User's Manual

51011, 51012, 51021 Digital Lux Meter

Store this manual in an easily accessible place for quick reference.

YOKOGAWA
Yokogawa Test & Measurement Corporation

IM 51011-01EN
4th Edition: Oct. 2017 (YMI)

Introduction

Thank you for purchasing the digital lux meter.
This user's manual primarily explains the handling precautions and basic operations of the digital lux meter.
To ensure correct use, please read this manual thoroughly before beginning operation.
After reading this manual, keep it in a safe place.

List of Manuals

The following manuals, including this one, are provided as manuals for the digital lux meter. Please read all manuals.

IM 51011-01E	User's Manual (this manual)
IM 51011-93Z2	Document for Korea

Contact information of Yokogawa offices worldwide is provided on the following sheet.

PIM 113-01Z2	Inquiries	List of worldwide contacts

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 functionality. 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.
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Revisions

- February 2013 1st Edition
- October 2013 2nd Edition
- May 2013 3rd Edition
- October 2017 4th Edition

4th Edition: October 2017 (YMI)

Checking the Contents of the Package

Unpack the box and check the contents before operating the instrument. If the wrong items have been delivered, if items are missing, or if there is a problem with the appearance of the items, contact your nearest YOKOGAWA dealer.

Digital Lux Meter

Check that the product that you received is what you ordered by referring to the model name on the name plate.

MODEL	Specifications
51011	JIS Class A Measurement ranges: 99.9/999/9,990/99,900/999,000
51012	JIS Class AA Measurement ranges: 99.9/999/9,990/99,900/999,000
51021	JIS Class AA Measurement ranges: 9.99/99.9/999/9,990/99,900/999,000

51011, 51012: Single-function model
Compliant standard: JIS C 1609-1: 2006
(JIS: Japanese Industrial Standards)

Standard Accessories

AA-size alkaline batteries 2
Recorder output plug (JC017A) 1
Soft-sided case (RB038A) 1
User's Manual (Japanese and English) 2

Optional Accessories (Sold separately)

Item	Specifications	Model
Light-detector extension cable	3 m	91001
	30 m	91002

Conventions Used in This Manual

Notes and Cautions

The notes and cautions in this manual are categorized using the following symbols.

Improper handling or use can lead to injury to the user or damage to the instrument. This symbol appears on the instrument to indicate that the user must refer to the user's manual for special instructions.

WARNING

Calls attention to actions or conditions that could cause serious or fatal injury to the user, and precautions that can be taken to prevent such occurrences.

CAUTION

Calls attention to actions or conditions that could cause light injury to the user, or cause damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.

Note

Calls attention to information that is important for the proper operation of the instrument.

Safety Precautions

This product is designed to be used by a person with specialized knowledge.The general safety precautions described herein must be observed during all phases of operation. If the instrument is used in a manner not specified in this manual, the protection provided by the instrument may be impaired. This manual is an essential part of the product; keep it a safe place for future reference.

YOKOGAWA assumes no liability for the customer's failure to comply with these requirements.

The following symbols are used on this instrument.

Warning: handle with care.
Refer to the user's manual or service manual.
This symbol appears on dangerous locations on the instrument which require special instructions for proper handling or use.
The same symbol appears in the corresponding place in the manual to identify those instructions.

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

WARNING

Use the instrument Only for Its Intended Purpose
The lux meter is for measuring illuminances.
Do not use this meter for any other purpose.

Check the Physical Appearance
Do not use the meter if there is a problem with its physical appearance.

Do Not Disassemble
Only qualified YOKOGAWA personnel may disassemble this product.

Do Not Operate in an Explosive Atmosphere
Do not use this meter in the presence of flammable gases or vapors. Doing so is extremely dangerous.

CAUTION

- The meter is for domestic use (Class B) and meets the electromagnetic compatibility requirements.
- Do not drop the meter or strike it against hard objects.
- Avoid storing the meter in direct sunlight or in a humid environment.
- Using the meter in an low-temperature environment (–10°C to 0°C) may slow down the display's response.
- Avoid using the meter in a dirty or dusty environment or in an environment with salt or corrosive gases.
- Do not wipe the meter with organic solvents.
  Dirt or dust adhering to the light-detecting surface of the meter decreases measurement accuracy.
  Wipe the surface clean with a soft, dry cloth.
- Do not separate the light-detector from the main unit with the power on.

Measurement Category

WARNING

- Do not use the meter for measurements in locations falling that fall under Measurement Categories II, III, and IV.

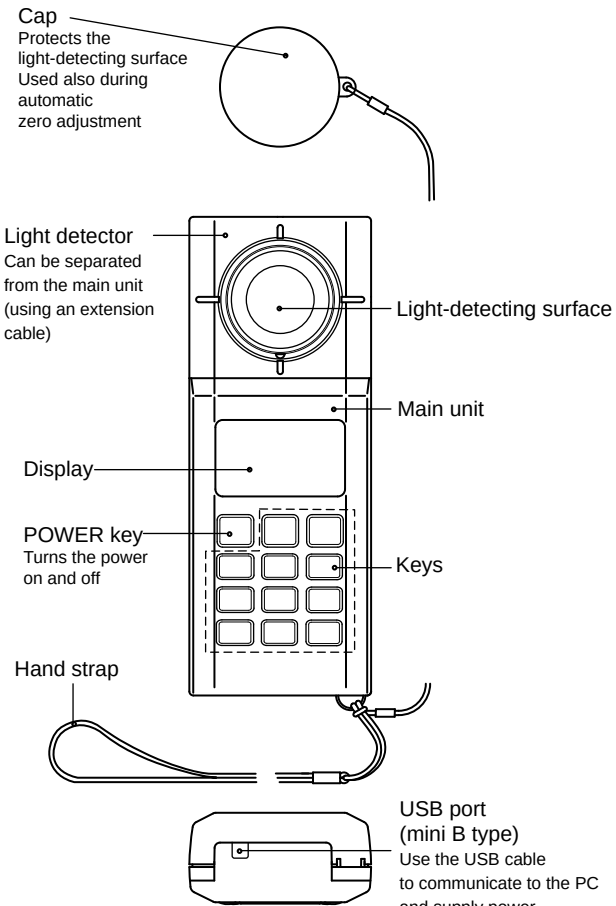
- Do not use the meter to measure voltage or current.

