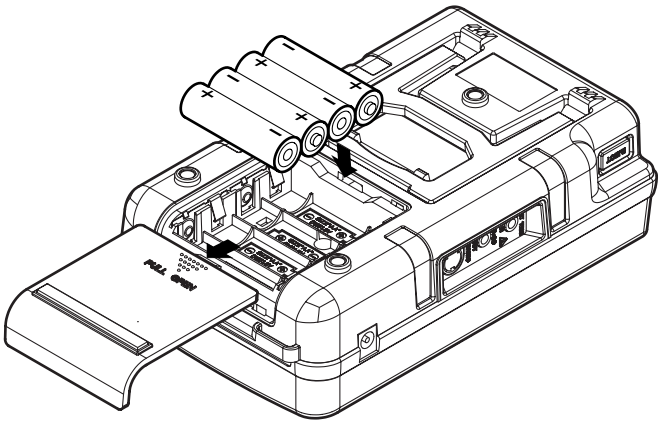
If you are using batteries, heed the cautions below.

CAUTION

- Use AA alkaline batteries. Do not use manganese batteries.
- To prevent the possibility of leakage and explosion, insert the batteries in the correct direction (positive and negative ends). See the figure below.
- Close the cover on the rear panel before use.
- Do not short the batteries.
- Do not charge the batteries.
- Do not solder the batteries.
- Use new batteries from the same manufacturer.
- When replacing the batteries, replace all four batteries at once.
- If you are not using the 3298F for an extended time, remove the batteries from the battery holder.
- If you connect the AC adapter to the 3298F when it is battery-driven, the power turns OFF.

Installing and Replacing the Batteries

1. Check that the power switch of the 3298F is turned OFF and that the AC adapter is disconnected.
2. Remove the battery cover on the back panel.
3. Remove the four used batteries from the holder and insert four new ones. Make sure that the positive and negative ends of the batteries are correct.
4. Attach the cover.



Indication of Low Battery

When the batteries are low, a warning message “Low Battery” or “Battery Empty” is displayed at the top section of the LCD. When “Battery Empty” is displayed, the power is turned OFF within a few seconds.
Under continuous operation, the 3298F can run for approximately six hours on four alkaline batteries.

Connecting the AC Adapter

Follow the warnings and cautions below to avoid the danger of electric shock and damage to the 3298F.

WARNING

- Only use YOKOGAWA’s AC adapters.
- Check that the power switch is turned OFF before connecting the AC adapter.

Connecting the AC adapter

The AC adapter is optional.

1. Check that the power switch is OFF.
2. Connect the AC adapter jack to the AC adapter terminal of the 3298F.

Turning ON/OFF the Power

The power is turned ON/OFF through dial operation.

Power ON

1. Check that the 3298F and the sensor are connected.
   For the procedure to connect the sensor, see section 3.3.
2. Connect external input/output as necessary.
3. Connect the AC adapter.
4. Place the cap on the tip of the sensor hood.
5. Turn the dial from the OFF position to the desired position (LUMINANCE, CONTRAST, FLICKER, CHROMA, or SET).
6. The power turns ON, and the LCD shows “Initial Data Loading...” followed by “Offset Calibration.”

Power OFF

7. Turn the dial to the OFF position.
   The power turns OFF.

Note

- When turning the power ON, make sure to place the sensor cap is attached.
- The setup information and data saved to the memory are retained even when the power is turned OFF.

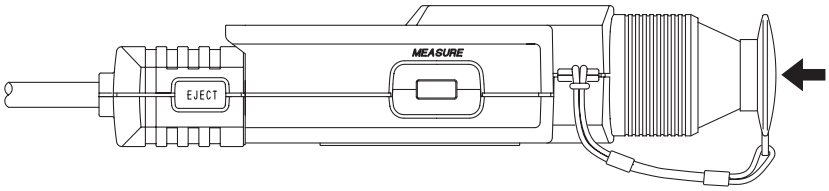
3.5 Offset Calibration

Zero level calibration (offset calibration) can be carried out using the following two methods on the 3298F.
In either case, always place the sensor cap and shut out the input light before calibration.

- At power up: Calibration is automatically executed.
- Manual: You can execute calibration as necessary. For the procedure, see below.

Executing Offset Calibration

1. Attach the sensor cap.



2. In the measurement screen, press **MENU**.
3. In the menu screen that appears, select **CAL**.
4. Press **ENTER**.
5. Offset calibration is executed.

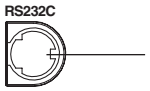
Note

If you execute the offset calibration without placing the sensor cap, “Calibration Error” is displayed on the screen.

3.6 Connecting External Input/Output

Serial (RS-232) Connection

Connect the 3298F and your PC using the dedicated cable. A serial cable with a D-sub 9 pin (part no. B8300LC) used to connect to the PC and another with a D-sub 25 pin (part no. B8300LD) are available. Select the appropriate cable for your PC.
For details on the communications conditions and commands, see chapter 6, “Serial (RS-232) Communications Function.”



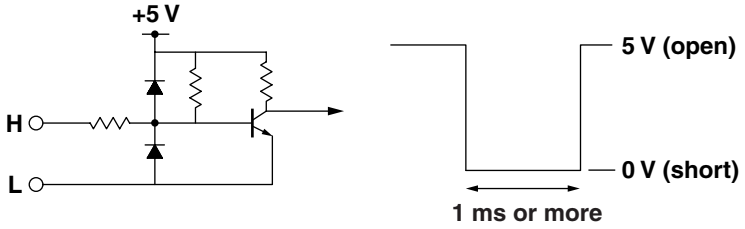
Serial (RS-232) interface terminal

External Trigger (Contact) Input

Makes measurements using an external signal. Connect a cable to the input terminal that is located on the side panel of the 3298F. For the procedure in making a connection cable, see page 3-12.

External trigger input terminal

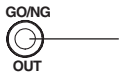
The structure and specifications of the input circuit are as follows:



Specification	Condition
Low: 0 (short) to 0.3 V High: 2.0 to 5 (open) V Pulse width: 1 ms or more	Input terminal allowable voltage: -0.5 to 5.5 V Cable length is less than 3 m.

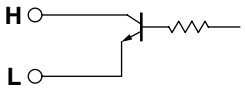
GO/NOGO Determination

Outputs the determination result of each measurement. Connect a cable to the input terminal that is located on the side panel of the 3298F. For the procedure to make a connection cable, see page 3-12.



GO/NOGO output terminal

The structure and specifications of the output circuit are as follows:



Specification		Condition
Contact (open collector) output		Contact capacity: 30 VDC, 100 mA
GO:	OPEN	Cable length is less than 3 m.
NOGO:	LO	

Monitor Output

Outputs a voltage proportional to the optical input level of the Y sensor. Can be used for photoelectric conversion (reference value of rise time: approx. 1.6 ms at 400 cd/m2 range). Connect a cable to the input terminal that is located on the side panel of the sensor. For the procedure in making a connection cable, see page 3-12.

Monitor output terminal

The specifications of the output circuit are as follows:

Specification		Condition
Output:	0 to 2 V	Cable length is less than 3 m.
Accuracy:	±5% F.S.	Load resistance 100 kΩ or more

Rise/Fall Time of the Monitor Output Signal (Typical Value)

- When set to 400 cd/m^2 range: Approximately 1.6 ms
- When set to 4000 cd/m^2 range: Approximately 0.8 ms

DC Luminance Output

Outputs a voltage proportional to the luminance of only the DC component of the luminous quantity of the Y sensor. Connect a cable to the input terminal that is located on the side panel of the sensor. For the procedure to make a connection cable, see page 3-12.

DC luminance output terminal

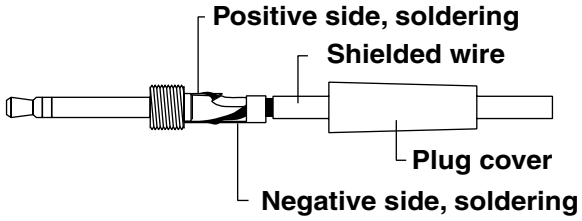
The specifications of the output circuit are as follows:

Specification		Condition
Output:	0 to 2 V	Cable length is less than 3 m.
Accuracy:	±5% F.S.	Load resistance 100 kΩ or more

Making Connection Cables

Follow the procedure below to create the connection cables for the external trigger input, GO/NOGO output, monitor output, and DC luminance output.

1. Prepare a single shielded wire.
2. Solder the wire to the recorder output plug (B8300LJ, sold separately) as shown in the figure.



WARNING

- Solder the wire to prevent reversing the plug polarity.
- To prevent erroneous operation of 3298F, make sure to use a shielded wire for the connection cable.

3.7 Screen Switching Operation and Parameter Selecting Operation

Switching Screens

Switching to a Lower Menu or Screen

1. Press ∧∨ to highlight the desired item.
2. Press **ENTER** or >.
3. The lower menu or screen appears.

Switching to a Higher Menu or Screen

4. Press **ESC** or <.
5. The higher menu or screen appears.

Selecting Items

Selecting Numeric Setting Items

1. Press ∧∨ to highlight the desired item.
2. Press **ENTER** or >.
3. The numeric input window appears.

Selecting Character Setting Items

3. Press ∧∨ to highlight the desired item.
4. Press **ENTER** or >.
5. The character input window appears.

Selecting Items

6. Press ∧∨ to highlight the desired item.
7. Press **ENTER** or >.
8. A ● appears by the selected item.

ESC Key and ENTER Key

When you press **ESC**, one of the following operations is performed.

- The operation in progress is aborted.
- The previous (higher) menu is selected.

When you press **ENTER**, one of the following operations is performed.

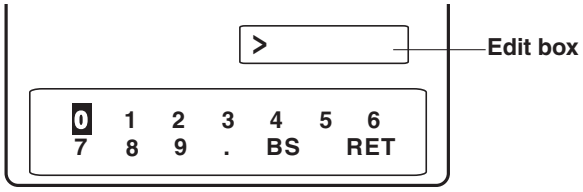
- A screen is selected.
- An item is selected.
- An input is confirmed.

3.8 Numeric Setting Operation and Character Setting Operation

Setting Numeric Values

In numeric setting operation, one of the following numeric input windows appears when you select an item.

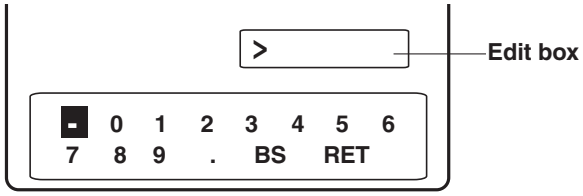
Window for Setting Positive Values



Edit box

0 1 2 3 4 5 6
7 8 9 . BS RET

Window for Setting Negative Values



Edit box

- 0 1 2 3 4 5 6
7 8 9 . BS RET

Note

The window for setting negative values is used in “User-Defining Standards” under “Standard” in section 4.4.

Numeric Input Operation

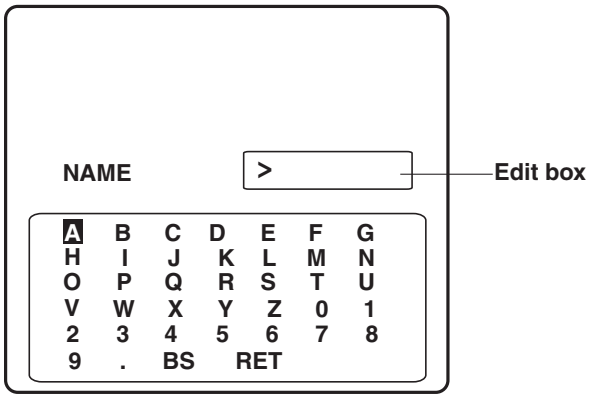
1. **Entering numbers**
   Press ∧∨<> to highlight the desired number.
   Press **ENTER**.
   The selected number is entered in the edit box.
   Repeat the above procedure the required number of times.
2. **Canceling the last input**
   Press ∧∨<> to highlight **BS**.
   Press **ENTER**.
   The last input number in the edit box is cleared.
3. **Completing the number input**
   Press ∧∨<> to highlight **RET**.
   Press **ENTER**.
   The input number of the edit box is confirmed and the numeric input window closes.

Canceling Numeric Input Operation

4. Press **ESC** in the middle of the operation.
   The numeric input window closes and the screen returns to the previous condition.

Setting Characters

In character setting operation, the following character input window appears when you select an item.



Character Input Operation

1. **Inputting Characters**
   Press ∧∨<> to highlight the desired character.
   Press **ENTER**.
   The selected character is entered in the edit box.
   Repeat the above procedure the required number of times.
2. **Canceling the last input**
   Press ∧∨<> to highlight **BS**.
   Press **ENTER**.
   The last input character in the edit box is cleared.
3. **Completing the number input**
   Press ∧∨<> to highlight **RET**.
   Press **ENTER**.
   The input character of the edit box is confirmed and the character input window closes.

Canceling the Character Input Operation

4. Press **ESC** in the middle of the operation.
   The character input window closes and the screen returns to the previous condition.

3.9 Memory Operations

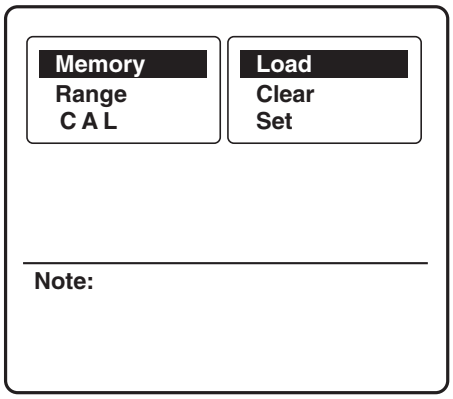
The 3298F can store 200 sets (memory no. 001 through 200) of data for each measurement.

Saving the Measured Results

The following operation is performed in each measurement screen.

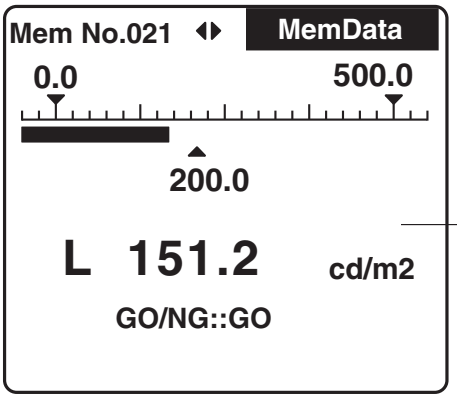
1. To save the data to the memory number that is currently displayed at the upper left corner of the LCD, proceed to step 3. To change the memory number, proceed to step 2.
2. Press <> to switch the memory number that is displayed at the upper left corner of the LCD to the desired memory number.
3. Press **ENTER**.
   The measured results area saved to the memory that is currently displayed at the upper left corner of the LCD.

Operations other than “Saving the Measured Results” described above are performed using Memory on the menu screen that appears when MENU is pressed in each measurement screen.



Loading the Memory

1. In the measurement screen, press **MENU**.
2. In the menu screen that appears, choose **Memory** > **Load**.
3. Press **ENTER** or >.
   The screen switches to memory data display mode.
   The display screen is the same as the measurement screen except MemData is highlighted at the upper right corner of the screen.



Example of luminance measurement

The screen is similar for other measurements.

4. To switch the memory to be loaded, press <> to switch the memory number that is displayed at the upper left corner of the LCD to the desired memory number.
5. To return to the measurement screen, press **ESC** three times.

Clearing the Memory

1. In the measurement screen, press **MENU**.
2. In the menu screen that appears, choose **Memory** > **Clear**.
3. Press **ENTER** or >.
   A confirmation message appears.
4. To clear the memory, press **ENTER**. To cancel, press **ESC**.

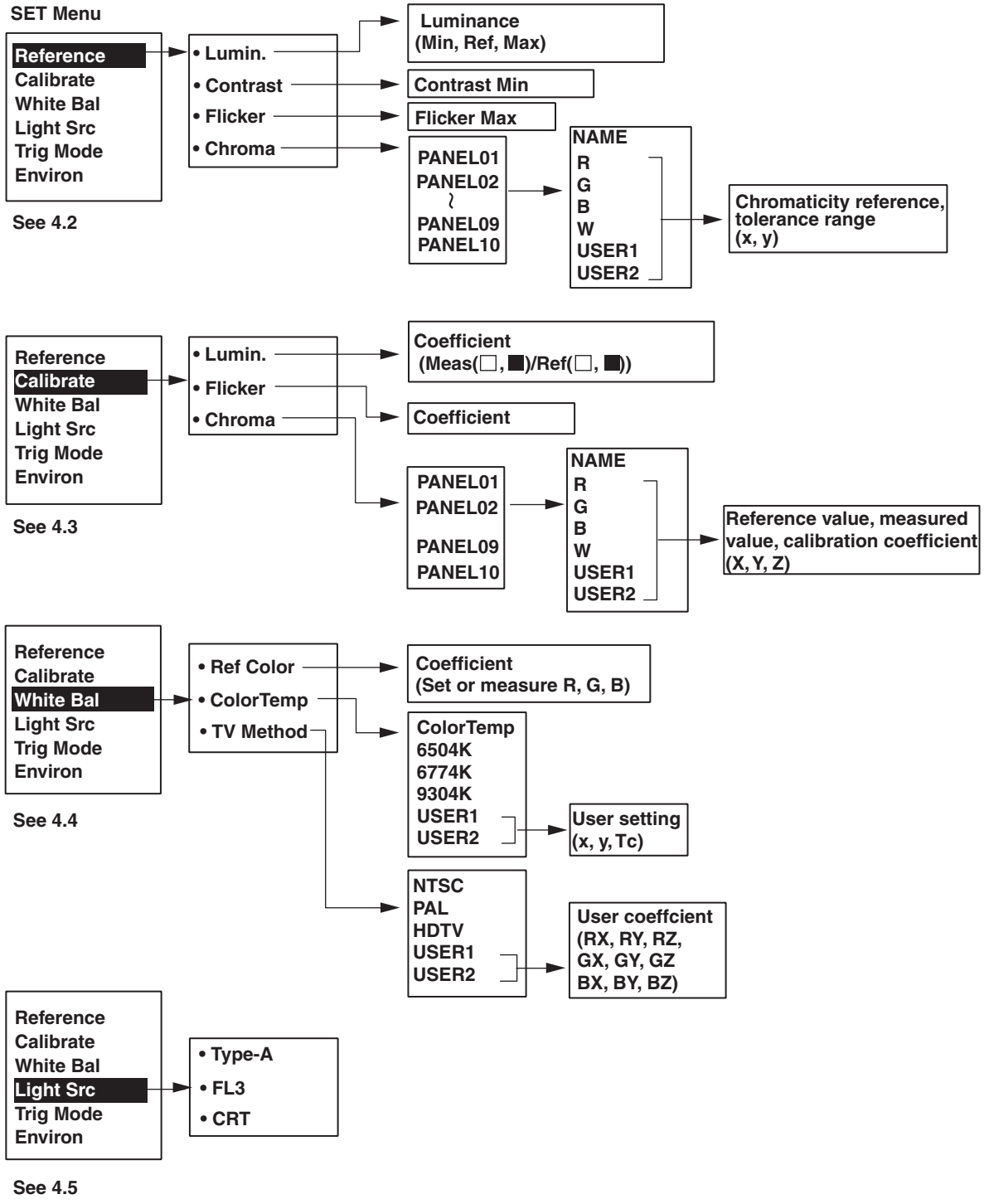
Fixing or Incrementing the Memory Number

1. In the measurement screen, press **MENU**.
2. In the menu screen that appears, choose **Memory** > **Set**.
3. Press **ENTER** or >.
4. Press ∧∨ to highlight the desired setting.

