

SPECTROPHOTOMETER CM-512m3A

INSTRUCTION MANUAL



Please read before
using this instrument.



KONICA MINOLTA

Safety Symbols

The following symbols are used in this manual or the Spectrophotometer to prevent accidents which may occur as a result of incorrect use of the instrument.



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



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



Denotes a prohibited action.
This action must never be performed.



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



Denotes a prohibited action.
Never disassemble the instrument.



Denotes an instruction.
Be sure to disconnect the AC adapter from the AC outlet.



This symbol indicates A.C.














This symbol indicates D.C.

Notes on this Manual

- Copying or reproduction of all or any part of the contents of this manual without KONICA MINOLTA SENSING's permission is strictly prohibited.
- The contents of this manual are subject to change without prior notice.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact the nearest KONICA MINOLTA SENSING-authorized service facility.
- KONICA MINOLTA SENSING will not accept any responsibility for consequences arising from the use of the instrument.

Safety Precautions

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

	Warning	(Failure to adhere to the following points may result in death or serious injury.)
	Do not use this instrument in places where flammable or combustible gases (gasoline etc.) are present. Doing so may cause fire.	
	Always use the AC adapter supplied as a standard accessory or optional, and connect it to indoor AC outlet of rated at 100V-240V(50Hz/60Hz) or 230V(50Hz). Failure to follow either of these may result in damage to unit, fire or electric shock.	
	If this instrument is not used for a long time, disconnect AC adapter from AC outlet. Accumulated dirt or water on prongs of AC adapter plug may cause fire and should be removed.	
	Do not handle the plug of the AC adapter with wet hands. Doing so may cause electric shock.	
	Do not disassemble or modify this instrument or AC adapter. Doing so may cause fire or electric shock.	
	Do not expose this instrument to liquid or metal object which may cause fire or electric shock. Should either of these happen, switch power off and unplug AC adapter immediately. If used on batteries, remove them and contact the nearest KONICA MINOLTA SENSING authorized service facility.	
	Do not dispose of batteries in fire, short their terminals, apply heat to them or disassemble them. Doing so may cause explosion or liquid leakage, resulting in fire or injury.	
	Should liquid leak from batteries and contact to eye, wash liquid off with clean water without rubbing eyes and immediately seek for medical professional's advice. In case liquid contacts with hand or clothes, wipe it off with plenty of water. Avoid further use of such unit.	
	Insulate battery contact with such object as tape in disposing of batteries. Contact to other metal object may cause explosion or fire. Follow local regulation for proper disposal or recycling of batteries.	
	Should this instrument or AC adapter be damaged or smoke or odd smell be generated, do not keep using such instrument or AC adapter without correction. Doing so may cause fire. In such situations, switch power off immediately, unplug AC adapter (or remove batteries in using ones) and contact the nearest KONICA MINOLTA SEANSING authorized service facility.	



Caution

(Failing to adhere to the following points may result in injury or damage to the instrument or other property.)



Do not direct the measurement aperture (measurement head) towards the eyes when making measurements. To do so may result in an eye injury.



Use this instrument near AC outlet for easy plugging or unplugging in using AC adapter.



Do not use batteries other than those specified by KONICA MINOLTA SENSING. Do not use new and old batteries together or combine different type batteries. When installing batteries in instrument, make sure that they are correctly oriented according to (+) and (-) marks. Failure to any of these may damage battery or liquid leakage, resulting in fire, injury or air pollution.



Do not place this instrument on unstable or sloping surface which may drop or overturn it. Dropping or overturning may injure someone around. Take care not to drop this instrument when carrying it.

Introduction

This Spectrophotometer offers multi-angle readings (25°, 45°, 75°) in one measurement. Read the following instructions carefully before use.

Packaging Material

Retain packaging materials (box carton, protector, and plastic bags). The Spectrophotometer is a precision device. Use the packaging material originally supplied at the time of purchase in order to minimize shock and vibration when transporting the device to KONICA MINOLTA SENSING for maintenance purposes (such as recalibration). In the event of loss or damage to the packaging material, contact the nearest KONICA MINOLTA SENSING authorized service facility.

Note on Use

- Be sure to use this instrument properly. Use of this instrument in ways other than those specified in this manual may result in risk of injury, electric shock, instrument damage, or other problems.

Operation Environment

- This instrument and the AC adapter supplied as a standard accessory have been designed exclusively for indoor use.
- Do not disassemble this instrument for being composed of delicate electronic components.
- Use this instrument at rated voltage of 100 V - 240 V or 230 V. Connect AC adapter cord to AC outlet with rated voltage and frequency. Connected voltage should not be outside the range of +/-10% of nominal.
- This instrument is classified into a Pollution Degree 2 as instrument used in mainly in manufacturing plant, laboratory, warehouse or equivalents. Use this instrument in metal dust free and non condensing potential environment.
- This instrument is categorized into Installation Category I as equipment which is powered by an AC adapter connected to commercially available power source.
- Connect PC for controlling this instrument to the outlet with protective grounding. Failure to follow this may result in electric shock due to short circuit.
- Take care not to enter foreign substance like water or metal in this instrument. Operating in such state cause serious danger.
- Do not use this instrument under direct sunlight or near heater. The internal temperature of this instrument to becomes much higher than ambient temperature which may break this instrument.
- Avoid rapid change in ambient temperature which may form dew condensation.
- Avoid using this instrument in extremely dusty or humid place.
- Use this instrument at ambient temperature between 0 and 40°C and relative humidity 85% or less (at 35°C) with no condensation(1). Operating this instrument outside specified temperature and humidity range may unsatisfy its original performance.
- Do not use this instrument at an altitude of 2000m or higher.

*1 Operating temperature/humidity range of products for North America: between 5 and 40 °C and relative humidity 80% or less (at 31°C) with no condensation

This Instrument

- Do not subject this instrument to strong impact or vibration.
- Do not forcibly pull, bend, or apply strong force to power cord for attached AC adapter or USB cable. This may result in snapping.
- Connect this unit to power source with minimal noise.
- Should breakage or abnormality be found during operation, switch power off immediately and unplug. Then refer to "TROUBLESHOOTING GUIDE" on page 55.
- Should this instrument break down, do not try to disassemble and repair it by yourself. Please contact the nearest KONICA MINOLTA SENSING authorized service facility.
- Before connecting and disconnecting the Spectrophotometer and host computer, ensure the power is off.
- Do not touch or apply pressure to the connector pins.
- When turning the power OFF and then ON again, wait several seconds after turning the power OFF.

Taking Measurements

- Use caution in keeping the specimen measuring aperture free from dust and foreign particles when using this device upside down.
- Using this instrument for an extended period may result in an inaccurate measurement value due to changes in the test environment. Perform white calibration regularly to maintain accuracy of measurement value.

White Calibration Plate

- The calibration data for the white calibration plate is calibrated at 23°C. When taking a measurement of absolute color data (colorimetric data), which requires precision, perform white calibration and take measurements at 23°C.
- Keep the white calibration plate free of scratches or smudges such as fingerprints.
- Keep the cap on when not in use to block outside light.