The meter is designed for measurement category I:
EN 61010-1: 2001

Measurement Category	Description	Remarks
CAT I	For measurement performed on circuits not directly connected to MAINS. CAT I: EN 61010-1: 2001	Circuits not connected to a mains power source.
CAT II	For measurement performed on circuits directly connected to the low-voltage installation.	Appliances, portable equipment, etc.
CAT III	For measurement performed in the building installation.	Distribution board, circuit breaker, etc.
CAT IV	For measurement performed at the source of the low-voltage installation.	Overhead wire, cable systems, etc.

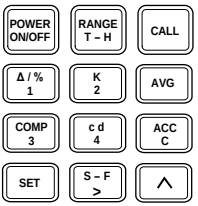
Contents

1. Component Names and Functions



Keys

51021



51011/51012
(single-function model)

RANGE Key

Use this key to switch the range.
Press the key to switch to manual range mode.The range changes each time you press the key.To return to auto range mode, hold the key down for at least 1 second.

T-H Key

Use this key to set the timer hold-time or start the timer.

CALL Key

Use this key to view settings.
Values (shown below) that are relevant to the measurement function that you are using are displayed while you hold the key down.
Color correction factor, intensity measurement distance, high and low comparator limits, and ripple ratio

Δ/% Key

Use to display deviation.
Press the key to display the deviation or percentage of measurement data in reference to a reference value.
To return to the normal luminance measurement,
hold the key down for at least 1 second.

K Key

Use this key in color correction measurement.
Color corrected results are displayed.
A switch is made between normal measurement and color correction measurement each time you press this key.
You can also set the color correction factor.

AVG Key
Use this key in average illuminance measurement.
To return to the normal illuminance measurement, hold the key down for at least 1 second.

1, 2, 3, 4, and C Keys
Use this key in average illuminance measurement.
You can store location data for the 4-point method and 5-point method.
(Location number display: 1 2 3 4 C)

COMP Key
Use this key to set the high and low comparator limits and to start the comparator function.
To return to the normal illuminance measurement, hold the key down for at least 1 second.

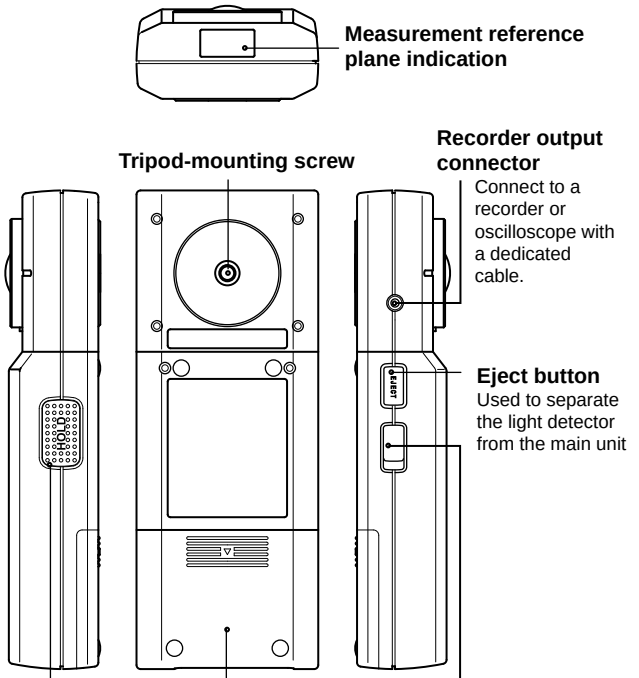
cd Key
Use this key to set the light intensity distance and to display the intensity.
A switch is made between normal measurement and light source intensity measurement each time you press the key.

ACC Key
Use this key to set the limit for the totalized intensity of illumination and to display the integral time and integral value.
To return to the normal illuminance measurement, hold the key down for at least 1 second.

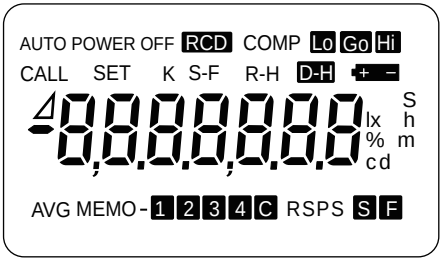
S-F Key
Use this key in ripple measurement.
A switch is made between normal measurement and ripple measurement each time you press the key.

SET Key
Use this key to configure various settings.

> Key and ^ Key
Use these keys to move the setting position and change values.


Measurement reference plane indication
Tripod-mounting screw
Recorder output connector
Connect to a recorder or oscilloscope with a dedicated cable.
Eject button
Used to separate the light detector from the main unit
Hold switch
Holds the measured data reading
Battery cover
Response selector switch
Switches the light detector response speed between FAST and SLOW
HOLD
EJECT

Display



*: When every element is showing (some elements are not used)

Element	Description
8,8.8.8,8.8.8	Digital display of measured, calculated, and set values
AUTO POWER OFF	Lights in automatic power-off mode
Δ	Deviation
CALL	Lights when CALL is pressed
SET	Lights in setting mode
K	Color correction factor
RCD	Lights when a plug is inserted into the recorder output connector
S-F	Ripple measurement
COMP Lo Go Hi	Lights in comparator mode
R-H	Lights in range hold mode
D-H	Lights in data hold and timer hold modes
+ −	Lights when the battery voltage is low
AVG-MEMO- 1 2 3 4 C	Lights during average illuminance
RSPS S F	Response setting
S	Timer hold-time unit (seconds)
lx	Unit for illuminance measurement
h	Unit for integral time of totalized intensity of illumination
%	Deviation display %
m	Unit for the distance to the light source
cd	Unit for luminous intensity; lights during light source luminous intensity measurement

2. Before Operation

2.1 Measurement Functions

The meter has the following measurement functions.

51011	Single-function model • Normal luminance measurement • Deviation display
51012	
51021	• Normal luminance measurement • Deviation display • Color correction luminance measurement • Average luminance measurement • Comparator function • Light source luminous intensity measurement • Totalized intensity of illumination • Ripple measurement

Only the color correction function can be used in combination with another function. Operation of other measurement functions are not allowed except for the normal luminance measurement and color correction measurement screens.

2.2 Turning the Power On and Off

CAUTION

Check that the meter operates normally.

Cover the light-detecting surface with the cap, and press the POWER key to turn on the meter.
The initial display appears.

All the LED elements will light, and [--CAL--] will appear (automatic zero-adjustment mode). Then, the display shows the luminance measurement [0.00 lx] display.
([0.0 lx] appears on Model 51011 and 51012.)
If you press the POWER key again, the meter will turn off.
(See chapter 3, “Normal Illuminance Measurement,” and section 17.1, “Error Messages.”)

2.3 Setting the Response

You can set the response speed of the light detector with the response selector switch.Set the switch to FAST or SLOW according to your application.