   MemNoFix: The memory number must be switched manually.
   Auto+1: When data is saved to memory, the memory number is automatically switched to the next one.

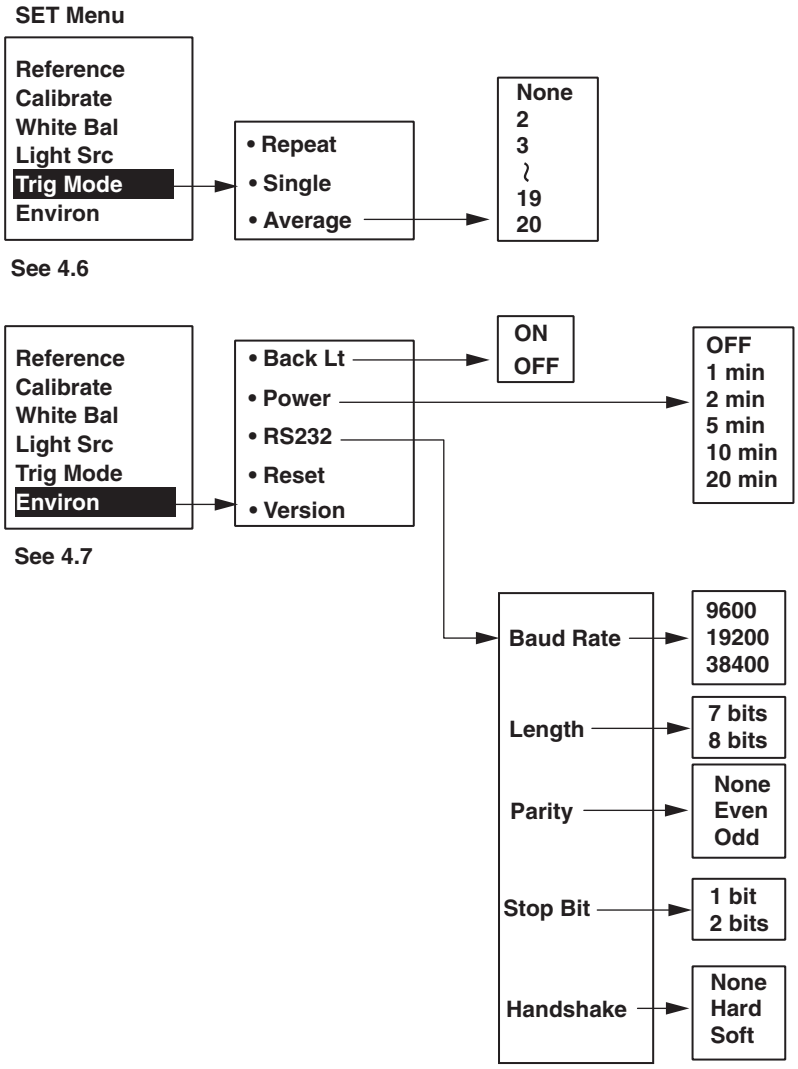
5. Press **ENTER** or >.
6. A ● appears by the selected item.

4.1 A List of Menus



• Continues to the next page

• Continued from the previous page



4.2 Setting the Reference Value

Explanation

Reference Values

Reference values refer to target values used for the GO/NOGO determination. The following reference values are available for each measurement function.

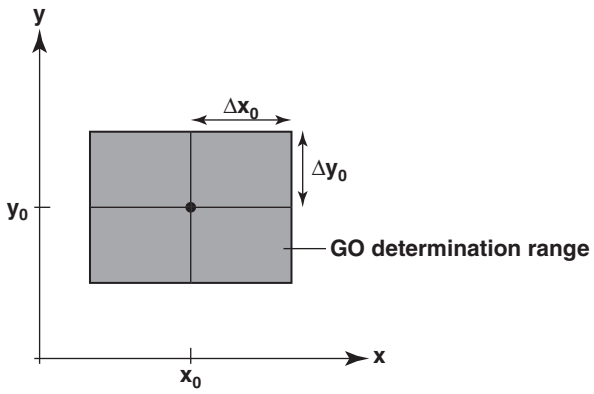
- Luminance reference
- Contrast reference
- Flicker reference
- Chromaticity reference

GO/NOGO Determination

GO/NOGO determination determines whether the measured value is within a preset range, displays the determination result (GO or NOGO), and outputs a state signal.

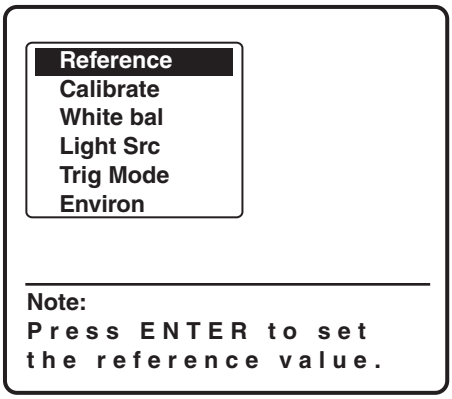
The reference values for each function are shown below.

- **Luminance reference**
  Set the reference (Ref) and the tolerance (Min and Max).
  Determines whether the measured luminance is within the tolerance.
- **Contrast reference**
  Set the minimum contrast.
  Determines whether the measured contrast is greater than or equal to the reference.
- **Flicker reference**
  Set the maximum flicker.
  Determines whether the measured flicker ratio is less than or equal to the reference.
- **Chromaticity reference**
  Set the reference (x and y) and the tolerances for x and y.
  Determines whether the measured chromaticity is within the tolerance around the reference.
  You can set the reference and tolerance for 6 colors × 10 sets. This feature allows you to switch the reference according to the measured color or panel type.
  Below is the GO determination range when the reference value is (x_0, y_0) and the tolerances for x and y are $\pm\Delta x_0$ and $\pm\Delta y_0$, respectively.



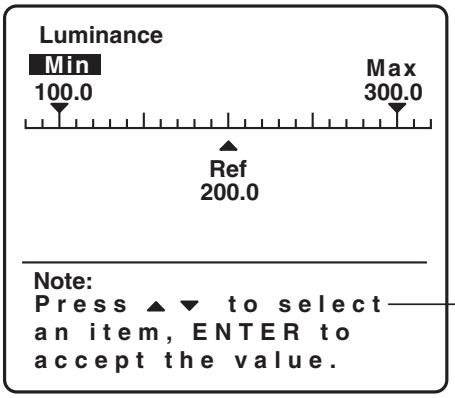
Procedure

1. Set the dial to **SET** to display the **SET** menu below.



Setting the Reference and Tolerances of Luminance

2. Select **Reference** > **Lumi** from the **SET** menu. The following screen appears.



If the setting does not satisfy the Min < Ref < Max condition, an error message is displayed in the operation guide display area.

3. Press ∧∨ to select the setup item. The highlighted item is the currently selected item.
4. To enter the value for a parameter, use the numeric input window that appears by pressing **ENTER** or >.
   For details on the operation, see “Setting Numeric Values” in section 3.8.

Setting the Contrast Reference (Minimum Value)

2. Choose **Reference** > **Contrast** from the **SET** menu.
3. To enter the value for a parameter, use the numeric input window (see section 3.8) that appears by pressing **ENTER** or >.

Flicker Reference (Maximum Value)

2. Choose **Reference** > **Flicker** from the **SET** menu.
3. To enter the value for a parameter, use the numeric input window (see section 3.8) that appears by pressing **ENTER** or >.

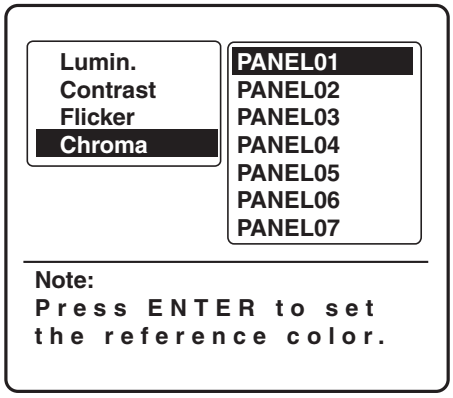
Note

- Press ESC to cancel the setup operation.
- The scale of the bar graph on the flicker measurement screen is determined by the maximum flicker value (criteria)

Maximum Flicker	Scale
Less than 2%	2%
Less than 4%	4%
Less than 8%	8%
Other	20%

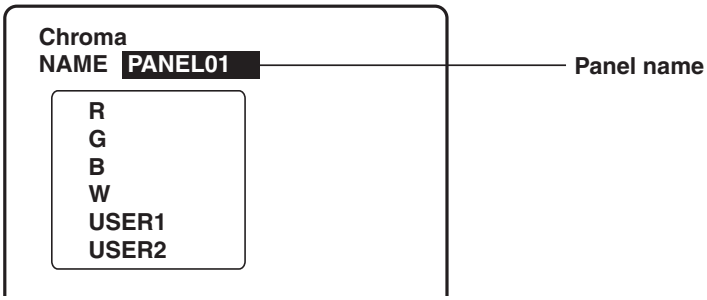
Setting the Reference and Tolerances of Chromaticity

2. Select **Reference** > **Chroma** from the **SET** menu. The following screen appears.



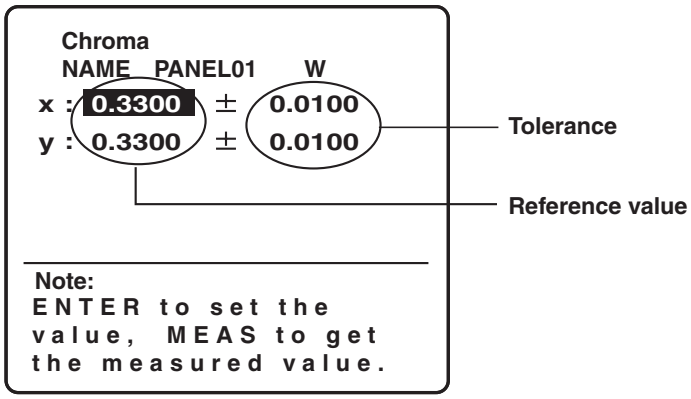
- **Changing the panel name**

3. Press ∧∨ to highlight the panel name to be changed.
4. Press **ENTER** or >. The following screen appears.



5. Press ∧∨ to highlight the NAME column.
6. To enter the name, use the character input window (see section 3.8) that appears by pressing **ENTER** or >.

- **Setting the reference and tolerance**
  7. Press ∧∨ to highlight the color to be specified (R, G, B, W, USER1, or USER2).
  8. Press **ENTER** or >. The following screen appears.



  9. Press ∧∨ to highlight the parameter to be specified.
  10. Set the value using one of the following methods.
      - **When setting the value through measurement (only when entering the reference)**
        Direct the sensor at the reference illuminant or the reference color and press **MEAS**. The measured chromaticity (x and y) appears in the chromaticity reference column.
      - **When entering the value through keys**
        Use the numeric input window (see section 3.8) that appears by pressing **ENTER** or >.

Note

- The panel names for the chromaticity reference value and chromaticity calibration coefficient are shared.
- If you change the panel name for the chromaticity reference value, the panel name for the corresponding chromaticity calibration coefficient is also changed.

4.3 Setting Calibration Coefficients

Explanation

If you use the calibration coefficient function, the values measured on the 3298F can be matched to the values measured on the standard. In flicker measurements, the flicker ratio can be converted to value conforming to the JEITA Standard or VESA Standard. You can set the following calibration coefficients for each measurement function.

- **Luminance calibration coefficients**
  You can set the luminance calibration coefficients only when using the luminance sensor.
  The luminance calibration coefficients are calculated by setting the following values.
  - White/Black luminance measured on the 3298F (Meas.)
  - White/Black luminance measured on the standard (Ref.)

  The measured luminance value using the luminance calibration coefficients is displayed. For details on how the calibration coefficients are determined, see section 1.5.
- **Flicker calibration coefficients**
  Set the following values.
  - A: Flicker calibration coefficient
  - B: LOG calculation coefficient

  For details on how to set the flicker calibration coefficients, see section 1.5.
- **Chromaticity calibration coefficients**
  You can set chromaticity calibration coefficients only when using the color sensor.
  You can display corrected measured chromaticity values using the chromaticity calibration coefficients.
  You can set chromaticity calibration coefficients for six colors (R, G, B, W, USER1, and USER2) for 10 types of target panels.
  Chromaticity calibration coefficients are calculated by setting the following values for each color
  - Tristimulus values X, Y, and Z measured on the 3298F (Meas.)
  - Tristimulus values X, Y, and Z measured on the standard (Ref.)

  The equation for calculating the chromaticity calibration coefficients is as follows:
  Chromaticity calibration coefficient = Meas./Ref.

Entering the Luminance and Chromaticity Calibration Coefficients

You can set the calibration coefficients using the following two methods.

- Use the numeric input window and enter the values using keys (Meas. and Ref.)
- Automatically set the measured values as calibration coefficients (Meas. only)

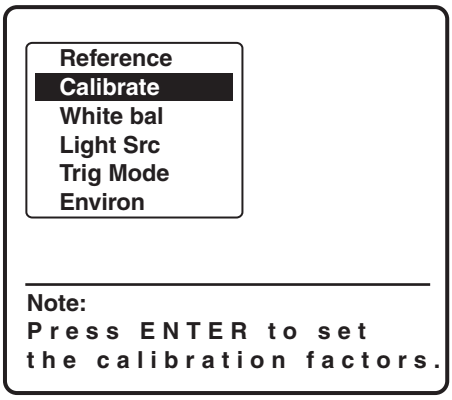
Note

Use tristimulus values X, Y, and Z to set each chromaticity calibration coefficient.

- **Reference value conversion**
  The calibration coefficient is set using the XYZ color system. If the values measured on the reference instrument are in x, y, L color system, convert the values to the X, Y, Z color system using the following equations.
  $X = x/y \times L$
  $Y = L$
  $Z = (1-x-y)/y \times L$
  - When you set the calibration coefficient, the coefficient applies to all color systems. For a description of the method of selecting the chromaticity calibration coefficient during measurement, see “Selecting the chromaticity reference value or chromaticity calibration coefficient” in section 5.4, “Measuring the Chromaticity.”
  - Enter the value measured on a calibration standard or a reference instrument that you specified in Meas of the chromaticity calibration coefficient. Enter the value measured on the 3298F in Ref.
  - If you set the Y value of the luminance calibration coefficients, the calibration coefficients are applied to the luminance (L) of all measurement functions.

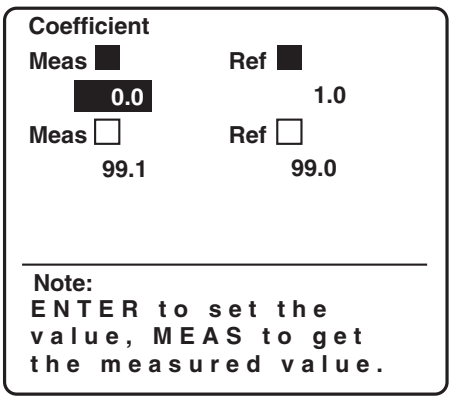
Procedure

1. Set the dial to **SET** to display the **SET** menu below.



Setting the Luminance Calibration Coefficients

2. Select **Calibrate** > **Lumi** from the **SET** menu. The following screen appears.



3. Press ∧∨ to highlight the values measured on the 3298F (Meas ■/Meas □) or the values measured on the standard (Ref ■/Ref □).

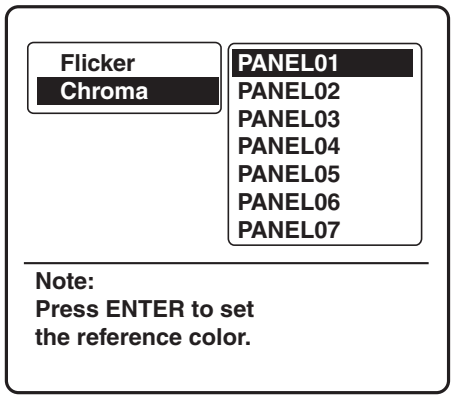
4. Set the value using one of the following methods.
   - **When setting the value through measurement (only when entering the value measured on the 3298F)**
     Direct the sensor at the reference illuminant or the target display and press MEAS. The measured black or white luminance is displayed in the Meas ■ or Meas. □ column.
   - **When entering the value through keys**
     Use the numeric input window (see section 3.8) that appears by pressing **ENTER** or >.

