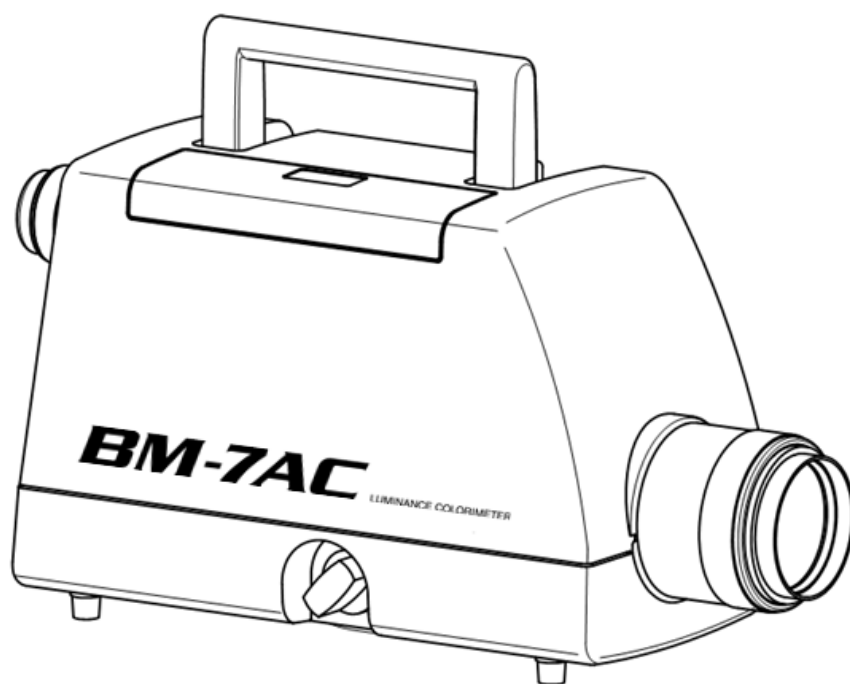


# TechnoOptis



INSTRUCTION MANUAL  
LUMINANCE COLORIMETER

---

# ***BM-7AC***



# Introduction

---

Thank you for purchasing our product, Luminance Colorimeter BM-7AC.

This instrument is a Luminance Colorimeter for measuring light with high precision from a light emitting element such as a CRT, LCD, LCD backlight, LED or the like, or reflected light from a painted surface or printed material.

Read this manual carefully before using the BM-7AC in work applications.



## Precautions for Use

- Use dedicated AC adapter, otherwise it may cause malfunction. For the power supply used for this instrument, the input voltage is 100 to 240 VAC and the frequency is 50 to 60 Hz.
- For energy saving, when this instrument will not be used for an extended period of time, disconnect the power plug from the outlet.
- Keep the instrument away from water and liquid. This instrument is not water-resistant.
- Never measure the light source exceeding the measurable range or the sunlight. Such behaviors may damage the photo detector and make it impossible to perform the stabilized measurement.
- Warm up the instrument for 10 minutes. Otherwise, the instrument might provide unreliable measured value.
- When using this instrument over a prolonged period of time, calibrate it on average once every 24 hour. Output fluctuation of the photo detector may prevent highly accurate measurement results from being obtained.
- Never use this instrument in the place which is dusty or humid or generates corrosive gas.
- Never use this instrument in a place where the temperature tends to vary rapidly. Although this instrument is equipped with a temperature compensating circuit, it may not perform the stabilized measurement under the environment where the temperature tends to vary rapidly.
- Never use or store the instrument in such place as is subject to heavy shock like falling or as tends to vibrate at any time. Such places may damage this instrument equipped with delicate optical components. And, to carry the instrument, please use the accessory carrying case(Optinal) not to directly vibrate or shock it.
- To store the instrument, be sure to put it in the accessory carrying case(Optinal) and keep it under constant temperature and humidity. Never store the instrument under high temperature and high humid environment such as in a car.
- To maintain the measurement precision, be sure to perform the calibration at least once a year. For the calibration adjustment, consult the local retailer from which you purchased the instrument or us.
- To request the calibration adjustment, be sure to put the instrument in the accessory carrying case and put the case in a carton box with cushioning materials packed to send it. If the accessory carrying case(optinal) has not been purchased, consult with your dealer or us.
- When the calibration is adjusted, **all data stored in the instrument are completely removed.** Therefore, be sure to back up the necessary data in your computer before requesting the calibration.
- Please do not peel off the sticker stuck on the back of the main unit. **If you peel it off, all warranty will be invalid.**
- Please check whether there is sufficient space at the instrument installation site or whether it can be used with the cable not tilted.
- We recommend that you remove the cable before moving the instrument.

# Display for safe use




In order to prevent unforeseeable injury to users and others, prevent damage to property or the like, and in order that the instrument is used safely, important items are indicated on the instrument and in the instruction manual.

After gaining a good understanding of the following displays and notation, carefully read the section 'Safety Precautions', and obey all precautions.

Display	Meaning of Display
 <b>Warning</b>	Ignoring this display could result in death or severe injury.
 <b>Caution</b>	Ignoring this display could result in injury * 1, or physical damage * 2.

\* 1: This indicates injury such as a burn, electric shock or the like that does not require hospitalization or long-term medical attention.

\* 2: Physical damage includes damage to the building, property, pets or the like.

Symbols	Meaning of Symbols
	Indicates things that are prohibited. A detailed explanation of the prohibition is indicated within the symbol, or is indicated by a symbol and text.
	Indicates an instruction (something that should be performed). A detailed explanation of the instruction is indicated within the symbol, or is indicated by a symbol and text.
	Indicates a caution (including warnings). A detailed explanation of the caution is indicated within the symbol, or is indicated by a symbol and text.

# Safety Precautions

## Warning



Prohibited

**Never use the system in flammable or explosive vapor-floated (gasoline, etc.) place.**

This may cause the fire.



Prohibited

**Keep the instrument away from water and liquid.**

This may cause the fire and electric shock.



Prohibited

**Never disassemble or modify the device.**

This may cause the fire and electric shock.



Mandatory

**Be sure to use the dedicated AC adapter.**

This may cause the fire and electric shock.



Prohibited

**Never disassemble AC adapter.**

This may cause the fire and electric shock.



Mandatory

**Be sure to remove the dust or moisture around the outlet.**

This may cause the fire.



Mandatory

**If abnormal sound, unusual smell, or smoke are found in the device, turn off the power quickly and pull out the AC adapter cable from the outlet.**

Continuing to use the device may cause the fire.

## **Caution**



Prohibited

**Never watch the sun or the filament of an electric bulb directly.**

This may injure your eyes.

---



Prohibited

**Never put the device (or other objects) on the unstable places like wobbly table or inclined surface.**

Dropping or falling of the device (or other objects) may injure you.

---



Prohibited

**Never pull out or insert the plug by wet hands.**

This may cause you electric shock.

---



Mandatory

**Use only specified screws when using the tripod screw and screw holes for jig attachment.**

Do not tighten the screws any more than necessary. Doing so might cause internal breakage.

## **Disclaimer**

- We are not responsible for the damages caused by various problems such as, fire, earthquake, behaviors by other persons, other accidents, intentional or negligent or wrong use of the device by the operator, and the use of the device under abnormal conditions.
- We are not responsible for incidental damages arising from the use or unavailability of the device (loss of business income, business interruption, etc.).
- We are not responsible for the damages caused by the uses other than specified in the Instruction Manual.
- We are not responsible for the damages caused by the malfunction due to the combination with the connecting devices.

## **User Maintenance**

In order to maintain safety and performance, any maintenance work other than that instructed in this manual should only be performed by a qualified service representative. However, the following maintenance can be performed by the user.

### **Cleaning the Cover and Lens**

When the cover or lens becomes dirty, wipe the case or lens with a soft cloth that has been dampened with mild detergent, then dry with a dry soft cloth.

Do not use solvents such as thinner, benzene, acetone or the like. It may cause discolor the surface.

# Table of Contents

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Introduction.....	1
Display for safe use.....	2
Safety Precautions.....	3
Notation Rules Used in This Manual.....	8
<b>1. Before Use.....</b>	<b>9</b>
1.1    Checking the Unit and Supplied Parts.....	9
1.2    Part Names and Function.....	10
1.3    Preparation.....	18
1.3.1    Connecting the AC Adapter.....	18
1.3.2    Connecting a PC.....	20
1.3.3    Collimation of the Measured Object.....	22
1.3.4    Turning ON/OFF the Power.....	23
1.3.5    Switching the Response Speed of the Photo-Receiver Circuit.....	24
1.4    Error Display.....	25
<b>2. Measurement Operation.....</b>	<b>27</b>
2.1    Example of use.....	27
2.1.1    Measuring a Light Source Having Directivity.....	27
2.1.2    Measuring a Minute Surface.....	27
2.1.3    Using the Unit in a other device.....	28
2.1.4    Reducing instrumental error between a plurality of instruments.....	28
2.2    Absolute Value Measurement.....	33
2.3    Difference Measurement.....	34
2.4    Measuring the Light Source Color.....	35
2.5    Measuring the Object Color.....	36
2.6    Measurement Value Display Mode.....	37
2.7    Using the Analog Output Connector.....	39
2.7.1    Relationship Between Analog Output Voltage and Luminance.....	39
2.7.2    Analog Output Response Speed.....	40
2.7.3    Usage.....	40
<b>3. Various Settings.....</b>	<b>41</b>
3.1    Function Mode.....	41
3.1.1    Entering /Returning from the Function Mode.....	41
3.1.2    Data/Setting Item Display.....	42
3.1.3    Numerical Value Setting.....	43





3.2	Standard sample .....	44
3.3	White Board .....	44
3.4	White Board Luminance Factor.....	45
3.5	White Board Correction Factor.....	45
3.6	Correction Factor.....	46
3.6.1	Checking/Setting the Correction Factor.....	47
3.6.2	Inputting the Correction Factor.....	48
3.6.3	Clearing the Correction Factor .....	51
3.7	Area Correction Factor.....	52
3.7.1	Setting an Area Correction Factor.....	54
3.7.2	Displaying an Area Correction Factor.....	54
3.8	Measurement Range.....	55
3.9	RS-232C Parameters .....	56
3.10	Buzzer Sound.....	57
3.11	Communication Format.....	57
3.12	Average Measure.....	58
<b>4.</b>	<b>Communication With a PC.....</b>	<b>59</b>
4.1	Communication Commands .....	59
4.2	BM-7A Series Mode Communication Commands.....	59
4.2.1	ST Command.....	61
4.2.2	CA Command.....	62
4.2.3	TF Command .....	62
4.2.4	TS Command.....	62
4.2.5	MA Command .....	62
4.2.6	MM Command.....	63
4.2.7	FR Command.....	63
4.2.8	F Command .....	63
4.2.9	R Command.....	64
4.2.10	W Command .....	64
4.2.11	CF Command.....	64
4.2.12	FK Command .....	65
4.2.13	FKR Command.....	65
4.2.14	FAG Command.....	65
4.2.15	FO Command.....	66
4.2.16	CGL Command.....	66
4.2.17	FGR Command.....	66
4.2.18	RG K Command .....	67
4.2.19	RG L Command .....	67
4.2.20	WG K Command .....	67

4.2.21	WG L Command.....	68
4.2.22	WHO/VER/SRL Command.....	68
4.2.23	UT Command.....	68
4.2.24	AM/SM Command.....	69
4.3	Remote Measurement Output Format.....	70
4.4	Communication Commands for the BM-7fast Mode.....	72
4.5	Error Code.....	73
<b>5.</b>	<b>USB Driver.....</b>	<b>74</b>
<b>Appendix</b>	<b>.....</b>	<b>76</b>
	Specifications.....	76
	Appended Tables.....	81
	System Diagram.....	82
	External Dimensions.....	83
	Internal Calculation Processing.....	84
	Terminology.....	86
<b>Warranty</b> .....		<b>87</b>
<b>Contact information:</b> .....		<b>88</b>

# Notation Rules Used in This Manual

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The following notation rules are used in this manual.

Notation	Explanation
[MODE], [UP]	Indicates buttons, or title of the screen displayed on the LCD display.
 「」	Indicates a reference location in the manual.
 『』	Indicates another manual as a reference.
 <b>Request</b>	Indicates items to keep in mind when performing an operation, or items that require attention.
 Memo	Indicates items to consider when performing an operation, or information that is useful.

# 1. Before Use

## 1.1 Checking the Unit and Supplied Parts

---

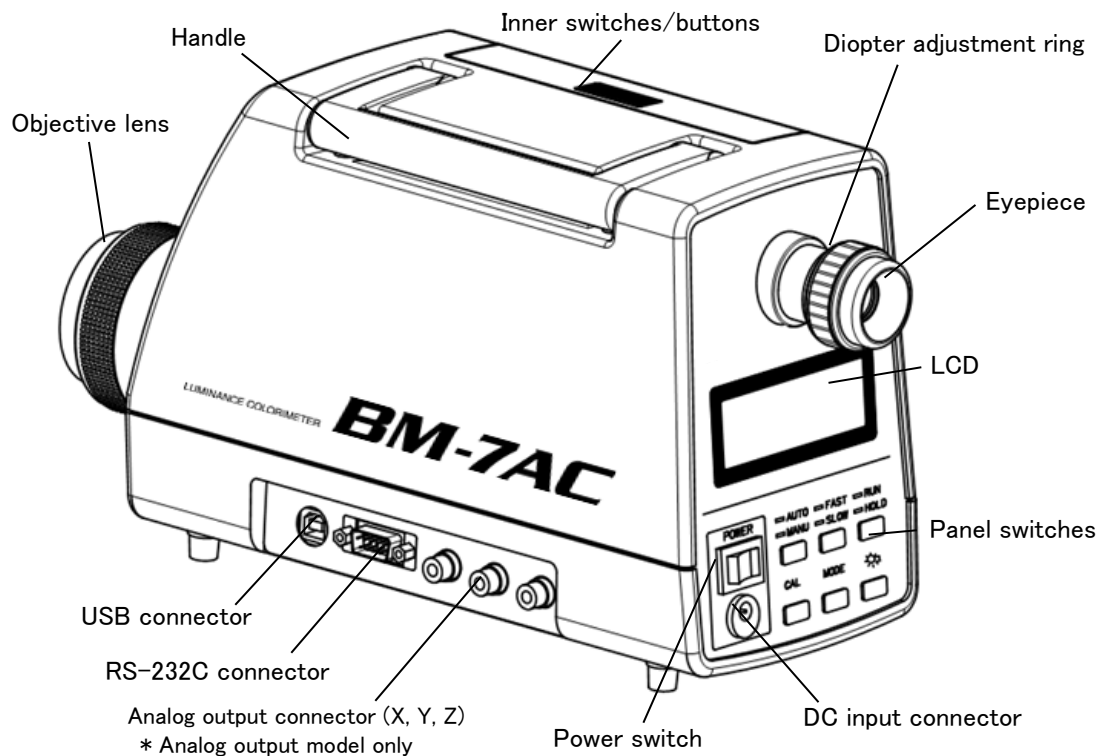
Make sure that the main unit and all of the following supplied parts are in proper order.

If there are any missing parts, contact the dealer or TechnoOptis.


- |  |   |                                  |
|--|---|----------------------------------|
| ▪ Main unit  | 1 |                                  |
| ▪ Instruction manual(Quick manual)                 | 1 |                                  |
| ▪ AC adapter                                       | 1 |                                  |
| ▪ Inspection report                                | 1 |                                  |
| ▪ CD-ROM   | 1 |                                  |
| (Instruction manual / Colorimetry program CS-900A) |   |                                  |
| ▪ Carrying case (option)                           | 1 |                                  |
| ▪ Analog output plug                               | 3 | * For analogue output model only |


## 1.2 Part Names and Function

### ■ Main Body

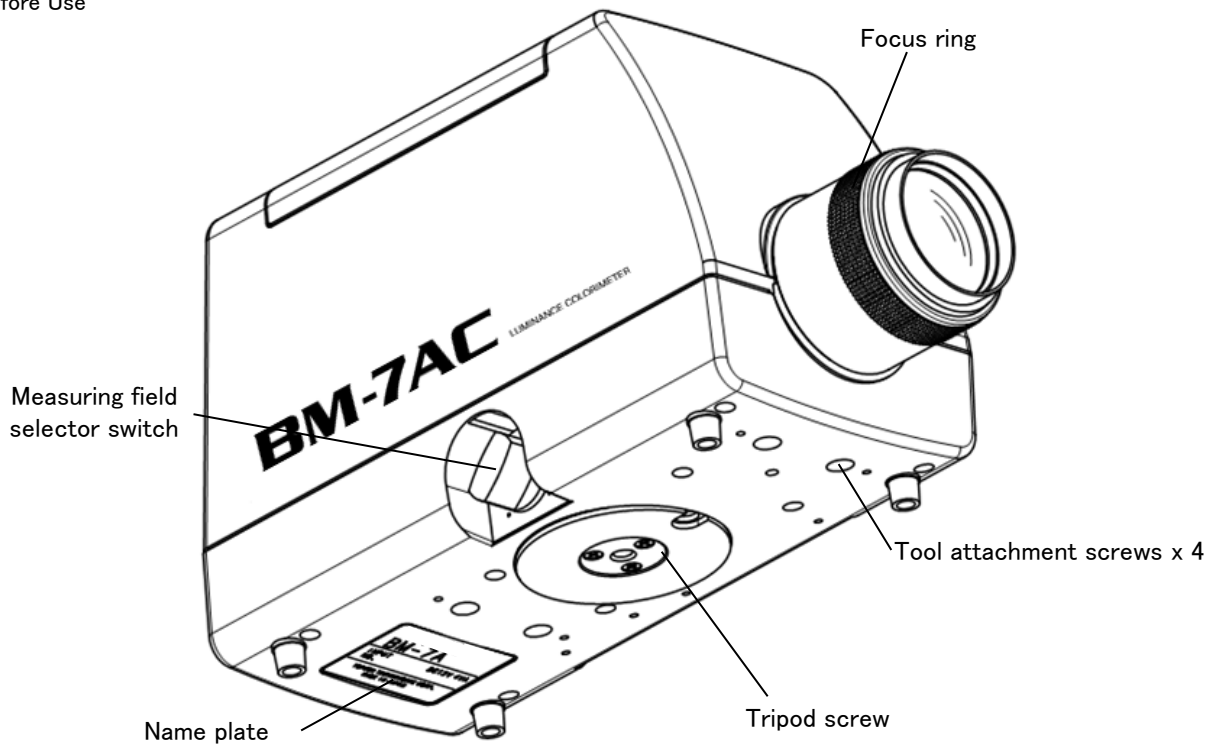




Name	Function
Inner switches/buttons	Buttons for performing various settings in the function mode, and dip switches for performing various settings for the remote mode, change in object color etc. ☞「■ Inner Switches/Buttons」
Diopter adjustment ring	Used when adjusting the focus of the finder on the reticle mark.
LCD	LCD with backlight for displaying various kinds of information such as measurement results and measurement conditions.
Panel switches	Switches for starting/stopping measurement, and switches for changing the response speed of the photo-receiver circuits and display mode. ☞「■ Panel Switches」
Power switch	Power switch to the instrument.
DC input connector	Connector for plugging in the output plug from AC adapter.
USB connector	Connector for connecting a PC when performing measurement in the remote mode. PC connection ☞「1.3.2 Connecting a PC」
RS-232C connector	Connector for connecting a PC when performing measurement in the remote mode. PC connection ☞「1.3.2 Connecting a PC」