Switch position	Response speed	Application
FAST	Approx. 10 ms	Measurement of continuous light such as daylight and interior lighting (fluorescent lamps, incandescent lamps). The display shows [RSPS **F**].
SLOW	Approx. 500 ms	Measurement of the average illuminance of flickering lights or a light that varies over time such as that from a TV screen. The display shows [RSPS **S**].

Note

If the recorder output is used for waveform observation, set the switch to FAST.

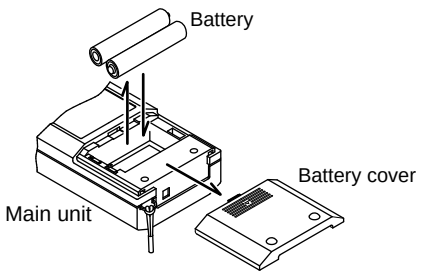
2.4 Checking and Replacing Batteries

When the battery voltage drops, the display area shows a [+ -] mark. When this mark appears, replace the batteries with new ones.

Turn off the power, and remove the battery cover.

Check the polarity markings, and insert the new batteries in the correct orientation. Close the battery cover completely.

Battery type: Two AA dry cells



2.5 Automatic Power Off

The meter has an automatic power-off function to prevent unnecessary battery usage when you forget to turn off the power. If there is no key activity for about 30 minutes, the meter beeps twice and automatically turns off.

Pressing any key while the meter is beeping extends the time until the power turns off for another 30 minutes.

The automatic power-off function is disabled while the totalized intensity of illumination or comparator function is being executed or when a plug is inserted in the recorder output connector.

When the automatic power-off function is enabled, [AUTO POWER OFF] is displayed.

Releasing the Automatic Power-Off Function

Cover the light-detecting surface with the cap.
Press the **HOLD** switch (HOLD switch lock) and then the **POWER** key to turn on the power.
After the initial display, [AUTO POWER OFF] disappears and the automatic power-off feature is released.
Press the **HOLD** switch again to release the HOLD state (lock), and perform measurements.

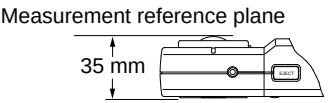
Reverting the Automatic Power-Off Function

Press the **POWER** key to turn the power off.
Cover the light-detecting surface with the cap.
(Check that the HOLD switch is not locked.)
Press the **POWER** key again to turn on the power.
After the initial display, [AUTO POWER OFF] appears, and the automatic power-off function returns.

2.6 Notes on Illuminance Measurement

To make accurate measurements, note the following items.

- Before starting measurement, turn on the light bulb 5 minutes and the discharge lamp 30 minutes beforehand.
- Set the position and angle of the light-detecting surface accurately.
  The measuring reference plane is shown below.



- Be careful that measurements are not affected by where you are and what you are wearing.
- For accurate measurements, perform color correction with a color correction factor that corresponds to the spectral distribution of the light source under measurement and the relative spectral response of the meter.
  The meter has color correction factors for typical light sources. You can also register up to 21 correction factors that you can use for color correction. (See chapter 4, “Color Correction Measurement”).
- When you measure for long period of time, the zero point may change due to large changes in the ambient temperature.
  In such a case, turn off the power once and then turn it on again. (See the procedure in chapter 3, “Normal Illuminance Measurement.”)

3. Normal Illuminance Measurement

Automatic Zero Adjustment

1. Cover the light-detecting surface with the cap.
(Check that the HOLD switch is not locked.)

2. Press the **POWER** key to turn on the power.
After all the elements light, automatic zero adjustment is executed ([--CAL--] is displayed).
When the adjustment is finished, [--CAL--] disappears.
(Initial display end)
The illuminance measurement [0.00 lx] display appears.
([0.0 lx] appears on Model 51011 and 51012.)
Note:
If the [--CAP--] display persists, the cap may not be on correctly. Put the cap on correctly. (The cap may be broken.)

Starting to Measure

3. Remove the cap, and start measuring.

4. When you are finished measuring, press the **POWER** key to turn off the power. Cover the light-detecting surface for protection.
Note:
If [Err] appears during measurement, check that the light detector is connected correctly to the main unit and that the cap is off, and then start from the beginning.
(See section 17.1, “Error Messages.”)

4. Color Correction Measurement (K Key)

This function is available on Model 51021.

Each meter product is pre-configured with color correction factors (for standard illuminant A) that have been calculated on the basis of the spectral distribution characteristics and relative spectral response characteristics (spectral sensitivity) for various light sources. The meter automatically multiplies a color correction factor that has been selected according to what is being measured and displays the result. In addition to the preset color correction factors, you can set up to 21 (user-defined) color correction factors. These factors remain even when the power is turned off.

Light source type and name	Indication (symbol)	Color correction factor (typical)*
(1) Daylight fluorescent lamp	FLd	0.994
(2) White fluorescent lamp	FW	0.996
(3) Three-way fluorescent lamp	FL3	1.007
(4) High-pressure mercury vapor lamp	HGL	0.993
(5) High-pressure sodium vapor lamp	nAL	0.988
(6) Standard light source B	Stb	0.996
(7) Standard light source C	StC	0.995
(8) Equal-energy source (400 to 760 nm)	Wt	0.997
(9) User area	U1 to U21	User definition

* The color correction factors are calculated based on the relative spectral distribution values of JIS Z 8719, JIS Z 8720, and CIE No. 53TC.2 lamps.
  JIS: Japanese Industrial Standards
  CIE: Commission Internationale de l'Éclairage (International Commission on Illumination)

Setting the Color Correction Factor

1. Press **SET** and then **K**. [SET, K] appears. The light source symbol and color correction factor appear.
2. Press △ to select the color correction factor (symbol) that you want to set.
   The light source symbol and color correction factor appear.
   If you select a factor from U1 to U21, set any value (up to 9.999) that you want. Press ▷ and △ to set the value.
3. Press **SET** to apply the selected color factor. The setting is complete. [SET, K] disappears.
   The color correction factor will be retained even if you turn off the power.

Measuring

1. Press **K**. [K] appears.
   While [K] is displayed, the meter multiplies the specified color correction factor to the measured value to show the illuminance.
2. To view the color correction factor, hold down **CALL**.
3. To return to normal illuminance measurement, press **K** again. [K] disappears.

Note

- The color correction measurement can be executed in combination with another measurement function.
  However, if another measurement function is already in execution, color correction measurement is not possible. In such a case, return to normal illuminance measurement, start color correction measurement and then the other measurement function.
  Note that if color correction measurement is being executed with another function, you cannot view the color correction factor.
- The color correction factors on the previous page—(1) FLd 0.994 to (8) Wt 0.997—are typical values.Each meter product has its own color correction factors (different from typical values), which have been memorized before shipping according to its characteristics.