Setting the Flicker Calibration Coefficients

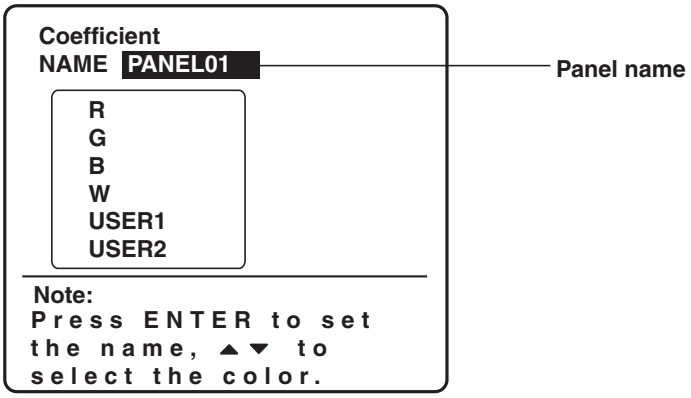
2. Choose **Calibrate** > **Flicker** from the **SET** menu.
3 Press ∧∨ to highlight A or B.
4. To enter the value for a parameter, use the numeric input window (see section 3.8) that appears by pressing **ENTER** or >.

Setting the Chromaticity Calibration Coefficients

2. Select **Calibrate** > **Chroma** from the **SET** menu. The following screen appears.

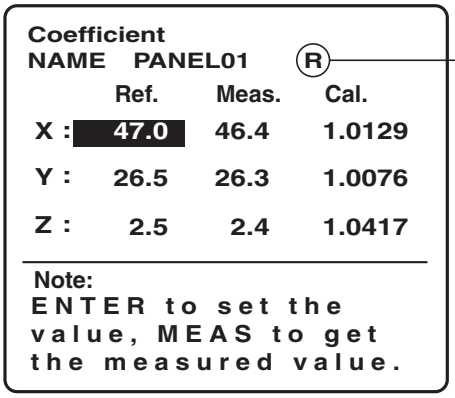


- **Changing the panel name**
  3. Press ∧∨ to highlight the panel name to be changed.
  4. Press **ENTER** or >. The following screen appears.



  5. Press ∧∨ to highlight **NAME**.
  6. To enter the name, use the character input window (see section 3.8) that appears by pressing **ENTER** or >.

- **Setting the calibration coefficients**
  7. Press ∧∨ to highlight the color to be specified (R, G, B, W, USER1, or USER2).
  8. Press **ENTER** or >. The following screen appears.



  9. Press ∧∨ to highlight the values measured on the 3298F (X/Y/Z of Meas.) or the values measured on the standard (X/Y/Z of Ref.).
  10. Set the value using one of the following methods.
      - **When setting the value through measurement (only when entering the value measured on the 3298F)**
        Direct the sensor at the illuminant having reference colors or the target display and press **MEAS**. The measured chromaticity (X, Y, Z) is retrieved and displayed in the Meas. column.
      - **When entering the value through keys**
        Use the numeric input window (see section 3.8) that appears by pressing **ENTER** or >.
  11. When you enter the Ref. and Meas. values, the calibration coefficients are automatically calculated and displayed in the Cal. column.

Note

- Press the ESC key to cancel the setup operation.
- The panel names for the chromaticity calibration coefficient and chromaticity reference value are shared.
- If you change the panel name for the chromaticity calibration coefficient, the panel name for the corresponding chromaticity reference value is also changed.
- The calibration coefficient registered in the panel name that was selected in section 5.4 is used. For the procedure of selecting the panel name, see section 5.4.

4.4 Setting the White Balance Adjustment

Explanation

Adjusting the White Balance

The white balance (color temperature) of the display is adjusted by changing the optical intensity of R, G, B. Therefore, the RGB color system is usually used when adjusting the white balance. To display in the RGB color system, the following parameters need to be configured.

- Reference color: Select the color to be fixed when adjusting RGB. The chromaticity of the selected color (R, G, or B) is taken to be 100%, and the chromaticity values of other colors are displayed as percentages.
- Color temperature: Select 6504K, 6774K, 9304K, USER1, or USER2. The target chromaticity x and y are automatically determined from the selected color temperature. You can arbitrarily set the target luminance L. If you select USER1 or USER2, set the target color temperature x and y and the target luminance L.
- Standard: The constants necessary to calculate the logical values of RGB and the measured values of RGB vary depending on the broadcasting system (NTSC, PAL, HDTV, and user-defined). Select the broadcasting system that complies with the target display.

In white balance adjustment, set these parameters correctly and use the RGB color system.

User-Defining Color Temperatures

You can register two types of settings.
You can set target color temperatures x and y and the target luminance L using one of two methods.

- Use the numeric input window and enter the values using keys
- Enter the values by retrieving measured values

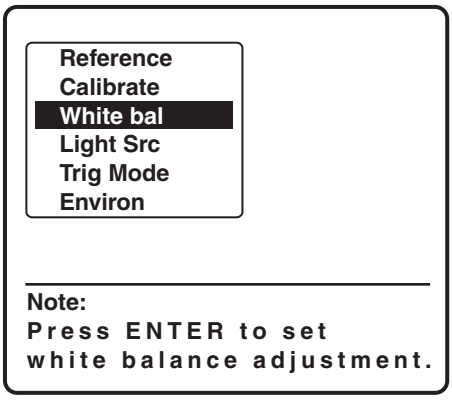
User-Defining Standards

You can user-define two sets of constants for standards other than the NTSC, PAL, and HDTV broadcasting systems.
You set the constants (R_X, R_Y, R_Z/G_X, G_Y, G_Z/B_X, B_Y, and B_Z) for the tristimulus values of R, G, B.

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} R_X & R_Y & R_Z \\ G_X & G_Y & G_Z \\ B_X & B_Y & B_Z \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$$

Procedure

1. Set the dial to **SET** to display the **SET** menu below.

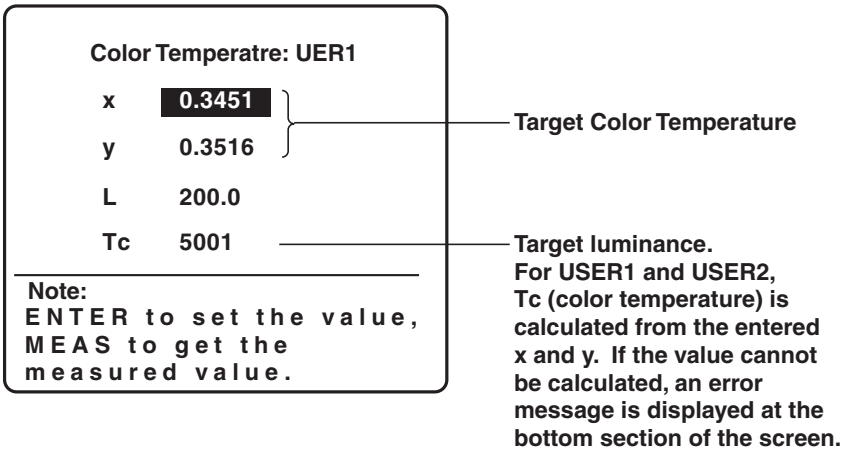


Setting the Reference Color

2. Choose **White Bal** > **Ref Color** from the **SET** menu.
3. Press ∧∨ to highlight one of the reference colors from **R**, **G**, and **B**.
4. Press **ENTER** or >.

Setting the Color Temperature

2. Choose **White Bal** > **ColorTemp** from the **SET** menu.
3. Press ∧∨ to highlight a color temperature of **6504K**, **6774K**, **9304K**, **USER1**, or **USER2.**
4. Press **ENTER** or >. The following screen appears.



5. Press ∧∨ highlight target color temperature x or y (for USER1 or USER2 only) or target luminance L.

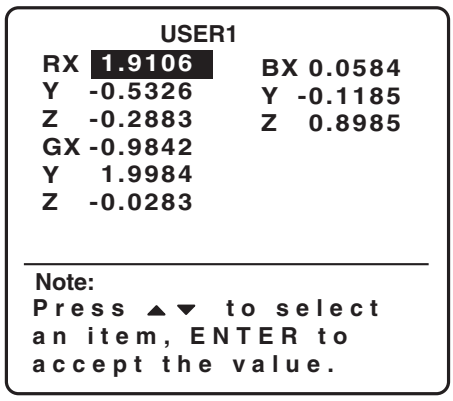
6. Set the value using one of the following methods.
   - **When setting the value through measurement (only for USER1 or USER2)**
     Direct the sensor at a reference panel (illuminant) having the target color temperature and press **MEAS**. The chromaticity and luminance measured are displayed on the screen.
   - **When entering the value through keys**
     Use the numeric input window (see section 3.8) that appears by pressing **ENTER** or >.

Note

You can set color temperature x and y only when defining the color temperature using USER1 or USER2. If you select 6504K, 6774K, or 9304K for the color temperature, you can only set the luminance L.

Setting the Standard

2. Choose **W Balance** > **TVmethod** from the **SET** menu.
3. Press ∧∨ to highlight one of the standards from **NTSC**, **PAL**, **HDTV**, **USER1**, and **USER2**.
4. Press **ENTER** or >. If you selected USER1 or USER2, proceed to step 5.
5. Press **ENTER** or >. The following screen appears.



6. Press ∧∨ to highlight the constant to be specified.
7. To enter the value for a parameter, use the numeric input window (see section 3.8) that appears by pressing **ENTER** or >.

4.5 Setting Light Source Calibration

Explanation

The 3298F has the light source calibration coefficients below. Select the appropriate light source calibration coefficient according to the target display.

- **Type A (Type-A standard light source)**
  Makes measurements using the light source calibration coefficient obtained when the 3298F was calibrated using standard illuminant A. For example, select this coefficient when measuring a car tail lamp that has a light bulb covered by a colored glass.
- **FL3 (Three-wavelength fluorescent lamp)**
  Makes measurements using the light source calibration coefficient obtained when the 3298F was calibrated using a three-wavelength fluorescent lamp.
  For example, select this coefficient when measuring an LCD that uses cold-cathode fluorescent lamp for its backlight.
- **CRT**
  Makes measurements using the light source calibration coefficient obtained when the 3298F was calibrated using a CRT. Select this coefficient when measuring CRTs.

For details on light source calibration coefficients, see section 1.4.

Procedure

1. Set the dial to **SET** to display the **SET** menu.
2. Choose **LightSrc** from the **SET** menu.

Selecting the Light Source Calibration Coefficient

3. Press $\wedge\vee$ to highlight a light source of **Type-A**, **FL3**, or **CRT**.
4. Press **ENTER** or $>$.

4.6 Setting the Trigger Mode

Explanation

Trigger Mode

You can select the measurement timing (trigger mode) from below.

- Repeat: Performs continuous measurements. The measured value is held when you press the MEAS key during repetitive measurements. The repetitive measurement resumes when you press the MEAS key in a held condition.
- Single: Performs a single triggered measurement. Makes a single measurement when you press the MEAS key or when an external trigger signal is received.

Average Count

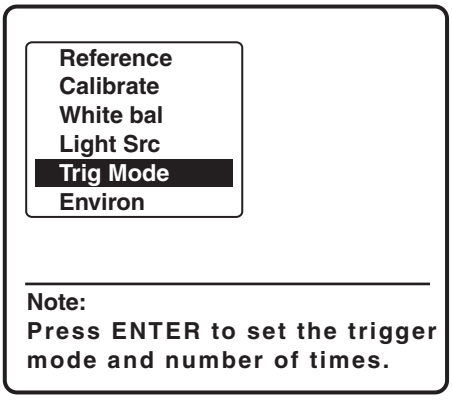
If you set the average count, the average value is calculated and displayed after executing the measurement the specified number of times.

You can select the average count from the following:

- None: Does not perform averaging of measured values.
- 2 to 20: Repeats the measurement the specified number of times and displays the average value.

Procedure

1. Set the dial to **SET** to display the **SET** menu below.



Selecting the Trigger Mode

2. Choose **Trig Mode** from the **SET** menu.
3. Press ∧∨ to highlight a trigger mode of **Repeat** or **Single**.
4. Press **ENTER** or >.

Setting the Average Count

3. Press ∧∨ to select Average and press **ENTER** or >.
4. Press ∧∨ to highlight **None**, or **2** through **20**.
5. Press **ENTER** or >.

Note

If you hold down the MEAS key for approximately 1 second when the dial is set to LUMINANCE, CONTRAST, FLICKER or CHROMA, you can switch the trigger mode (between single and repeat).

4.7 Setting the 3298F

Procedure

1. Set the dial to **SET** to display the **SET** menu.

Back Light

2. Choose **Environ** > **Back Lt** from the **SET** menu.

Turning the Back Light ON/OFF

3. Press ∧∨ to highlight either of the backlight settings from **OFF** and **ON**.
4. Press **ENTER** or >.

Note

If you turn the backlight ON when the 3298F is battery-driven, the backlight automatically turns OFF after approximately 20 seconds. The backlight turns back ON when a key is pressed.

Shut Down

2. Choose **Environ** > **Shutdown** from the **SET** menu.

Setting Shut Down

3. Press ∧∨ to highlight a shut down setting of **OFF**, **1 min**, **2 min**, **5 min**, **10 min**, or **20 min**.
4. Press **ENTER** or >.

Note

This function is valid when the 3298F is battery-driven.

Setting Communications

To set communications conditions, use the screen that appears by choosing **Environ** > **RS232**.
The following items and selections are available.

Item	Selection
Baud rate	9600, 19200, and 38400
Data length	7 bits and 8 bits
Parity	None, Even, and Odd
Stop bit	1 bit and 2 bits
Handshaking	None, Hard, and Soft

Setting the Baud Rate

2. Choose **Environ** > **RS232** > **Baud Rate** from the **SET** menu.
3. Press ∧∨ to highlight one of the baud rates choosing from **9800**, **19200**, and **38400**.
4. Press **ENTER** or >.

Setting Data Length through Handshaking Parameters

Set other parameters in a fashion similar to the aforementioned baud rate.

Initial

2. Choose **Environ** > **Initial** from the **SET** menu.
3. Press **ENTER** or > to display a screen for selecting the items to be initialized.
4. Press ∧∨ to highlight **[ALL]**, **[Settings]**, **[Reference]**, or **[Calibrate]**.
5. Press **ENTER** or > to execute the initialization of the selected items. Press ESC to abort initialization.

Note

You can select the items to be initialized from the following:

- ALL: Initializes setting values, reference values, and calibration coefficients.
- Settings: Initializes only the settings.
- Reference: Initialize the reference values and panel names
- Calibrate: Initializes only the calibration coefficients.

For details on the default values, see Appendix 1.

Version

2. Choose **Environ** > **Version** from the **SET** menu.
3. The ROM version of the 3298F is displayed.

5.1 Measuring the Luminance

Explanation

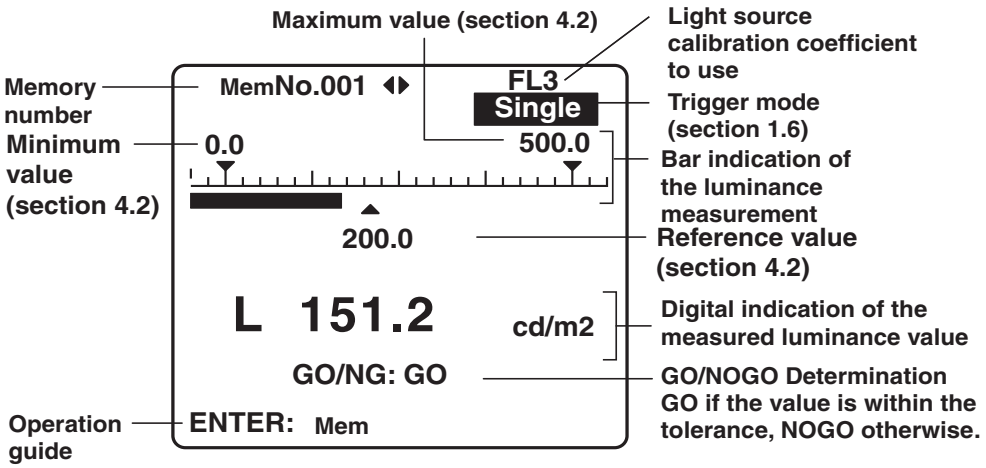
Measurement Range

You can select the measurement range from the following:

- AUTO: The measurement range is automatically set to match the luminance of the target display.
- 40 [cd/m^2]: Selectable only when using the luminance sensor
- 400 [cd/m^2]
- 4000 [cd/m^2]
- 40000 [cd/m^2]

Procedure

1. Set the dial to **LUMINANCE**. The following screen appears.



Selecting the Measurement Range

2. Press **MENU**.
3. In the menu screen that appears, select **Range**.
4. Press **ENTER** or >.
5. The measurement range setting menu appears.
6. Press ∧∨ to highlight a measurement range of **AUTO**, **40** (black and white sensor only), **400**, **4000**, or **40000**.
7. Press **ENTER** or >.

Executing Measurements

8. Confirm and change various parameters such as the reference value.
   For details, see section 4.1, “A List of Menus.”
9. Press **MEAS** on the 3298F or the sensor.
10. The measured results are displayed on the screen.

Recording the Measured Results to the Memory

Loading, Clearing, and Setting the Memory

See section 3.9, “Memory Operations.”

Executing Offset Calibration

See section 3.5, “Offset Calibration.”