Backup Battery

- Measurement data and settings are stored in memory which is backed up by internal backup battery. Backup battery is charged during operation of this instrument, and can retain memory content for 1~2 months if it has been fully charged. At the time of purchasing, battery may have already been partially discharged, so switch power on to charge. Battery can be fully charged in 24 hours. Overcharge does not have to be worried about in this case.
- If this instrument is used only infrequently, the voltage of the backup battery will gradually decrease, and if the power-on time for the next use is short, recharging of the backup battery during that time may be insufficient. In such case, the backup battery may become completely exhausted, resulting in the loss of all settings (reset) and all measurement data. If the instrument is used, for example, once every 2 weeks, it should be left switched on for at least 1 hour; if it is used only once per month, it should be left switched on for at least 2 hours. In addition, the instrument should be left switched on for at least 24 hours once every 6 months to ensure that the backup battery is fully charged. When the instrument has been in use for several years, the backup battery may be approaching the end of its service life and require more frequent recharging. In such case, please contact the nearest KONICA MINOLTA SENSING authorized service facility.
- Do not replace internal backup battery (Type: ML2020/H1B 3V) by yourself. Please contact the nearest KONICA MINOLTA SENSING authorized service facility.
- We recommend that you should backup important data with Color Data Software CM-S100w as optional accessories to store separately.

Storage

- Do not store this instrument under direct sunlight or near heater. The internal temperature of this instrument becomes much higher than ambient temperature which may break this instrument.
- Store this instrument at ambient temperature between -20 and 45°C and relative humidity 85% or less (at 35°C) with no condensation. Storage under high temperature and humidity may deteriorate performance of this instrument. For added safety, we recommend storage with such drying agent at room temperature.
- Take care not to form condensation. Avoid rapid change in ambient temperature when transferring body for storage.
- Keep this instrument free from dust, cigarette smoke or chemical fumes while in storage, all of which may affect its performance, possibly resulting in product failure.
- Keep the measurement aperture free from dust to ensure accurate reading. Cover the measurement aperture to keep dust out.
- Do not expose the white calibration plate to light, as doing so may result in discoloration. Keep the cap on when not in use, to prevent outside light from making contact with the plate in storage.
- Keep this instrument in the box carton used in shipping or in the Hard Case (CM-A64) provided as a standard accessory and store in a safe area.
- Remove batteries when this instrument is kept in storage for more than two weeks. The batteries may leak, resulting in damage to the instrument.

Care

- Wipe any stain off this instrument with a soft, dry cloth. Do not use chemicals, especially those containing organic solvent (benzene, paint thinner, etc.) for cleaning purposes. Contact the nearest KONICA MINOLTA SENSING authorized service facility should the stain prove obstinate.
- Gently wipe the white calibration plate to remove any stain with a soft, clean, dry cloth. When the stain is not easily removed, moisten a cloth with a commercial lens cleaning fluid to clean the plate. It is imperative that the white calibration plate be dry before use.
- Contact the nearest KONICA MINOLTA SENSING authorized service facility if the inner surface of the measurement aperture is smudged.
- Do not disassemble this instrument in the event of a product failure. Contact the nearest KONICA MINOLTA SENSING authorized service facility.

Notes on transfer

- Use packaging material supplied when purchased to minimize vibration or shock generated during transfer.
- Put all material including unit and accessories in original packaging material when returning this instrument for service.

Maintenance

- Periodical checkup is recommended to maintain measurement accuracy of instrument. The appropriate intervals of checkup vary by the condition such as operation environment and frequency of use. However, in the typical case, annual checkup is recommended. For details on checkup, please contact the nearest KONICA MINOLTA SENSING authorized service facility.

Disposal Method

- Make sure that the CM-512m3A, its accessories, and the packing materials are either disposed of or recycled correctly in accordance with local laws and regulations.

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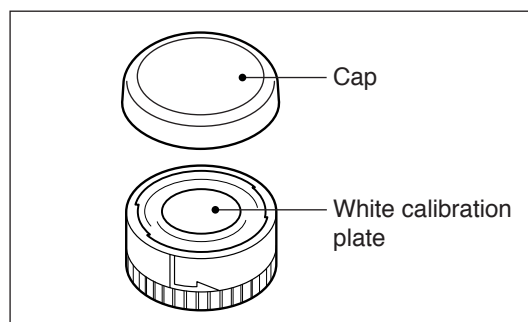
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Standard Accessories

White Calibration Cap CM-A138

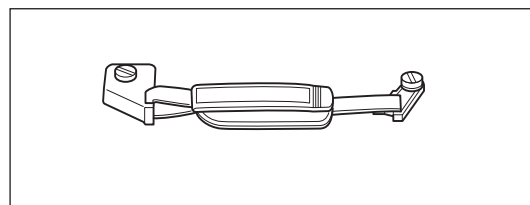
White calibration cap is attached to this instrument when performing white calibration.

It also protects the specimen measuring aperture from dust while in storage. White calibration cap comes with a cover, which serves as protection from dust and discoloration, and a CD-ROM containing white calibration data, software for writing the white calibration data, and a datasheet containing the white calibration data.



Hand Strap CM-A137

Hand Strap CM-A137 helps users to hold the Spectrophotometer more securely.

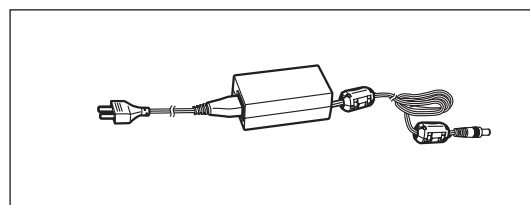


AC Adapter AC-A308

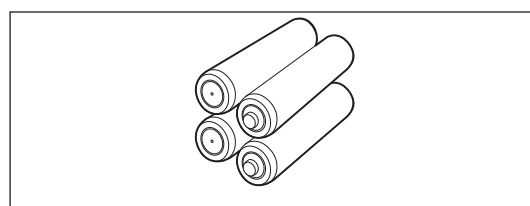
AC Adapter provides power for the Spectrophotometer from an AC outlet.

Input: 100 to 240 V \sim 50/60 Hz

Output: 8 V \equiv 1.5 A

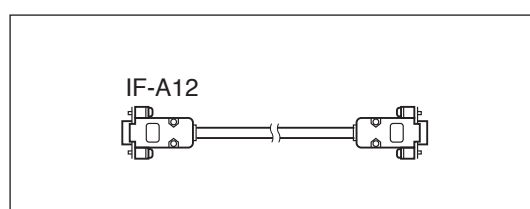


4 AA-size batteries



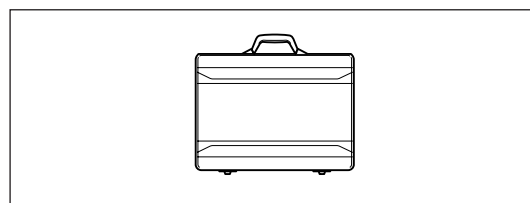
RS-232C Cable (2m) IF-A12

RS-232C cable connects the Spectrophotometer with an external device as a host computer, allowing for exchanges of data with external media.



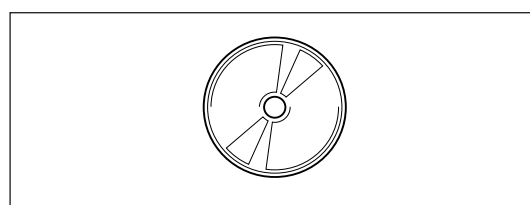
Hard Case CM-A64

Hard Case CM-A64 protects the Spectrophotometer and accessories while they are stored or carried in hands. Space is provided for not only the Spectrophotometer itself, but also for instruction manuals and standard accessories such as the White Calibration Cap, AC Adapter, and RS-232 cable.



User Calibration Software CM-S20w

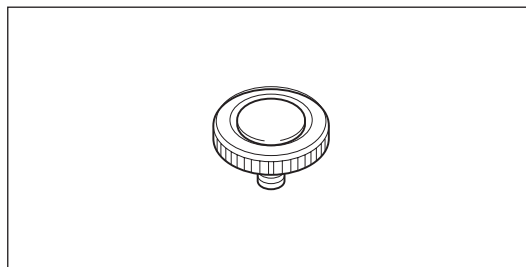
When you wish to use two or more instruments of this model for strict control of the color difference, this software allows you to calibrate the instruments relative to a standard instrument selected among them.