Holding Data (HOLD Switch)

You can hold the measured value.

You can use this function when the measured value is hard to read, such as when you are measuring in a dark place.

Measuring

1. Press **HOLD** to lock the switch. The measured value is held, and [D-H] appears.
2. To release the hold (lock), press **HOLD**. [D-H] disappears.

5. Timer Hold (HOLD and T-H Keys)

The timer hold function makes measurements (holds the value) after the specified time elapses.

If where you are or what you are wearing is going to affect the measurement, you must move away from the meter. This function enables you to set the time needed for you to move away from the meter so that you can make accurate measurements.

51011 and 51012 timer setting: 5 seconds (fixed)

51021 timer setting: 000 to 999 seconds (as specified)

Setting the Timer (on Model 51021)

1. Press **SET** and then **T-H**.
   [SET, D-H, S] appears.
2. Press △ and ▷ to enter the time (value).
   The range is 000 to 999 seconds.
3. Press **SET** to finish setting the timer. [SET, D-H, S] disappears.
   The timer value will be (memorized) retained even if you turn off the power.

Measuring

1. Press **HOLD** (the switch will be held in the pressed state). [D-H] appears.
2. Press **T-H** to start the timer. [D-H] starts blinking.
   When the specified time elapses, the meter beeps and holds the measured value at that point. [D-H] stops blinking.
   To make another measurement, press **T-H** again.
3. To release the timer hold, press **HOLD** again.
   [D-H] disappears, and the meter returns to normal measurement mode.

6. Range Hold (RANGE Key)

You can switch between auto range and manual range modes.
In manual range mode, you can specify a fixed range.
If measured values are known to be within a particular range, you can use a fixed range to increase the meter response.

Range configurations:

51021	51011/51012
0.00 to 9.99	0.0 to 99.9
0.0 to 99.9	
0 to 999	0 to 999
0**0** to 9,99**0**	0**0** to 9,99**0**
0**00** to 99,9**00**	0**00** to 99,9**00**
0,**000** to 999,**000**	0,**000** to 999,**000**

The small zeros in the table are fixed (they are for indicating digits).

Setting the Range

1. Press **RANGE**. The range is set to manual range mode and is fixed at the current range.
   [R-H] appears.
2. Press **RANGE** to set the range you want. The range increases each time you press the key. Pressing the key at the maximum range causes the range to be set to the minimum range.
3. To return to auto range mode, hold down **RANGE** for at least 1 second. [R-H] disappears.

Note

To view the range during measurement, cover the light-detecting surface with the cap so that the illuminance is zero.

7. Average Illuminance (AVG Key)

This function is available on Model 51021.

The average illuminance can be calculated using the 4-point or 5-point method.

(See chapter 3, “Normal Illuminance Measurement.”)

The meter can save the measured values of up to five measurement points.

When the measurement of all the points is complete, the meter calculates the average illuminance and displays the result.

Measuring

1. Press **AVG**. [AVG MEMO -] appears.

2. In accordance with the description in chapter 22, “Illuminance Measurement Method,” measure the illuminance of location 1, and press 1.

The measured value is stored.

Location number: 1 2 3 4 (4-point method)

1 2 3 4 C (5-point method)

3. Repeat step 2 at each of the locations.

For the 5-point method, measure the illuminance at the center of the room (median point), and press **C**.

(You can measure the locations in any order.)

The display shows the numbers of the locations in which values are stored after [AVG MEMO -].

If you press a number key for a location in which a value is stored, the value will be overwritten.

If you hold down a number key for a location in which a value is stored for more than 1 second, the value is deleted, and the location number disappears from the display.

4. After storing the measured values for all locations, press **AVG**. [AVG] appears, and the calculated result (average illuminance) is displayed.

   If you press **AVG** again, [AVG MEMO -] appears, and you will be able to overwrite or delete measured values.

5. To return to the normal illuminance measurement, hold down **AVG** for at least 1 second.

   All the stored values will be deleted.

Note

- To repeat average illuminance measurements, we recommend that you return to normal illuminance measurement once or delete all stored data before making the next measurement.
- To view the value of a location while the measured result is displayed, hold down the number for the location.

8. Deviation Display (Δ/% Key)

You can display measurement deviation.
Set a reference illuminance, and the meter will display the deviation based on the reference.
There are two display modes.

Deviation value display
Δ = measured value – reference value

Percentage display
% = (deviation/reference value) × 100

Measuring

1. Measure the reference illuminance, and then press **Δ/%**.
   The measured value is stored as the reference value.
   [Δ, R-H] appears, and the measurement range is fixed.
   Measured values are displayed as deviation values.
2. Press **Δ/%** to change to the percentage display.
   [%] appears.
   The display switches between deviation value display and percentage display each time you press **Δ/%**.
3. To view the reference value, hold down **CALL**.
4. To return to the normal measurement display, hold down **Δ/%** for at least 1 second.

Note

If the measured value falls outside the measurement range, [OL] will appear.

9. Light Source Luminous Intensity (cd Key)

This function is available on Model 51021.

If the light source can be regarded as a single, single-point light source, you can set the distance from the light source to the measuring point and make the meter calculate and display the luminous intensity.

Luminous intensity (cd) = illuminance (lx) × distance $(m)^2$

Set the distance to the measuring light source in advance.

Setting the Distance

1. Press **SET** and then **cd**. [SET, m] appears.
2. Press △ and ▷ to enter the distance from the light source under measurement to the reference plane of the lux meter.
   The range is 00.00 to 99.99 m. (In unit of meter)
3. Press **SET**.
   [SET, m] disappears, and the setting is complete.

Measuring

1. Press **cd**. [cd] appears.
2. Face the light-detecting surface of the lux meter towards the light source. Take a measurement at the specified distance.
   To view the distance that you have specified, hold down **CALL**.
3. Read the value.
4. To return to normal measurement, press **cd**. [cd] disappears.

10. Totalized Intensity of Illumination (ACC Key)

This function is available on Model 51021.

The meter calculates the totalized intensity of illumination and integral time.

The maximum totalized intensity of illumination is 9990000000 lx h (three significant digits), and the maximum integral value is 10000 h. (In unit of hours)

If the comparator function is enabled and the totalized intensity of illumination reaches a preset value, totalization stops at this point and the display is held. You can read the integral time when totalization stopped.

To use the comparator function, set the limit value.