5.2 Measuring the Contrast

Explanation

Measurement Range

You can select the measurement range from the following:

- AUTO: The measurement range is automatically set to match the luminance of the target display.
- 40 [cd/m^2]: Selectable only when using the luminance sensor
- 400 [cd/m^2]
- 4000 [cd/m^2]
- 40000 [cd/m^2]

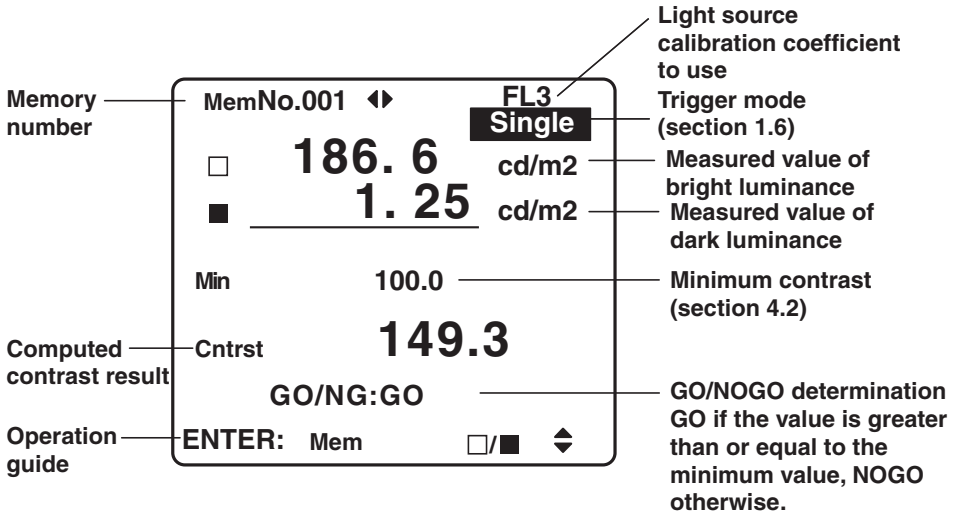
Measurement Mode

You can select the contrast measurement mode from below.

- AUTO: Of the luminance values obtained from two measurements, the larger luminance value is measured as white and the smaller luminance value as black, and the contrast value is displayed.
- Manual: Measurement is made after specifying whether the measured item is white or black. The contrast is calculated by the equation white luminance/black luminance, and the resultant value is displayed.

Procedure

1. Set the dial to **CONTRAST**. The following screen (when the measurement mode is set to Manual) appears.



Selecting the Measurement Range

2. Press **MENU**.
3. In the menu screen that appears, select **Range**.
4. Press **ENTER** or >.
5. The measurement range setting menu appears.
6. Press ∧∨ to highlight a measurement range of **AUTO**, **40** (black and white sensor only), **400**, **4000**, or **40000**.
7. Press **ENTER** or >.

Select Measurement Mode

8. At the measurement screen, press **MENU**.
9. In the menu screen that appears, select **MeasMode**.
10. Press **ENTER** or >.
11. The measurement mode setting menu appears.
12. Press ∧∨ to highlight either the **Auto** or **Manual** measurement mode.
13. Press **ENTER** or >.

Executing Measurements

14. Confirm and change various parameters such as the reference value.
    For details, see section 4.1, “A List of Menus.”
15. Execute the measurement.
    - **When the Measurement Mode is Set to Auto**
      Press **MEAS** on the 3298F or the sensor. Switch the display condition of the target display, and press **MEAS** again.
    - **When the Measurement Mode is Set to Manual**
      Check whether the display condition of the target display is the same as the underlined color. Then, press **MEAS** on the 3298F or the sensor.
      Press ∧∨ and switch the display condition of the target display, and press **MEAS** again.

- **Recording the Measured Results to the Memory**
- **Loading, Clearing, and Setting the Memory**
  See section 3.9, “Memory Operations.”

- **Executing Offset Calibration**
  See section 3.5, “Offset Calibration.”

5.3 Measuring the Flicker

Explanation

Measurement Range

You can select the measurement range from the following:

- AUTO: The measurement range is automatically set to match the luminance of the target display.
- 40 [cd/m^2]: Selectable only when using the luminance sensor
- 400 [cd/m^2]
- 4000 [cd/m^2]
- 40000 [cd/m^2]

Flicker Rate

Select the flicker frequency of the target display from below. The cutoff frequency of the low-pass filter that is used is fixed according to the flicker rate.

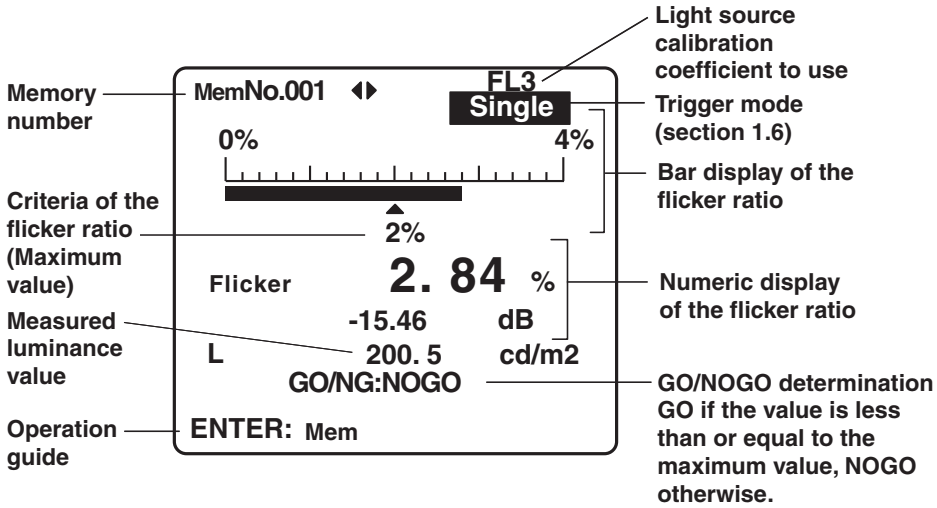
Flicker rate (Hz):	20	30	40	50	60	70	80	90
Cutoff frequency (Hz):	30	45	60	75	90	105	120	135

Turning ON/OFF the Luminance Display

You can select whether to display the measured luminance value.

Procedure

1. Set the dial to **FLICKER**. The following screen appears.



Selecting the Measurement Range

2. Press **MENU**.
3. In the menu screen that appears, select **Range**.
4. Press **ENTER** or >.
5. The measurement range setting menu appears.
6. Press ∧∨ to highlight a measurement range of **AUTO**, **40** (black and white sensor only), **400**, **4000**, or **40000**.
7. Press **ENTER** or >.

Selecting the Luminance Display

8. At the measurement screen, press **MENU**.
9. In the menu screen that appears, select **Lumi.dsp**.
10. Press **ENTER** or >.
11. The luminance display setting menu is displayed.
12. Press ∧∨ to highlight **ON** or **OFF**.
13. Press **ENTER** or >.

Note

If you turn ON the luminance display, the measurement time (screen updating) takes longer.

Selecting the Flicker Rate

14. In the measurement screen, press **MENU**.
15. In the menu screen that appears, select **Freqency**.
16. Press **ENTER** or >.
17. The flicker rate setting menu is displayed.
18. Press ∧∨ to highlight one of the flicker rates from **20 Hz** through **90 Hz** (10 Hz steps)
19. Press **ENTER** or >.

Executing Measurements

20. Confirm and change various parameters such as the reference value.
    For details, see section 4.1, “A List of Menus.”
21. Press **MEAS** on the 3298F or the sensor.
22. The measured result is displayed on the screen.

Recording the Measured Results to the Memory
Loading, Clearing, and Setting the Memory

See section 3.9, “Memory Operations.”

Executing Offset Calibration

See section 3.5, “Offset Calibration.”

5.4 Measuring the Chromaticity

Measurement Range

You can select the measurement range from the following:

- AUTO: The measurement range is automatically set to match the luminance of the target display.
- 400 [cd/m^2]
- 4000 [cd/m^2]
- 40000 [cd/m^2]

Reference Values and Calibration Coefficients

From the measurement condition panels registered in advance in section 4.2 and 4.3, select the panel that is used for GO/NOGO determination and calibration. Each measurement condition panel has a set of registered chromaticity reference values and chromaticity calibration coefficients. There is also a DEFAULT panel in which chromaticity reference values and chromaticity calibration coefficients are not specified. If you select this panel and make measurements, GO/NOGO determination and calibration will not be performed.

Selecting the Target Color for GO/NOGO Determination and Chromaticity Calibration

Select the target color for GO/NOGO determination and chromaticity calibration.

R, G, B, W, USER1, or USER2

Display Mode

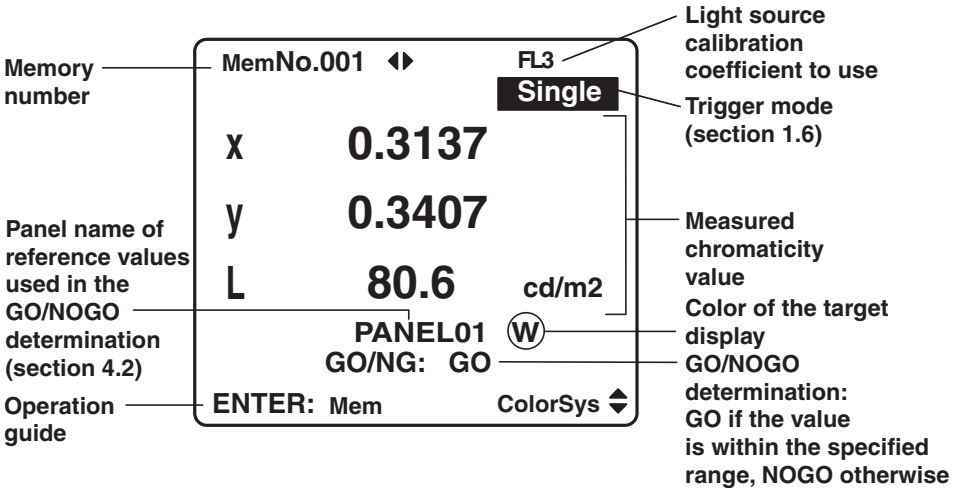
You can select the color system from the following:

x, y, L/u', v', L/X, Y, Z/r,g,b ratio/R, G, B/Tc, duv, or L

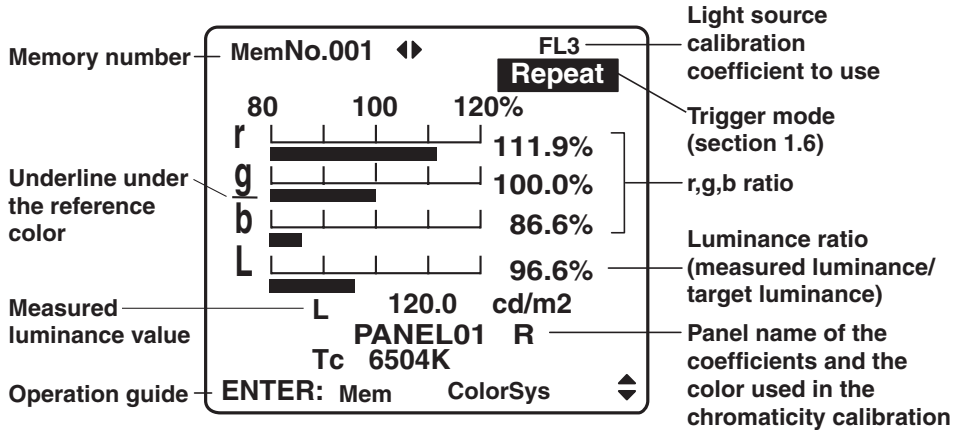
Procedure

1. Set the dial to **CHROMA**. The following screen appears (when the display mode is set to x, y, L).

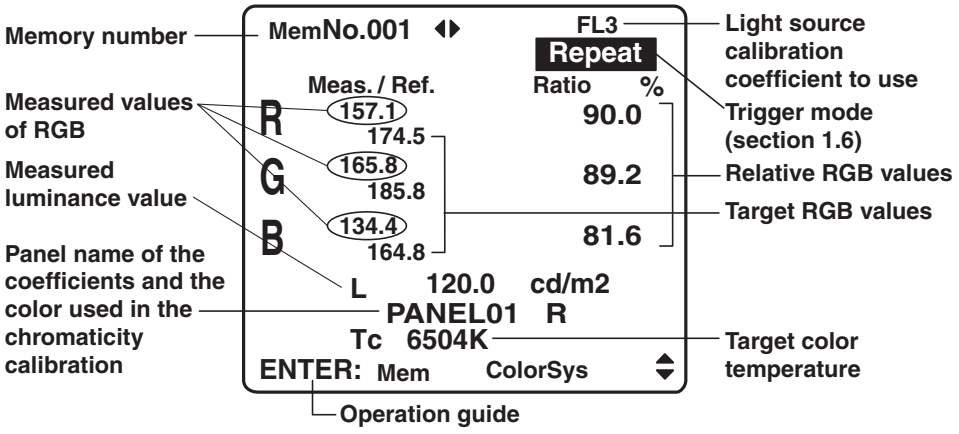
When the Display Mode is Set to x, y, L or u', v', L or X, Y, Z or Tc, duv, L



When the Display Mode is r, g, b Ratio (with Bar Display)



When the Display Mode is RGB

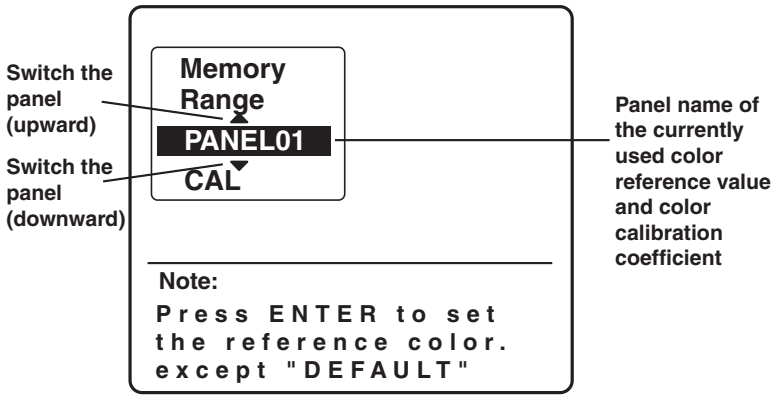


Selecting the Measurement Range

2. Press **MENU**.
3. In the menu screen that appears, select **Range**.
4. Press **ENTER** or >.
5. The measurement range setting menu appears.
6. Press ∧∨ to highlight a measurement range of **AUTO**, **40** (black and white sensor only), **400**, **4000**, or **40000**.
7. Press **ENTER** or >.

Selecting the Chromaticity Reference Value or Chromaticity Calibration Coefficient

8. On the measurement screen press **MENU**. The following screen appears.



Note

- A chromaticity reference value (six colors: R, G, B, W, USER1, USER2) and a chromaticity calibration coefficient (six colors: R, G, B, W, USER1, USER2) are registered in each panel.
- For details on the registration of chromaticity reference values and chromaticity calibration coefficients, see sections 4.2 and 4.3.
- If the panel name is DEFAULT, chromaticity reference values and chromaticity calibration coefficients are not set. In addition, the reference panel name of GO/NOGO determination and the determination result are not displayed.

9. Highlight ▲▼.
10. Press **ENTER** until the desired panel name appears.

Selecting the Target Color for GO/NOGO Determination and Chromaticity Calibration

11. Press **ENTER** or >.
12. The color selection menu is displayed.
13. Press ∧∨ to highlight a color of **R**, **G**, **B**, **W**, **USER1**, or **USER2.**
14. Press **ENTER** or >.

Executing Measurements

15. Confirm and change various parameters such as the reference value.

For details, see section 4.1, “A List of Menus.”

16. Press **MEAS** on the 3298F or the sensor.
17. The measured result is displayed on the screen.

Switching the Display Mode (Color System)

18. Press ∧∨ to switch the display mode (color system) in a cyclic fashion as shown below.

[x,y,L] ↔ [u',v',L] ↔ [X,Y,Z] ↔ [r,g,b] ↔ [R,G,B] ↔ [Tc,duv,L] ↔ [x,y,L]

Recording the Measured Results to the Memory
Loading, Clearing, and Setting the Memory

See section 3.9, “Memory Operations.”

Executing Offset Calibration

See section 3.5, “Offset Calibration.”

6.1 RS-232 Interface Functions and Specifications

Reception Functions

You can specify the same settings as those specified by front panel key operations.
The 3298F receives output requests for measured and computed data, and setup information.

Transmission Functions

Outputs measured and computed data.
Able to output setup information.

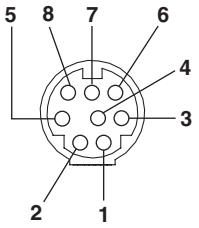
RS-232 Interface Specifications

Electrical characteristics:	Conforms to EIA RS-232
Connection method:	Point-to-point
Transmission mode:	Full-duplex
Synchronization:	Start-stop synchronization
Baud rate:	9600, 19200, and 38400
Start bit:	Fixed to 1 bit
Data length:	7 or 8 bits
Parity:	Even, odd, or no parity
Stop bit:	1 or 2 bits
Connector:	8-pin circular DIN connector
Hardware handshaking:	Controlled using the RS and CS signals.
Software handshaking:	Controls transmission and reception using the X-ON and X-OFF signals. X-ON (ASCII 11H) X-OFF (ASCII 13H)
Received buffer length:	64 bytes

6.2 Connection via the RS-232 Interface

When you connect the 3298F to a PC, you must set the 3298F so that the handshaking method, data transfer rate, data format, and other parameters match those on the PC side. For details on the settings, see the following pages. In addition, use the dedicated interface cable for the 3298F.

Connector and Signal Names



1 CS (Clear to Send)
Handshaking used to send data to the PC.
Signal direction: Input

2 RD (Received Data)
Received data from the PC.
Signal direction: Input

3 RS (Request to Send)
Handshaking used to receive data from the PC.
Signal direction: Output

4 SD (Send Data)
Transmitted data to the PC.
Signal direction: Output

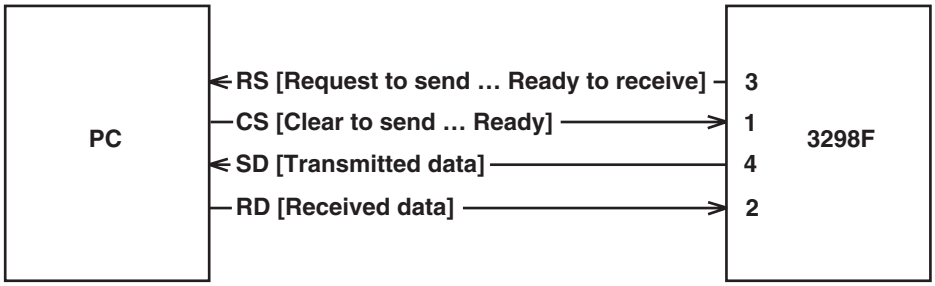
7 Sens
Detects that the connector has been inserted into the 3298F. Connected to pin 8 in the dedicated cable.