Optional Accessories

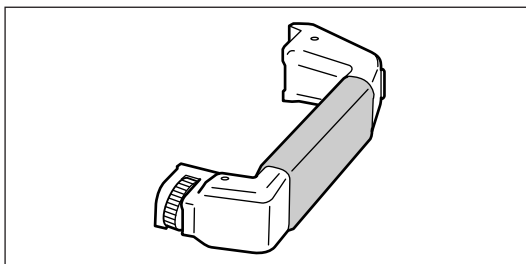
Accessory Switch CM-A23

Accessory Switch CM-A23 attaches to the Spectrophotometer and functions as an additional measuring button. Convenient when holding the Spectrophotometer with two hands and measuring a vertical surface, such as a wall.



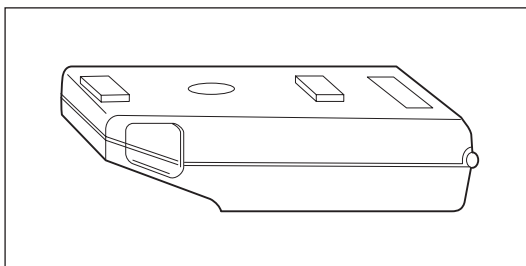
Grip CM-A43

This grip is attached to the Spectrophotometer and is used to hold a specimen steady when it is difficult to position the instrument perpendicular to the specimen surface, as in taking a measurement on the side of a vehicle. The grip is equipped with a measurement button and serves the same function as its counterpart on the Spectrophotometer.



Zero Calibration Box CM-A32

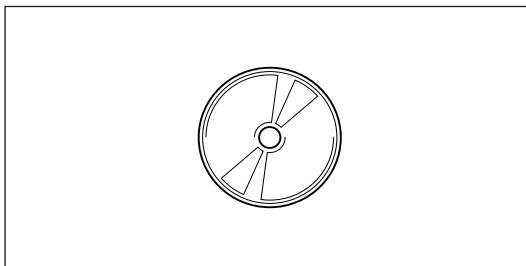
Zero Calibration Box CM-A32 allows accurate zero calibration to be performed easily.



Software

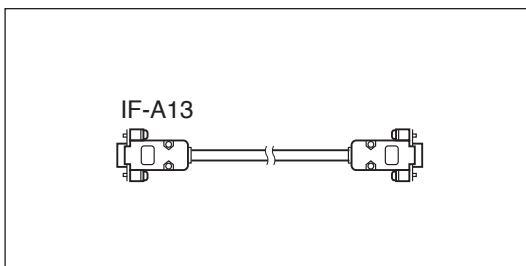
SpectraMagic™ NX CM-S100w

This software allows for interactive communication between the Spectrophotometer and a PC and facilitates remote control of this instrument as well as data input/output. Data processing and file management can be completed using a PC with this software installed.



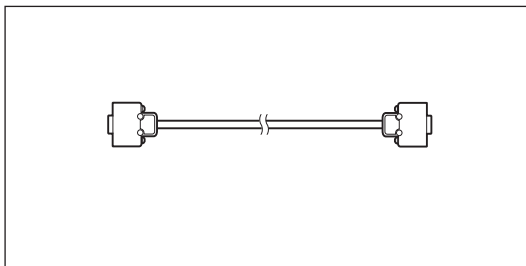
RS-232C Cable (5m) IF-A13

RS-232C cable connects the Spectrophotometer with an external device as a host computer, allowing for exchanges of data with external media.

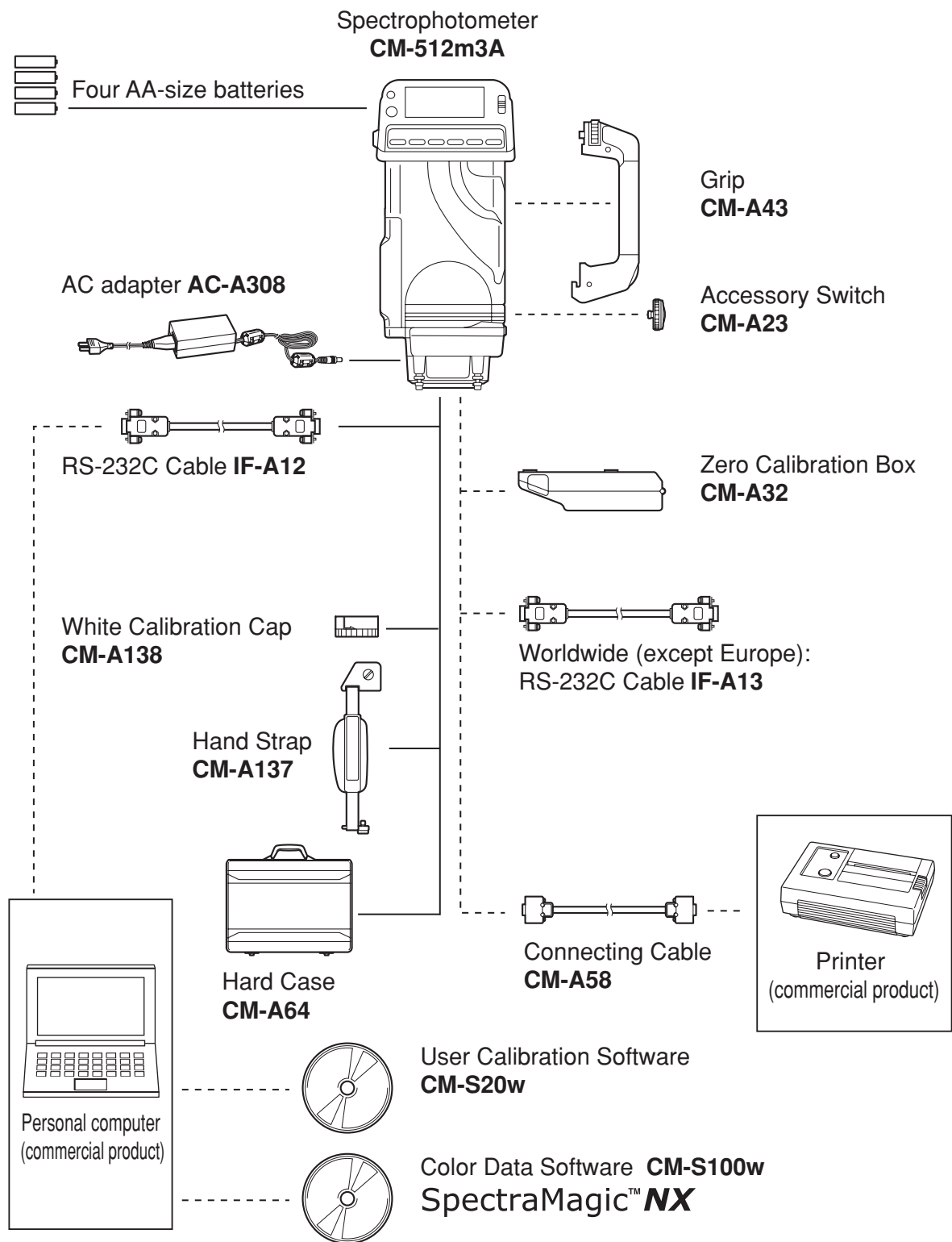


Connecting Cable CM-A58

This cable is used to obtain printer output: It connects the Spectrophotometer with a printer by means of the RS-232C connector on the Spectrophotometer side and the D-sub 9 pin connector on the printer side.