Name	Function
Analog output connector * Analog output is a function only used for analog output model.	Connected when using analog output. There are three connectors corresponding to tristimulus value X, Y, Z.  <b>Memo</b> _____ <ul style="list-style-type: none"> <li>▪ Use the manual range when using this output.</li> </ul>

 <b>Request</b>	<ul style="list-style-type: none"> <li>▪ Do not insert or remove connectors when the power of the instrument is ON.</li> <li>▪ Only uses the authorized AC adapter.</li> </ul>
---	--

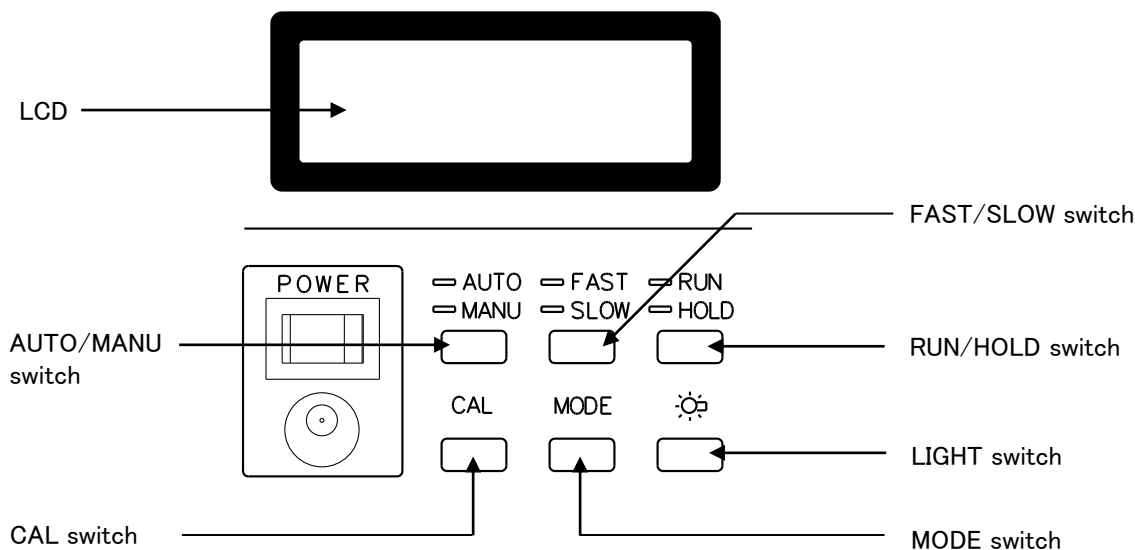
1. Before Use



Name	Function
Focus ring	Used when focusing on the measured object during measurement.
Tool attachment screws	Used when assembling a system, and are screws for attaching the BM-7AC. M4 × 0.7 (Dia: 4 mm, Pitch: 0.7 mm) screws Details  「Appendix: External Dimensions」
Tripod screw	Screw used when attaching the instrument to a tripod. Nominal designation: 1/4-20UNC No. of threads: 20 Pitch: 1.270 mm Depth: 6 mm
Measuring field selector switch	Used when selecting the measurement angle. The size of the measurement range and measurement areas differ depending on measuring angle. Details  「Appendix: Specifications」

 <b>Request</b>	<ul style="list-style-type: none"> <li>Use only specified screws when using the tripod screw and screw holes for jig attachment. Do not tighten the screws any more than necessary. Doing so might cause internal breakage.</li> </ul>
---	--

## ■ Panel Switches



The function of each of the switches is as described below.

### AUTO/MANU Switch

This switch is used to select AUTO or MANUAL measurement ranges.

The range is set to AUTO when the power is ON.

**AUTO range:** Automatically sets the measurement range according to the brightness of the object being measured.

**MANUAL range:** Performs measurement in the measurement range set in the function mode.  
Used when using analog output.  
Factory default setting is range 3.

### FAST/SLOW Switch

This switch is used to select the response speed of the photo-receiver circuit. The response speed is the time required for the analog output of the instrument to reach 90% of the peak value when measuring an LED driven by a square wave from a function generator.

SLOW is set when the power is ON, and SLOW is used for normal measurement.

**FAST :** The response speed of the photo-receiver circuit is increased.

This is set when measuring fixed light such as the sun or halogen lamp, and a light source having high frequency lamp such as a LCD.

Set when measuring a flashing light source and analog output is connected to an oscilloscope. (Analog output is only used for analog output model.)

The response speed differs depending on the measurement range (30 milliseconds to 1 millisecond).

**SLOW :** The response speed of the photo-receiver circuit is decreased.

This is used for normal measurement such as measuring fixed light, and flashing light such as high-frequency flashing light, fluorescent light, and a CRT.

Set when recording waveforms of analog output using a pen recorder.

### RUN/HOLD Switch

This switch is used to select free-run status or hold status for display.

This switch is set to RUN when the power is ON.

It is also used as a switch for starting measurement of a standard sample, or white board.

### CAL Switch

This switch is used to perform zero-adjustment.

Internal shutter of BM-7AC make a shaded state and perform measurement in the shaded state, and saves the value.

The saved value in the shaded state is subtracted from the measurement value and the result is displayed.

Zero-adjustment should be performed with the cap to the Eyepiece attached.

### MODE Switch

By pressing this switch in the HOLD state (when [HOLD] of the RUN/HOLD switch is blinking), the display mode of the measurement data can be changed.

Each time the switch is pressed, the display mode changes as shown below.

xy/L → u'v'/L → XYZ → Tc/duv/L → xy/L ……

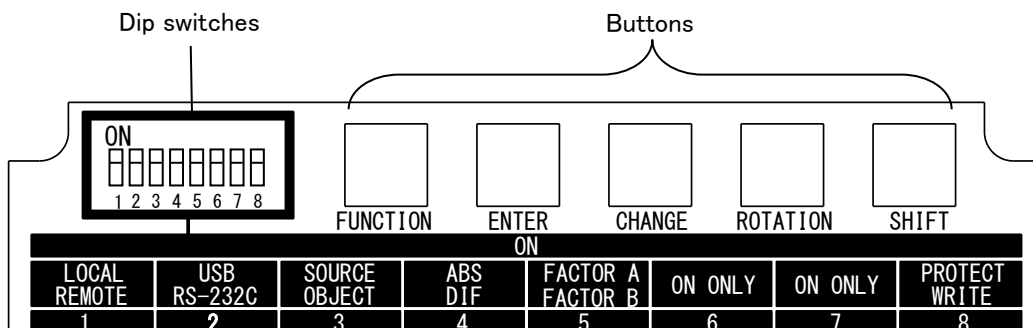
This switch is set to xy/L mode when the power is turned ON.

### LIGHT Switch

This switch is used to switches ON/OFF the lighting (backlight) to the LCD.

The switch is set ON when the power is turned ON.

## ■ Inner Switches/Buttons



### — Buttons —

#### FUNCTION

This button is used to enter/return from the function mode.

Press this button once to enter function mode, and press it again to return form function mode.

#### ENTER

This button is used when changing the display page and when storing the data in the memory after entering value.

#### CHANGE

This button is used to change setting.

## ROTATION

This button is used to select a parameter to be inputted.

Each time the button is pressed, the selection candidate is displayed in order.

The displayed contents differ according to the parameter type.

Example :  $\cdot \rightarrow 0 \rightarrow 1 \rightarrow 2 \rightarrow \dots \rightarrow 8 \rightarrow 9 \rightarrow + \rightarrow - \rightarrow E \rightarrow \cdot \rightarrow \dots$

2400  $\rightarrow$  4800  $\rightarrow$  9600  $\rightarrow$  19200  $\rightarrow$  38400  $\rightarrow$  2400  $\rightarrow$  .....

EVEN  $\rightarrow$  ODD  $\rightarrow$  NONE  $\rightarrow$  EVEN  $\rightarrow$  .....

## SHIFT

This button is used to move among digits when entering a multi-digit numerical value.

It moves from the highest order digit to the lowest order digit.


## — Dip Switches —

### 1 LOCAL/REMOTE

This switch is used to select the control state of the instrument.

LOCAL : Sets the LOCAL mode.

REMOTE : Sets the REMOTE mode.


 Request	<ul style="list-style-type: none"> <li>The connection method is read into the instrument when the power is turned ON. To change the setting, turn the power OFF and ON again.</li> </ul>
--	--

### 2 USB/RS-232C

This switch is used to select the connection method between the instrument and PC.

USB : Connection with PC through USB.


RS-232C : Connection with PC through RS-232C.

 Request	<ul style="list-style-type: none"> <li>The connection method is read into the instrument when the power is turned ON. To change the setting, turn the power OFF and ON again.</li> </ul>
--	--

### 3 SOURCE/OBJECT

SOURCE : Set when measuring the light source.

OBJECT : Set when measuring the object.

 Request	<ul style="list-style-type: none"> <li>The connection method is read into the instrument when the power is turned ON. To change the setting, turn the power OFF and ON again.</li> </ul>
--	--

### 4 ABS/DIF

This switch is used to select the display between an absolute value and difference.

ABS : Sets the absolute value display.

DIF : Sets the difference display.

#### Memo


- This switch can be changed during power ON.

## 5 FACTOR A/B


FACTOR A : Select when setting a single correction factor.

The correction is set in the function mode.

FACTOR B : Select when setting the direct correction function, using other instrument BM-7AC, SC-777 or SR-3. The correction is set in the function mode.

Function Mode  [3.1 Function Mode]

Direct Correction Function

 [2.1.4 Reducing Error Among a Plurality of Measurement Instruments and Performing Measurement]

### Memo

- This switch can be changed during power ON.

## 6 NC

This is an empty switch and should always be set to the ON side.

## 7 NC

This is an empty switch and should always be set to the ON side.

## 8 PROTECT/WRITE

PROTECT : Prevents writing to internal memory.

This switch should always be set to the PROTECT side during measurement.

WRITE : Allows writing to internal memory.

This switch should be set to the WRITE side when changing memory contents.

### Memo

- This switch can be changed during power ON.

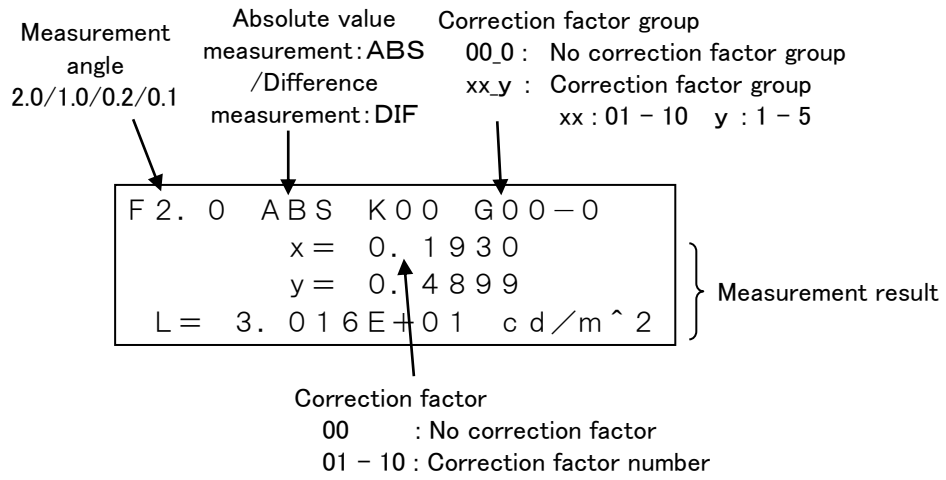


### Request

- Put the cover on the internal switches/buttons during measurement to prevent a light from intruding into instrument. Otherwise accurate measurement result can not be obtained.




■ LCD

Measurement results are displayed on the LCD as follows.



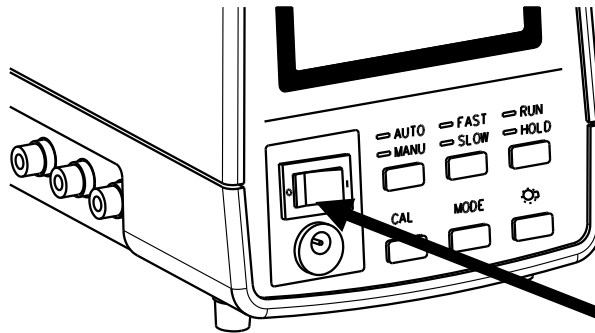
# 1.3 Preparation

## 1.3.1 Connecting the AC Adapter

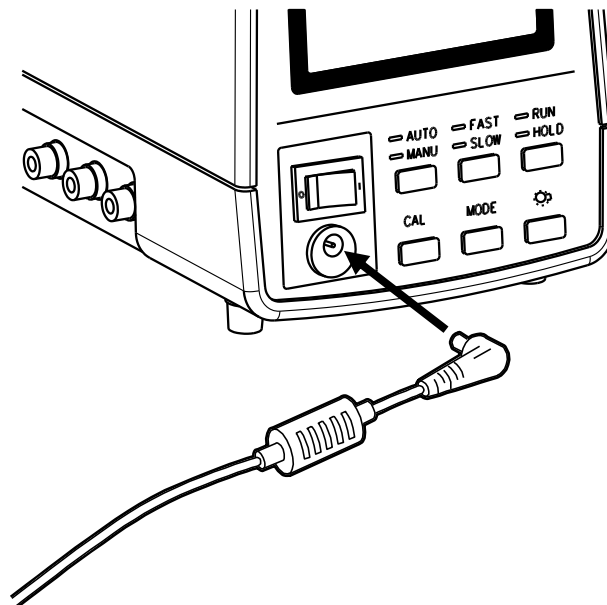
 Mandatory	<b>Be sure to use the dedicated AC adapter.</b> This may cause the fire and electric shock.
 Mandatory	<b>Be sure to remove the dust or moisture around the outlet.</b> This may cause the fire.
 Prohibited	<b>Never pull out or insert the plug by wet hand.</b> This may cause electric shock.

The procedure for connecting the AC adapter to the instrument is explained below.

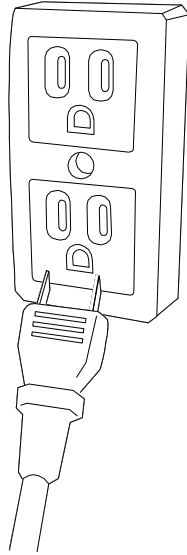
- 1 Make sure the power to the instrument is OFF.



- 2 Insert the connector on the output side of the AC adapter to the DC input connector of the instrument.



- 3** Plug in the AC adapter plug into the power outlet.



## 1.3.2 Connecting a PC

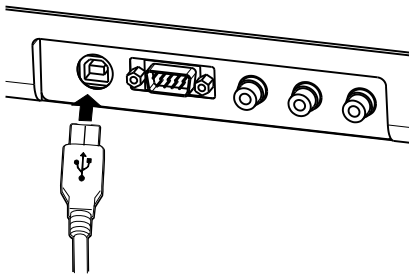
When connecting a PC, use a RS-232C cable or USB cable to connect the BM-7AC and PC. When using a RS-232C cable, use a straight cable supporting for a DOS/V PC. It is possible to connect up to a maximum of 16 instruments to one PC by USB, also parallel use with an RS-232C cable is possible. However, the USB and RS-232C cannot be used at the same time for one BM-7AC.

### Memo

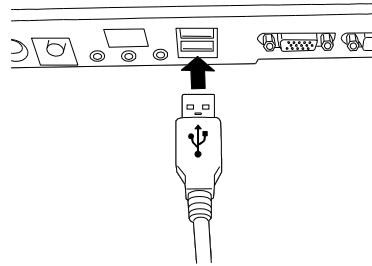
- The connection cables are not supplied with the unit. If cables are to be used, they should be purchased separately.
- For details regarding the connection on the PC side, refer to the manual for the PC being used.

### USB connection

- BM-7AC side -

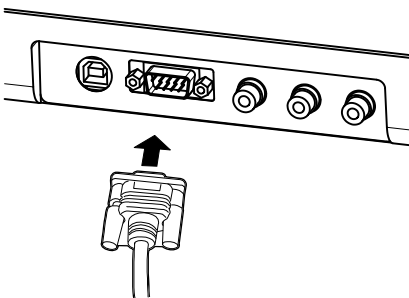


- PC side -

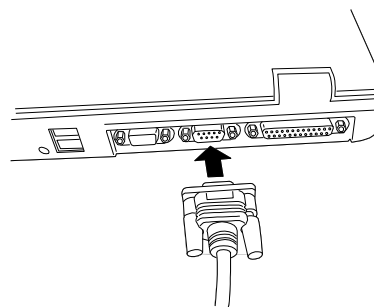


### RS-232C connection

- BM-7AC side -



- PC side -



RS-232C specification for this unit is as shown below.