Note

If the battery runs low during long-term totalization, an error may be introduced in the calculation. To perform long-term totalization, we recommend that you supply power through USB.

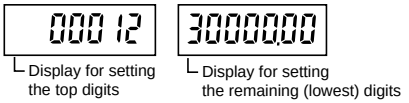
Setting the Limit Value (Only When Using the Comparator)

The maximum number of digits available is 12.
Of these digits, 3 digits are significant, and the rest are place holders (fixed at 0; including 2 decimal digits).
A value is entered in two parts: the top 5 digits and the remaining 7 digits.

1. Press **SET** and then **ACC**.
[SET, lx h] appears.

2. First, enter the top 5 digits.
Use △ and ▷ to enter the digits one by one.
After entering the 5 digits, press ▷ to switch the display to enter the remaining digits.
Use △ and ▷ to set the limit value.

Example of how to set 1230000



└ Display for setting the top digits
└ Display for setting the remaining (lowest) digits

3. After entering the value, press **SET**.
[SET] disappears, and the setting is complete.

Measuring

1. Press **ACC**.
   Totalization starts, and [lx h] appears.
   The automatic power-off function is disabled, and [AUTO POWER OFF] disappears.
   To use the comparator function, press **COMP**.
   [COMP, Go] appears. Go indicates that totalization is in progress.
2. The display switches between integral time display and totalized value display each time you press **ACC**.
   [h] appears when the integral time is displayed.
3. To pause totalization, press **HOLD**.
   [D-H] appears, and the integration of illuminance and time is paused.
   To resume totalization, press **HOLD** again.
   If the comparator function is in use and the totalized value exceeds the limit value, [D-H, Hi] appears and totalization stops. (The integral time is displayed.)
4. To view the limit value, hold down **CALL**.
   If the specified number of digits is greater than 7, the top and bottom digits are displayed alternately.
5. To return to the normal illuminance measurement, hold down **ACC** for at least 1 second.

Note

If the totalized intensity of illumination or integral time reaches its maximum value, totalization stops. [D-H] appears.

11. Comparator (COMP Key)

This function is available on Model 51021.

The comparator function determines whether the measured value (displayed value) is within the specified range, greater than the high limit, or less than the low limit.

Set the low limit (Lo) and high limit (Hi) to define the reference range. The maximum number of digits available is 8.

Of these digits, 3 digits are significant, and the rest are place holders (fixed at 0; including 2 decimal digits).

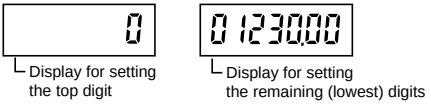
The meter displays the comparison result.

Display	Condition
Hi	high limit (Hi) < measured value
Go	low limit (Lo) ≤ measured value ≤ high limit (Hi)
Lo	measured value < low limit (Lo)

Setting the Comparator (Change)

1. Press **SET** and then **COMP**.
[SET COMP Lo] appears. Lo indicates the low limit.

2. Set the low limit. The top digit is displayed,
so use [^] to set the number.
Press [>]. Set the remaining digits.
Use [^] and [>] to enter the digits one by one.
Example of how to set 1230



Display for setting the top digit

Display for setting the remaining (lowest) digits

3. Press **COMP**. The display for setting the high limit appears.
Set the high limit in the same manner as in step 2.
(Press **COMP** to switch between high and low limits.)

4. After entering the values, press **SET**. The setting is complete, and [SET] disappears.

Measuring

1. While normal illuminance measurement or color correction measurement is in progress, press **COMP**.
   The comparator function is enabled, and [COMP, Lo], [COMP, Hi], or [COMP, Go] is displayed.The automatic power-off function is disabled, and [AUTO POWER OFF] disappears.
2. To view the high and low limits, hold down **CALL**.
   The high and low limits are displayed alternately at 1.5 second intervals.
3. To return to the normal illuminance measurement, hold down **COMP** for at least 1 second.
   [COMP, Lo], [COMP, Hi], or [COMP, Go] disappears.

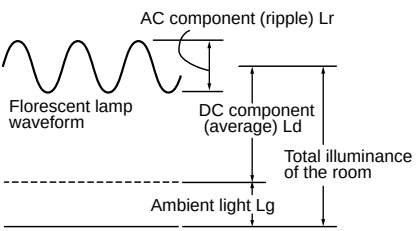
12. Ripple Measurement (S-F Key)

This function is available on Model 51021.
The ripple measurement function facilitates the measurement of indoor fluorescent lamps during the daytime.
When the illuminance of fluorescent lamps is measured with a lux meter during the daytime, the sunlight influence is large.
A typical method to overcome this phenomenon is to measure the fluorescent lamps with the sunlight first, measure the sunlight without the fluorescent lamps (ambient light only) second, and take the difference. However, this method requires you to turn on and off the lamps at each measurement point, wait for the lamps to stabilize each time they are turned on, and so forth.
In other words, this method takes trouble and time.
Another method is to measure all the measurement points first with the fluorescent lamps turned on, then measure the same points with the lamps turned off second, and then take the differences. This method is disadvantageous in that taking measurements at the same location and height when the lamps are turned on and when they are turned off is difficult, which results in errors.

Measurement Principle

The lux meter can calculate the illuminance by using the AC component characteristics of the radiation of fluorescent lamps illuminating at the commercial power frequency.
The AC component is related to the DC component (average value) at a constant ratio (ripple ratio).
The relationship between the ripple ratio and illuminance is shown below.

$$\text{Ripple ratio} = \frac{\text{DC component (Ld)}}{\text{AC component (Lr)}} = \frac{\text{Total illuminance of the room} - \text{Ambient light (Lg)}}{\text{AC component (Lr)}}$$



Thus, the illuminance (DC component Ld) can be determined with the following equation.

Illuminance = DC component (Lr) × Ripple ratio

The ripple ratio must be determined in advance through the measurement of the total illuminance of the room and ambient light Lg.
The lux meter can use the ripple ratio and AC component measurements to calculate illuminance.

Setting the Ripple Ratio

The ripple ratio must be set prior to ripple measurements.
As long as the conditions remain the same (same type of fluorescent lamp), you do not have to reset the ripple ratio.
Fluorescent lamps are unstable immediately after they are turned on. Set the ripple ratio after at least 30 minutes elapses after the lamps are turned on.
Select a location in the room where there is little ambient light and also directly below the fluorescent lamps.
Never move the lux meter during this procedure.