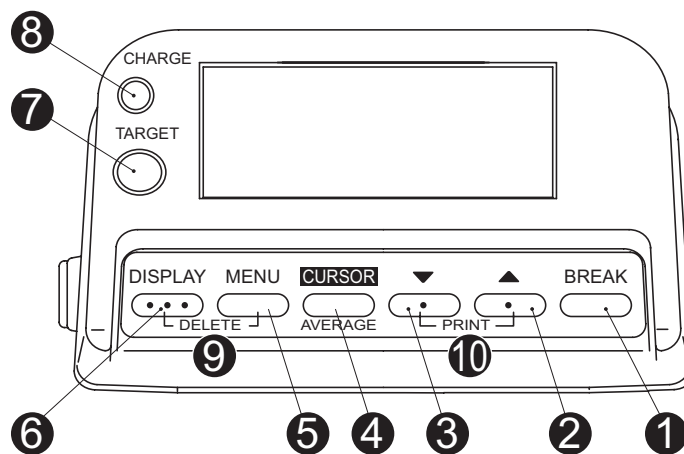
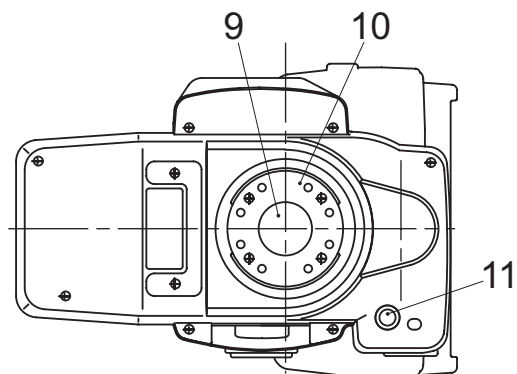
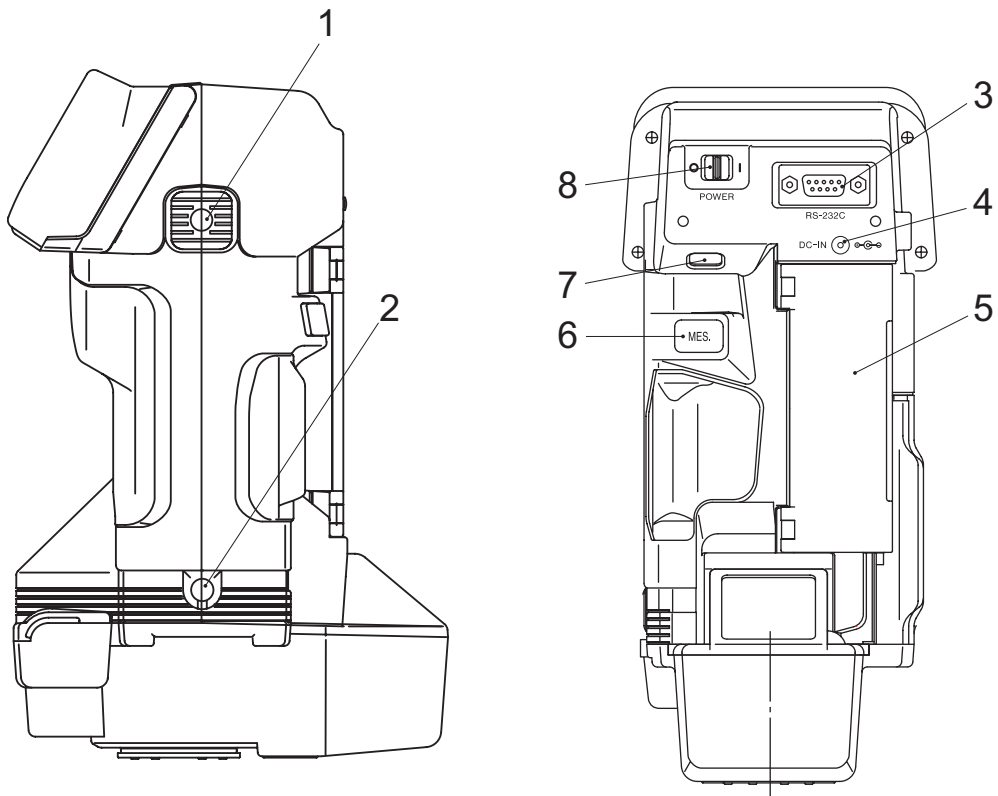


SYSTEM Configuration



—— Standard accessories
----- Optional accessories

NAMES OF PARTS AND FUNCTIONS OF CONTROLS



- 1 Strap mounting socket A
 - 2 Accessory switch mounting socket
 - 3 RS-232C terminal
 - 4 AC adapter socket
 - 5 Battery chamber cover
 - 6 Measuring button
 - 7 Measuring button selector
 - 8 POWER switch
 - Switches power on (I) and off (O).
 - 9 Measurement aperture
 - 10 Specimen contact plate
 - 11 Strap mounting socket B
-
- ❶ BREAK
 - When pressed together with TARGET, causes data to be displayed inverted.
 - ❷ ▲
 - Changes settings or changes to next higher specimen number, target number, or numerical value.
 - ❸ ▼
 - Changes settings or changes to next lower specimen number, target number, or numerical value.
 - ❹ CURSOR/AVERAGE
 - Moves cursor when setting data or changing MENU settings.
 - In measurement mode or TARGET mode, starts/stops manual averaging sequence.
 - ❺ MENU
 - Changes between MENU displays in MENU mode.
 - ❻ DISPLAY
 - Changes between MENU displays in MENU mode.
 - ❼ TARGET
 - Enters TARGET mode for setting or selecting target color data.
 - When pressed together with BREAK, causes data to be displayed inverted.
 - Pressing this button when you are on the TARGET screen will open the USER CALIBRATION screen on which you can view the user calibration data.
 - ❽ CHARGE lamp
 - Blinks upon completion of the measurement and lit when lamp circuit has completed charging and is ready to take a next measurement.
 - ❾ DELETE
 - Causes the Spectrophotometer to enter the measurement data delete mode or target color data delete mode. Hold DISPLAY and MENU keys down simultaneously along with this key.
 - ❿ PRINT
 - Prints screen. Hold ▼ and ▲ keys down simultaneously along with this key.

PREPARATIONS

Power

The Spectrophotometer can be powered by 4 AA-size batteries (alkaline or nickel-metal-hydride rechargeable batteries) or the included AC adapter.

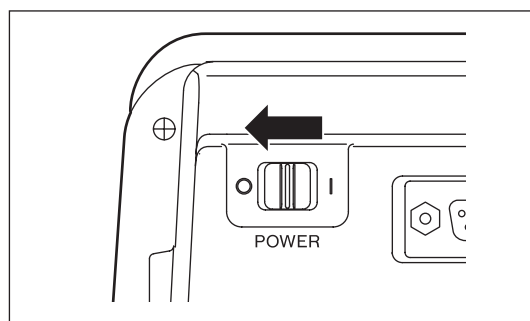
Note, however, that you cannot use this AC adapter to charge the nickel-metal-hydride rechargeable batteries installed in the instrument.

- When data communication via the RS-232C port will be performed, it is recommended that the AC adapter be used to power the Spectrophotometer.

Using AC Adapter

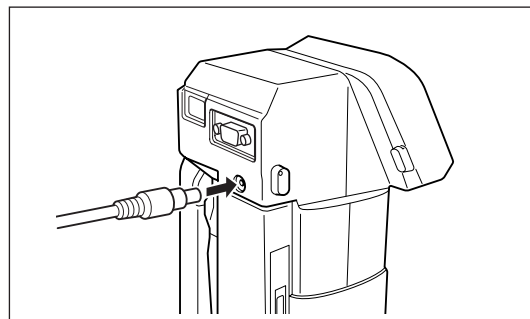
1 Check that the **POWER** switch is set to ○ (off).