- Cable                                      Straight cable supporting for a DOS/V PC
- Communication method      Full duplex
- Synchronous system          Start stop synchronization
- Baud rate                                2400/4800/9600/19200/38400 BPS (Bits Per Second)
- Bit configuration                      Data length 7 bits/8 bits  
    Parity EVEN/ODD/NONE  
    Stop bits 1 bit/2 bits
- Communication format          ASCII format
- Delimiter                                "CR+LF" or "CR" added to the end of communication data strings.


### Dip Switch Settings

When connected with a PC, the dip switches should be set as shown below.

Dip switch 1 : REMOTE side


Dip switch 2 : Either the RS-232C side or USB side depending on the connection method used


When the power is turned ON in this state, the instrument will warm up for 10 minutes, then the instrument enter the remote mode and the following screen will be displayed.

Turning on the Power  「1.3.4 Turning ON/OFF the Power」

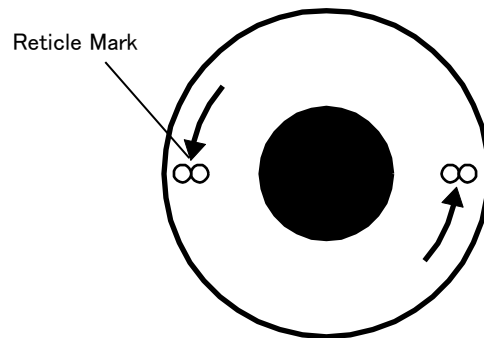
Remote Mode  
 Warm-up... Ver. 1.00

### 1.3.3 Collimation of the Measured Object

 Prohibited	<b>Do not look directly at a bright light such as the sun or a bulb filament. Doing so could damage the eyes.</b>
---	---

 Request	<b>Use only specified screws when using the tripod screw and screw holes for jig attachment. Do not tighten the screws any more than necessary. Doing so might cause internal breakage.</b>
--	---

- 1 Set the instrument on a tripod or the like.
- 2 Remove the objective lens cap.
- 3 Look into the eyepiece, and turn the diopter adjustment ring of the eyepiece so that the reticle marks are clearly seen in the view finder.



- 4 Collimate with the measured object, and turn the focus ring of the objective lens and adjust the focus on the measured object.
- 5 Change the measurement angle according to the size and brightness of the measured object.

 **Memo**

- When changing the measurement angle, use the Measuring field selector switch.
- The current measurement angle will be displayed on the LCD.

Measuring field selector switch, LCD Display

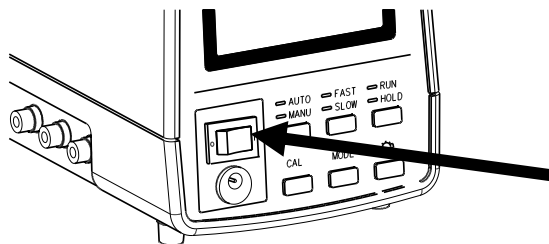
 「1.2 Part Names and Function」

- The measurable luminance range changes according to the measurement angle.

 「Appendix: Specifications Luminance Measurement Range」

## 1.3.4 Turning ON/OFF the Power

When turning the power ON, flip the power switch to the right side.



After the power has been turned ON, the instrument will warm up for 10 minutes, then the zero-adjustment starts and then measurement starts automatically.

C a l i b r a t i n g



```
F 2. 0  ABS  K 0 0  G 0 0 - 0
      x = 0. 1 9 3 0
      y = 0. 4 8 9 9
L = 3. 0 1 6 E + 0 1  c d / m ^ 2
```

To finish measurement, press the RUN/HOLD switch. The final measurement results of continuous measurement will be displayed.

### Memo

- In the REMOTE mode (when dip switch 1 is on the REMOTE side), the screen that is displayed after the power is turned ON will differ.

 「1.3.2 Connecting a PC」 「Dip Switch Settings」

When the power is turned ON and dip switch 8 is on the WRITE side, the following screen is displayed.

```
A t t e n t i o n  ! !
P l e a s e  s e t
t h e  P R O T E C T / W R I T E  S W
t o  t h e  P R O T E C T  s i d e .
```

After this screen is displayed, set dip switch 8 to the PROTECT side.


## 1. Before Use

### Canceling the warm up

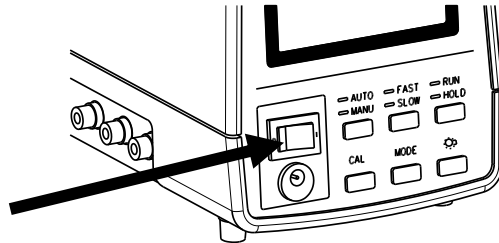
To cancel the warm up, press the CAL switch during warm up.

The following screen is displayed, and when the CAL switch is pressed again, zero-adjustment begins.

DARK MEASURE  
Push CAL Key.

 <b>Request</b>	<ul style="list-style-type: none"><li>When turning the power ON again after a short time has elapsed after the power is turned OFF, do not cancel the warm up. Doing so could result in not being able to obtain accurate measurement results.</li></ul>
---	--

To turn the power OFF, flip the power switch to the left side.



## 1.3.5 Switching the Response Speed of the Photo-Receiver Circuit

When performing measurement, switch the response speed of the photo-receiver circuit as needed.

The response speed has FAST speed and SLOW speed. The response speed is switched by using the FAST/SLOW switch. Each time the switch is pressed, the speed changes between FAST and SLOW.

The measurement method for each response speed is as shown below.





Measurement Method	
FAST	Make sure the [FAST] LED is blinking, then press the RUN/HOLD switch and start measurement.
SLOW	Make sure the [SLOW] LED is blinking, then press the RUN/HOLD switch and start measurement.

### Memo




- When observing a blinking light source using analog output, set the speed to the FAST mode. (Analogue output is a function only used for analog output model)
- To obtain stable measurement result, set the speed to SLOW.

## 1.4 Error Display

When an error occurs with this instrument, an error display is displayed on the LCD.

Error Display	Contents
BAT	<p>Displayed when the AC adapter voltage is low. Make sure that power from the power outlet is being supplied, and that the AC adapter is plugged in properly.</p>
FERR	<p>Displayed when the measurement angle is not properly set. Check the Measuring field selector switch, and make sure the measurement angle is properly set.</p>
* * * * *	<p>Displayed when the luminance of the measured object exceeds the measurement range of the instrument (when Over Range). Check the measurement range. Measurement Range  「Appendix: Specifications」 When it is not possible to change the measurement range, use a dark filter (optional).</p>
— —	<p>Displayed when the luminance of the measured object is below the measurement range of the instrument (when Under Range). Check the measurement range. Measurement Range  「Appendix: Specifications」</p>
Timeout	<p>Displayed when data communication cannot be done between two luminance colorimeters during setting the Direct correction function. Make sure that the RS-232C parameter settings, communication method and data output method of the two luminance colorimeters are set the same.</p>
Different Instrument	<p>Displayed when the model name of reference instrument which is set to the BM-7AC differ from the model name of the instrument that is the actual reference during setting the direct correction function. Check the model name of reference instrument setting to the BM-7AC.</p>
OVER	<p>Displayed when the luminance of the measured object exceeds the measurement range of the instrument (Over Range) during setting the Direct correction function. Check the measurement range. Measurement Range  「Appendix: Specifications」 When it is not possible to change the measurement angle or measurement range, use a mesh filter (optional).</p>
Under	<p>Displayed when the luminance of the measured object is below the measurement range of the instrument (Under Range) during setting the Direct correction function. Check the measurement range. Measurement Range  「Appendix: Specifications」</p>
Field ERROR	<p>Displayed when the measurement angle is not properly set during setting the Direct correction function. Check the Measuring field selector switch, and make sure the measurement angle is set properly.</p>
Calibration ERROR	<p>Displayed when the calibration cannot be completed. Check that the cap is attached to the eyepiece and the measurement condition is in operating conditions. If an error is still displayed even after retrying, repair may be required. Contact the dealer or TechnoOptis office.</p>

## 2. Measurement Operation

RS232C ERROR	Displayed when the communication with PC is failed. Check the connection of RS-232C or USB cable and communication condition.  Connection  「1.3.2 Connecting a PC」 Communication Conditions  「3.9 RS-232C Parameters」  「3.12 Communication Format」
USB ERROR	
Shutter ERROR	Displayed when there is an internal shutter error. The shutter may be broken, so contact the dealer or TechnoOptis office.



### 2.1.3 Using the Unit in a other device

It is possible to use the BM-7AC in a system. A system is presumed to be an apparatus in which the BM-7AC is mounted on an XY stage, and measurement is performed while moving.

When using the unit in a system, refer to the followings.

Communication Specifications  「4. Communication With a PC」

Installation Materials  「Appendix: External Dimensions」

### 2.1.4 Reducing instrumental error between a plurality of instruments

It is possible for the BM-7AC to perform correction between a pair of BM-7AC or with this company's high-end models SR-3, SC-777 to reduce instrumental error.

There are two methods for performing correction between instruments.

- Use Colorimetry program CS-900A.
- Use the Direct Correction function.


#### ■ Using CS-900A

The reference light source sample should be the same kind of light source as the light source actually being measured, and should have stable light output.

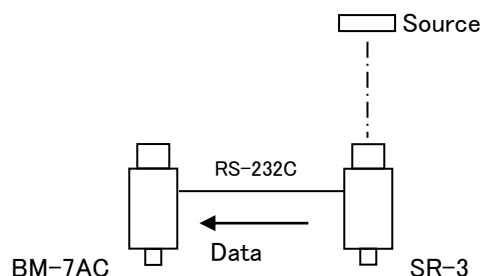
The procedure for performing correction between instruments using CS-900A, refer to the [CS-900A INSTRUCTION MANUAL].

#### ■ Using the Direct Correction Function

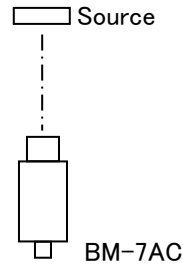
In the method of using the Direct Correction function, a RS-232C cable and a reference light source sample are necessary.

 <b>Request</b>	<ul style="list-style-type: none"> <li>▪ The reference light source sample should have stable light output and be the same type as the light source to be measured.</li> <li>▪ To use the Direct Correction function, the RS-232C parameters of the two luminance colorimeters must be the same.</li> </ul>
---	---

When using the Direct Correction function, first, measure the light source using the reference instrument, and write that measurement data to the BM-7AC to be corrected.



Next, place the BM-7AC to be corrected in the location where the reference instrument placed, and measure the same light.



A correction factor is calculated for the BM-7AC to be corrected based on the data of the reference instrument, and the data of the BM-7AC to be corrected.

The procedure of measurement for correction between instruments using the Direct Correction function is as explained below.

- 1 Set beforehand the data output method and communication method for the reference instrument in reference to the table below. Then connect it with the BM-7AC to be corrected using a specified cable. Also, set the RS-232C parameter settings of the BM-7AC to be corrected are the same as those of the reference instrument.

Reference Luminescence Colorimeter	RS-232C Cable	Data Output Method	Communication type
BM-7AC	Interlink	FACTOR B	RS-232C

- 2 Set dip switch 5 of the BM-7AC to be corrected to the FACTOR B side, and turn ON the power.
- 3 Turn on the power to the reference luminance colorimeter.
- 4 The BM-7AC to be corrected changes to the function mode, and the [\*Direct-Correction Factor\*] screen is displayed.

Moving to the Function Mode 「3.1.1 Moving/Returning to the Function Mode」

Display Method 「3.1.2 Data/Setting Items Display」

```

*Direct-Conn Factor*
  Measure Reference
  Measure Factor
  All Factor Clear
  
```

- 5 Press the [CHANGE] button.

## 2. Measurement Operation

- 6** Press the [ROTATION] button, and select "Measure Reference" ("\*" is displayed) and press the [ENTER] button.

Measure Reference : Perform measurement using the reference instrument, and write the measurement data in the BM-7AC to be corrected.

Measure Factor : Perform measurement using the BM-7AC to be corrected, then a correction factor is calculated based on data found in the "Measure Reference".

All Factor Clear : Clear the correction factor and measurement data found above.

```
*Direct-Conn Factor*
*Measure Reference
Measure Factor
All Factor Clear
```

- 7** Select the type of the reference luminance colorimeter.

Press the [ROTATION] button and select the type of the reference luminance colorimeter ("\*" is displayed), then press the [ENTER] button. In the case of a BM-7AC, select "COMMON"

```
SELECT REF DEVICE
COMMON
*SR-3
SC-777
```

- 8** Select the number of the data to be written.

Press the [ROTATION] button to display the number of the data to be written

```
REF 1 1
NO DATA
R=NEXT S=PAGE
```

[ROTATION] : Data for the next number is displayed.

[SHIFT] : Each time the button is pressed, the display changes as shown below.

REF → SMP → K → ...

REF : This means "Reference". Measurement data of the reference luminance colorimeter is written.

SMP : This means "Sample". Measurement data of the BM-7AC to be corrected is written.

K : This means Correction factor. A correction factor that is calculated based on data measured using REF and SMP, and automatically input.

### Memo

- It is possible to store up to 5 items of correction factor data.

**9** Press the RUN/HOLD switch.

The message "Measuring" is displayed on the LCD, and measurement by the reference luminance colorimeter starts. After measurement end, the following screen is displayed.

```

      A t t e n t i o n  ! !
P l e a s e  s e t
t h e  P R O T E C T / W R I T E  S W
t o  t h e  P R O T E C T  s i d e .

```

**Request**

- In the case that each of the various communication settings is not correct, data communication cannot be performed. Check whether setting has been performed properly according to the Error display.

Meaning of Error Displays 「1.5 Error Display」

**10** Switch dip switch 8 of the BM-7AC to be corrected to the WRITE side to write data.**11** Place the BM-7AC to be corrected at the location where the reference luminance colorimeter is placed, then press the [ENTER] button to display the following screen. Select "Measure Factor" and press the [ENTER] button.

```

* D i r e c t - C o n n  F a c t o r *
  * M e a s u r e  F a c t o r
    E x i t

```

**12** Specify a number to write the data for the BM-7AC to be corrected. Select the number where the data for the reference luminance colorimeter is written, then press the RUN/HOLD switch to start measurement.

- If the data of the reference luminance colorimeter is not written in "REF", measurement is not performed.

```

K 1 1
      N O  D A T A
      R = N E X T  S = P A G E

```

**13** The message "Measuring" is displayed on the LCD, and the BM-7AC to be corrected begins measurement. After finish of measurement, the following screen will be displayed for about 3 seconds.

```

S M P 1 1  x =  0 . 4 4 7 5
           y =  0 . 4 3 2 0
           L =  2 . 0 7 1 E + 0 1

```

## 2. Measurement Operation


- 14** The correction factor is calculated and the following screen is displayed.

K 1 1	K X =	9. 3 4 3 E - 0 1
	K Y =	9. 5 8 9 E - 0 1
	K Z =	9. 3 9 6 E - 0 1
C = S E T	R = N E X T	S = P A G E

- 15** When "SET" is displayed on the following screen by pressing the [CHANGE] button, indicates that the correction factor has been set.

K 1 1	K X =	9. 3 4 3 E - 0 1
S E T	K Y =	9. 5 8 9 E - 0 1
	K Z =	9. 3 9 6 E - 0 1
C = S E T	R = N E X T	S = P A G E

- 16** After returning to the function mode, the correction factor becomes valid.  
Entering to the Function Mode

 「3.1.1 Entering /Returning from the Function Mode」

## 2.2 Absolute Value Measurement

---

The procedure for absolute value measurement is described below.

- 1** Set dip switch 4 to the ABS side.
- 2** Press the RUN/HOLD switch.  
The panel switch [RUN] blinks and continuous measurement starts.
- 3** To end measurement, press the RUN/HOLD switch.  
The panel switch [HOLD] blinks, and the measurement result is displayed.

F 2. 0	ABS	K 0 0	G 0 0 - 0
	x =	0. 1 9 3 0	
	y =	0. 4 8 9 9	
L =	3. 0 1 6 E + 0 1	cd / m ^ 2	

## 2.3 Difference Measurement

With this device it is possible to measure the difference from reference data.

The procedure for measuring the difference is as described below.

- 1 Set dip switch 4 to the DIF side.

When DIF is set for the first time after the instrument was turned ON, the following screen will be displayed.

```

      A t t e n t i o n  ! !
P l e a s e   s e t
t h e   S t d   s a m p l e ,   t h e n
p u s h   R U N / H O L D   k e y .

```

- 2 Set the reference sample, and press the RUN/HOLD switch.

After measurement, the measurement result will be displayed for about 3 seconds, then difference measurement will be performed automatically in continuous measurement.

```

F 2 . 0   D I F   K 0 0   G 0 0 - 0
          x =   0 . 6 0 0 7
          y =   0 . 1 3 1 6
L =   3 . 4 1 8 E - 0 2   c d / m ^ 2

```




### Request

- Reference data is stored internally until the power is turned OFF. After returning to ABS after once setting DIF, if DIF is set again, the reference sample is not measured. Difference measurement will be performed using the stored reference data. To change the reference data, turn OFF the power to the instrument and turn it ON again, then perform the procedure again from step 1.

### Memo

- To return to absolute value measurement, set dip switch 4 to the ABS side.
- The stored reference data can be check in the function mode.


Checking Reference Data  「3.2 Standard sample」

## 2.4 Measuring the Light Source Color

---

The procedure for measuring the light source color is described below.

- 1 Make sure the power to the instrument has been turned OFF. If the power is ON, turn it OFF.
- 2 Set dip switch 3 to the SOURCE side.