8 SG (Signal Ground)
Signal ground.

Pins 5 and 6 are not used.

Signal Direction

The following figure shows the direction of the signals used by the serial interface of the serial (RS-232).



RS-232 Standard Signals and Their JIS and CCITT Abbreviations

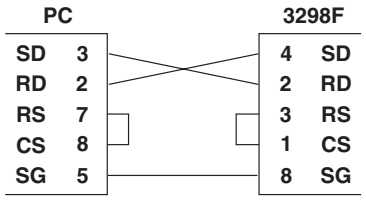
Signal Table

Pin No. (8-pin connector)	Symbol			Name
	RS-232	CCITT	JIS	
8	AB (GND)	102	SG	Signal ground
4	BA (TXD)	103	SD	Transmitted data
2	BB (RXD)	104	RD	Received data
3	CA (RTS)	105	RS	Request to send
1	CB (CTS)	106	CS	Clear to send

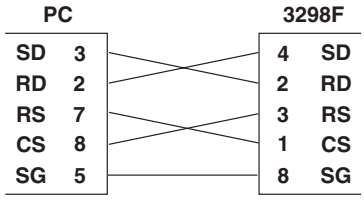
Signal Wiring Example

The pin numbers are for the 8-pin connector.

1. OFF-OFF/XON-XON



2. HARD(CS-RS)



6.3 Handshaking Method

When using the RS-232 interface for transferring data, it is necessary for equipment on both sides to agree on a set of rules to ensure the proper transfer of data. The set of rules is called handshaking. Because there are various handshaking methods that can be used between the 3298F and the PC, one must make sure that the same method is chosen for both the 3298F and the PC.
You can choose any of the three methods in the table below.

Table of Handshaking Methods (○ indicates that it is supported)

Handshaking method		Data reception control			Data transmission control		
		Software handshaking	Hardware handshaking	No handshaking	Software handshaking	Hardware handshaking	No handshaking
	3298F menu	Stops transmission when X-OFF is received. Resume when X-ON is received.	Stops transmission when CB (CTS) is false. Resume when it is true.		Send X-OFF when the received data buffer is 3/4th filled. Send X-ON when the received data buffer becomes 1/4th filled.	Set CA (RTS) to False when the received data buffer is 3/4th filled. Set to True when the received data buffer becomes 1/4th filled.	
OFF-OFF	None			○			○
XON-XON	Soft	○			○		
CS-RS	Hard		○			○	

1. OFF-OFF

Data Transmission Control

There is no handshaking between the 3298F and the PC. The "X-OFF" and "X-ON" signals are treated as data, and the CS signal is ignored.

Data Reception Control

There is no handshaking between the 3298F and the PC. When the received buffer becomes full, all overflow data are discarded.
RS = True (fixed).

Note

The PC program must be designed so that the received buffers of both the 3298F and the PC do not become full.

2. XON-XON

Data Transmission Control

Software handshaking is performed between the 3298F and the PC. When an "X-OFF" code is received while sending data to the PC, the 3298F stops the data transmission. When it receives the next "X-ON" code, it resumes the data transmission. The CS signal received from the PC is ignored.

Data Reception Control

Software handshaking is performed between the 3298F and the PC. When the free area of the receive buffer decreases to 16 bytes, the 3298F sends an "X-OFF" code. When the free area increases to 48 bytes, it sends an "X-ON" code.
RS = True (fixed).

3. CS-RS

Data Transmission Control

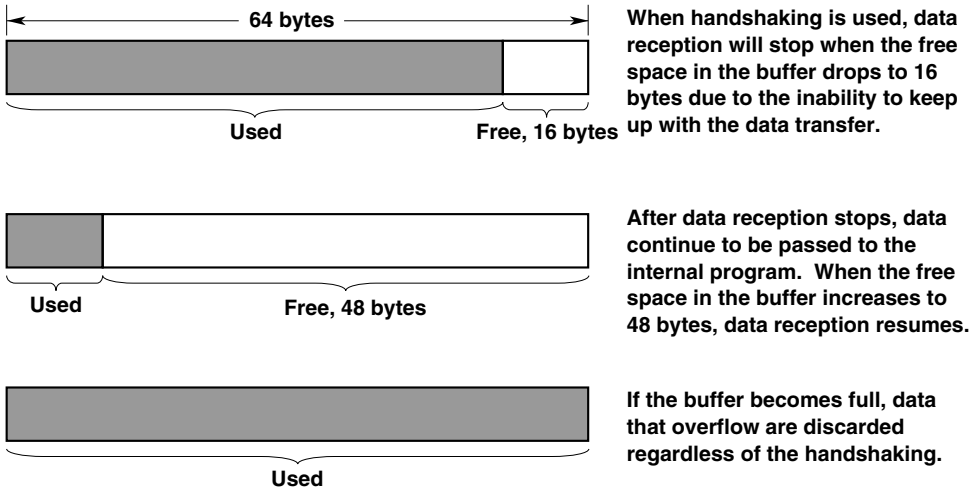
Hardware handshaking is performed between the 3298F and the PC. When the CS signal becomes False while sending data to the PC, the 3298F stops the data transmission. When the CS signal becomes True, it resumes the data transmission. The "X-OFF" and "X-ON" signals are treated as data.

Data Reception Control

Hardware handshaking is performed between the 3298F and the PC. When the free area of the receive buffer decreases to 16 bytes, the 3298F sets "RS=False." When the free area increases to 48 bytes, it sets "RS=True."

Precautions Regarding Data Receiving Control

When handshaking is used to control the reception of data, data may still be sent from the PC even if the free space in the receive buffer drops below 64 bytes.
In addition, if the receive buffer becomes full, the excess data will be lost regardless of whether handshaking is in effect. Storage of data resumes when there is free space in the buffer.



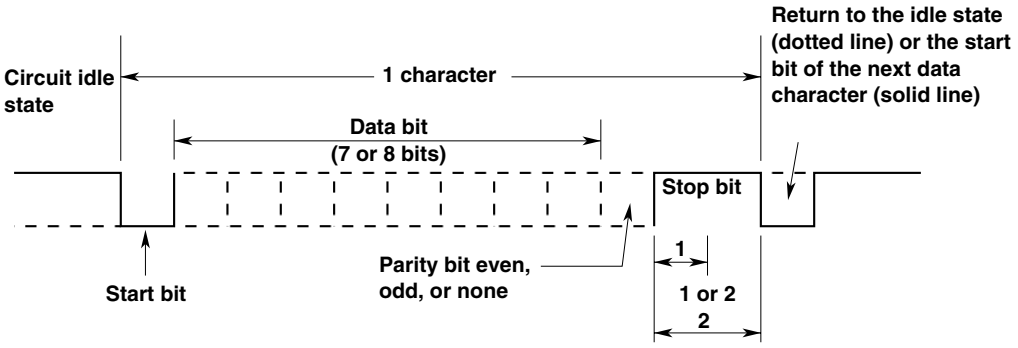
Data Receiving Control through Handshaking

Terminator

The terminator that is used when the 3298F receives data is CR+LF.

6.4 Data Format

The RS-232 interface on the 3298F performs communications using start-stop synchronization. In start-stop synchronization, characters are transmitted one at a time. Each character consists of a start bit, data bits, a parity bit, and a stop bit (see the figure below).



6.5 RS-232 Commands

A List of Commands

A command is normally expressed using two characters. The parameters inside the brackets can be omitted.

However, the number of characters that succeeds the command varies depending on the command.

Command	Functions	Page
FM,nn(CrLf)	Specifies or reads measurement function.	6-7
RG,nn,m[,o](CrLf)	Sets the measurement range.	6-7
LS,n(CrLf)	Specifies or reads light source calibration coefficient.	6-8
TM,n[,mm](CrLf)	Specifies or reads the trigger mode.	6-8
GM(CrLf)	Instructs measurement start.	6-8
CM,n(CrLf)	Controls continuous measurement.	6-8
OR(CrLf)	Reads the data.	6-8
MO[,nn](CrLf)	Starts the measurement and reads the data.	6-8
CE(CrLf)	Executes calibration.	6-8
MN,nnn(CrLf)	Specifies memory number.	6-8
ME(CrLf)	Executes memory.	6-9
MR,nn,mmm(CrLf)	Reads memory data	6-9
MC,nn(CrLf)	Clears the memory data.	6-9
CA,n(CrLf)	Specifies contrast measurement mode.	6-9
FR,n(CrLf)	Specifies or reads the flicker rate.	6-9
LE,n(CrLf)	Specifies or reads the luminance display during flicker measurement.	6-9
CS,n,m(CrLf)	Specifies or reads chromaticity calibration coefficient.	6-9
BR,n(CrLf)	Specifies or reads the RGB bar graph range.	6-9
RF,+c+c(CrLf)	Sets or reads reference value.	6-10
CN,+c+c(CrLf)	Sets or reads calibration coefficient.	6-10
WB,n,m(CrLf)	Specifies or reads white balance.	6-11
BL,n(CrLf)	Specifies or reads the back light.	6-11
PW,n(CrLf)	Specifies or reads auto power down.	6-11
RM,n(CrLf)	Specifies or clears remote mode, stops display updating.	6-11
FI,n(CrLf)	Initialization the setting.	6-11
VR(CrLf)	Read version.	6-11

Command Reference

FM

Function: Specifies the measurement function.

Syntax:
- FM,nn(CrLf): Specify the function
- FM(CrLf): Read the function.

Return value:
- FM,nn(CrLf) → FM,OK(CrLf)
- FM(CrLf) → FM,nn(CrLf)

Description: The measurement function is specified through nn that follows FM using the following values.

00	Luminance
10	Contrast
20	Flicker
31	xyL
32	u'v'L
33	XYZ
34	rgb ratio
35	RGB
36	Tc duv L

RG

Function: Sets the range for each measurement mode.

Syntax:
- RG,nn,m[,o](CrLf): When setting
- RG,nn(CrLf): When reading

Return value:
- When setting → RG,OK(CrLf)
- When reading → RG,nn,m,o(CrLf)

Description: When m = 0 (Auto), o (range) can be omitted.

nn=
- 00:Luminance
- 10:Contrast
- 20:Flicker
- 30:Chromaticity

m=
- 0:Auto
- 1:Manual

o=
- 0:40
- 1:400
- 2:4000
- 3:40000

LS

Function	Sets the type of light source calibration coefficient.
Syntax	LS,n(CrLf): When setting LS(CrLf): When reading
Return value	LS,n(CrLf) → LS,OK(CrLf) LS(CrLf) → LS,n(CrLf)
Description	n=0: type-A, 1: FL3, 2: CRT

TM

Function	Specifies the trigger mode.
Syntax	TM,n[,mm](CrLf): When setting TM(CrLf): When reading
Return value	When setting → TM,OK(CrLf) When reading → TM,n,mm(CrLf)
Description	Set the trigger mode using the following parameters (n and mm) that succeed TM. n= 0: Single, 1: Repeat mm= Average count (00 or 01 signifies no average.)

GM

Function	Starts the measurement.
Syntax	GM,n(CrLf)
Return value	GM,OK(CrLf)
Description	Performs the same operation as the MEAS key on the 3298F and the sensor. The operation varies depending on the trigger mode as follows: When the trigger mode is repeat: Switches between repeat (continuous measurement) and hold. When the trigger mode is single: Performs a single measurement (single trigger measurement).

CM

Function	Starts/Stops continuous measurement.
Syntax	CM,n(CrLf)
Return value	CM,OK(CrLf)
Description	Instructs starting and stopping of continuous measurement and the transmission of continuous data. n=0: Stops continuous measurement. n=1: Starts continuous measurement. Equivalent to issuing the GM command when repeat is specified. n=2: Starts continuous measurement and outputs data each time a measurement is completed. When n=2, CM,OK is not transmitted.

OR

Function	Reads the measured data.
Syntax	OR(CrLf)
Return value	See output data format (page 6-11).
Description	The measured data is read according to the current measurement function that is selected. This command always reads the last measured value. To retrieve the newest measured value, perform measurements in advance using the GM command.

MO

Function	Starts the measurement and reads the data.
Syntax	MO[,nn](CrLf) Switches the function and performs measurement and data read. If you omit [], measurement and data read are performed using the current function. MO,10,m(CrLf) Switches the function to contrast and performs measurement and data read. Specify white measurement or black measurement using parameter m.
Return value	See output data format (page 6-11).
Description	nn = 00: Luminance 10: Contrast 20: Flicker 31: xyL 32: u'v'L 33: XYZ 34: RGB ratio 35: RGB 36: Tc duv L m= 0: Black measurement 1: White measurement Parameter m is valid only during contrast measurement.

CE

Function	The CE command executes zero calibration.
Syntax	CE(CrLf)
Return value	CE,OK(CrLf)
Description	The 3298F returns CE,OK when the calibration is completed.

MN

Function	Specifies the memory number.
Syntax	MN,nnn(CrLf)
Return value	MN,OK(CrLf)
Description	nnn: Memory number (001 through 200)

ME

Function	Saves the current measured value to the memory.
Syntax	ME(CrLf)
Return value	ME,OK(CrLf)

MR

Function	Reads the memory data at number mmm of the function specified by nn.
Syntax	MR,nn,mmm(CrLf)
Return value	Same format as the returned value for the OR command.
Description	The memory data can be read regardless of the position of the dial. nn: Measurement function (see the FM command) mmm: Memory number (001 through 200)

MC

Function	Clears the memory for each measurement mode.
Syntax	MC,nn(CrLf)
Return value	MC,OK(CrLf)
Description	nn= 00: Luminance 10: Contrast 20: Flicker 30: Chromaticity

CA

Function	Specifies the measurement mode (Auto/Manual) for contrast measurement.
Function	CA,n(CrLf): When setting CA(CrLf): When reading
Return value	When setting → CA,OK(CrLf) When reading → CA,n(CrLf)
Description	n:0=Manual 1=Auto

FR

Function	Specifies the flicker rate.
Syntax	FR,n(CrLf): When setting FR(CrLf): When reading
Return value	When setting → FR,OK(CrLf) When reading → FR,n(CrLf)
Description	Specifies the flicker rate. n= 0: 20Hz, 1: 30Hz, 2: 40Hz, 3: 50Hz 4: 60Hz, 5: 70Hz, 6: 80Hz, 7: 90Hz

LE

Function	Enables or disables the luminance display during flicker measurement.
Syntax	LE,n(CrLf):When setting LE(CrLf): When reading
Return value	When setting → LE,OK(CrLf) When reading → LE,n(CrLf)
Description	n:0=Disable luminance display 1=Enable luminance display

CS

Function	Sets the chromaticity reference.
Syntax	CS,n,m(CrLf): When setting CS(CrLf): When reading
Return value	When setting → CS,OK(CrLf) When reading → CS,n,m(CrLf)
Description	n= Reference pannel number (0 through 9) m= 0: R, 1: G, 2: B, 3: W, 4: USER1, 5: USER2 When pannel name is “DEFAULT”, n=“-”.

BR

Function	Sets the bar range for RGB measurement.
Syntax	BR,n(CrLf): When setting BR(CrLf): When reading
Return value	When setting → BR,OK(CrLf) When reading → BR,n(CrLf)
Description	n:0=±2% 1=±4% 2=±10% 3=±20% 4=±40%

RF

Function	Sets the reference values for each measurement mode.
Syntax	RF,nn,mm,oo,pp,value(CrLf): When setting RF,nn,mm,oo,pp(CrLf): When reading
Return value	When setting → RF,OK(CrLf) When reading → RF,value(CrLf)
Description	Sets the reference values of each measurement mode using the following parameters (nn, mm, oo, and pp) that come after RF. Minimum luminance reference: 00, 00, 00, 00 (nn,mm,oo,pp) Luminance reference: 00, 00, 00, 01 Maximum luminance reference: 00, 00, 00, 02 Minimum contrast: 10, 00, 00, 00 Maximum flicker: 20, 00, 00, 00 Chromaticity name: 30, *1, 00, 00 Chromaticity reference x: 30, *1, *2, 01 Chromaticity reference y: 30, *1, *2, 02 Chromaticity tolerance x: 30, *1, *2, 03 Chromaticity reference y: 30, *1, *2, 04 White balance target color temperature: 34, *3, 00, 00 White balance target color temperature y: 34, *3, 00, 01 White balance target luminance L: 34, *3, 00, 02 *1 Reference panel number 00 through 09 *2 00: R, 01: G, 02: B, 03: W, 04: USER1, 05: USER2 *3 00: USER1, 01:USER2, 02: 6504K, 03:6774K, 04: 9304K

CN

Function	Sets the calibration coefficients for each measurement mode.
Syntax	CN,nn,mm,oo,pp,value(CrLf): When setting CN,nn,mm,oo,pp(CrLf): When reading
Return value	When setting → CN,OK(CrLf) When reading → CN,value(CrLf)
Description	Specify the type of calibration coefficient using the parameters (nn, mm, oo, and pp) that succeed CN. Luminance calibration coefficient a: 00, 00, 00, 00 Luminance calibration coefficient b: 00, 00, 00, 01 Flicker calibration coefficient A: 20, 00, 00, 00 Flicker calibration coefficient B: 20, 00, 00, 01 Chromaticity calibration coefficient X: 30, *1, *2, 01 Chromaticity calibration coefficient Y: 30, *1, *2, 02 Chromaticity calibration coefficient Z: 30, *1, *2, 03 User-defined white balance setting: 34, *3, *4, *5 *1 Reference panel number 00 through 09 *2 00: R, 01: G, 02: B, 03: W, 04: USER1, 05: USER2 *3 00: USER1, 01: USER2 *4 00: R, 01: G, 02: B *5 00: X, 01: Y, 02: Z

WB

Function	Sets parameters related to white balance.
Syntax	WB,n,m(CrLf): When setting WB,n(CrLf): When reading
Return value	When setting → WB,OK(CrLf) When reading → WB,n,m(CrLf)
Description	Sets the parameters necessary for the white balance adjustment using the following parameters (n and m) that come after WB.