2 Insert the output plug of the AC adapter into the Spectrophotometer's AC adapter socket.



3 Insert the input plug of the AC adapter into an **AC outlet**.

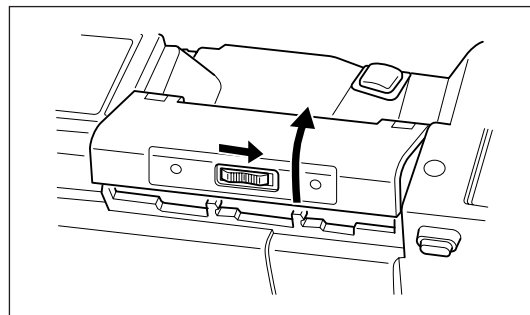
- Use only the included AC Adapter (output:8V 1.5A) to supply power to the Spectrophotometer from AC outlet. Do not use other AC adapters.
- When disconnecting the AC adapter, be sure that the Spectrophotometer's POWER switch is set to ○ (off).



Installing Batteries

1 Check that the POWER switch is set to ○ (off).

2 Slide battery chamber cover lock up and open the battery chamber cover.

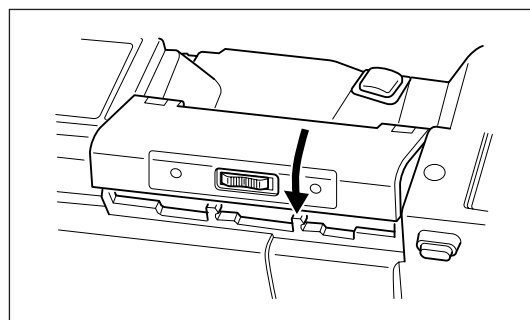


3 Install four AA-size alkaline-manganese, carbon-zinc, or nickel-cadmium batteries in the battery chamber with their polarities as indicated inside battery chamber.

- Do not use manganese batteries.
- Do not mix battery types or ages. Mixing battery types or ages may result in battery leakage or bursting, or in shorter battery life.
- Do not touch or short out the battery contacts in the battery chamber. Doing so may the Spectrophotometer to malfunction.

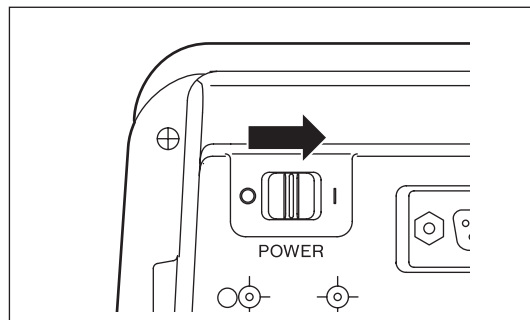
4 Close the battery-chamber cover.

- When the Spectrophotometer will not be used for more than two weeks, remove the batteries to avoid the possibility of damage due to battery leakage or corrosion.

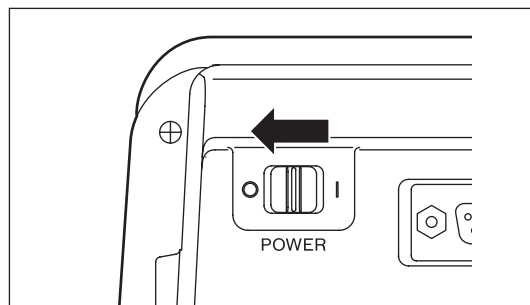


Switching Power On and Off

To switch the power on, slide the **POWER** switch to **I (on)**. The startup display sequence will occur and then the calibration display will appear.



To switch the power off, slide the **POWER** switch to **O (off)**.



Auto Power Save Function

The Spectrophotometer is equipped with an auto power save function which switches off the charging circuits if none of the Spectrophotometer's controls are operated for more than approximately three minutes. (Except same screens) When the auto power save function has been activated, the **CHARGE** lamp will go out. The auto power save function is cancelled when any of the Spectrophotometer's controls are operated and lit the **CHARGE** lamp.

Adjusting Display Contrast

The contrast of the display can be adjusted by moving the contrast-adjustment slide in either direction to obtain the best contrast viewing.

The appearance of the display also varies according to the angle from which it is viewed.

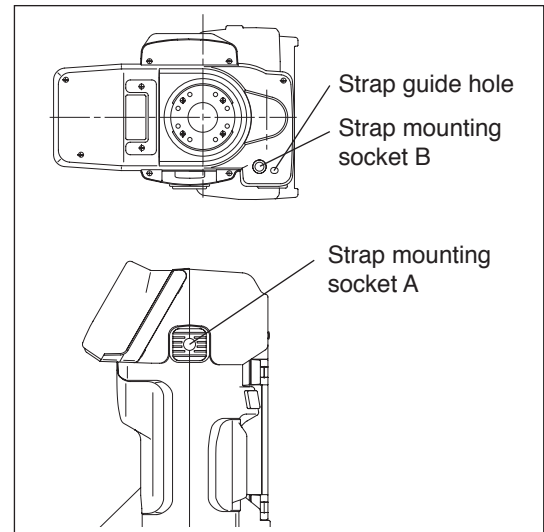
Inverting Displayed Data

Data can be shown upside-down in the display if desired by pressing **TARGET** and **BREAK** at the same time. (Except same screens) To return the display to normal, press **TARGET** and **BREAK** at the same time again.