 <b>Request</b>	<ul style="list-style-type: none"><li>▪ If the dip switch is changed while the power is ON, the change will not take effect.</li></ul>
---	--

- 3 Turn the power to the instrument ON. The instrument will be in the free run state and measurement will start.

## 2.5 Measuring the Object Color

The procedure for measuring the color of an object is as described below.

- 1 Make sure the power to the device has been turned OFF. If the power is ON, turn it OFF.
- 2 Set dip switch 3 to the OBJECT side.

 <b>Request</b>	<ul style="list-style-type: none"> <li>▪ If the dip switch is changed while the power is ON, the change will not take effect.</li> </ul>
---	--

- 3 Turn the power to the instrument ON.  
White board measurement will start, and the following screen will be displayed.

Attention !! Please set the WS (100.0%), then push RUN/HOLD key.
---

- 4 Make sure that the displayed luminance factor for the white board matches the luminance factor for the white board used. If it does not match, set the proper value.


Setting the Luminance Factor of the White Board

 [3.4 White Board Luminance Factor]

### Memo


- |   |
|---|
| <ul style="list-style-type: none"> <li>▪ The factory setting for the white board luminance factor is 100.0%.</li> </ul> |
|---|

- 5 Set the white board, and perform measurement.

 <b>Request</b>	<ul style="list-style-type: none"> <li>▪ White board measurement should be performed after setting the proper luminance factor. If the proper luminance factor is not set, an incorrect measurement value will be displayed.</li> <li>▪ For the white board, use a TechnoOptis standard white board WS-3.</li> </ul>
---	--

After measurement, the measurement result will be displayed for about 3 seconds, then measurement of the object color will start automatically in continuous measurement.

### Memo

- |  |
|--|
| <ul style="list-style-type: none"> <li>▪ The white board measurement value is store internally until the power is turned OFF. However, in the following cases, the white board data will be lost.           <ul style="list-style-type: none"> <li>▪ When the white board luminance factor is changed</li> <li>▪ When the white board correction factor is changed</li> </ul> <p style="text-align: right;">Checking the White Board Measurement Value  [3.3 White Board]</p> </li> <li>▪ To measure the white board again, turn the power OFF and ON again, then perform the operation from step 1.</li> </ul> |
|--|

## 2.6 Measurement Value Display Mode

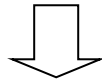
When the display is in the HOLD state ([HOLD] of the RUN/HOLD switch is blinking), it is possible to change the measurement value display mode by pressing the MODE switch.

Each time the switch is pressed, the display changes as shown below.

### — Light Source Color —

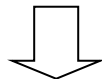
#### Chromaticity xy Luminance L

F 2. 0	ABS	K 00	G 00-0
		x =	0. 2963
		y =	0. 3688
		L =	1. 411E+02 cd/m <sup>2</sup>



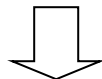
#### Chromaticity u' v' Luminance L

F 2. 0	ABS	K 00	G 00-0
		u' =	0. 1734
		v' =	0. 4857
		L =	1. 411E+02 cd/m <sup>2</sup>



#### Tristimulus value XYZ

F 2. 0	ABS	K 00	G 00-0
		X =	1. 134E+02
		Y =	1. 411E+02 cd/m <sup>2</sup>
		Z =	1. 282E+02



#### Color temperature Tc Deviation duv Luminance L

F 2. 0	ABS	K 00	G 00-0
		T <sub>c</sub> =	6976 K
		duv =	0. 055
		L =	1. 411E+02 cd/m <sup>2</sup>

2. Measurement Operation

— Object Color —

Chromaticity xy Luminance Lv

F 2. 0	ABS	K 0 0
	x =	0. 2 9 0 7
	y =	0. 2 2 8 1
	L =	5. 3 5 0 E+0 2 c d / m ^ 2



CIELAB

F 2. 0	ABS	K 0 0
	a * =	0. 2
	b * =	0. 0
	L * =	1 0 0. 5



CIELUV

F 2. 0	ABS	K 0 0
	u * =	0. 4
	v * =	0. 0
	L * =	1 0 0. 5

## 2.7 Using the Analog Output Connector

It is possible to obtain analog output from the internal photo-detectors X, Y, Z using this connector.



### Memo

- The analog output connector is a function that can only be used for analog output model.

### 2.7.1 Relationship Between Analog Output Voltage and Luminance

The relationship between the luminance and Y output voltage of analog output 0 to 3.0V is as shown in the table below, however, this table should be used just as a reference.

The data shown on the LCD have been processed digitally, so when the exact relationship between the analog output voltage and luminance is needed, it is necessary to take the correlation with the display into consideration.

(Unit: cd/m<sup>2</sup>)

	2°	1°	0.2°	0.1°
<b>Range1</b>	0 ~ 30	0 ~ 120	0 ~ 3,000	0 ~ 12,000
<b>Range2</b>	0 ~ 90	0 ~ 360	0 ~ 9,000	0 ~ 36,000
<b>Range3</b>	0 ~ 300	0 ~ 1,200	0 ~ 30,000	0 ~ 120,000
<b>Range4</b>	0 ~ 3000	0 ~ 12,000	0 ~ 300,000	0 ~ 1,200,000
<b>Range5</b>	0 ~ 30,000	0 ~ 120,000	0 ~ 3,000,000	0 ~ 12,000,000



### Request

- The analog output depends on the processing precision of the aperture mirror, so when an exact value is needed, take the correlation with the display into consideration.




### Memo

- In regards to the analog output for X and Z, theoretically it do not have relationship between the analog output voltage and luminance (even though the luminance is the same, the analog output voltage differs when the spectral distribution of the light source is not same). Details of relationship between analog output for X / Z and luminance not be given here.

## 2.7.2 Analog Output Response Speed

The analog output response speed differs depending on the range used.

Response Speed  [Appendix: Response Speed]

When checking the build up characteristics when a light is on, set the FAST/SLOW switch to FAST. (In the case of SLOW, the integral capacitor value is increased and operation is performed smoothly, so the response speed becomes slow.)


## 2.7.3 Usage

The procedure for analog output measurement is as described below.

- 1 Solder and attach the shielded wire of the supplied analog output plug, and connect it to the device.

- The pin side of the plug is the signal.

- 2 In the function mode, set the respective measurement ranges for X, Y, Z.

Range Setting  [3.8 Measurement Range]

- 3 Press the panel switch AUTO/MANU, and make sure that [MANU] of the panel switch blinks. The manual range state is set

- 4 Set FAST/SLOW depending on the measurement purpose.

FAST/SLOW Setting  [1.2 Name and Function of Each Part]



### Request

- When an absolute value is necessary for the tristimulus value, take the correlation with the display into consideration.
- When used with the output voltage in the saturated state, proper measurement cannot be performed. Be sure to set the proper measurement range.
- The output impedance is about  $100\ \Omega$ . Use a recorder having an input impedance of  $10\text{k}\ \Omega$  or more.

- The zero point may move due to temperature change, but this does not mean the instrument is not broken.

# 3. Various Settings

## 3.1 Function Mode

The function mode is a mode for checking or changing various data or settings that are stored in the internal memory of the instrument.


### 3.1.1 Entering /Returning from the Function Mode

Entering /returning from the function mode is performed using the [FUNCTION] button. Press the button once, the mode moves to the function mode, and when the button is pressed again, the mode returns from the function mode.

The procedure for moving to the function mode is as described below.

- 1 Check if the instrument is in the waiting state (HOLD state).
- 2 Press the [FUNCTION] button.

The function mode is set, and the data in the internal memory is displayed.

Kinds of Displayed Data  [3.1.2 Data/Setting Item Display]

The procedure for returning from the function mode is as described below.

- 1 Press the [FUNCTION] button.
- The function mode ends, and the measurement mode screen is displayed.

When dip switch 8 is on the WRITE side when ending the function mode, the following screen is displayed.

Attention !!  
Please set  
the PROTECT/WRITE SW  
to the PROTECT side.

Select dip switch 8 to the PROTECT side, the setting changes become valid, and the measurement mode screen is displayed.

## 3.1.2 Data/Setting Item Display









After moving to the function mode, each time the [ENTER] button is pressed, the type of data/setting items changes. Press the [ENTER] button until the data/setting item to be checked or changed is displayed.

The displayed data/setting items are as shown below.











### Memo

- The Standard sample and white board are not displayed when measurement of them are not performed.

#### **When measuring light source color – Dip switch 3 is on the SOURCE side –**

- Standard sample  「3.2 Standard sample」
- Correction Factor  「3.6 Correction Factor」
- Area Correction Factor  「3.7 Area Correction Factor」
- Measurement Range  「3.8 Measurement Range」
- RS-232C Parameter  「3.9 RS-232C Parameter」
- Buzzer Sound  「3.10 Buzzer Sound」
- Communication Format  「3.11 Communication Format」
- Average Measure  「3.12 Average Measure」

#### **When measuring object color – Dip switch 3 is on the OBJECT side –**

- Standard sample  「3.2 Standard sample」
- White board  「3.3 White Board」
- White Board Luminance Factor  「3.4 White Board Luminance Factor」
- White Board Correction Factor  「3.5 White Board Correction Factor」
- Correction Factor  「3.6 Correction Factor」
- Measurement Range  「3.8 Measurement Range」
- RS-232C Parameter  「3.9 RS-232C Parameter」
- Buzzer Sound  「3.10 Buzzer Sound」
- Communication Format  「3.11 Communication Format」
- Average Measure  「3.12 Average Measure」

### 3.1.3 Numerical Value Setting

Numerical values are set when setting the luminance factor of the white board or the like.

The procedure for setting numerical values in the function mode is the same for all setting items.

Here, an example of setting the luminance factor of the white board is used to explain the procedure for setting numerical values in the function mode.

#### White board luminance factor setting screen

```
*   White board   *
  Luminance factor
        100.0 %
```

- 1 Press the [CHANGE] button.

The following screen is displayed.

```
      Attention !!
Please set
the PROTECT/WRITE SW
to the WRITE side.
```

#### Memo

- When dip switch 8 is on the WRITE side, this screen is not displayed. In that case, advance to step 3.

- 2 Set dip switch 8 to the WRITE side.

A "." is displayed in the area where input is possible.

```
*   White board   *
  Luminance factor
        .
        .
        .
```

- 3 Press the [ROTATION] button and select the value to input.

Each time the button is pressed, the display changes as shown below.

. → 0 → 1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → + → - → E → . . . . .

```
*   White board   *
  Luminance factor
         1
```

#### Memo

- When entering a numerical value having more than one digit, press the [SHIFT] button to move to the next digit, and repeat step 3 to select the value to be input.

### 3. Various Settings


4 After setting has been completed, press the [ENTER] button.

#### Memo


- If a mistake is made during input of the numerical value, complete the procedure to step 4 then start over again from step 1.

## 3.2 Standard sample

After the power has been turned ON, first the measurement value of the standard sample from when difference measurement was performed is displayed.

Display Method  [3.1.2 Data/Setting Item Display]

In difference measurement, the difference value is displayed with this measurement value as a reference.

Difference Measurement  [2.3 Difference Measurement]

```
* Standard sample *
  x = 0.2279
  y = 0.2615
L = 8.100E+02 cd/m^2
```

- Not displayed when there are no data.
- The display mode can be changed using the MODE switch.


 [2.6 Measurement Value Display Mode]

- Cannot be changed from just the display.

## 3.3 White Board

The white board measurement value from when the object color was measured is displayed.

Display Method  [3.1.2 Data/Setting Item Display]

Object Color Measurement  [2.5 Object Color Measurement]


```
* White board *
X = 1.020E+03
Y = 1.000E+03 cd/m^2
Z = 1.143E+03
```

#### Memo

- Not displayed when there are no data.
- Displayed by XYZ regardless of the display mode.
- Cannot be changed from just the display.


## 3.4 White Board Luminance Factor

The white board luminance factor is displayed.

Display Method  「3.1.2 Data/Setting Item Display」


```

*   White board   *
  Luminance factor
    100.0 %
  
```

Change Procedure  「3.1.3 Numerical Value Setting」

## 3.5 White Board Correction Factor


The white board correction factor is displayed. If the correction factor has not been registered, "REF NO DATA" is displayed.

Display Method  「3.1.2 Data/Setting Item Display」

```

W      KX=2. 481E+02
      KY=3. 745E+02
      KZ=1. 364E+02
      S=PAGE
  
```

The input/change method is the same as the input/change method for the correction factor.

 「3.6.2 Inputting the Correction Factor」

### Memo

- It is possible to set just one white board correction factor.

## 3.6 Correction Factor

The number of the currently set correction factor is displayed.

Display Method  [3.1.2 Data/Setting Item Display]

```
*   FACTOR NUMBER   *
      SET FACTOR 01
```

The correction factor is a factor for correcting the measurement value by using it to multiply the measurement value.

The procedure for changing the factor is as described below.

- 1 Press the [CHANGE] button.

The following screen is displayed.


```
FACTOR
DISP&SET   OFF
INPUT      *BACK
CLEAR
```

- 2 Press the [ROTATION] button, and select the process to be performed (indicated by “\*”).

DISP&SET : Selected when checking the value of the registered correction factors (K01 to K10), or when setting the number of the correction factor to be used.

 [3.6.1 Checking/Setting the Correction Factor]

INPUT : Selected when entering or changing the correction factor.

 [3.6.2 Inputting the Correction Factor]

CLEAR : Selected when clearing the correction factor.

 [3.6.3 Clearing the Correction Factor]

OFF : Selected when not using a correction factor.

BACK : Selected when returning to the previous screen.

- 3 Press the [ENTER] button.

The screen corresponding to the selected process is displayed.

### Memo

- The correction factor is not valid when dip switch 5 is set to the FACTOR B side.
- The factory settings for KX, KY, and KZ are all 1.

### 3.6.1 Checking/Setting the Correction Factor

The values of the registered correction factors are displayed. If there are no factors registered, "NO DATA" is displayed. "SET" is displayed underneath the number of the correction factor currently being used.


```

K01   KX=  1.000E+00
SET   KY=  1.000E+00
      KZ=  1.000E+00
C=SET R=NEXT S=PAGE

```

[CHANGE] : The displayed correction factor takes effects. When it is set, "SET" will be displayed underneath the number of the correction factor.

When the value of the correction factor is not set, the input screen for inputting the correction factor will be displayed.

Correction Factor Input Screen  「3.6.2 Inputting the Correction Factor」

[ROTATION] : Display the correction factor of next number.

[SHIFT] : Each time the button is pressed, the display changes as shown below.

Reference data → Sample data → Correction factor data → ...

#### - Reference Data -

The reference data from when the displayed correction factor was calculated is displayed.

```

REF01  x =  0.4476
        y =  0.4074
        L =  1.000E+02
C=SET  R=NEXT  S=PAGE

```


#### - Sample Data -

The sample data from when the displayed correction factor was calculated is displayed.

```

SMP01  x =  0.4476
        y =  0.4074
        L =  1.000E+02
C=SET  R=NEXT  S=PAGE

```

Calculating the Correction Factor  「3.6.2 Inputting the Correction Factor」

[ENTER] : Returns to the previous screen.

#### Memo

- Numbers such as "REF01" and "SMP01" that are displayed at the top left of the reference data screen and sample data screen correspond to the number of the correction factor. In other words, when the correction factor for K01 is calculated, the reference data for K01 is REF01 and the sample data for K01 is SMP01.
- In versions prior to ver1.02, the remote correction factors is not displayed on the panel.

## 3.6.2 Inputting the Correction Factor

---

The correction factor for No. 01 is displayed.

```

K 0 1   K X =  1. 0 0 0 E+0 0
S E T   K Y =  1. 0 0 0 E+0 0
        K Z =  1. 0 0 0 E+0 0
        R=N E X T   S=P A G E
```

The procedure for inputting the correction factor is as described below.

- 1 Press the [ROTATION] button to display the data for the number of the correction factor to be input
  - [ROTATION] : The correction factor for the next number is displayed.
  - [SHIFT] : Each time the button is pressed, the display changes as shown below.  
Reference data → Sample data → Correction factor data → ...
  - [ENTER] : Returns to the previous screen.

- 2 Press the [CHANGE] button.  
The following screen is displayed.

```

F A C T O R   I N P U T
  D I R E C T
  R E F.   &   M E A S U R E
  * B A C K
```

- 3 Press the [ROTATION] button, and select the process to be performed (indicated by "\*").
  - DIRECT : Selected when inputting the correction factor directly. ☞ [Direct Input]
  - REF. & MEASURE : Selected when inputting already known luminance and chromaticity data, performing sample measurement and calculating the correction factor. ☞ [Calculation from Measurement]
  - BACK : Selected when returning to the previous screen.
- 4 Press the [ENTER] button.

## Direct Input

The correction factor input screen is displayed.

```

K01  DIRECT  INPUT
KX=  1. 000E+00
KY=  1. 000E+00
KZ=  1. 000E+00

```

The procedure for inputting the correction factor directly is as described below.

- 1 Press the [CHANGE] button.

The KX value can be input and, set the value.

Method for Setting a Value  3.1.3 Numerical Value Setting

- 2 After KX has been input, press the [ENTER] button. Now KY can be input, so similarly set the values for KY and KZ.

## Calculation from Measurement

The reference data input screen for calculating the correction factor is displayed.

```

K01  REF.  INPUT
x =  *****
y =  *****
L =  *****

```

The procedure for calculating the correction factor from measurement is as described below.

- 1 Press the [CHANGE] button.

The value for x can be input so, set the value for reference data x.

Method for Setting a Value 3.1.3 Numerical Value Setting

- 2 After the value for x has been input, press the [ENTER] button. Now, the value for y can be input, so similarly input the values for y and L.

After the value for L has been input and the [ENTER] button has been pressed, the following screen is displayed.

```

      Attention !!
Please set
the Ref. sample, then
push RUN/HOLD key.

```

### 3. Various Settings

**3** Set the sample data and press the RUN/HOLD switch.

After measurement, the measurement result is displayed for about 10 seconds, then, the correction factor is calculated using the input reference data and measured sample data is displayed.