1. Face the light-detecting surface of the lux meter to the fluorescent lamps to be measured, and then press **SET** and then **S-F**. The total illuminance will be measured. After about 5 seconds, [-------] appears.
2. When [L-OFF] appears, turn off the fluorescent lamps.
3. Press **SET**. The ambient light will be measured. After about 3 seconds, [-------] appears. When the ripple ratio is set properly, the meter returns to normal illuminance measurement.
   If “Err” appears, the ripple ratio is not set.
   If this occurs, press **SET** to return to normal illuminance measurement, change the location, and try again.
   An error will occur in the following circumstances.
   - If the illuminance of ambient light is greater than or equal to that of the fluorescent lamps: Err. 3
   - If the AC component is extremely small or large compared to the illuminance to be calculated: Err. 0

   The set ripple ratio is retained even when the power is turned off (the ratio is retained until it is changed).

Ripple Measurement

1. Press **S-F**. [S-F] appears, and measurement starts. To view the ripple ratio, hold down **CALL**.
2. To return to normal measurement, press **S-F**. [S-F] disappears.

13. Communication Functions

13.1 Cable Connection and Interface Specifications

You can configure the lux meter from a PC and view settings and measured values through USB communications (serial communication via a virtual COM port).

Installing the USB Driver

To connect the lux meter to a PC, you must first install the appropriate USB driver.

USB specifications: Conforms to version 1.1

Download the driver from the YOKOGAWA's lux meter website.

http://tmi.yokogawa.com/products/portable-and-bench-instruments/luxmeters/digital-lux-meters/

Communication settings

Baud rate:	9600 bps
Parity:	None
Stop bits:	2 bits
Data length:	8 bits
Handshaking:	None
Received delimiter:	CrLf, Lf, 0x03 (any of the above is acceptable)
Transmitted delimiter:	CrLf, Lf, 0x03 (default: CrLf) (selected with a command)

13.2 List of Commands

Command	Description
HD	Sets whether to include a header in measured data sent from the lux meter to the PC
IC	Enables or disables the comparator during the measurement of totalized intensity of illumination
IL	Reads the totalized intensity of illumination and time
IS	Starts and stops the measurement of the totalized intensity of illumination
KC	Selects the user area number of the color correction factor
KS	Enables the color correction factor
LD	Selects how to send data from the lux meter to the PC
PO	Enables automatic power-off
RA	Sets auto range mode
RD	Requests to send measured data
RH	Sets the range hold function
RS	Checks unsent (measured) data in buffer
TM	Sets the transmitted delimiter

13.3 Detailed Description of Commands

Command	51011 51012	51021	Description
HD	Yes	Yes	Sets whether to include a header in measured data sent from the lux meter to the PC
			Set whether to include a header: HDm<delimiter> m = 0: no header, 1: with header (default) → Response: 0<delimiter>
IC	-	Yes	Enables or disables the comparator during the measurement of totalized intensity of illumination
			Use the comparator: IC,m<delimiter> m = 0: OFF, 1: ON Note: This applies only during the measurement of totalized intensity of illumination. → Response: IC,m<delimiter> m = 0: successful, 1: error
IL	-	Yes	Reads the totalized intensity of illumination and time
			Read the totalized intensity of illumination and time: IL<delimiter> → Response: IL,mmmEsn,ttttt.t<delimiter> m = mantissa of totalized value: 3 digits (000 to 999) sn = exponent of totalized value: -2 to +3 t = integral time: 00000.0 to 10000.0 h
IS	-	Yes	Starts and stops the measurement of the totalized intensity of illumination
			Start totalized intensity of illumination: IS,m<delimiter> m = 0: OFF, 1: ON → Response: IS,m<delimiter> m = 0: successful, 1: error

KC	-	Yes	Selects the user area number of the color correction factor
			Select the user area:KC,mm<delimiter> m = 01 to 20 → Response: KC,m<delimiter> m = 0: successful, 1: error

KS	-	Yes	Enables the color correction factor
			Use the color correction factor: KS,m<delimiter> m = 0: OFF, 1: ON → Response: KS,m<delimiter> m = 0: successful, 1: error

LD	Yes	Yes	Selects how to send data from the lux meter to the PC
			Select how to send: LD,m<delimiter> m = 0: every measurement 1: every data request (RD) command (default) → Response: LD,n<delimiter> n = 0: command successful, 1: command error

PO	Yes	Yes	Enables automatic power-off
			Enable automatic power-off PO,m<delimiter> m = 0: disable automatic power-off 1: enable automatic power-off Note: If this command is received while totalized intensity of illumination or comparator measurement is in progress, the command will be executed after the meter returns to normal measurement. → Response: PO,m<delimiter> m = 0: successful, 1: error

RA	Yes	Yes	Sets auto range mode
			Set auto range mode: RA<delimiter> → Response: RA,m<delimiter> m = 0: successful, 1: error

RD	Yes	Yes	Requests to send measured data
			Request to send: RD<delimiter> → Response: RD,m<delimiter> m = 0: command successful, 1: command error

RH	Yes	Yes	Sets the range hold function
			Set range hold: RH,m<delimiter> m = 0: 9.99,* 1: 99.9, 2: 999, 3: 9,990, 4: 99,900, 5: 999,000 *: Model 51021 only → Response: RH,m<delimiter> m = 0: successful, 1: error

RS	Yes	Yes	Checks unsent (measured) data in buffer
			Check: RS<delimiter> → Response: RS,m,n<delimiter> m = 0: command successful, 1: command error n = 0: no unsent data, 1: unsent data available

TM	Yes	Yes	Sets the transmitted delimiter
			Set the delimiter: TM,m<delimiter> m = 0: CRLF (default) 1: LF 2: 0x03 → Response: 0<delimiter that was set before the TM command was received >

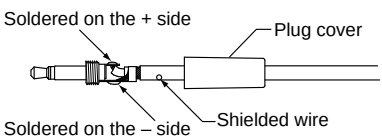
14. Recorder Output (Analog Output)

You can connect the lux meter to a recorder or oscilloscope and use the recorder output function to record illuminance trends or observe light source waveforms.

Output Signal Specifications

999 mV ± 5%
(range fixed for full scale of each range)
Load resistance: 100 kΩ or more

1. Prepare a coated single-core shielded wire, and solder it to the recorder accessory output plug.
Connect the other end of the wire to the input of the monitoring instrument.



2. Attach the cap, turn on the lux meter, and insert the plug into the recorder output connector.
[REC, R-H] appears, and the range is fixed (manual range mode).
The automatic power-off function is disabled, and [AUTO POWER OFF] disappears.

3. Set the **RESPONSE** switch to FAST.

4. 1 mV of output voltage corresponds to a value of 1 in the least significant digit of the three significant digits.
Set the appropriate range.
For details on setting the range, see chapter 6, “Range Hold”.