Hand Strap CM-A24

ATTACHING

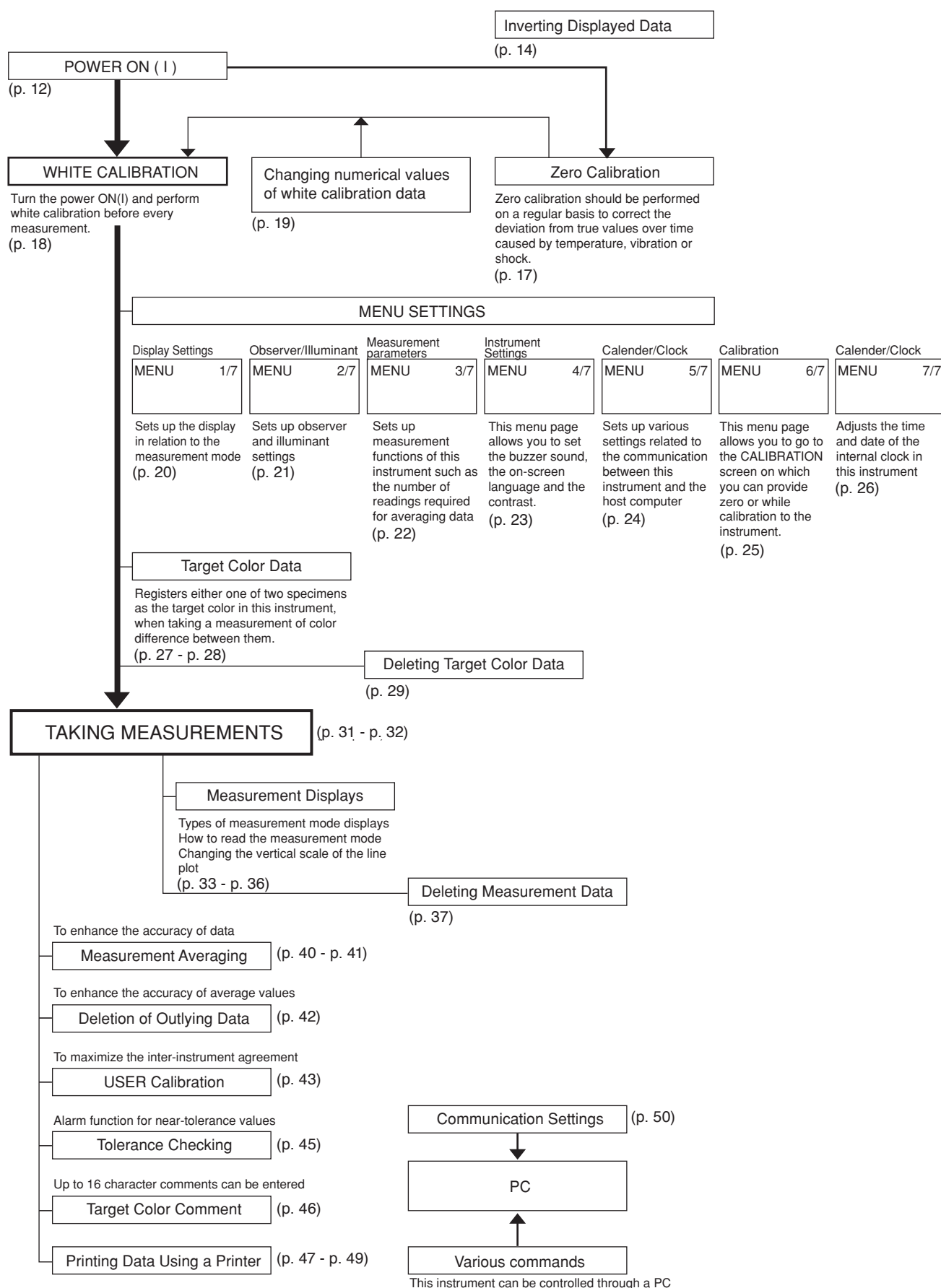
- 1** Align the pin of the hand strap's lower mounting plate with the Spectrophotometer's strap guide hole.
- 2** Align the hand strap's mounting screw B with the Spectrophotometer's strap mounting socket B and turn the screw clockwise unit. Do not overtighten.
- 3** Align the hand strap's mounting screw A with the Spectrophotometer's strap mounting socket A and turn the screw clockwise unit snug. Do not overtighten.



REMOVING

To remove the hand strap, reverse the above procedure.

Flow of basic measurement procedures



Calibration

Zero Calibration

Zero calibration is performed to compensate for the effects of stray light due to the flare characteristics of the optical system. At the time of shipment, zero calibration data measured by Konica Minolta are stored in an EEPROM in the Spectrophotometer. However, since the flare characteristics will change over time due to dust, stains, etc. in the optical system, zero calibration should be performed periodically to enable the effects of stray light to be eliminated more accurately.

- Zero calibration should also be performed periodically to eliminate variations in measured values due to changes in ambient temperature or in the internal temperature of the Spectrophotometer or due to repeated measurements, vibration, shock, etc. In addition, if the Spectrophotometer has not been used for a long time, it is recommended that zero calibration be performed to ensure the best possible accuracy.
- Measured zero calibration data will remain in the Spectrophotometer's memory even if the POWER switch is set to ○ (off).
- If the Spectrophotometer is not used for a long period of time, it is recommended that zero calibration be performed.
- Zero calibration should be performed under the same ambient conditions (temperature, etc.) as those under which measurements will be taken.

- 1 Slide POWER switch from ○ (off) to I (on). The startup sequence will occur for approximately three seconds and then the Spectrophotometer will automatically change to <CALIBRATION> mode.**

- If you wish to calibrate the instrument during use, press MENU and then select the CALIBRATION menu page. (see p. 25)

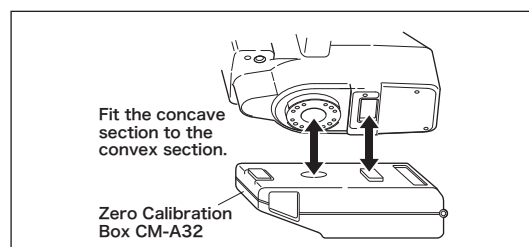
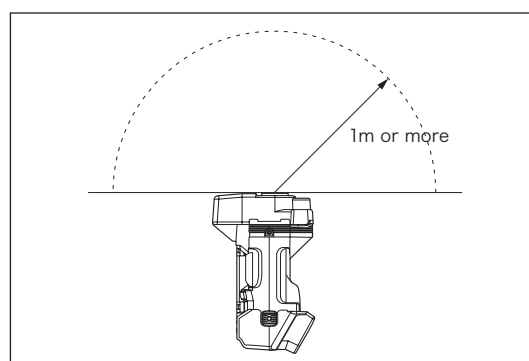
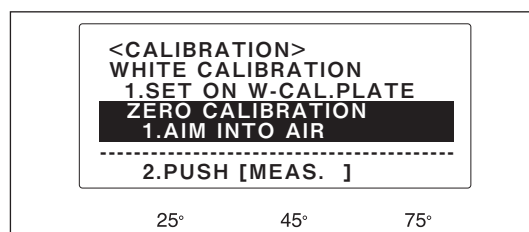
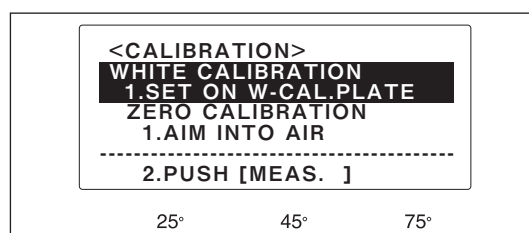
- 2 Press CURSOR to move cursor to “ZERO CALIBRATION”.**

- 3 Aim the Spectrophotometer's measurement aperture into the air.**

- Do not aim it toward a light source.
- There should be no object within 1m (39 inches) of the measurement aperture.

- 4 After the CHARGE lamp has become lit, press the measuring button. Nine measurements will be taken for calibration. After calibration has been completed, the display will automatically return to <CALIBRATION> mode. Continue by performing white calibration (see p. 18).**

- Use of the optional Zero Calibration Box (CM-A32) ensures proper zero calibration.
- If the CHARGE lamp does not light due to the auto power save function, this may be due the fact that it can take time to start zero calibration after the measuring button is pressed.



White Calibration

After the Spectrophotometer has been switched on, white calibration should be performed before starting measurements.

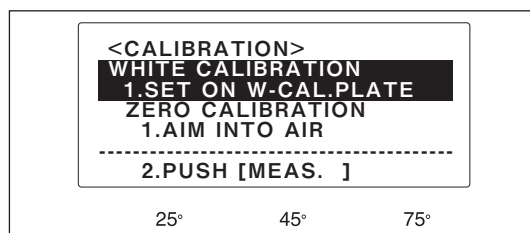
- When measurements will not be taken, white calibration is unnecessary. Press **BREAK** to skip calibration.
- When using the calibration plate first time or when using a calibration plate other than the white calibration plate included as a standard accessory, white calibration data should be set according to the following procedure (see p. 19).
- To ensure measurement accuracy, perform white calibration fairly frequently if the ambient temperature varies or if measurements are taken repeatedly within a relatively short period of time (which may cause the internal temperature of the Spectrophotometer to increase). Any change in temperature (both ambient temperature and the internal temperature of the Spectrophotometer) may affect measurement accuracy.

Performing White Calibration

- White calibration should be performed under the same ambient conditions (temperature, etc.) as those under which measurements will be taken.

1 Slide **POWER** switch from ○ (off) to I (on). The startup sequence will occur for approximately three seconds and then the Spectrophotometer will automatically change to <CALIBRATION> mode.