K 0 1	K X =	5. 6 5 4 E - 0 1
S E T	K Y =	9. 2 3 9 E - 0 1
	K Z =	7. 4 5 4 E + 0 0
	R = N E X T	S = P A G E

[ROTATION] : The correction factor for the next number is displayed.

[SHIFT] : Each time the button is pressed, the display changes as shown below.  
Reference data → Sample data → Correction factor data → ...

[ENTER] : Returns to the previous screen.

### 3.6.3 Clearing the Correction Factor

The following screen is displayed.

```

FACTOR CLEAR
  ALL CLEAR
  SELECT CLEAR
*BACK
  
```

Press the [ROTATION] button, and select the process to perform (indicated by "\*").

ALL CLEAR : Selected when clearing all correction factors.

SELECT CLEAR : Selected when clearing individual correction factors.

#### When "ALL CLEAR" is Selected

```

FACTOR CLEAR
  ALL FACTOR CLEAR
  YES
*BACK
  
```

YES : Clears all registered correction factors.

BACK : Returns to the previous screen.

#### When "SELECT CLEAR" is Selected

```

CL1   KX= 1.000E+00
SET   KY= 1.000E+00
      KZ= 1.000E+00
C=DEL R=NEXT S=PAGE
  
```

[CHANGE] : Clears the displayed data.

[ROTATION] : Displays the data for the next number.

[SHIFT] : Each time the button is pressed, the display changes as shown below.  
Correction factor → Reference data → Correction factor data ...

[ENTER] : Returns to the previous screen.



#### Request

- When the reference data is cleared, correction factor data and sample data of the same number are also cleared.

# 3.7 Area Correction Factor

The number of the currently set area correction factor group is displayed.

Display Method [3.1.2 Data/Setting Item Display]



The area correction factor corrects measurement values in an arbitrarily specified area of a xy chromaticity diagram or u'v' chromaticity diagram.

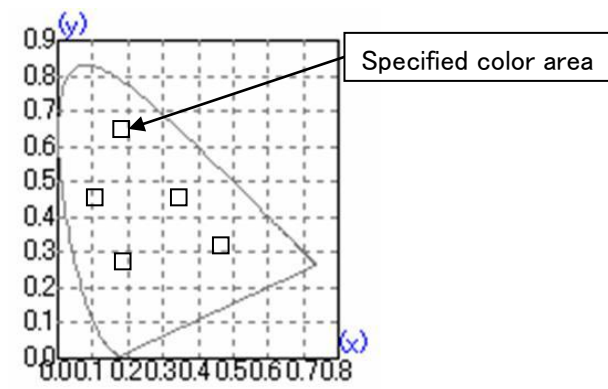
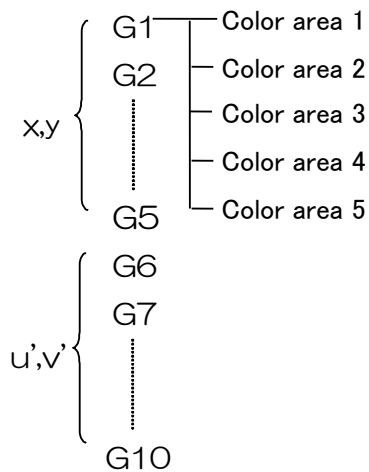
Memo

- To register an area correction factor, it is necessary to use software CS-900A, or create communication software that references a command list.

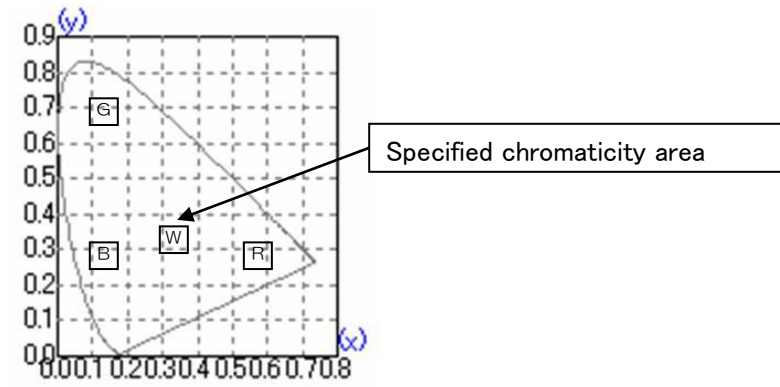
Command List [4. Communication with a PC]

Area correction factors can be registered for a total of 10 groups to the BM-7AC. Groups 1 to 5 are assigned to area correction factors for the xy chromaticity diagram, and groups 6 to 10 are assigned to area corrections factors for the u'v' chromaticity diagram. Also, it is possible to set 5 chromaticity areas in 1 group. In the chromaticity area setting, the correction factors are specified by KX, KY and KZ, and the minimum and maximum areas of application of correction are specified by x, y, or u',v', and minimum Luminance are specified by L.


Area correction group  
(measurement device side)



The area correction function enable measurement data to activate the correction factor automatically at preset area in chromaticity diagram when measured chromaticity value enter the preset area. The area can be specified up to 5 areas at once. For example, when you intend to measure the luminance and chromaticity of R (red), G (green), B (blue), and W (white) color with each correction factor applied, once you preset correction factor and area data for each of colors, it is not necessary to change the setting of correction factor at each color measurement.




It is possible to specify up to a maximum of 5 areas. Also, the minimum luminance value is set.

 <b>Request</b>	<ul style="list-style-type: none"> <li>The range of chromaticity area is depend on actual measurement values, and small errors may occur. Depending on the situation, leeway should be set for the range.</li> </ul>
---	--

The method for specifying a chromaticity area is as described below.

xy chromaticity diagram : Specify the minimum and maximum xy values of chromaticity area, and the minimum L luminance value, and specify the area to which the correction factor is applied.

u' v' chromaticity diagram : Specify the minimum and maximum u' v' values of the chromaticity, and the minimum L luminance value, and specify the area to which the correction factor is applied.

 <b>Request</b>	<ul style="list-style-type: none"> <li>The chromaticity area should be specified within the limits of 0.03 between minimum value and maximum value.</li> </ul>
---	--

### 3.7.1 Setting an Area Correction Factor

---

The procedure for changing the setting for an area correction factor group is as described below.

- 1 Press the [CHANGE] button.  
The currently set area correction group is displayed.

```

GROUP SET
GROUP *OFF
```

- 2 Press the [ROTATION] button and select the setting contents.
- 3 After selection is finished, press the [ENTER] button.

### 3.7.2 Displaying an Area Correction Factor

---

The procedure for displaying the chromaticity area that is set for an area correction factor group is as described below.

- 1 Press the [CHANGE] button.  
The currently set area correction group is displayed.

```

GROUP SET
GROUP *OFF
```

- 2 Press the [ROTATION] button, and select the area correction factor group for which the chromaticity area is to be displayed.
- 3 Press the [CHANGE] button.  
The data of the set chromaticity area is displayed.

```

G1-1   x0. 2000-0. 2300
SET    y0. 3000-0. 3300
      L1. 000E+02
C=SET  R=NEXT  S=PAGE
```

[CHANGE] : Sets the displayed chromaticity area.

When set, "SET" is displayed underneath the number of the chromaticity area.

[ROTATION] : Displays the chromaticity area of the next number.


[SHIFT] : Each time the button is set, the display changes as shown below.

Correction factor data → Chromaticity area data → Correction factor data ...

[ENTER] : Returns to the previous screen.

## 3.8 Measurement Range

When using the manual range, the measurement range for X, Y, and Z is displayed.

Display Method  「3.1.2 Data/Setting Item Display」


```

*   M e a s u r i n g   r a n g e   *
      X   :R a n g e 1
      Y   :R a n g e 3
      Z   :R a n g e 3

```

The procedure for making changes is as described below.

- 1** Press the [CHANGE] button.  
It is no possible to select the value for X.
- 2** Press the [ROTATION] button and select the setting contents
- 3** After setting is completed, press the [ENTER] button.  
Now, the value for Y can be selected, so similarly select the value for Y and Z.

- The measurement range is from 1 to 5, with range 1 having the maximum sensitivity.  
Measurement Range Details  「Appendix: Specifications」
- When the AUTO/MANU switch is set to AUTO, and dip switch 1 is set to the remote side, the measurement range setting is invalid.
- The factory settings for X, Y and Z are all range 3.
- After selecting Z, press the [ENTER] button. The next setting item (screen) is displayed.

## 3.9 RS-232C Parameters

The RS-232C interface parameters are displayed.

Display Method  [3.1.2 Data/Setting Item Display]

This setting is a necessary to set when BM-7AC connect with a PC through a RS-232C cable.

```

*RS-232C Parameters*
Baud rate=38400
Length=7 Parity=ODD
Stop bit= 1
```

The procedure for setting parameter is as described below.

- 1** Press the [CHANGE] button.  
The portion of the parameters that can be changed blink.
- 2** Press the [ROTATION] button and select the setting contents.  
Each time the button is pressed, the display changes as shown below.  
Baud rate (Communication speed):

38400 → 2400 → 4800 → 9600 → 19200 → 38400 ……

Length (Data length) : 7 → 8 → 7 …

Parity (Parity bit) : ODD → NONE → EVEN → ODD …

Stop bit (Stop bit) : 1 → 2 → 1 …

### Memo

- When there are no contents to be changed, press the [ENTER] button, and move the cursor to the next parameter.

- 3** After selection is finished, press the [ENTER] button.  
Move the cursor to the next parameter.
- 4** Repeat steps 2 and 3.

### Memo

- After the stop bit has been selected, press the [ENTER] button to display the next setting item (screen).

## 3.10 Buzzer Sound

The setting for whether or not to set a buzzer sound is displayed.

Display Method  「3.1.2 Data/Setting Item Display」

```
*   SET   BUZZER   *
      BUZZER OFF
```

The procedure for setting the buzzer is as described below.

- 1 Press the [CHANGE] button.
- 2 Press the [ROTATION] button and select the setting contents.  
Each time the button is pressed, the buzzer is turned ON/OFF.
- 3 After selection is finished, press the [ENTER] button.

## 3.11 Communication Format

The communication format with the PC is displayed.

Display Method  「3.1.2 Data/Setting Item Display」

```
*   DATA FORMAT   *
      BM-7A Series
```

The communication format consists of BM-7A Series and BM-7FAST.

 Memo

- BM-7FAST is a communication format for the purpose of using communication software for old model BM-7 and BM-7fast. The commands for BM-7AC is increased than the BM-7 and BM-7fast, so when creating new communication software, the BM-7A Series mode is recommended.


The procedure for selection the mode is as described below.

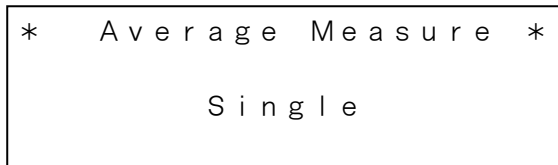
- 1 Press the [CHANGE] button.
- 2 Press the [ROTATION] button and select the setting contents.  
Each time the button is pressed, the display will change as shown below.  
BM-7A Series → BM-7FAST → BM-7A Series ……
- 3 After selection is finished, press the [ENTER] button.

## 3.12 Average Measure

---

The average measurement can be set.

Display Method  [3.1.2 Data/Setting Item Display]



When measuring varying-luminance light source, use this function. Measurement result in Average measure is the average value of 5 times measurement and, measurement interval is about 1 second.

- 1** Press the [CHANGE] button.
- 2** Press the [ROTATION] button and select the setting contents.  
Each time the button is pressed, the display will change as shown below.  
Single → Average → Single .....
- 3** After selection is finished, press the [ENTER] button.

# 4. Communication With a PC

## 4.1 Communication Commands


This instrument can communicate with a PC. The communication format is either the BM-7A Series mode and the former BM-7fast mode.

Changing the Communication Format  「3.11 Communication Format」

This chapter described the commands for creating communication program with the BM-7AC on user own.

BM-7A Series Mode Communication Commands

 「4.2 BM-7A Series Mode Communication Commands」

BM-7fast Mode Communication Commands  「4.4 BM-7fast Mode Communication Commands」

## 4.2 BM-7A Series Mode Communication Commands

A list of communication commands in the BM-7A Series mode is given below.

Communication Commands	Function
ST	Sets the instrument to the measurement state. After measurement is finished, transmits the measurement data from the instrument.
CA	Performs calibration.
TF	Switches the response speed of the photo-receiver circuit to the FAST mode.
TS	Switches the response speed of the photo-receiver circuit to the SLOW mode.
MA	Switches the measurement range to the AUTO range.
MM_X[l]_Y[m]_Z[n]	Switches the measurement range to the MANUAL range. l, m, n: Measurement range (1 to 5)
FR	Reads the number of the correction factor currently being used.
F[n]	Writes the number of the correction factor currently to be used. n: Number of the correction factor currently to be used (0 to 15)
R[n]	Reads the correction factor. n: Number of the correction factor to be read (1 to 15)
W[n]_####_####_####_####	Writes the correction factor. n: Number of the correction factor to be written (1 to 10)
CF[n]	Clears the correction factor. n: Number of the correction factor to be cleared (1 to 15)

4. Communication With a PC

FK[n]	Switches between normal correction/direct correction. n: 1 or 2; 1: Normal correction, 2: Direct correction
FKR	Reads the current correction type. 1: Normal correction 2: Direct correction
FAG[n]	Enables area correction. n: Number of the area correction group (1 to 10)
FO	Disables area correction.
CGL[n]	Clears the chromaticity area in the area correction factor per group units. n: Number of the area correction group (1 to 10)
FGR	Reads the number of the area correction group currently being used.
RG[m]K[n]	Reads the area correction factor. m: Group number (1 to 10) n: Area number (1 to 5)
RG[m]L[n]	Reads the chromaticity area in the area correction factor. m: Group number (1 to 10) n: Area number (1 to 5)
WG[m]K[n]_####_####_####	Writes the area correction factor. m: Group number (1 to 10) n: Area number (1 to 5)
WG[m]L[n]_####_####_####	Writes the chromaticity area in the area correction factor. m: Group number (1 to 10) n: Area number (1 to 5)
WHO	Reads the product name ("BM-7AC" is output).
VER	Reads the software version.
SRL	Reads the manufacturing serial number.
UT	Reads the measurement unit. C:cd/m <sup>2</sup>

"\_" indicates a space. "####" indicates a number.

When a communication command is sent from the PC, the BM-7AC returns "OK" as a reception check command. When the BM-7AC received an improper command, it returns "NO".

## 4.2.1 ST Command

When this command is sent to the BM-7AC, measurement starts. After measurement is finished, the measurement data is sent from the BM-7AC.

### Transmission from the PC to the BM-7AC


After the USB or RS-232C line has been made active, the PC transmits the character string "ST" (ASCII code 53H 54H), and then the PC transmits Cr (0Dh), Lf (0Ah).

### Check of reception in the BM-7AC

After the BM-7AC receives "ST" + (Cr·Lf), it returns "OK" + (Cr·Lf) as a check command and starts measurement.

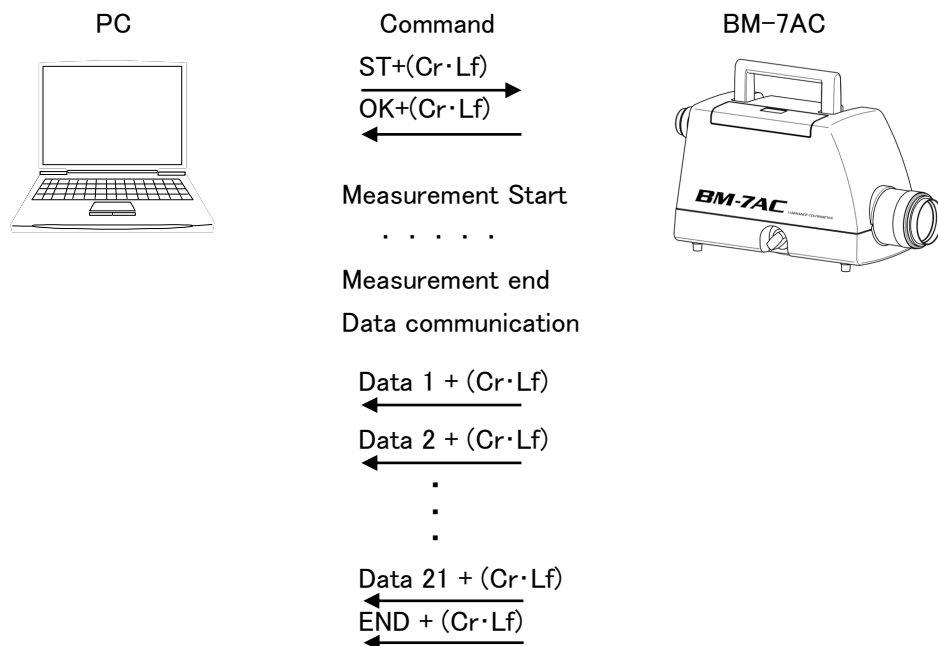
### Communication of measurement data


After measurement, the BM-7AC transmits the measurement conditions and measurement data. The delimiter (Cr·Lf) is attached to the end of 1 data string and the data are sent. After all the data is transmitted, the ending code "END" is transmitted.

Output Format of Measurement Data  「4.3 Remote Measurement Output Format」

A data check is not performed.

Data continues to be sent from the BM-7AC until "END" is sent.

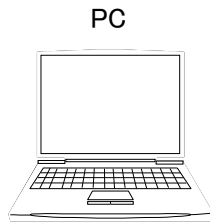


When Error Code E003 or E004 is displayed  「4.5 Error Codes」

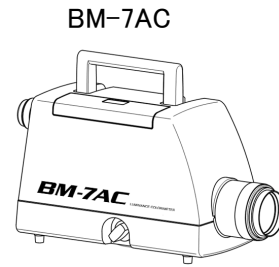
## 4.2.2 CA Command

---

The Zero-adjustment is performed.