Reference color	R:	0, 0
	G:	0, 1
	B:	0, 2
Color temperature	6504K:	1, 0
	6774K:	1, 1
	9304K:	1, 2
	USER1:	1, 3
	USER2:	1, 4
Standard	NTSC:	2, 0
	PAL :	2, 1
	HDTV :	2, 2
	USER1:	2, 3
	USER2:	2, 4

BL

Function	Turns ON/OFF the backlight.
Syntax	BL,n(CrLf): When setting BL(CrLf): When reading
Return value	When setting → BL,OK(CrLf) When reading → BL,n(CrLf)
Description	Turns ON/OFF the backlight. n= 0: OFF, 1: ON

PW

Function	Sets the auto power down function.
Syntax	PW,n(CrLf): When setting PW(CrLf): When reading
Return value	When setting → PW,OK(CrLf) When reading → PW,n(CrLf)
Description	n= 0: OFF, 1: 1 min, 2: 2 min, 3: 5 min, 4: 10 min, 5: 20 min

RM

Function	Sets remote or local.
Description	n = 0: Local 1: Remote + measured value display 2: Remote + no measured value display High-speed measurement is possible by setting n to 2.

FI

Function	Initializes the setup parameters of the 3298F.
Description	n = 0: All 1: Setting values 2: Reference values 3: Calibration coefficients For details on the parameters that are initialized, see Appendix 1.

VR

Function	Reads version information.
Syntax	VR(CrLf)
Return value	VR,X.XX(CrLf)

Output Data Format

1. Luminance

OR,nn,s,r,mmmmmmm,j(CrLf)
nn: Measurement function (see the FM command)
mmmmmmm: Measured value
Example: +1.2340 -123.40 +0.1234
s: Data status
0=normal, 1=low battery, 2=recalibration required, 3=over
r: Range
0=40.00, 1=400.0, 2=4000, 3=40000
j: Determination
0=OK, 1=NG

2. Contrast

OR,nn,s,r,p,mmmmmmm,r,p,mmmmmmm,p,mmmmmmm,j(CrLf)
nn: Measurement function (see the FM command)
mmmmmmm: Measured values in the order: bright luminance, dark luminance, contrast.
Example: +1.2340 -123.40 +0.1234
s: Data status
0=normal, 1=low battery, 2=recalibration required, 3=over
r: Range
0=40.00, 1=400.0, 2=4000, 3=40000
p: Measurement status
0=not measured, 1=measured
j: Determination
0=OK, 1=NG

3. Flicker

OR,nn,s,r,mmmmmmm,mmmmmmm,mmmmmmm,j(CrLf)
nn: Measurement function (see the FM command)
mmmmmmm:Measured values in the order: flicker, luminance, dB
Example: +1.2340 -123.40 +0.1234
s: Data status
0=normal, 1=low battery, 2=recalibration required, 3=over
r: Range
0=40.00, 1=400.0, 2=4000, 3=40000
j: Determination
0=OK, 1=NG

4. xyL,u'v'L,XYZ,Tc duv L

OR,nn,s,r,mmmmmmm,mmmmmmm,mmmmmmm,j(CrLf)
nn: Measurement function (see the FM command)
mmmmmmm: Measured values in the order:
L, x, y for xyL
L, u', v' for u'v'L
X, Y, Z for XYZ
L, Tc, duv for Tc duv L
Example: +1.2340 -123.40 +0.1234
s: Data status
0=normal, 1=low battery, 2=recalibration required, 3=over
r: Range
0=40.00, 1=400, 0,2=4000, 3=40000
j: Determination
0=OK, 1=NG

5. RGB, rgb ratio

OR,nn,s,r,mmmmmmm,mmmmmmm,mmmmmmm,
mmmmmmm,j(CrLf)
nn: Measurement function (see the FM command)
mmmmmmm: Measured values in the order: L (%), r, g, b for RGB ratio, L, R, G, B for RGB
Example: +1.2340 -123.40 +0.1234
s: Data status
0=normal, 1=low battery, 2=recalibration required, 3=over
r: Range
0=40.00, 1=400.0, 2=4000, 3=40000
j: Determination
0=OK, 1=NG

Examples of Command Sequence for Various Measurements

Common Settings		Example
Set the light source calibration coefficient	LS command	LS,1
Sets the trigger mode and average count	TM command	TM,0,00 (single mode and average count of 00)
Execute calibration	CE command	CE
Luminance measurement		
• Measurement preparation		
Switch to the luminance measurement function	FM command	FM,00
Set the luminance reference and criteria range	RF command	RF,00,00,00,01,150.0
Set the luminance calibration coefficient	CN command	CN,00,00,00,00,1.0
Set the measurement range*1	RG command	RG,00,1,1
• Starts the measurement and retrieves the data	MO command	MO
Contrast measurement		
• Measurement preparation		
Switch to the contrast measurement function	FM command	FM,10
Set the contrast criteria	RF command	RF,10,00,00,00,100.0
Set the measurement range*1	RG command	RG,10,1,1
• Start the measurement	GM command	GM,1
(Can specify bright luminance measurement or dark luminance measurement)		
• Retrieve data	OR command	OR
Flicker measurement		
• Measurement preparation		
Switch to the flicker measurement function	FM command	FM,20
Setting the flicker criteria	RF command	FM,20,00,00,00,4.0
Set the flicker calibration coefficient	CN command	CN,20,00,00,00,1.0
Set the flicker rate	FR command	FR,1
Set the measurement range*1	RG command	RG,20,1,1
• Start the measurement	GM command	GM
• Retrieve data	OR command	OR
Chromaticity measurement		
• Measurement preparation		
Switch to the chromaticity measurement function*2	FM command	FM,31
Set the chromaticity reference and criteria range	RF command	RF,30,00,00,01,0.31
Set the chromaticity calibration coefficient	CN command	CN,30,00,00,01,1.00
Specify the chromaticity reference value and the calibration coefficient	CS command	CS,0,0
Set the measurement range*1	RG command	RG,30,1,1
• Start the measurement	GM command	GM
• Retrieve data	OR command	OR

*1: You can set the range for each measurement function.
*2: Set the color system for the chromaticity measurement function.

Note

If you are performing auto adjustment using a PC, the measurement cycle is shortened by turning OFF the 3298F screen. To turn OFF the screen, use the RM command. For details on the RM command, see section 6.5.

6.6 Sample Program

Before Programming

Environment

Target machine: IBM-AT compatible PC
Target language: Visual Basic Ver5.0 Professional Edition or later.

Settings on Visual Basic

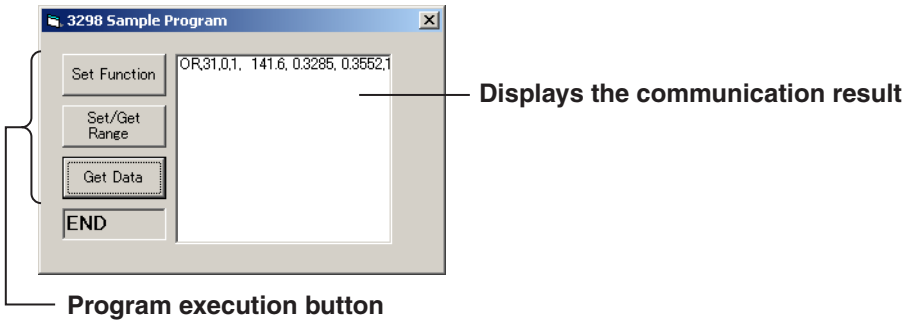
Used component: MSComm

3298F Settings

The sample programs in this section assumes the RS-232 settings of the 3298F as follows:

Baud Rate:	38400
Handshake:	Hardware (CTS-RTS)
Parity:	None
Stop Bit:	2
Data Length:	8
Terminator:	CR+LF

Sample Program Image



Resetting the 3298F and Displaying Communication Errors

```
Option Explicit
Dim StartFlag As Integer                'Start Flag
Dim TimerCount As Integer               'Timer Count
Dim Timeout As Integer                  'Timeout
Dim CtsFlag As Integer                  'CTS Flag
Dim Term As String                      'Terminator
Dim Query(1) As String                  'Query String
Dim Dummy As Integer
```

```
Private Function InitSerial() As Integer
    Dim rat As String

    MSComm1.CommPort = 1                    'Port = COM1

    rat = "38400,N,8,2"      'Rate = 38400, NoParity, 8Bit, 2Stopbit

    MSComm1.Settings = rat

    MSComm1.Handshaking = comRTS            'Handshake = CTS-RTS
    MSComm1.RTSEnable = True                'RTS = TRUE
    CtsFlag = 1
    Term = Chr(13) + Chr(10)                'Terminator = CR+LF
    Timeout = 10                            'Timeout = 10s
    InitSerial = 0

End Function
```

```
Private Sub DisplayRS232Error(ByVal erm As String, Optional ByVal
msg As String = "")
    MsgBox (erm + Chr(13) + msg), vbExclamation, "Error!!"
End Sub
```

```
Private Sub Command1_Click()
    Dim sts As Integer

    If (StartFlag = 1) Then
        Exit Sub
    End If
    StartFlag = 1
    Text1.Text = "START"
    List1.Clear
    sts = SetFunction                   'Set measurement function
    If (sts = 0) Then
        List1.AddItem Query(0)
    End If

    Text1.Text = "END"
    StartFlag = 0

End Sub
```

```
Private Sub Command2_Click()
    Dim sts As Integer

    If (StartFlag = 1) Then
        Exit Sub
    End If
    StartFlag = 1
    Text1.Text = "START"
    List1.Clear
    sts = SetRange                    'Set/Get measurement range
    If (sts = 0) Then
        List1.AddItem Query(0)
    End If
    Text1.Text = "END"
    StartFlag = 0

End Sub
```

```
Private Sub Command3_Click()
    Dim sts As Integer

    If (StartFlag = 1) Then
        Exit Sub
    End If
    StartFlag = 1
    Text1.Text = "START"
    List1.Clear
    sts = GetData
    If (sts = 0) Then
        List1.AddItem Query(0)
    End If
    Text1.Text = "END"
    StartFlag = 0

End Sub
```

```
Private Sub Form_Load()

    StartFlag = 0                         'Clear Start Flag
    Timer1.Interval = 0
    Command1.Caption = "Set Function"
    Command2.Caption = "Set/Get" + Chr(13) + "Range"
    Command3.Caption = "Get Data"
    Text1.Text = ""

End Sub
```

```
Private Sub MSComm1_OnComm()
    Dim evt As Integer

    evt = MSComm1.CommEvent
    Select Case evt
    'Error
        Case comBreak
            Call DisplayRS232Error("comBreak:Break received")
        Case comCDTO
            Call DisplayRS232Error("comCDTO CD(RLSD) timeout")
        Case comCTSTO
            Call DisplayRS232Error("comCTSTO:CTS timeout")
        Case comDSRTO
            Call DisplayRS232Error("comCDRTO:DSR timeout")
        Case comFrame
            Call DisplayRS232Error("comFrame:Frame error")
        Case comOverrun
            Call DisplayRS232Error("comOverrun:Overrun")
        Case comRxOver
            Call DisplayRS232Error("comRxOver:Receive buffer
overflow")
        Case comRxParity
            Call DisplayRS232Error("comRxParity:Parity error")
        Case comTxFull
            Call DisplayRS232Error("comTxFull:Send buffer overflow")
    'Event
        Case comEvReceive
        Case comEvCD
        Case comEvCTS
        Case comEvDSR
        Case comEvRing
        Case comEvSend
    End Select

End Sub
```

```
Private Sub Timer1_Timer()
    TimerCount = TimerCount + 1
End Sub
```

Setting the Measurement Function

```
Private Function SetFunction()
    Dim msg As String                          'Command buffer
    Dim qry As String                          'Query buffer
    Dim sts As Integer

    qry = CStr(Empty)

    sts = InitSerial                           'Initialize RS232
    If (sts <> 0) Then
        Exit Function
    End If

    MSComm1.InputLen = 0                       'Recive All Data
    MSComm1.InputMode = comInputModeText       'Text Mode
    MSComm1.PortOpen = True                    'Port Open
    MSComm1.OutBufferCount = 0                 'Out Buffer Clear
    MSComm1.InBufferCount = 0                  'In Buffer Clear
    Timer1.Interval = 1000

    If CtsFlag = 1 Then                        'If CTS = FALSE
        TimerCount = 1                         'Wait until CTS = TRUE
        Do
            Dummy = DoEvents()
            If (TimerCount >= Timeout) Then
                Call DisplayRS232Error("CTS Timeout")
                SetFunction = 1
                GoTo finish
            End If
        Loop Until MSComm1.CTSHolding = True
    End If

    ' Send Message
    msg = "FM,31" + Term    'Set measurement function (Chromaticity)
    MSComm1.Output = msg

    TimerCount = 1
    Do                      'Wait until OutBufferCount = 0
        Dummy = DoEvents()
        If (TimerCount >= Timeout) Then
            Call DisplayRS232Error("Send Timeout", msg)
            SetFunction = 1
            GoTo finish
        End If
    Loop Until MSComm1.OutBufferCount = 0
```

```
    TimerCount = 1
    Do                              'Receive Query
        qry = qry + MSComm1.Input   'Wait until End Data = Terminator
        Dummy = DoEvents()
        If (TimerCount >= Timeout) Then
            Call DisplayRS232Error("Receive Timeout", msg)
            SetFunction = 1
            GoTo finish
        End If
    Loop Until Right$(qry, 1) = Chr(10)

    Query(0) = Left$(qry, Len(qry) - 2)
    SetFunction = 0

finish:
    MSComm1.PortOpen = False        'Port Close
    Timer1.Interval = 0

End Function
```

Setting/Querying the Measurement Range

```
Private Function SetRange() As Integer
    Dim msg As String                          'Command buffer
    Dim qry As String                          'Query buffer
    Dim sts As Integer

    qry = CStr(Empty)

    sts = InitSerial                           'Initialize RS232
    If (sts <> 0) Then
        Exit Function
    End If

    MSComm1.InputLen = 0                       'Recive All Data
    MSComm1.InputMode = comInputModeText       'Text Mode
    MSComm1.PortOpen = True                    'Port Open
    MSComm1.OutBufferCount = 0                 'Out Buffer Clear
    MSComm1.InBufferCount = 0                  'In Buffer Clear
    Timer1.Interval = 1000

    If CtsFlag = 1 Then                        'If CTS = FALSE
        TimerCount = 1                         'Wait until CTS = TRUE
        Do
            Dummy = DoEvents()
            If (TimerCount >= Timeout) Then
                Call DisplayRS232Error("CTS Timeout")
                SetRange = 1
                GoTo finish
            End If
        Loop Until MSComm1.CTSHolding = True
    End If

    ' Send Message
    msg = "RG,30,1,1" + Term          'Set the measurement range
         ' (Function:Chromaticity, Auto/Manual:Manual,Range:400)
    MSComm1.Output = msg

    TimerCount = 1
    Do                                 'Wait until OutBufferCount = 0
        Dummy = DoEvents()
        If (TimerCount >= Timeout) Then
            Call DisplayRS232Error("Send Timeout", msg)
            SetRange = 1
            GoTo finish
        End If
    Loop Until MSComm1.OutBufferCount = 0
```

```
    TimerCount = 1
    Do                              'Receive Query
        qry = qry + MSComm1.Input   'Wait until End Data = Terminator
        Dummy = DoEvents()
        If (TimerCount >= Timeout) Then
            Call DisplayRS232Error("Receive Timeout", msg)
            SetRange = 1
            GoTo finish
        End If
    Loop Until Right$(qry, 1) = Chr(10)
```

```
qry = CStr(Empty)

    ' Send Message
    msg = "RG,30" + Term            'Get the measurement range
    MSComm1.Output = msg

    TimerCount = 1
    Do                              'Wait until OutBufferCount = 0
        Dummy = DoEvents()
        If (TimerCount >= Timeout) Then
            Call DisplayRS232Error("Send Timeout", msg)
            SetRange = 1
            GoTo finish
        End If
    Loop Until MSComm1.OutBufferCount = 0

    TimerCount = 1
    Do                              'Receive Query
        qry = qry + MSComm1.Input   'Wait until End Data = Terminator
        Dummy = DoEvents()
        If (TimerCount >= Timeout) Then
            Call DisplayRS232Error("Receive Timeout", msg)
            SetRange = 1
            GoTo finish
        End If
    Loop Until Right$(qry, 1) = Chr(10)

    Query(0) = Left$(qry, Len(qry) - 2)
    SetRange = 0

finish:
    MSComm1.PortOpen = False        'Port Close
    Timer1.Interval = 0

End Function
```