- If you wish to calibrate the instrument during use, press MENU and then select the CALIBRATION menu page. (see p. 25)
- After the Spectrophotometer changes to <CALIBRATION> mode, the cursor (highlighted area) should be on WHITE CALIBRATION. If the cursor is on ZERO CALIBRATION, press CURSOR to move cursor to WHITE CALIBRATION.



2 Press the white calibration cap up against the Spectrophotometer and turn the cap in the direction of the arrow unit stops.

3 After the CHARGE lamp has become lit, press the measuring button. Nine measurements will be taken for calibration. After calibration has been completed, the display will automatically change to the measurement display.

- To perform white calibration again, turn off the Spectrophotometer once and then repeat the above procedure from step 1. Alternatively, press MENU and then select the CALIBRATION menu page.
- If the CHARGE lamp does not light due to the auto power save function, this may be due the fact that it can take time to start white calibration after the measuring button is pressed.

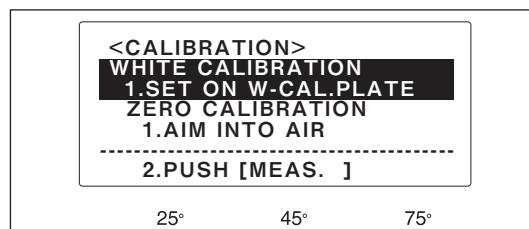
Setting White Calibration Data

You may also use the “Data Setting Tool software” stored on the CD-ROM accompanying White Calibration Cap CM-138 or the optional Color Data Software SpectraMagic™ NX to set the white calibration data.

1 Slide POWER switch from ○ (off) to I (on).

The startup sequence will occur for a pproximately three seconds and then the Spectrophotometer will automatically change to <CALIBRATION> mode.

- If you wish to calibrate the instrument during use, press MENU and then select the CALIBRATION menu page. (see p. 25)



2 Press MENU. The display will change to WHITE CAL. DATA.

3 Press ▲ and ▼ to set the value and press CURSOR to move the cursor to the next value.

- Repeat this procedure to set all data for 400 to 460 nm.

WHITE CAL. DATA			
1. [▲▼] INPUT DATA			
2. [CURSOR] NEXT DATA			
400	90.00	90.00	90.00
420	90.00	90.00	90.00
440	90.00	90.00	90.00
460	90.00	90.00	90.00

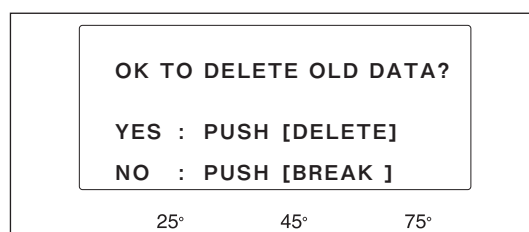
25° 45° 75°

4 Press DISPLAY to change the screen and repeat step 3 to set the data for 480 to 540 nm.

- Repeat steps 3 and 4 to set all data for 560 to 620 nm and for 640 to 700 nm.

5 Press BREAK.

- The confirmation display shown at right will appear. To overwrite the white calibration data in memory with the data that were just set, press DELETE; to cancel the changes just made to the white calibration data and keep the white calibration data presently in memory, press BREAK. After either key is pressed, the display will change to <CALIBRATION>. If measurements will be taken or target color data will be measured, perform white calibration (see p. 18).



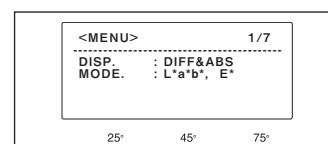
Menu Settings

The Spectrophotometer's functions can be set in the following six menus:

<MENU> 1/7:	Display type; color modes
<MENU> 2/7:	Observer; illuminants
<MENU> 3/7:	Automatic measurement averaging; abnormal data delete
<MENU> 4/7:	Buzzer; language; contrast
<MENU> 5/7:	Data communications settings
<MENU> 6/7:	Calibration
<MENU> 7/7:	Date and time

<MENU> 1/7 (Display Settings)

DISP.:



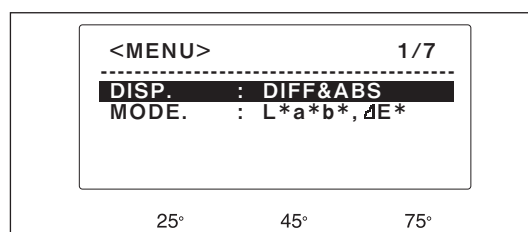
DIFF & ABS:	Displays color difference and absolute color data measured under the illuminant selected for ILLUMINANT 1 in <MENU> 2/7.
METAMERISM:	Displays metamerism index.
DIFF 1 & 2:	Displays color difference data measured under the illuminants selected for ILLUMINANT 1 and ILLUMINANT 2 .
ABS 1 & 2:	Displays absolute color data measured under the illuminants selected for ILLUMINANT 1 and ILLUMINANT 2 .
PASS/FAIL:	Displays the results of tolerance checking. See p. 45.
GRAPH & DIFF:	Draws a line plot of the color difference data measured under the setting ILLUMINANT 1 .
GRAPH & ABS:	Draws a line plot of the absolute color data measured under the setting ILLUMINANT 1 .

MODE:

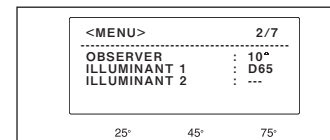
L*a*b*, ΔE*:	CIE 1976 L*a*b* color system; color difference data shown as ΔL*, Δa*, and Δb* plus ΔE* _{ab} .
L*a*b*, CMC:	CIE 1976 L*a*b* color system; color difference data shown is terms of CMC color difference.
L*a*b*, ΔE₀₀:	CIE 1976 L*a*b* color system; color difference data shown in terms of ΔE ₀₀ .
L*C*h, ΔE*:	CIE 1976 L*C*h color system; color difference data shown as ΔL*, ΔC*, and ΔH* plus ΔE* _{ab} .
L*C*h, CMC:	CIE 1976 L*C*h color system; color difference data shown in terms of CMC color difference.
L*C*h, ΔE₀₀:	CIE 1976 L*C*h color system; color difference data shown in terms of ΔE ₀₀ .

Setting procedure

- 1** In measuring mode, press **MENU**. The display will change to one of the menus (the last menu which was exited from).
- 2** Press **DISPLAY** repeatedly to select <MENU> 1/7.
 - The menu displayed will change to the next higher numbered menu each time **DISPLAY** is pressed and will return to <MENU> 1/7 if **DISPLAY** is pressed while <MENU> 7/7 is shown.
- 3** Press **CURSOR** repeatedly to move the cursor to the item to be set.
- 4** Use **▲** or **▼** to select the desired setting. The setting is selected when it is displayed.
 - To select settings in other menus, press **DISPLAY** to change to that menu.
 - To return to measurement display, press **BREAK**.