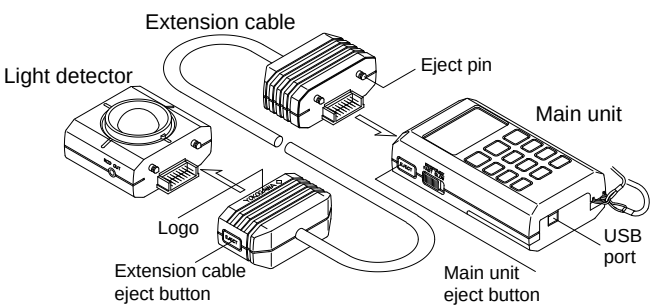
5. Cover the light-detecting surface with the cap, and adjust the zero level of the monitoring instrument.
Remove the cap and start measuring.

15. Separating the Light Detector

You can separate the light detector from the main unit for use.
Use the dedicated light detector extension cable (sold separately).

1. Turn off the power.
2. Press **the eject button** to release the lock, and separate the light detector from the main unit.
3. Insert the extension cable connector (the end with the eject pin) to the main unit, and check that it is locked in place.
4. Connect the other end (the end with the Logo) to the light detector, and check that it is locked in place.
5. Turn on the power, and start measuring.

(To disconnect the extension cable, press the eject button to release the lock first.)



16. Supplying Power through USB

You can supply power through USB (5 VDC ± 5%) from external by connecting a off-the-shelf USB cable (mini B type) to the USB port of the lux meter.

Note

You can supply power through USB even when batteries are installed.

17. After-Sales Service

17.1 Error Messages

Errors when setting the ripple ratio

Err. 0, Err. 3 (see chapter 12, “Ripple Measurement”)

If any of the following errors occur, repair may be necessary.

Err. 1: Light detector error

Err. 2: Offset error

Err. 4: Main unit memory error

If the error persists even after checking the following items, repair is necessary.

- Is the light detector securely connected to the main unit (is the eject pin locked correctly)?
- Was the cap attached properly during zero adjustment?
- Was the cap broken during zero adjustment?
- Is the battery (voltage) appropriate? (Does Err: 2 occur even when the batteries are replaced with new ones?)

17.2 Calibration

If repair or calibration is necessary, contact your nearest YOKOGAWA dealer.

18. Specifications

51011

Class: Conforms to Class A in JIS C 1609-1: 2006

Measurement ranges:

0.0 to 99.9/999/9,990/99,900/999,000 lx

(automatic and manual range mode switching)

Linearity (accuracy): at 23°C ± 2°C

Reading of 3000 lx or less: ±4% of reading ± 1 digit

Reading greater than 3000 lx: ±6% of reading ± 1 digit

Response time: 5 sec. or less in auto range mode

2 sec. or less in manual range mode

Characteristics of oblique incident light:

(Deviation from the cosine law)

Angle 10° ± 1.5%

30° ± 3%

60° ± 10%

80° ± 30%

Characteristics of relative visible-spectrum response:

Deviation from the standard spectrum luminous efficiency f1':

within 9%

Fatigue characteristics: ±2%

Temperature characteristics:

±5% (at 23°C reference and a range of –10 to 40°C)

Humidity characteristics: ±3%

51012

Class: Conforms to Class AA in JIS C 1609-1: 2006

Measurement ranges:

0.0 to 99.9/999/9,990/99,900/999,000 lx

(automatic and manual range mode switching)

Linearity (accuracy): at 23°C ± 2°C

Reading of 3000 lx or less: ±2% of reading ± 1 digit

Reading greater than 3000 lx: ±3% of reading ± 1 digit

Response time: 5 sec. or less in auto range mode

2 sec. or less in manual range mode

Characteristics of oblique incident light:

(Deviation from the cosine law)

Angle	
	10° ± 1%
	30° ± 2%
	50° ± 6%
	60° ± 7%
	80° ± 25%

Characteristics of relative visible-spectrum response:

Deviation from the standard spectrum luminous efficiency f1': within 6%

Fatigue characteristics: ±1%

Temperature characteristics:

±3% (at 23°C reference and a range of –10 to 40°C)

Humidity characteristics: ±3%

51021

Class: Conforms to Class AA in JIS C 1609-1: 2006

Measurement ranges:

0.00 to 9.99/99.9/999/9,990/99,900/999,000 lx

(automatic and manual range mode switching)

Linearity (accuracy): at 23°C ± 2°C

Reading of 3000 lx or less: ±2% of reading ± 1 digit

Reading greater than 3000 lx: ±3% of reading ± 1 digit

Response time: 5 sec. or less in auto range mode

2 sec. or less in manual range mode

Characteristics of oblique incident light:

(Deviation from the cosine law)

Angle 10° ± 1%

30° ± 2%

50° ± 6%

60° ± 7%

80° ± 25%

Characteristics of relative visible-spectrum response:

Deviation from the standard spectrum luminous efficiency f1':

within 6%

Fatigue characteristics: ±1%

Temperature characteristics:

±3% (at 23°C reference and a range of –10 to 40°C)

Humidity characteristics: ±3%

Ripple measurement:

Illuminance measurement of fluorescent lamps

(except for high-frequency lighting) in the daytime

Measuring range: 100 to 3000 lx

Accuracy: at 23°C ± 2°C

± 7% of reading ± 1 digit

Common Specifications for 51011, 51012, and 51021

Photoelectric element: Silicon photodiode

Display: 7-digit liquid crystal display (LCD)
with function and unit displays
Maximum effective display
(for illuminance measurement):
999 + 0's for place holders
Overrange display: [OL]
Low battery voltage display: [ ]

Measurement cycle: Twice per second

Recorder output:

999 mV ± 5% (range fixed for full scale of each range)

Load resistance: 100 kΩ or more

Automatic power-off:

Disabled for totalized measurement and comparator measurement and when the recorder output plug is inserted approx. 30 minutes after the last key activity. Can be extended or disabled.