Making Measurements and Retrieving Data

```
Private Function GetData() As Integer
    Dim msg As String                          'Command buffer
    Dim qry As String                          'Query buffer
    Dim sts As Integer

    qry = CStr(Empty)

    sts = InitSerial                           'Initialize RS232
    If (sts <> 0) Then
        Exit Function
    End If

    MSComm1.InputLen = 0                       'Recive All Data
    MSComm1.InputMode = comInputModeText       'Text Mode
    MSComm1.PortOpen = True                    'Port Open
    MSComm1.OutBufferCount = 0                 'Out Buffer Clear
    MSComm1.InBufferCount = 0                  'In Buffer Clear
    Timer1.Interval = 1000

    If CtsFlag = 1 Then                        'If CTS = FALSE
        TimerCount = 1                         'Wait until CTS = TRUE
        Do
            Dummy = DoEvents()
            If (TimerCount >= Timeout) Then
                Call DisplayRS232Error("CTS Timeout")
                GetData = 1
                GoTo finish
            End If
        Loop Until MSComm1.CTSHolding = True
    End If

    ' Send Message
    msg = "TM,0" + Term                        'Set trigger mode
    MSComm1.Output = msg

    TimerCount = 1
    Do                                  'Wait until OutBufferCount = 0
        Dummy = DoEvents()
        If (TimerCount >= Timeout) Then
            Call DisplayRS232Error("Send Timeout", msg)
            GetData = 1
            GoTo finish
        End If
    Loop Until MSComm1.OutBufferCount = 0
```

```
    TimerCount = 1
    Do                              'Receive Query
        qry = qry + MSComm1.Input   'Wait until End Data = Terminator
        Dummy = DoEvents()
        If (TimerCount >= Timeout) Then
            Call DisplayRS232Error("Receive Timeout", msg)
            GetData = 1
            GoTo finish
        End If
    Loop Until Right$(qry, 1) = Chr(10)

 qry = CStr(Empty)

    ' Send Message
    msg = "MO" + Term               'Measurement start
    MSComm1.Output = msg

    TimerCount = 1
    Do                              'Wait until OutBufferCount = 0
        Dummy = DoEvents()
        If (TimerCount >= Timeout) Then
            Call DisplayRS232Error("Send Timeout", msg)
            GetData = 1
            GoTo finish
        End If
    Loop Until MSComm1.OutBufferCount = 0

    TimerCount = 1
    Do                              'Receive Query
        qry = qry + MSComm1.Input   'Wait until End Data = Terminator
        Dummy = DoEvents()
        If (TimerCount >= Timeout) Then
            Call DisplayRS232Error("Receive Timeout", msg)
            GetData = 1
            GoTo finish
        End If
    Loop Until Right$(qry, 1) = Chr(10)

    Query(0) = Left$(qry, Len(qry) - 2)
    GetData = 0

finish:
    MSComm1.PortOpen = False        'Port Close
    Timer1.Interval = 0

End Function
```

7.1 Specifications

Parameter	Specification
Type	Shading cylinder luminance meter/shading cylinder colorimeter
Photo-detecting device	
Black and white	Silicon photodiode 1 device
Color	Silicon photodiode 3 devices
Black and white LCD dot matrix display	128 × 128 dots (with backlight) Bar graph Overrange display
Photodetecting diameter/visual angle	ϕ 10 mm (minimum)/approximately 30 degrees
Measurement distance (mm)	In contact 10 20 50 80 100
Measuring field diameter (mm)[*1]	10 19 25 42 61 73
Measurable range of luminance	
Black and white	0.01 to 40,000 cd/m^2
Color	0.01 to 40,000 cd/m^2
Measurement range (cd/m^2)	
Black and white	40.00, 400.0, 4,000, 40,000
Color	400.0, 4,000, 40,000
Spectral responsivity	
Black and white	Approximated to CIE-1931 spectral luminous efficiency
Color	Approximated to CIE-1931 color matching functions Satisfies the tolerance limit as defined by JIS Z 8724-1983, “Methods of colour measurement”
Measurement functions	
	Black and white / Color
Luminance	Yes / Yes
Contrast	Yes / Yes
Flicker	Yes / Yes
Chromaticity	– / Yes
	The following color systems are available for chromaticity • Chromaticity coordinates: xyL and u’v’L • Tristimulus values: XYZ, RGB (NTSC, PAL, and HDTV), RGB ratio • Correlated color temperatures: Tc duv L
Measurement interval (Display update rate)[*2]	
Luminance and flicker measurement	400 ms
Error from correlated color Temperature and blackbody radiation	1 s
Other measurements	700 ms
Data memory	
Data memory	200 data points per measurement
Luminance measurement accuracy	±4% of the displayed value ±0.035% of the full scale • Standard measurement conditions[*3] • Standard light source A • Minimum luminance of 2% of the full scale of each range and 2cd/m^2

7.1 Specifications

Parameter	Specification
Chromaticity accuracy (color type only) Error of x and y values[*4]	±0.002 or less • Standard measurement conditions[*3] • Standard light source A • Minimum luminance of 2% of the full scale of each range
Error of x and y values[*4]	±0.03 or less • Standard measurement conditions[*3] • For combinations of standard light source A with color filters[*4] and three-wavelength fluorescent lamp with color filters • Minimum luminance of 1% of the full scale of each range
Light source calibration coefficient	3 data types (standard light source A, three-wavelength fluorescent lamp, and CRT)
User-calibration coefficient	Black and white: Linear function compensation on luminance and flicker measurement Color: Linear function compensation on flicker measurement Compensation on chromaticity measurements 6 colors × 10 panels
Reference color	6 colors × 10 panels (set using key input or by measurement)
Flicker measurement range	2, 4, 8, 20% rms
Flicker measurement accuracy	±1% (Reference value) • Standard measurement conditions[*3] • For sine wave of 200 cd/m2, 10% rms, and 30 Hz
Luminance range for flicker measurement (Standard measurement conditions[*3]. For sine wave of 10% rms, 30 Hz) Black and white Color	 5 to 40,000 cd/m^2 25 to 40,000 cd/m^2
Programmable low-pass filter Flicker frequency	 20, 30, 40, 50, 60, 70, 80, 90 Hz (selectable)
Auto power down	Selectable from OFF, 1 min, 2 min, 5 min, 10 min, and 20 min • Valid only when battery-driven
Average count	Selectable between 1 and 20
Range hold	Auto range and range hold available
Trigger (measurement) mode	Repeat and single
Data hold	The display is held using the MEAS key when the trigger mode is set to repeat. In addition, pressing the MEAS key starts the measurement
Temperature characteristics	Deviations of the tristimulus values (X, Y, and Z): ±3% or less In the 5 to 40°C range. 23°C is the reference
Humidity characteristics	Deviations of the tristimulus values (X, Y, and Z): ±3% or less 80% RH or less. 65% RH is the reference
Distance characteristics	Deviations of the tristimulus values (X, Y, and Z): ±1% or less In the measurement distance from 0 to 100 mm, 50 mm is the reference
External trigger input	Contact input Low: 0 (short) to 0.3 V High: 2.0 to 5 V (open) Pulse width: 1 ms or more Input terminal allowable voltage: –0.5 to 5.5 V • Cable length is less than 3 m

Parameter	Specification
GO/NOGO output	Contact (open collector) output GO: Open NO GO: Low Contact capacity: 30 VDC, 100 mA • Cable length is less than 3 m
Monitor output	0 to 2 V Accuracy: ±5% F.S. Load resistance: 100 kΩ or more • Cable length is less than 3 m
DC luminance output	0 to 2 V Accuracy: ±5% F.S. Load resistance: 100 kΩ or more • Cable length is less than 3 m
Data communication	Conforms to RS-232. 9,600 to 38,400 bps
Safety standard	Complying standard EN61010-1: 2001 When using with AC adapter (optional), only B9108WB comform to the safety regulation (A1020UP/ A1022UP are excluded)
Emission	Complying standard EN55011-Group1, ClassA EN61326-1; 1997+A1; 1998 This is a Class A product (for industrial environment). In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measure.
Immunity*5	Complying standard EN61326-1; 1997+A1; 1998 Susceptibility under immunity condition At the strength of a radio-frequency electromagnetic field of 3 V/m Deviations of the tristimulus values (X, Y, and Z): Within ±100% range Monitor output: Within ±50% of F.S. DC luminance output: Within ±50% of F.S.
Power supply	4 AA alkaline batteries, or an AC adapter (optional) • Secondary batteries cannot be used • Manganese batteries cannot be used
Battery operation time	Approximately 6 hours • When continuously operated at room temperature using the alkaline batteries provided • LCD back light OFF • No data communication
Dimensions 3298F Sensor	 Approximately 67(W) × 150(H) × 40(D) mm Approximately 107(W) × 176(H) × 55(D) mm

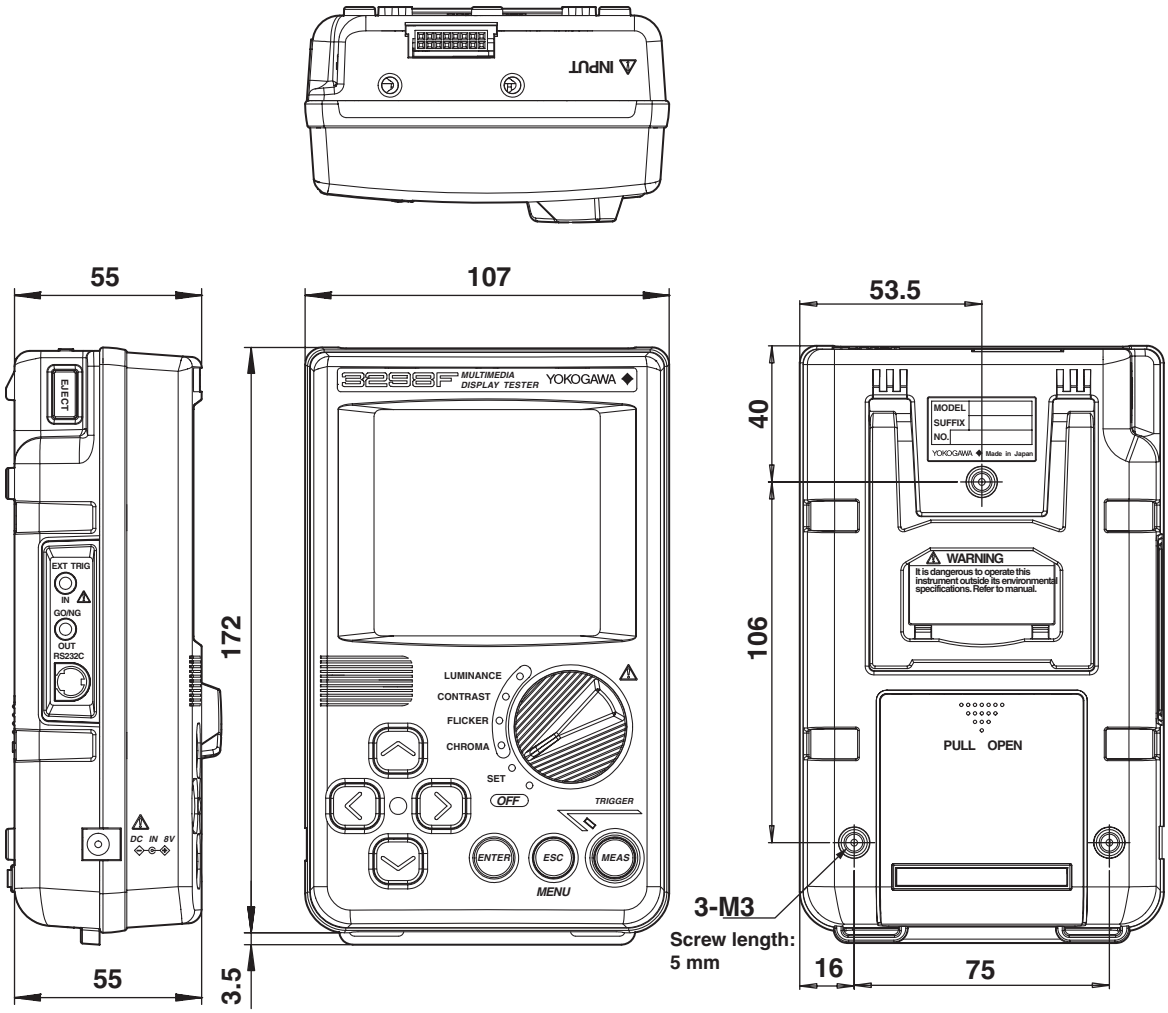
7.1 Specifications

Parameter	Specification
Weight	
3298F	Approximately 590 g
Sensor	Approximately 210 g
Cable	Approximately 170 g

*1 Measuring field diameter (mm) = 0.6 × (21.1 + measurement distance)
*2 If you are performing auto adjustment using a PC, the measurement cycle is shortened by turning OFF the 3298F screen.
*3 Measured a non-polarizing diffusive bright surface that was sufficiently uniform over the field of measurement at a distance of 50 mm under the following conditions. Temperature: 23±3°C, humidity: 70% RH or less, with the light source calibration coefficient specified for the corresponding measured light source, after zero calibration.
*4 Error with respect to the values measured by YOKOGAWA's standard spectral luminance meter that was calibrated against a spectral irradiance standard lamp.
*5 The color filters that were used are as follows:
SC-48,SC-56,SC-60 Fuji Photo Film Co., Ltd.
V-44,B-46,A-73B,T-44,G-54 Toshiba Glass Co., Ltd.

7.2 Dimensional Drawings

3298F Main Unit

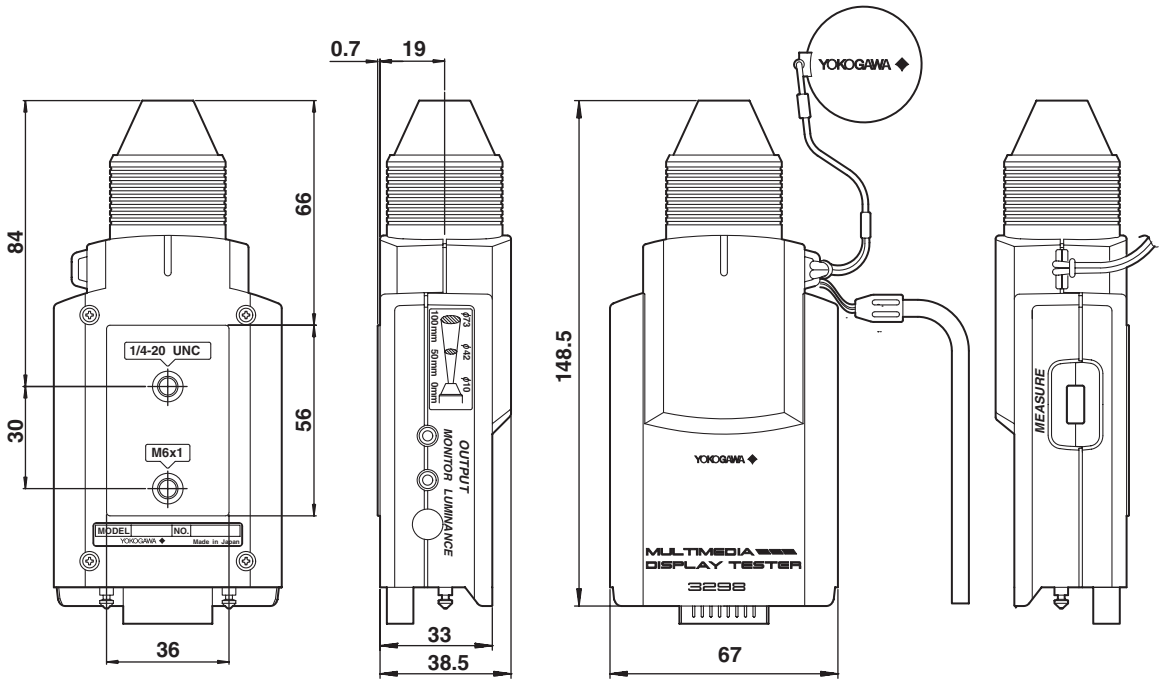


Unless othewise specified, tolerance is ±3%. (Tolerance is always ±0.3 mm when the dimension is under 10 mm.)

Sensor

There are two types of color sensors, one for black and white and another for color. They are of the same shape.
They are differentiated by the model that is written on the name plate.

- Black and white sensor: 329811
- Color sensor: 329821



Appendix 1 List of Default Values

The default values for the items that are initialized are as follows:

Factory Default Conditions

	Item		Default Value	Initialization		
				Setting values	Reference values	Calibration coefficients
Reference values & calibration coefficients	Chromaticity	Panel name	PANEL01		✓	
			PANEL02		✓	
			PANEL03		✓	
			PANEL04		✓	
			PANEL05		✓	
			PANEL06		✓	
			PANEL07		✓	
			PANEL08		✓	
			PANEL09		✓	
			PANEL10		✓	
Reference values	Luminance	Minimum value	100.0 cd/m^2		✓	
		Reference value	150.0 cd/m^2		✓	
		Maximum value	200.0 cd/m^2		✓	
	Contrast	Minimum value	100.0		✓	
	Flicker	Maximum value	2%		✓	
	Chromaticity	x	0.3000		✓	
		y	0.3000		✓	
		Δx	0.0100 (tolerance x)		✓	
		Δy	0.0100 (tolerance y)		✓	
Calibration coefficients	Luminance	Measured value (black)	0.00 cd/m^2			✓
		Reference value (black)	0.00 cd/m^2			✓
		Measured value (white)	100.0 cd/m^2			✓
		Reference value (white)	100.0 cd/m^2			✓
		a	1.0000 (internal coefficient)			✓
		b	0.0000 (internal coefficient)			✓
	Flicker	A	1.0000			✓
		B	10.000			✓
	Chromaticity	X	1.0000			✓
		Y	1.0000			✓
		Z	1.0000			✓
White balance	White balance	Reference color	G	✓		
		Color temperature	6504K	✓		
		6504K L	100.0 cd/m^2	✓		
		6447K L	100.0 cd/m^2	✓		
		9304K L	100.0 cd/m^2	✓		
		User X x	0.3127	✓		
		User X y	0.3292	✓		
		User X L	100.0 cd/m^2	✓		
		User X Tc	6504K	✓		
		RGB conversion coefficient	NTSC	✓		
		User X a1	1.9106	✓		
		User X b1	–0.5326	✓		
		User X c1	–0.2883	✓		
		User X a2	–0.9843	✓		
		User X b2	1.9984	✓		
		User X c2	–0.0283	✓		
		User X a3	0.0584	✓		
		User X b3	–0.1185	✓		
		User X c3	0.8985	✓		

Appedix 1 List of Default Values

Item			Default Value	Initialization		
				Setting values	Reference values	Calibration coefficients
Light source calibration coefficient			FL3	✓		
Trigger		Mode	Repeat	✓		
		Average count	None	✓		
Device setting	Backlight		OFF	✓		
	Auto power down		10 minutes	✓		
	Communication*					
		Baud rate	38400 bps	✓		
		Data length	8 bits	✓		
		Parity	None	✓		
		Stop bit	2 bits	✓		
		Handshaking	None	✓		
Measurement	Luminance	Range	Auto	✓		
	Contrast	Range	Auto	✓		
		Measurement mode	Manual	✓		
	Flicker	Range	Auto	✓		
		Rate	30 Hz	✓		
		Luminance display	OFF	✓		
	Chromaticity	Range	Auto	✓		
		Color system	xyL	✓		
	Memory	Setting	Number fixed	✓		
	Chromaticity reference	Reference name	DEFAULT	✓		
	RGB color system	Bar range	40%	✓		
	Memory	Memory data		✓		

* Not initialized with the communication command (FI).