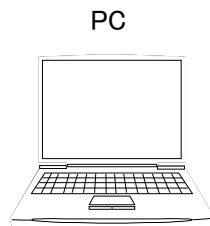
Command  
CA + (Cr·Lf) →  
OK + (Cr·Lf) ←  
END + (Cr·Lf) ←



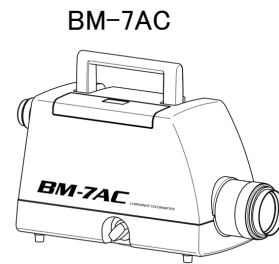
## 4.2.3 TF Command

---

The response speed of the photo-receiver circuit of the instrument is changed to the FAST mode.



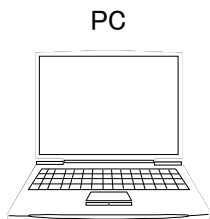
Command  
TF + (Cr·Lf) →  
OK + (Cr·Lf) ←



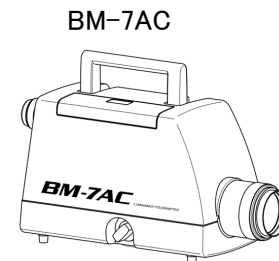
## 4.2.4 TS Command

---

The response speed of the photo-receiver circuit of the instrument is changed to the SLOW mode.



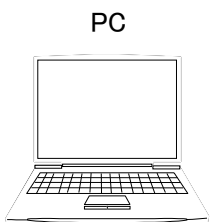
Command  
TS + (Cr·Lf) →  
OK + (Cr·Lf) ←



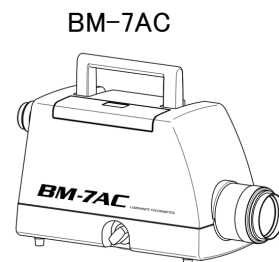
## 4.2.5 MA Command

---

The measurement range of the instrument is changed to the AUTO range.



Command  
MA + (Cr·Lf) →  
OK + (Cr·Lf) ←



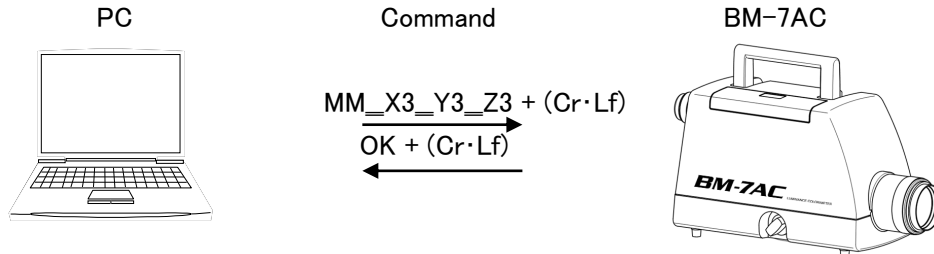
## 4.2.6 MM Command

The measurement range of the instrument is changed to the MANUAL mode.

Sets the X,Y and Z setting ranges.

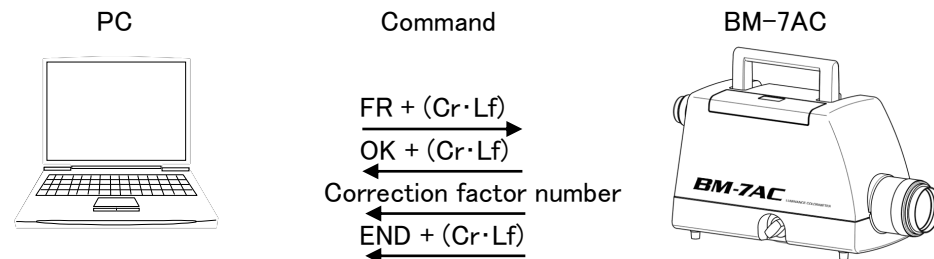
MM\_X[l]\_Y[m]\_Z[n] : l is the measurement range for X 1 to 5  
 m is the measurement range for Y 1 to 5  
 n is the measurement range for Z 1 to 5

"\_" indicates a space.



## 4.2.7 FR Command

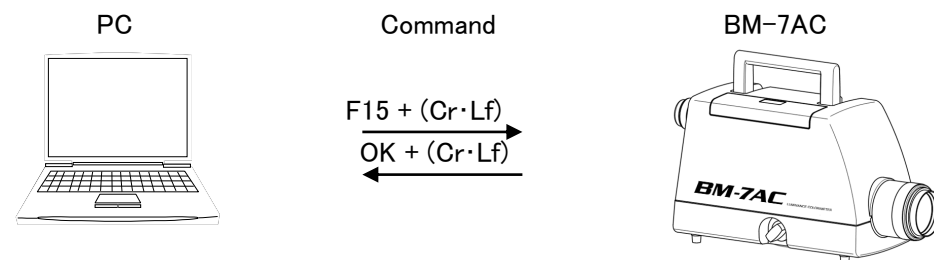
The correction factor currently being used by the instrument are read out.



## 4.2.8 F Command

The correction factor currently to be applied to the instrument are stored the instrument.

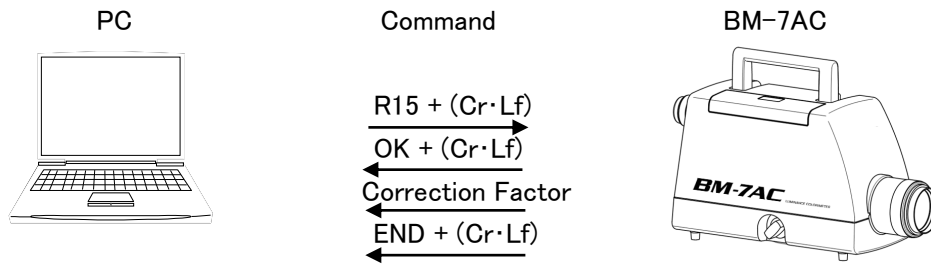
F [n] : n is the number of the correction factor to be currently being used. 0 to 15



## 4.2.9 R Command

The Correction factor in the instrument is read out.

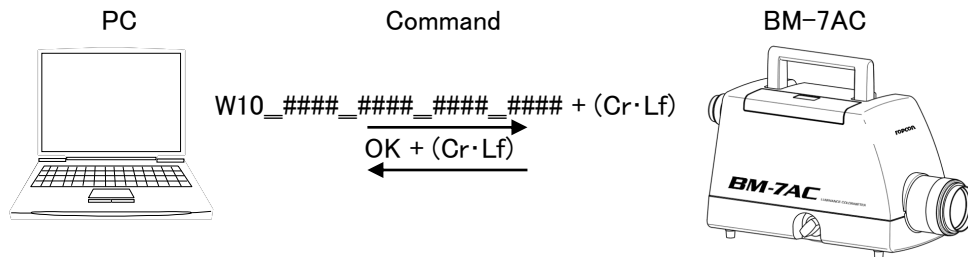
R [n] : n is the number of the correction factor to be read. 1 to 15



## 4.2.10 W Command

The correction factor is stored in the instrument.

W [n] : n is the number of the correction factor to be stored. 1 to 10

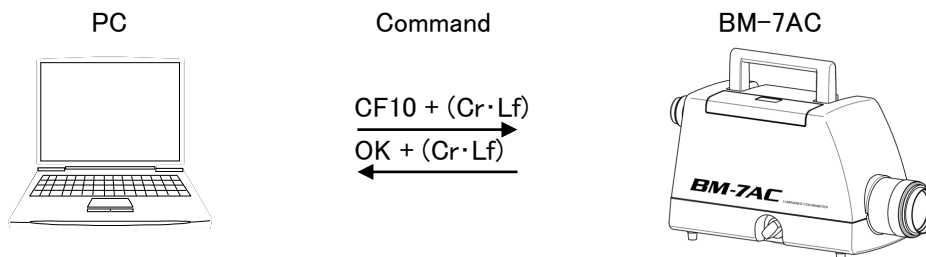


The values for the correction factors KX, KY, KZ and comments are input in order in ####\_####\_####\_####.

## 4.2.11 CF Command

The correction factor in the instrument is cleared.

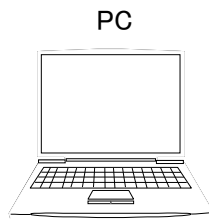
CF [n] : n is the number of the correction factor to be cleared. 1 to 15



## 4.2.12 FK Command

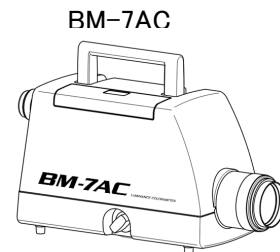
Normal correction/direct correction can be selected by this command.

FK[n]:n is 1 or 2. 1: Normal correction 2: Direct correction



Command

FK1 + (Cr·Lf)  
 OK + (Cr·Lf)

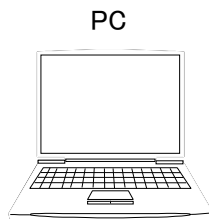


When Error code E012 is displayed → 「4.5 Error Codes」

## 4.2.13 FKR Command

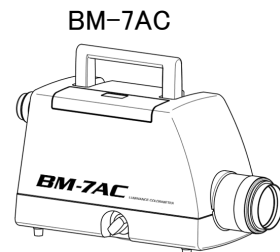
The current type of correction can be read out by this command.

1: Normal correction 2: Direct correction



Command

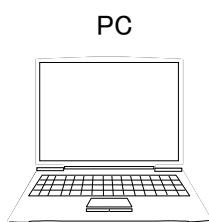
FKR + (Cr·Lf)  
 OK + (Cr·Lf)  
 ← Correction type  
 END + (Cr·Lf)



## 4.2.14 FAG Command

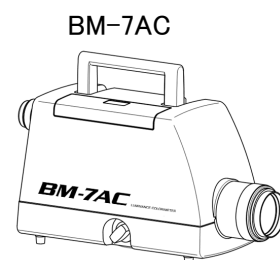
The area correction of the instrument can be activated by this command.

FAG [n] : Number of the area correction factor group that is activated, 1 to 10



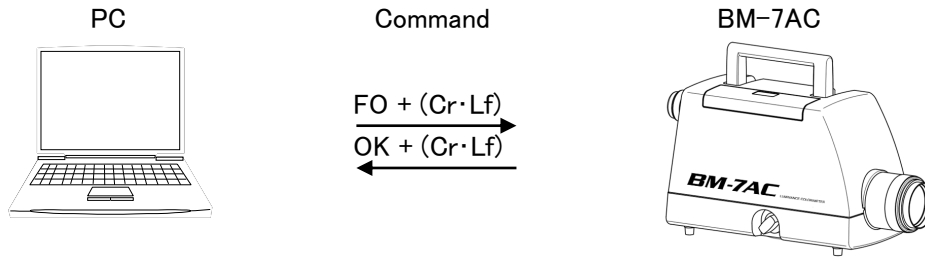
Command

FAG2 + (Cr·Lf)  
 OK + (Cr·Lf)



## 4.2.15 FO Command

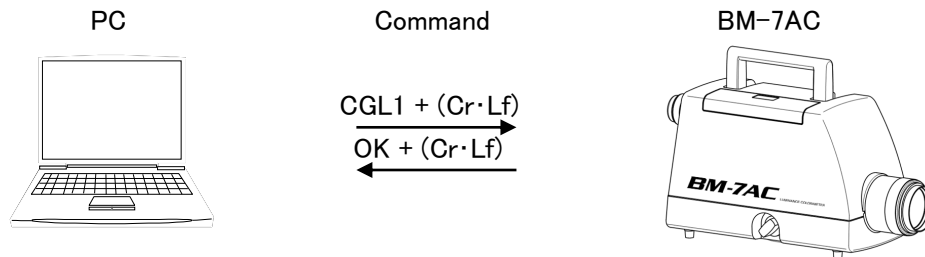
The area correction can be deactivated by this command.



## 4.2.16 CGL Command

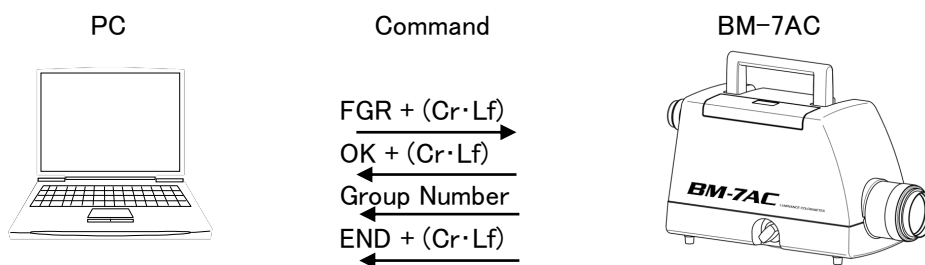
The chromaticity area data in the area correction function per group units can be cleared by this command.

CGL [n] : Number of area correction factor groups to be cleared. 1 to 10



## 4.2.17 FGR Command

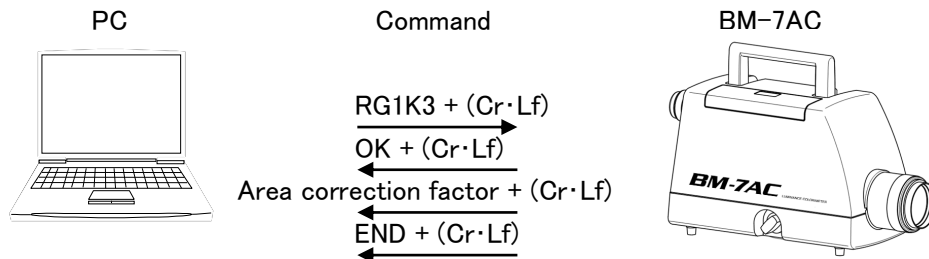
The number of the area correction factor group currently being used can be read out by this command.



## 4.2.18 RG K Command

The area correction factor data can be read out by this command.

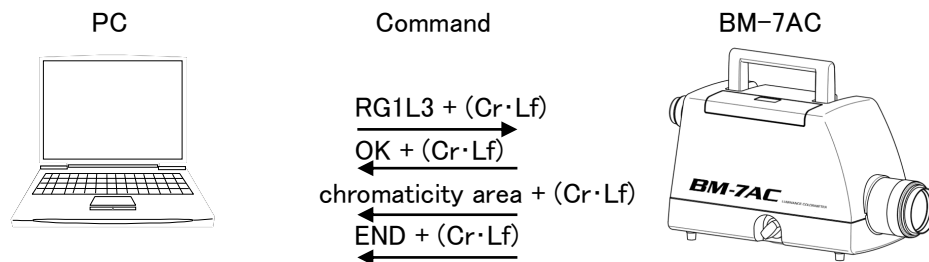
RG[m]K[n] : m is the area correction factor group number 1 to 10  
n is the area number 1 to 5



## 4.2.19 RG L Command

The chromaticity area data to be applied area correction factor are read out by this command.

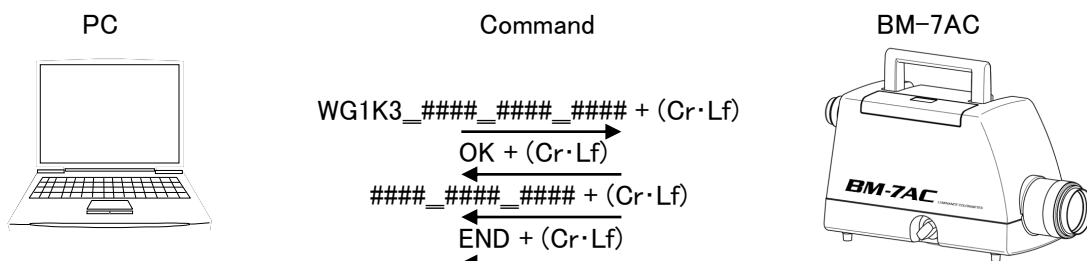
RG[m]L[n] : m is the number of the area correction factor group. 1 to 10  
n is the area number. 1 to 5



## 4.2.20 WG K Command

The area correction factor can be stored in the instrument.

WG[m]K[n] : m is the number of the area correction factor group. 1 to 10  
n is the area number. 1 to 5

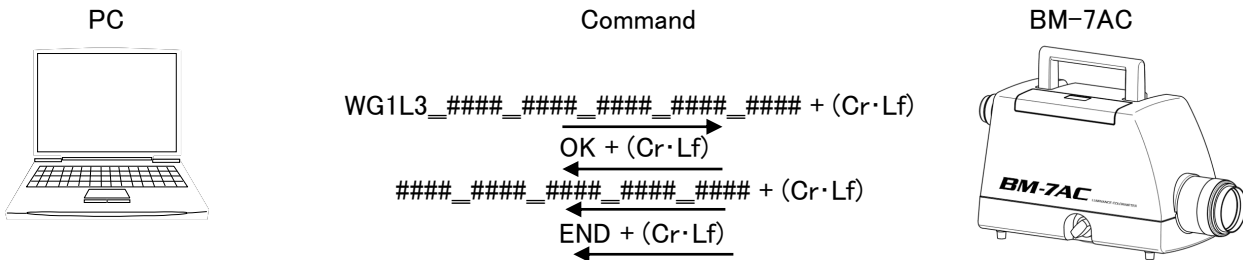


The values for the correction factors KX, KY and KZ are input in order in **####\_####\_####**.

### 4.2.21 WG L Command

The chromaticity area to be applied the area correction factor can be store in the instrument by this command.

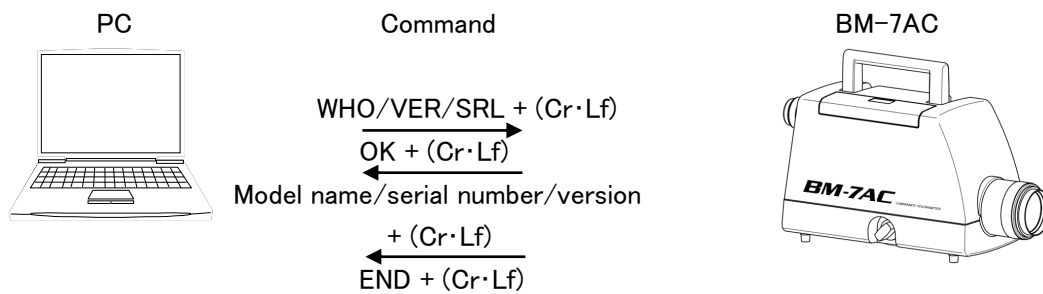
WG[m]L[n] : m is the number of the area correction factor group. 1 to 10  
 n is the area number. 1 to 5



The minimum value of the chromaticity x, the minimum value of the chromaticity y, the maximum value of the chromaticity x, the maximum value of the chromaticity y and the luminance are input in order in ####\_####\_####\_####\_####.