Operating temperature and humidity:

–10°C to 40°C, 80% RH or less (no condensation)

Storage temperature and humidity:

–25°C to 70°C, 5 to 95% RH (no condensation)

Measurement cycle: Twice per second

Safety standards:	EN 61010-1: 2001 CAT I Pollution degree 2, Indoor use, Altitude 2000 m or less
EMC standards:	EN 61326-1 Class B EMC Regulatory Arrangement in Australia and New Zealand EN 55011 Class B, Group 1 Korea Electromagnetic Conformity Standard (한국 전자파적합성기준)

Influence in the immunity environment:
±10% or less of range
(Recorder output: ±15% or less of range)

Cable condition:
Use a USB cable that is 3 m or less in length

Power supply:	Two AA dry cells or power supply through USB
Battery life:	Approx. 40 h (when using alkaline dry cells)
Input rating:	Battery: 3 VDC (0.3 W) USB: 5 VDC ± 5% (0.5 W)
Dimensions:	Approx. 67 (W) × 177 (H) × 38 (D) mm
Weight:	Approx. 260 g (including batteries)
USB port:	mini B type

19. Characteristics of Relative Visible-spectrum Response

The visible spectrum of light for human beings is from approximately 360 nm to 830 nm. Even within this narrow range, the sensitivity to light varies greatly depending on the wavelength. This phenomenon is called the standard spectral luminous efficiency and is indicated by V(λ).

The characteristics of relative visible-spectrum response of lux meters play an important role in illuminance measurement.

It is important to approximate the relative visible-spectrum response to V(λ).

These characteristics are stipulated in engineering standards (JIS C 1609-2) for certified lux meters and JIS C 1609-1.

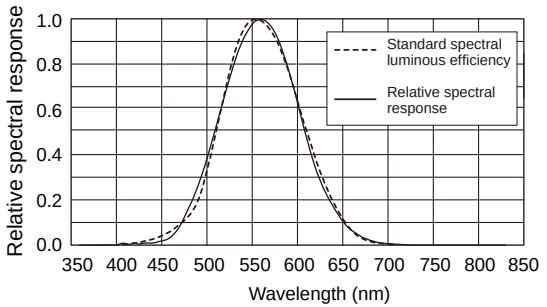
The relative spectral response of an illuminance meter S (λ) is measured at 5-nm intervals for 95 wavelengths to calculate the deviation (f1') from V(λ).

This method of evaluation is based on the performance evaluation of the Commission Internationale de l'Eclairage (International Commission on Illumination; CIE).

There are various light sources such as white light, fluorescent lamps, and mercury lamps on the market.

Normally, the relative spectral response of a lux meter is slightly off from V(λ). So when a light source with a different spectral distribution than the source that was used to calibrate the lux meter is measured, the readings will be slightly off.

The color correction factor is used to correct this error.
To make accurate measurements, we recommend that you correct the readings by multiplying the color correction factor of the light source under measurement.
The following figure shows the characteristics of the relative spectral response.



20. Characteristic of Oblique Incident Light

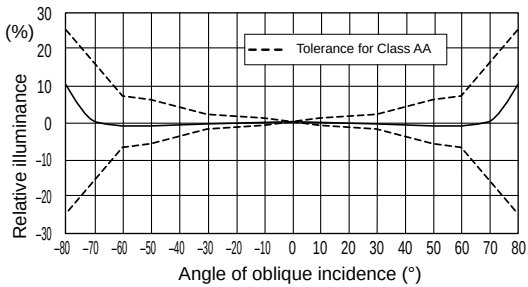
When reading a book at night, the brightness differs between reading under a light and reading a little farther from the light. In such a case, you probably noticed that the book was easier to read when you faced the book toward the light.

If the angle between the incident light and the line perpendicular to the illuminated surface is defined to be θ, the illuminance of the surface is proportional to cos θ.

This characteristic is standardized.

If the lux meter does not meet the standard, illuminance of oblique incident light cannot be measured accurately.

The following figure shows the characteristic of oblique incident light.



21. Illuminance Measurement Method

(Extract from the JIS C 7612 standard)

For general lighting, illuminance of a horizontal surface is typically measured and averaged.

Unless otherwise specified, the height of the measured surface shall be within 85 cm from the floor, 40 cm from the tatami floor in the case of a Japanese-style room, or the surface of the floor or ground in the case of a corridor or in outdoors (if it is difficult to measure the illuminance on the floor or ground, the height shall be within 15 cm from the floor or ground).

The location for measurement shall be divided into equal areas by vertical and horizontal partitioning lines, and the average illuminance for each area shall be calculated. The calculated average of the areas shall be the average illuminance of the total area measured.

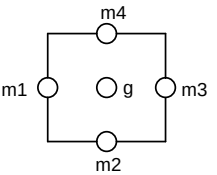
There are two methods to determine the average illuminance for each area: the 5-point method and 4-point method.

(JIS: Japanese Industrial Standards)

5-point method

The middle of each side (the **m** point) and the center of gravity (the **g** point) shall be measured to obtain illuminances Em and Eg, and then the average illuminance for each area shall be determined according to the following expression:

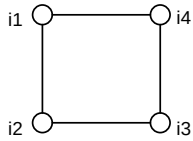
$$\bar{E}_0 = \frac{1}{6}(Em_1+Em_2+Em_3+Em_4+2Eg) = \frac{1}{6}(\sum Em+2Eg)$$



4-point method

The 4-point method is used when the variation in the illuminance is small. The four corners (the **i** points) shall be measured to obtain illuminance Ei, and then the average illuminance for each area shall be determined according to the following expression:

$$\bar{E}_0 = \frac{1}{4}(Ei_1+Ei_2+Ei_3+Ei_4) = \frac{1}{4}\sum Ei$$



If you use Model 51021, measurements using the 4-point and 5-point methods are easy.
(See chapter 7, “Average Illuminance.”)
There is another method in which the average illuminance of multiple partitioned areas can be determined directly.
For details, see JIS C 7612.

22. For the Pollution Control of Electronic and Electrical Products of the People's Republic of China

They are applicable only in China.

产品中有害物质的名称及含量

部件名称	有害物质					
	铅（Pb）	汞（Hg）	镉（Cd）	六价铬（Cr（VI））	多溴联苯（PBB）	多溴二苯醚（PBDE）
框架（塑料）	×	×	×	×	○	○
线路板 ASSY	×	×	×	×	○	○
电池	×	×	×	×	○	○
Plug JC017	×	×	×	×	○	○
○：表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。 ×：表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。						
＜选购＞ 91001，91002						
框架（塑料）	×	×	×	×	○	○
线路板 ASSY	×	×	×	×	○	○
CABLE	×	×	×	×	○	○

环保使用期限：

该标识适用于 SJ/T 11364 中所述，在中华人民共和国销售的电子电气产品的环保使用期限。
只要您遵守该产品相关的安全及使用注意事项，
在自制造日起算的年限内，则不会因产品中有害物质泄漏或突发变异，而造成对环境的污染或对人体及财产产生恶劣影响。

注）
该年数为“环保使用期限”，并非产品的质量保证期。
零件更换的推荐周期，请参照使用说明书。