Appendix 2 Adjusting the White Balance

Setting the 3298F before Adjusting the White Balance

You must set the color temperature (x and y) and the luminance (L) of the target white, the reference color, and the RGB conversion coefficient (standard).
For details how to enter the settings, see section 4.4. The communication commands that are used to enter these settings are shown below. For details on each command, see section 6.5.

Selecting the Reference Color
WB, 0, n (CrLf)
n = 0: R, 1: G, or 2: B

Selecting the Color Temperature
WB, 1, n (CrLf)
n = 0:6504K, 1:6774K, 2: 9304K, 3: USER1, or 4: USER2

Setting the Target Color Temperature (Only When the Color Temperature Is Set to USER1 or USER2)
RF, 34, *1, 00, 00, value (CrLf) x setting
RF, 34, *1, 00, 01, value (CrLf) y setting
RF, 34, *1, 00, 02, value (CrLf) L setting
*1 = 00: USER1, 01: USER2, 02: 6504K, 03: 6774K, or 04: 9304K
Value:

Selecting the Standard
WB, 2, n (CrLf)
n = 0: NTSC, 1: PAL, 2: HDTV, 3: USER1, or 4: USER2

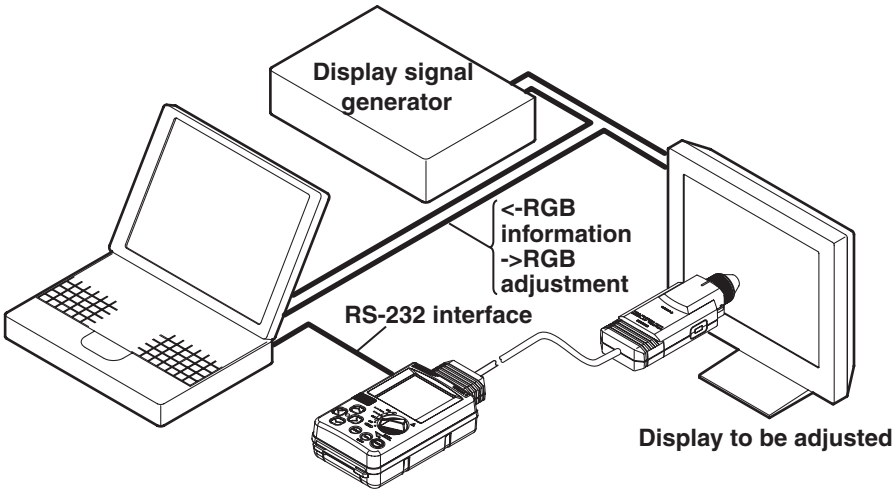
Setting the RGB Calculation Coefficients (Only When the Standard Is Set to USER1 or USER2)
CN, 34, *1, 00, 00, value (CrLf) RX setting
CN, 34, *1, 00, 01, value (CrLf) RY setting
CN, 34, *1, 00, 02, value (CrLf) RZ setting
CN, 34, *1, 01, 00, value (CrLf) GX setting
CN, 34, *1, 01, 01, value (CrLf) GY setting
CN, 34, *1, 01, 02, value (CrLf) GZ setting
CN, 34, *1, 02, 00, value (CrLf) BX setting
CN, 34, *1, 02, 01, value (CrLf) BY setting
CN, 34, *1, 02, 02, value (CrLf) BZ setting
*1 = 00: USER1 or 01: USER2
Value:

Changing the Measurement Function to r, g, b Ratio Color System
FM, 34 (CrLf)

Setting the Measurement Range
RG, 30, m, o (CrLf)

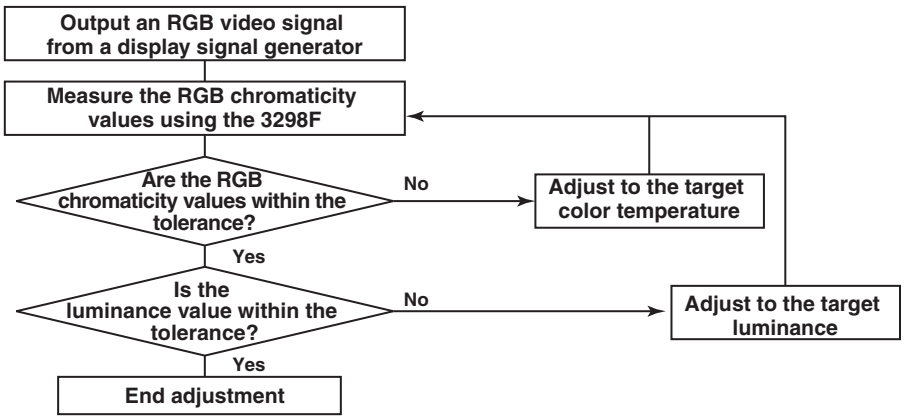
Adjusting the White Balance

System Configuration Example When Adjusting the White Balance



Measure the chromaticity of the display to be adjusted using the 3298F. Load the R, G, B chromaticity values into a PC or a similar device and adjust the R, G, B signal levels of the display.
You can adjust the color temperature (white balance) of the display in a short period of time by using the RGB chromaticity values of the 3298F.

Adjustment Work Flow



The procedure for adjusting the color temperature and luminance to the target values is as follows:

Adjusting to the Target Color Temperature

1. Output an RGB video signal from the signal generator.
2. Measure the RGB chromaticity values using the 3298F.
3. Determine whether the RGB values are within the tolerance.
4. Adjust to the target color temperature.

Adjusting to the Target Luminance

5. Measure the RGB chromaticity values using the 3298F (the luminance value is also displayed).
6. Determine whether the luminance value is within the tolerance.
7. Adjust to the target luminance.

Note

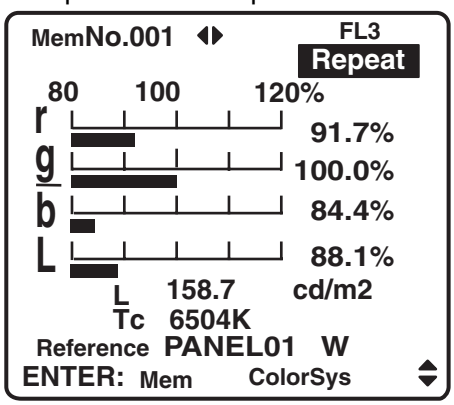
If you are performing auto adjustment using a PC, the measurement cycle is shortened by turning OFF the 3298F screen. To turn OFF the screen, use the RM command. For details on the RM command, see section 6.5.

Procedure

1. Output a signal from the display signal generator to the display to be adjusted.

Adjusting to the Target Color Temperature (White) (Adjusting the White Balance)

2. Measure the chromaticity value with respect to the target color temperature (white) on the 3298F (using rgb ratio color system). (Communication command: MO(CrLf))
3. If the r, g, b ratio is within the specifications (100±5%, for example), proceed to step 5 (end of color temperature adjustment). If not, proceed to step 3.



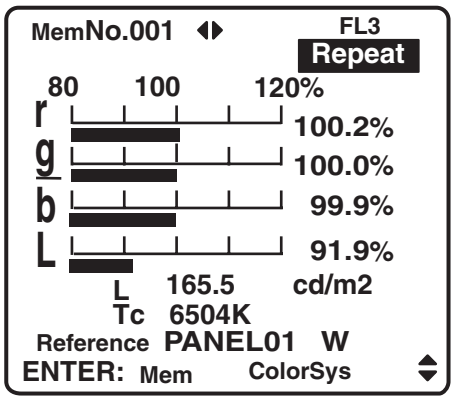
(Data retrieval example using a communication command: MO,34,0,1,88.1,91.7,100.0,84.4,1)
Luminance %, r, g, b

4. Based on the measured r, g, b ratio, calculate the R, G, B levels to be specified next referring to the information below and adjust the R, G, B levels of the display. Adjustment is not necessary for the reference color (G in the example).
   Measure the chrominance values on the 3298F again (using the RGB color system).
   (Communication command: MO(CrLf))
   If the r, g, b ratio is within the specifications, the color temperature adjustment is complete. Proceed to step 5. If not, return to step 3.

- **Calculation example of the adjustment level**

$$\text{R adjustment level} = \frac{100}{91.7} \times \text{Current level}$$

$$\text{B adjustment level} = \frac{100}{84.4} \times \text{Current level}$$



(Data retrieval example using a communication command: MO,34,0,1,91.9,100.2,100.0,99.9,1)
Luminance %, r, g, b

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Adjusting to the Target Luminance

5. Measure the current luminance L (the luminance can be measured with the measurement function set to chromaticity). (Communication command: MO(CrLf))
6. If the current luminance is within the specifications of the target luminance (100±5%, for example), the adjustment of the luminance is complete. If not, proceed to step 7.
7. Adjust the luminance value by multiplying the coefficient (100%/91/9% in the case of the figure on the previous page) to the RGB gradation so that the target luminance is obtained.

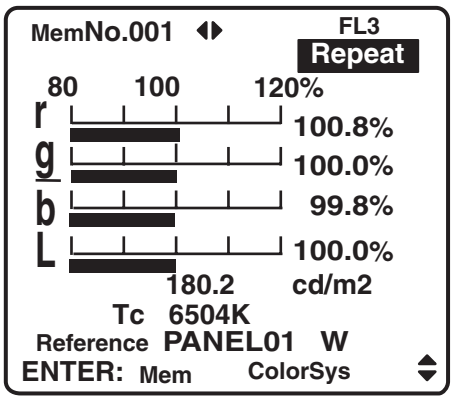
- **Calculation example of the adjustment level (adjust from the current luminance of 91.9% to the target luminance)**

$$\text{R adjustment level} = \frac{100}{91.9} \times \text{Current level}$$

$$\text{G adjustment level} = \frac{100}{91.9} \times \text{Current level}$$

$$\text{B adjustment level} = \frac{100}{91.9} \times \text{Current level}$$

Measurement example after adjustment to the target color temperature and target luminance is complete



Note

White Balance Adjustment in Relative RGB Display Mode

For organic ELs and LEDs, the emitted spectrum bandwidth of R, G, B is narrow with hardly any region overlapping. When adjusting the white balance on such displays, there is little effect on other colors. Therefore, a color that has been adjusted seldom changes due to the adjustment of other colors (example: R that has been adjusted to 100% seldom changes due to the adjustment of G). Consequently, white balance can be completed simply by adjusting each color of R, G, B to 100% using relative RGB display mode.

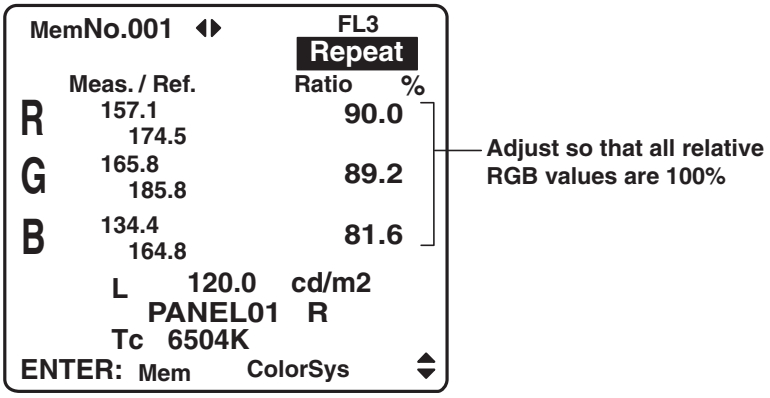
The adjustment procedure is as follows:

1. Measure the RGB values.
2. Calculate the R, G, B levels so that all relative RGB values are 100%.

$$\text{R adjustment level} = \frac{100}{90.0} \times \text{Current level}$$

$$\text{G adjustment level} = \frac{100}{89.2} \times \text{Current level}$$

$$\text{B adjustment level} = \frac{100}{81.6} \times \text{Current level}$$



3. Set the calculated levels. If all relative RGB values are close to 100%, the adjustment is complete.

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Appendix 3 Adjusting the Flicker

Setting the 3298F before Adjusting the Flicker

You must set the flicker calibration coefficients, switch the measurement function, and set the measurement range and flicker rate.
For details how to enter the settings, see sections 4.3 and 5.3. The communication commands that are used to enter these settings are shown below. For details on each command, see section 6.5.

Setting the Flicker Calibration Coefficients

Flicker calibration coefficient A: CN,20,00,00,00,1.0
Flicker calibration coefficient B: CN,20,00,00,01,10.0

Measurement Function (Change to Flicker)

FM, 20 (CrLf)

Selecting the Measurement Range

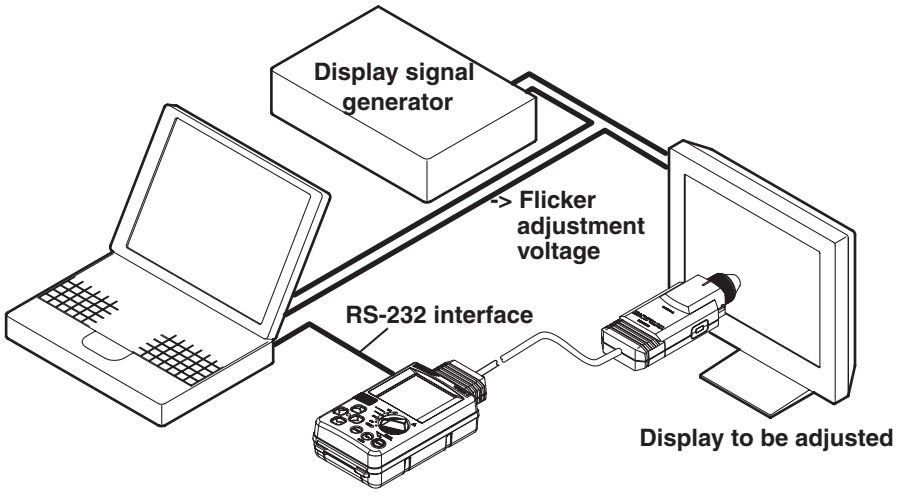
RG,20,m,o (CrLf)
m = 0: Auto range or 1: specified range
o= 0: 40, 1: 400, 2: 4000, or 3: 40000

Selecting the Flicker Rate

FR,n (CrLf)
n = 0: 20 Hz, 1: 30 Hz, 2: 40 Hz, 3: 50 Hz, 4: 60 Hz, 5: 70 Hz, 6: 80 Hz, or 7: 90 Hz

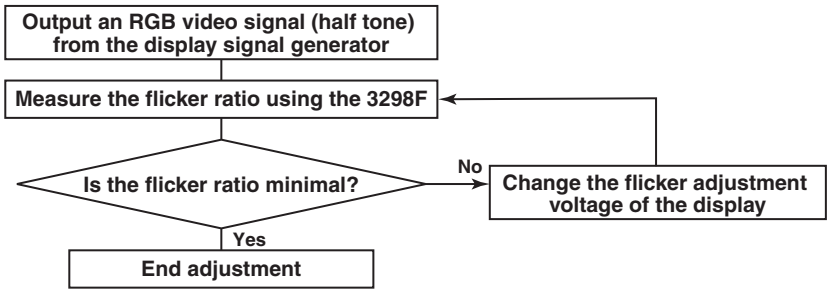
Adjusting the Flicker

System Configuration Example When Adjusting the Flicker



Measure the flicker of the display to be adjusted using the 3298F. Load the flicker ratio into a PC or a similar device and adjust the flicker adjustment voltage of the display.

Adjustment Work Flow



The flicker adjustment procedure is as follows:

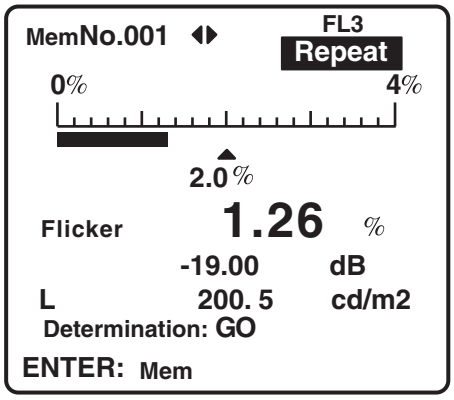
1. Output a video (half tone) signal from the signal generator.
2. Measure the flicker ratio using the 3298F.
3. Determine whether the flicker ratio is minimal.
4. Change the flicker adjustment voltage.

Note

If you are performing auto adjustment using a PC, the measurement cycle is shortened by turning OFF the 3298F screen. To turn OFF the screen, use the RM command. For details on the RM command, see section 6.5.

Procedure

1. Output a signal from the display signal generator to the display to be adjusted.
   (Communication command: MO(CrLf))
2. Measure the flicker ratio using the 3298F.
   (Communication command: MO(CrLf))



(Data retrieval example using a communication command: MO,20,0,1,80.5,1.26,-19.00,1)

3. Detect the minimum point of the flicker ratio.
4. Change the flicker adjustment voltage.
   Repeat steps 2 to 4 until the minimum point of flicker ratio is found.

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