### 4.2.22 WHO/VER/SRL Command

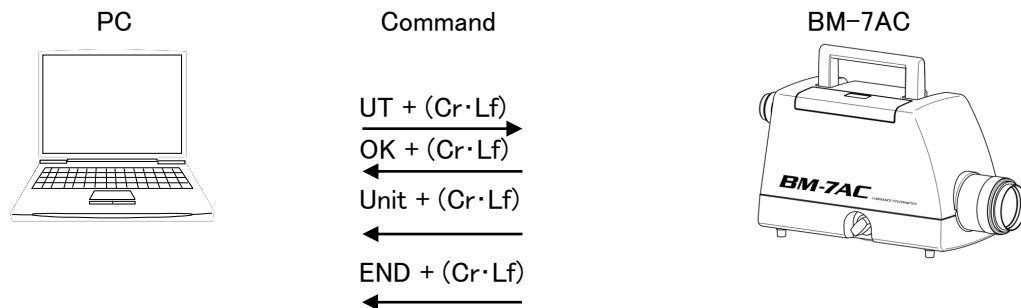
The model name, serial number and program version of the instrument are read out by this command.



### 4.2.23 UT Command

The unit of luminance of the instrument can be read out by this command.

C:cd/m<sup>2</sup>



## 4.2.24 AM/SM Command

---

The average measurement and single measurement can be selected by this command.

AM: Performs averaging measurement.

SM: Performs single measurement.

PC

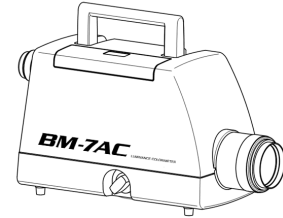


Command

AM/SM + (Cr·Lf)

OK + (Cr·Lf)

BM-7AC



## 4.3 Remote Measurement Output Format

During remote measurement (ST command), the output format of data from the instrument is as shown below.

### ■ BM-7A Series Mode

Row number	Output data example	Data Contents
1	D1	Level of luminance of the measured object with respect to the measurement range of the instrument 0: Normal 1: Under 2: Over
2	TS	Response speed of the photo-receiver circuit TF: FAST TS: SLOW
3	MA	Measurement range MA: AUTO MM: MANUAL
4	X1	X Range (X1 to X5)
5	Y1	Y Range (Y1 to Y5)
6	Z1	Z Range (Z1 to Z5)
7	UC	Unit UC: cd/m <sup>2</sup>
8	F2	Measurement angle F1: 0.1° F2: 0.2° F3: 1.0° F4: 2.0°
9	K2	Correction factor K0: No correction K1 to K9: Correction factor number
10	FG1	Area correction group number in area correction function FG0: No correction FG1 to FG10: Area correction group number
11	GK0	Applicable chromaticity area in the area correction function GK0: No applicable area GK1 to GK5: Color data corresponding to the area
12	1.234E+56	Luminance
13	1.234E+56	Tristimulus value X
14	1.234E+56	Tristimulus value Y
15	1.234E+56	Tristimulus value Z
16	1.234	Chromaticity x
17	1.234	Chromaticity y
18	1.234	Chromaticity u'
19	1.234	Chromaticity v'
20	12345	Color temperature
21	123456	Deviation
22	END	Data end command

## ■ BM-7fast Mode

Output data are three kinds of data; measurement conditions, color coordinates/correlated color temperature and tristimulus values.

### -M0 Command-

```
T*R*XnYnZnUCFn__
x=#.#####_y=#.#####_
X=#.###E±##_Y=#.###E±##_Z=#.###E±##CR
```

### -M1 Command -

```
T*R*XnYnZnUCFn__
u'=#.#####_v'=#.#####_
X=#.###E±##_Y=#.###E±##_Z=#.###E±##CR
```

### -M2 Command -

```
T*R*XnYnZnUCFn__
Tc=#.#####_duv=#.###_
X=#.###E±##_Y=#.###E±##_Z=#.###E±##CR
```

T\* : Response speed TF:FAST TS:SLOW  
 R\* : Measurement range RA:AUTO RM:MANUAL  
 Xn : X measurement range used in actual measurement n = 1 to 5  
 Yn : Y measurement range used in actual measurement n = 1 to 5  
 Zn : Z measurement range used in actual measurement n = 1 to 5  
 UC : Measurement unit, cd/m<sup>2</sup>  
 Fn : Measurement angle F1: 0.1° F2: 0.2° F3: 1° F4: 2°

\* A space is indicated by \_.

\* A numerical value is indicated by #.

\* A carriage return is indicated by CR.

## 4.4 Communication Commands for the BM-7fast Mode

A list of communication commands for the BM-7fast mode is given below.

Communication Command	Function
ST	Sets the instrument in the measurement status. After measurement, returns measurement data from the device.
CA	Performs calibration.
TF	Switches the response speed of the light-receiver circuit to the FAST mode.
TS	Switches the response speed of the light-receiver circuit to the SLOW mode.
RA	Switches the measurement range to the AUTO range.
RM	Switches the measurement range to the MANUAL range.
X[n]	Sets the MANUAL range for X. n: Measurement range (1 to 5)
Y[n]	Sets the MANUAL range for Y. n: Measurement range (1 to 5)
Z[n]	Sets the MANUAL range for Z. n: Measurement range (1 to 5)
M0	Switches the display mode (xyL mode).
M1	Switches the display mode (u'v'L mode).
M2	Switches the display mode (TC, duv, L mode).
FR	Reads out the number of the correction factor currently being used.
F[n]	Writes the number of the correction factor to be used. n: Number of the correction factor to be used (0 to 15)
R[n]	Reads out the correction factor. n: Number of the correction factor to be read out (1 to 15)
W[n]	Writes the correction factor. n: Number of the correction factor to be write (1 to 10)
CF[n]	Clears the correction factor. n: Number of the correction factor to be cleared (1 to 15)
WHO	Reads out the product name.
VER	Reads out the software version.
SRL	Reads out the manufacturing serial number.

## 4.5 Error Code

When an error occurs in the instrument when connected with a PC and performing measurement, the following error messages will be sent to the PC.

Error Code	Contents
E003	Displayed when there is an abnormal measurement angle. Make sure the measurement angle is set properly.
E004	Displayed when a measurement command is sent before executing zero adjustment. Execute zero adjustment.
E006	Displayed when the value of the correction factor is abnormal.
E007	Displayed when the value of the area correction factor is abnormal.
E008	Area correction limit write error. Displayed when the value of one side of specified squared area is greater than 0.03.
E009	Area correction limit write error. Displayed when specified area overlap with other area in same group.
E010	Area correction limit write error. Displayed when the specified area does not place on the chromaticity diagram, or when the maximum and minimum value of chromaticity area is improper.
E011	Area correction limit write error. Displayed when the entered data does not correctly stored in instrument.
E012	Displayed when the single correction/direct correction dip switch setting and communication command setting do not match. Make sure that the dip switch setting matches to the communication command.
E013	Displayed when zero-adjustment is abnormal. There is a possibility that the instrument do not make perfect dark condition during zero-adjustment, so perform zero-adjustment with the eyepiece cap attached.
E014	Displayed when the internal shutter is abnormal. There is a possibility that it is broken, so contact the dealer or TechnoOptis.
E015	Displayed when average measurement is abnormal. There is a possibility that the number of times that the instrument perform measurement are less than necessary in average measurement mode, due to over range. Check the measurement range setting for the measured object, and make sure the measurement angle is properly set.
E016	Communication error. The power OFF then back ON again.

# 5. USB Driver

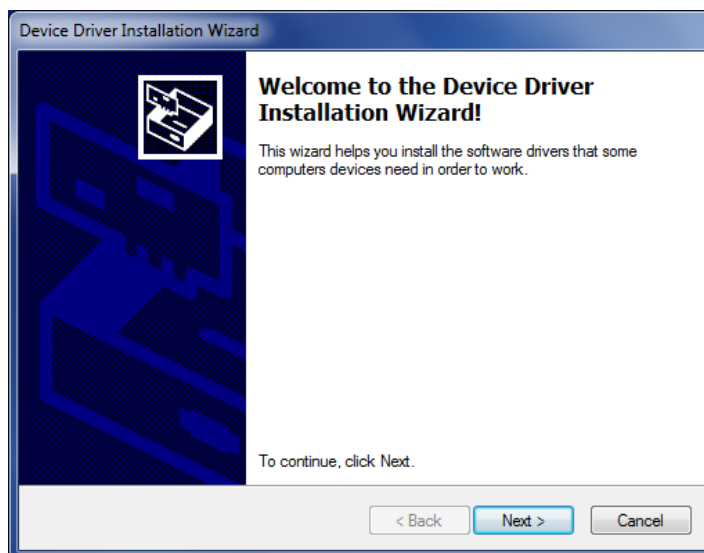
The procedure for installing the USB Driver in the PC is as follows.

- 1 Place the CS-900A CD-ROM in the CD-ROM drive.
- 2 Select and double-click the “dpinst.exe” file in [¥USB\_Driver¥{os name}¥ {x86} or {x64}] folder in the CD-ROM via Explorer.

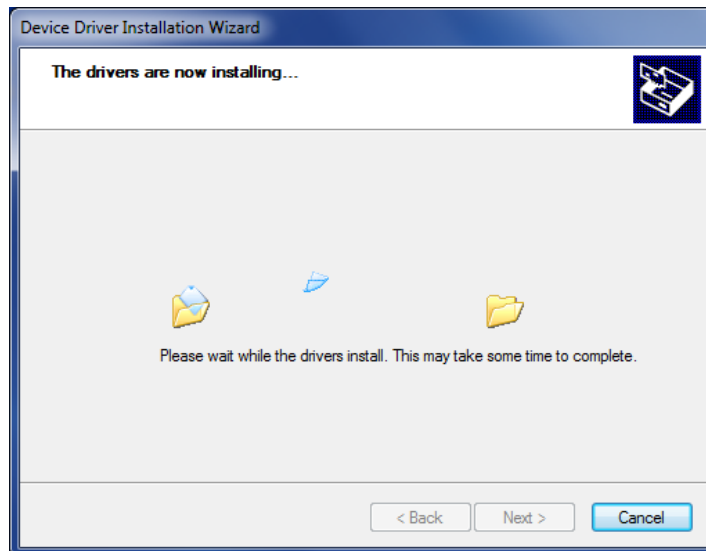
OS	Windows® 10 Pro (32bit/64bit) Windows® 11 Pro (64bit)
----	--

For example, in the case of Windows10/11(64bit), it becomes {USB\_DRIVER¥Windows10¥x64}.

- 3 The User Account Control Dialog appears. Click [OK] button.
- 4 The Device Driver Installation Wizard appears. Click [Next] button.



- 5 The following dialog will be displayed, start installing the USB Driver.



- 6 After installation of USB Driver, The following dialog will be displayed. Click the [Finish] button.



# Appendix

## Specifications

### Measurement angle

2° /1° /0.2° /0.1° Switch type

### Optical system

Finder visual field : 5°

Objective lens : f = 80 mm F2.5

### Spectral sensitivity characteristics

Similar to color matching function CIE 1931

\* Satisfies router conditions JIS Z 8724-1997.

### Photo-detector

Silicon photodiode 3-element type (X, Y, Z)

### Measurement diameter

(Unit: mm  $\phi$ )

Measurement angle	Measurement distance (m)				
	0.35	0.5	1	5	10
2°	10.0	15.4	32.8	169	341
1°	5.0	7.7	16.4	85	170
0.2°	1.0	1.5	3.3	17	34
0.1°	0.5	0.8	1.6	8	17

\* Some changes may occur according to the aperture mirror.

\* The measurement distance is the distance from the tip end of the form of the objective lens.

### Measurement Functions

The following measurement can be performed by using display mode.

x, y, L (x, y: Chromaticity coordinates, L: Luminance)  $\pm \Delta$

u', v', L (u', v': Chromaticity coordinates, L: Luminance)  $\pm \Delta$

X, Y, Z (X, Y, Z: Tristimulus values)  $\pm \Delta$

Tc, duv, L (Tc: Color temperature, duv: Deviation)  $\pm \Delta$

CIE 1976 L\*a\*b\*  $\Delta E_{ab}^*$   $\pm \Delta$

CIE 1976 L\*u\*v\*  $\Delta E_{uv}^*$   $\pm \Delta$

\*  $\pm \Delta$  indicates the difference from the reference value.

For example, in the case of x, y and L, it means  $\Delta x$ ,  $\Delta y$  and  $\Delta L$ .

## Response Speed

Display interval: About 0.5 seconds for both FAST and SLOW.

Analog Output

(Unit: ms)

		Range1	Range2	Range3	Range4	Range5
FAST	X	30	30	30	0.3	0.3
	Y	30	30	30	0.3	0.3
	Z	30	30	30	0.3	0.3

The response speed in the table above means the time that it takes analog output from the instrument to reach 90% of the peak value, when measuring an LED driven by a square wave from a function generator.

## Luminance Unit

Candela per square meter (cd/m<sup>2</sup>)

## Luminance Measurement Range

(Unit: cd/m<sup>2</sup>)

	2°	1°	0.2°	0.1°
Range1	0.01 ~ 30	0.04 ~ 120	1 ~ 3,000	4 ~ 12,000
Range2	0.03 ~ 90	0.12 ~ 360	3 ~ 9,000	12 ~ 36,000
Range3	0.1 ~ 300	0.4 ~ 1,200	10 ~ 30,000	40 ~ 120,000
Range4	1 ~ 3,000	4 ~ 12,000	100 ~ 300,000	400 ~ 1,200,000
Range5	10 ~ 30,000	40 ~ 120,000	1,000 ~ 3,000,000	4,000 ~ 12,000,000

The measurement range for a measurement angle of 1°, 0.2° and 0.1° depends on the processing accuracy of the aperture mirror and so they shown with rough values.

In color measurement, there are cases when measurement is not possible even when the luminance is within the measurement range given above. The cause of this trouble is that output of X and Z are over range, and it does not mean that the instrument is broken. Be careful when measuring extreme red or blue colored light.

## Luminance accuracy

For a measurement angle of 2° :

1 to 5cd/m<sup>2</sup> : ±4% or less (auto range, standard sources A)

5cd/m<sup>2</sup> or greater: ±2% or less (auto range, standard sources A)

Guaranteed Accuracy Range

Measurement Angle	Range and Specification
2°	1 to 5cd/m <sup>2</sup> : ±4% or less
	5cd/m <sup>2</sup> or more : ±2% or less
1°	4 to 20cd/m <sup>2</sup> : ±4% or less
	20cd/m <sup>2</sup> or more : ±2% or less
0.2°	100 to 500cd/m <sup>2</sup> : ±4% or less
	500cd/m <sup>2</sup> or more : ±2% or less
0.1°	400 to 2000cd/m <sup>2</sup> : ±4% or less
	2000cd/m <sup>2</sup> or more : ±2% or less

## Chromaticity accuracy

Guaranteed accuracy range

Measurement Angle	Luminance (cd/m <sup>2</sup> )
2°	10 ~ 30,000
1°	40 ~ 120,000
0.2°	1,000 ~ 3,000,000
0.1°	4,000 ~ 12,000,000

$\Delta x$ ,  $\Delta y$  :  $\pm 0.002$  or less (auto range, standard sources A)

\* Chromaticity is displayed even at a luminance less than that given above.

## Repeatability

Luminance

For 2°

1 to 5cd/m<sup>2</sup> : 1% or less (2 $\sigma$ , SLOW Mode, AUTO range, standard sources A)

5cd/m<sup>2</sup> or greater : 0.5% or less (2 $\sigma$ , SLOW mode, AUTO range, standard sources A)

Measurement Angle	Range and Specification
2°	1 to 5cd/m <sup>2</sup> : 1% or less 5cd/m <sup>2</sup> or more : 0.5% or less
1°	4 to 20cd/m <sup>2</sup> : 1% or less 20cd/m <sup>2</sup> or more : 0.5% or less
0.2°	100 to 500cd/m <sup>2</sup> : 1% or less 500cd/m <sup>2</sup> or more : 0.5% or less
0.1°	400 to 2000cd/m <sup>2</sup> : 1% or less 2000cd/m <sup>2</sup> or more : 0.5% or less

Chromaticity

For 2°

1 to 5cd/m<sup>2</sup> : Chromaticity xy 0.005 or less (SLOW mode, AUTO range, standard sources A)

5cd/m<sup>2</sup> or more : Chromaticity xy 0.002 or less (SLOW mode, AUTO range, standard sources A)

Measurement Angle	Range and Specification
2°	1 to 5cd/m <sup>2</sup> : Chromaticity xy 0.005 or less 5cd/m <sup>2</sup> or more : Chromaticity xy 0.002 or less
1°	4 to 20cd/m <sup>2</sup> : Chromaticity xy 0.005 or less 20cd/m <sup>2</sup> or more : Chromaticity xy 0.002 or less
0.2°	100 to 500cd/m <sup>2</sup> : Chromaticity xy 0.005 or less 500cd/m <sup>2</sup> or more : Chromaticity xy 0.002 or less
0.1°	400 to 2000cd/m <sup>2</sup> : Chromaticity xy 0.005 or less 2000cd/m <sup>2</sup> or more : Chromaticity xy 0.002 or less




**FCC Compliance Information**

This device complies with Part 15 of FCC Rules. Operation is subject to the following two conditions:

- (1) the device may not cause interference, and
- (2) the device must accept any interference, including interference that may cause undesired operation of this device.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in commercial environment. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

	<b>EU Battery Directive</b>
This symbol is applicable to EU members states only.	
Battery users must not dispose of batteries as unsorted general waste, but treat properly.	
If a chemical symbol is printed beneath the symbol shown above, this chemical symbol means that the battery or accumulator contains a heavy metal at a certain concentration. This will be indicated as follows:	
Hg: mercury(0.0005%), Cd: cadmium(0.002%), Pb: lead(0.004%)	
These ingredients may be seriously hazardous to human and the global environment.	
This product contains a backup battery cell.	
You cannot replace batteries by yourself. When you need to replace and/or dispose batteries, contact your local dealer.	
✘Products manufactured after April 2024 are not applicable.	

# Appended Tables

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## Unit Conversion Table

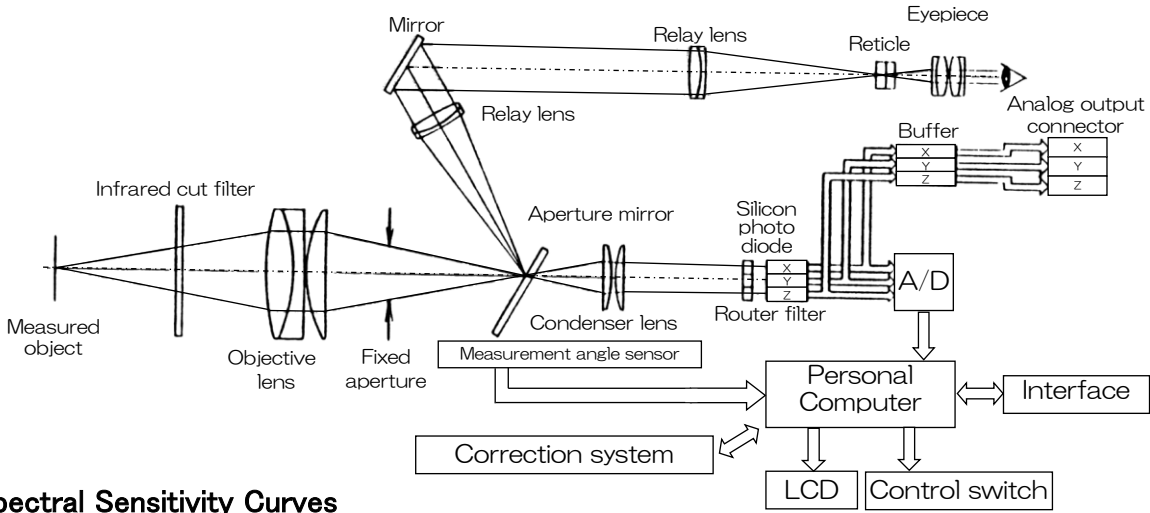
cd/m <sup>2</sup> (nt)	cd/cm <sup>2</sup> (sb)	cd/ft <sup>2</sup>	rlx (asb)	Lamberts	Foot-Lamberts (ft-L)
1	10 <sup>-4</sup>	0.0929	3.1416	0.000314	0.2919
3.426	0.0003426	0.3183	10.764	0.001076	1

Chromaticity accuracy of the combination of standard light source A and our colored glass filter. (Reference)

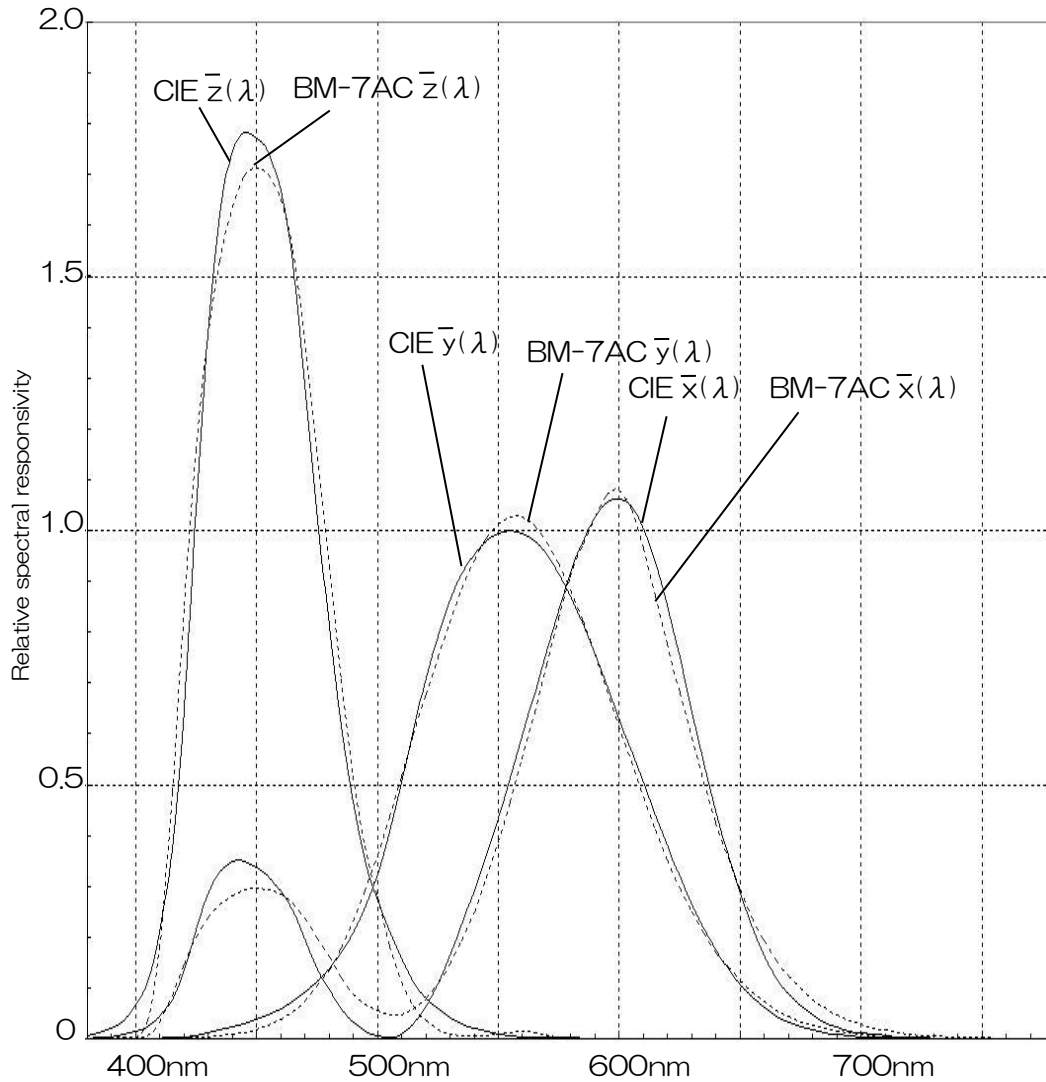
$\Delta x, \Delta y$  :  $\pm 0.03$  or less (auto range, standard sources A)

# System Diagram


## Block Diagram

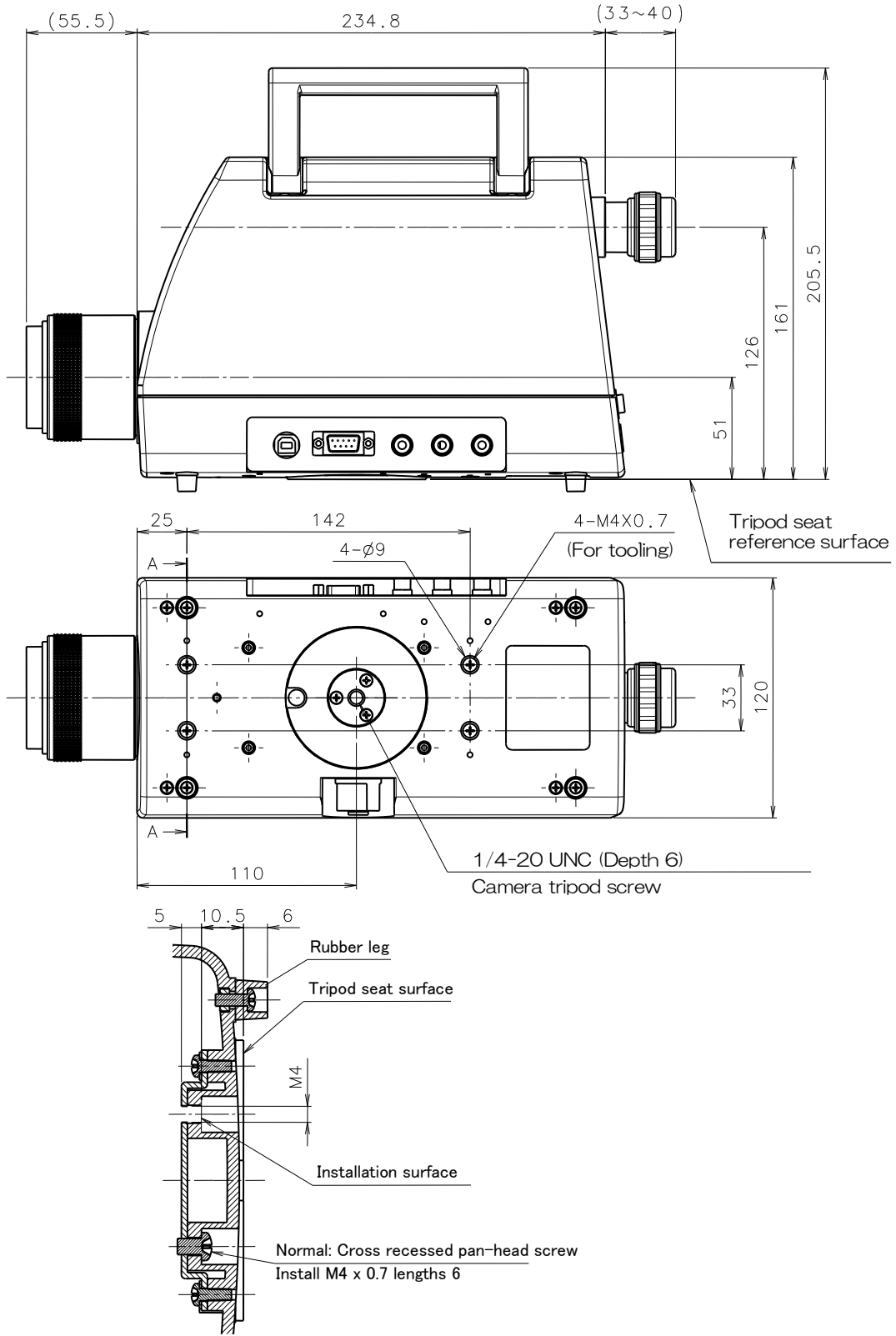


## Spectral Sensitivity Curves



# External Dimensions

 <b>Request</b>	<p>Use only specified screws when using the tripod screw and screw holes for jig attachment. Do not tighten the screws any more than necessary. Doing so might cause internal breakage.</p>
---	---



A-A Cross section (enlarged view)

# Internal Calculation Processing

In this device, the following calculation processing is performed for data.

## Chromaticity Coordinates

xy chromaticity coordinates of XYZ color coordinate system

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

u'v' chromaticity coordinates of UCS color coordinate system

$$u' = \frac{4X}{X+15Y+3Z} \quad v' = \frac{9Y}{X+15Y+3Z}$$

## Lightness Index

$$L^* = 116 \left( \frac{Y}{Y_n} \right)^{\frac{1}{3}} - 16 \quad \frac{Y}{Y_n} > 0.008856$$

Y : Tristimulus value Y in XYZ color coordinate system

Y<sub>n</sub> : Y value according to standard light on perfect reflecting diffuser

However, when  $\frac{Y}{Y_n}$  is less than 0.008856, the following formula must be applied.

$$L^* = 903.29 \left( \frac{Y}{Y_n} \right) \quad \frac{Y}{Y_n} \leq 0.008856$$

## Chromaticness Index

CIE 1976 L\*a\*b\* color coordinate system

$$a^* = 500 \left\{ \left( \frac{X}{X_n} \right)^{\frac{1}{3}} - \left( \frac{Y}{Y_n} \right)^{\frac{1}{3}} \right\} \quad \frac{X}{X_n} > 0.008856$$

$$b^* = 200 \left\{ \left( \frac{Y}{Y_n} \right)^{\frac{1}{3}} - \left( \frac{Z}{Z_n} \right)^{\frac{1}{3}} \right\} \quad \frac{Y}{Y_n} > 0.008856$$

$$\frac{Z}{Z_n} > 0.008856$$

X, Y, Z : Tristimulus values in the XYZ color coordinate system

X<sub>n</sub>, Y<sub>n</sub>, Z<sub>n</sub> : Tristimulus values in the XYZ color coordinate system on a perfect reflecting diffusier.

However, if  $\frac{X}{X_n}$ ,  $\frac{Y}{Y_n}$  or  $\frac{Z}{Z_n}$  have a value less than 0.008856, substitute the corresponding cube roots in the above formula with the values as shown below;

$$7.787 \left( \frac{X}{X_n} \right) + \frac{16}{116}$$

$$7.787 \left( \frac{Y}{Y_n} \right) + \frac{16}{116}$$

$$7.787 \left( \frac{Z}{Z_n} \right) + \frac{16}{116}$$

#### CIE 1976 L\*u\*v\* color coordinate system

$$u^* = 13L^*(u' - u_n')$$

$$v^* = 13L^*(v' - v_n')$$

$u', v'$  :  $u'v'$  color coordinates

$u_n', v_n'$  :  $u'$  and  $v'$  values according to standard light on perfect reflecting diffuser.

#### Color Difference

##### CIE 1976 L\*a\*b\* color difference

$$\Delta E^*_{ab} = \left\{ (\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2 \right\}^{\frac{1}{2}}$$

$\Delta L^*$ ,  $\Delta a^*$ ,  $\Delta b^*$ : Difference in lightness indexes  $L^*$ , and chromatic indexes  $a^*$ ,  $b^*$  between two non-luminous object color.

##### CIE 1976 L\*u\*v\* color difference

$$\Delta E^*_{uv} = \left\{ (\Delta L^*)^2 + (\Delta u^*)^2 + (\Delta v^*)^2 \right\}^{\frac{1}{2}}$$

$\Delta L^*$ ,  $\Delta u^*$ ,  $\Delta v^*$ : Difference between the lightness indexes  $L^*$ , and chromatic indexes  $u^*$ ,  $v^*$  between two non-luminous object color.

#### Color Temperature, Deviation

Color temperature and Deviation are calculated according to JIS Z 8725 "Method for determining distribution temperature and color temperature or correlated color temperature of light source".

Color temperature display range  $1563\text{K} \leq T_c \leq 100000\text{K}$

Deviation display range  $-0.02 \leq d_{uv} \leq 0.02$

Deviation is the distance from the blackbody locus on the CIE 1960 UCS color diagram.

# Terminology

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## **Correction Factor :**

This means three factors, KX, KY and KZ to correct tristimulus values.

## **Area Correction Factor :**

When an arbitrary area is specified on the xy chromaticity diagram and u'v' chromaticity diagram, these factors are for correcting values that enter that area.

## **Correction Reference Sample :**

This is a sample to determine a correction factors.

(Such as monitor TV valued in correction with tristimulus values through spectrometry.)

## **Standard sample :**

This is a sample used as standard for color matching.

## **White Board :**

This is a white board with good diffusion, which is made of barium sulfate, etc.

## **Local Mode :**

This means a normal measuring status.

The instrument is operated by the panel switches, allowing no control from outside.

## **Remote Mode :**

The instrument is controlled by an external personal computer via interface.

It can also be controlled by its panel switches.

## **Function Mode :**

This is a mode to display and change the data stored in the memory of this instrument.

## **Direct Correction Function :**

This is a function for performing correction between two Luminance Colorimeters that are directly connected by a RS-232C cable.

## Warranty

### Warranty Period

One year from the date of shipment

### Repairs during the Warranty Period

Failure occurs to the instrument when the instrument has been operated according to the instruction manual and, the failure caused by design or manufacture will be repaired free of charge.

### Repairs after the Warranty Period

Repair after the warranty period is carried out if possible and have to be paid in full by the user.

### Maintenance Period

The repair parts (\*1) are retained by us for eight years (\*2) after purchase.

The repairable period is this period that parts are kept in stock.

Even after the storage period has elapsed, there are cases in which repair may be possible, so contact the dealer or TechnoOptis.

(\*1) Maintenance and repair parts are parts that are necessary to maintain the function of the product.

(\*2) We make our most effort to keep maintenance and repair parts in stock for the complete storage period, however, due to some unexpected occurrence, the storage period may have to be shortened.

### Disposal

Dispose of the instrument in according with local disposal and recycling laws and regulations.

### California, U.S.A only

This product contains a CR Lithium Battery which

Contains Perchlorate Material—special handling may apply

See [www.dtsc.ca.gov/hazardouswaste/perchlorate](http://www.dtsc.ca.gov/hazardouswaste/perchlorate)

※Products manufactured after April 2024 are not applicable.

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### When you ask for service, advise us of the following data.

- Manufacturing serial number      Located on the Name plate on the bottom of the device.
- Period of use      The date of purchase of the instrument, and date of last calibration.
- Operating conditions      Type of light source measured, device settings, measurement values, measurement state, etc.
- Problem      Description of the trouble as much detail as possible.

Contact information      Make inquiries to the address indicated on the base of the instruction manual.

Luminance  
Colorimeter

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***BM-7AC***

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Contact information:

**TechnoOptis Co., Ltd.**

4F, Imas Itabashi BASE, 2-4-1, Sakashita, Itabashi-ku, Tokyo 174-0043 JAPAN

◆ For inquiries about the product:

Tel +81-3(3558)2666 Fax +81-3(3558)4661

◆ For inquiries about the after-care service including repairs:

Tel +81-3(3558)2710 Fax +81-3(3558)3011

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