<MENU> 2/7 (Observer/Illuminant)



- OBSERVER:** Determines observer functions to be used for calculating colorimetric measurement data.
- 2°** CIE 2° Standard Observer functions.
 - 10°** CIE 10° Standard Observer functions.
- ILLUMINANT 1:** Can be set to **D65, D50, C, A, F2, F6, F7, F8, F10, F11, or F12**. When **DISP.** is set to **METAMERISM**, **ILLUMINANT 1** serves as the reference illuminant for determining the metamerism index.
- ILLUMINANT 2:** Can be set to **D65, D50, C, A, F2, F6, F7, F8, F10, F11, F12 or ---**. When **DISP.** is set to **METAMERISM**, **ILLUMINANT 2** serves as the test illuminant for determining the metamerism index.
- Illuminant settings:**
- D65** Standard illuminant D65; daylight, Color temperature: 6504K
 - D50** Complementary illuminant D50; Daylight, Color temperature: 5003K
 - C** Complementary illuminant C; daylight (Ultraviolet part is small in comparison with the daylight), Color temperature: 6774K
 - A** Standard illuminant A; Incandescent lamp, Color temperature : 2856K
 - F2** Cool white (fluorescent lamp), Color temperature : 4230K
 - F6** Cool white (fluorescent lamp), Color temperature : 4150K
 - F7** Color rendering A daylight white (fluorescent lamp), Color temperature : 6500K
 - F8** Color rendering AAA natural white (fluorescent lamp), Color temperature : 5000K
 - F10** 3-band type natural white (fluorescent lamp), Color temperature : 5000K
 - F11** 3-band type cool white (fluorescent lamp), Color temperature : 4000K
 - F12** 3-band type warm white (fluorescent lamp), Color temperature : 3000K
 - None (Not selectable "ILLUMINANT 1")

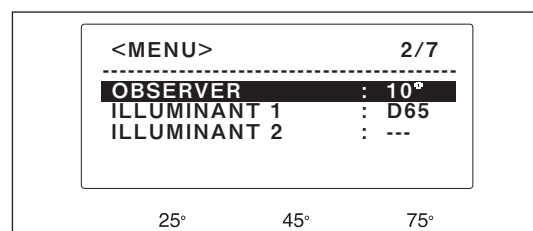
Setting procedure

- If the display presently shows a menu, skip step 1.

1 In measuring mode, press **MENU**. The display will change to one of the menus (the last menu which was exited from).

2 Press **DISPLAY** repeatedly to select **<MENU> 2/7**.

- The menu displayed will change to the next higher numbered menu each time **DISPLAY** is pressed and will return to **<MENU> 1/7** if **DISPLAY** is pressed while **<MENU> 7/7** is shown.

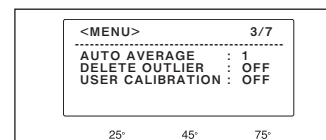


3 Press **CURSOR** repeatedly to move the cursor to the item to be set.

4 Use **▲** or **▼** to select the desired setting. The setting is selected when it is displayed.

- To select settings in other menus, press **DISPLAY** to change to that menu.
- To return to measurement display, press **BREAK**.

<MENU> 3/7 (Data Processing Functions)

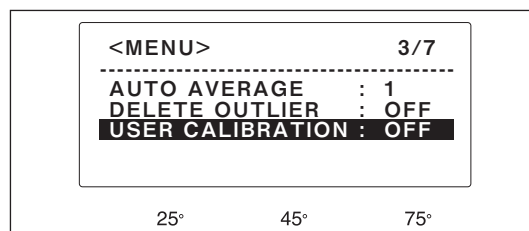


- AUTO AVERAGE:** Number of measurements to be taken and averaged (if **3**, **5**, or **8** is set) when measuring button is pressed. The average of the measurements will then be treated as one measurement by the Spectrophotometer. See p. 40.
1, 3, 5, or 8
- DELETE OUTLIER:** **ON** Deletes the two measurements most different from the average and recalculates the average to improve accuracy.
OFF Automatic averaging is performed without deleting outlier data. See p. 42.
- USER CALIBRATION** **ON** Measured data is corrected with the correction coefficient already determined by the user calibration process.
OFF Measured data is not corrected. (see p.43)

Setting procedure

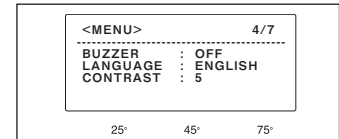
- If the display presently shows a menu, skip step 1.

- 1 In measuring mode, press MENU. The display will change to one of the menus (the last menu which was exited from).**
- 2 Press DISPLAY repeatedly to select <MENU> 3/7.**
 - The menu displayed will change to the next higher numbered menu each time **DISPLAY** is pressed and will return to **<MENU> 1/7** if **DISPLAY** is pressed while **<MENU> 7/7** is shown.
- 3 Press CURSOR repeatedly to move the cursor to the item to be set.**
- 4 Use ▲ or ▼ to select the desired setting. The setting is selected when it is displayed.**
 - To select settings in other menus, press **DISPLAY** to change to that menu.
 - To return to measurement display, press **BREAK**.



- BUZZER:** **ON** Buzzer will sound each time a key is pressed or when the color of the measured specimen is beyond the set tolerance values.
OFF Buzzer will not sound.

<MENU> 4/7 (Instrument Settings)



BUZZER ON: Buzzer will sound each time a key is pressed or when the color of the measured specimen is beyond the set tolerance values.

OFF Buzzer will not sound.

LANGUAGE: ENGLISH: The on-screen language is set to English.

LANGUAGE: CHINESE: The on-screen language is set to Chinese.

CONTRAST:: The display contrast can be adjusted in 10 levels. The appearance of the display also varies according to the angle from which it is viewed.

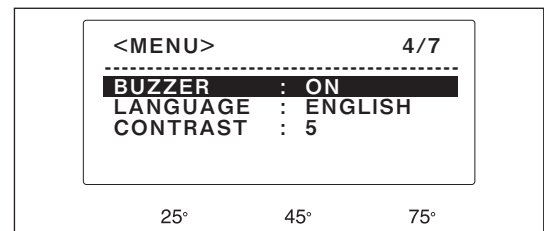
Setting procedure

- If the display presently shows a menu, skip step 1.

1 In measuring mode, press **MENU**. The display will change to one of the menus (the last menu which was exited from).

2 Press **DISPLAY** repeatedly to select <MENU> 4/7.

- ☐ The menu displayed will change to the next higher numbered menu each time **DISPLAY** is pressed and will return to <MENU> 1/7 if **DISPLAY** is pressed while <MENU> 5/7 is shown.

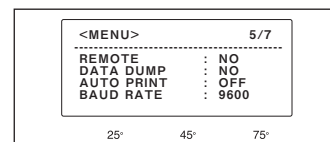


3 Press **CURSOR** repeatedly to move the cursor to the item to be set.

4 Use **▲** or **▼** to select the desired setting. The setting is selected when it is displayed.

- ☐ To select settings in other menus, press **DISPLAY** to change to that menu.
- ☐ To return to measurement display, press **BREAK**.

<MENU> 5/7 (Data Communication Functions)

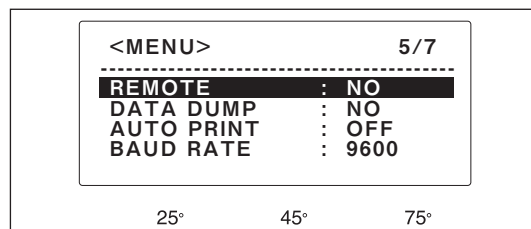


REMOTE:	NO	(Normally selected) Normal handheld operating mode, with operation controlled by keys and measurement results shown in display.
	YES	REMOTE mode for when Spectrophotometer is controlled by a separate computer connected to the RS-232C terminal. This mode is entered immediately after ▲ or ▼ is pressed to change setting to YES . See p. 50 for further information on remote operation.
DATA DUMP:	NO	(Normally selected)
	YES	Immediately enters <MENU> DATA DOWNLOAD mode (see p. 49) for selecting measurement data to be dumped to a printer.
AUTO PRINT:	ON	Data will be automatically printed out immediately after each measurement (see p. 48).
	OFF	Data will not be printed out automatically.
BAUD RATE:		Baud rate for data communication. 1200, 2400, 4800, 9600, or 19200

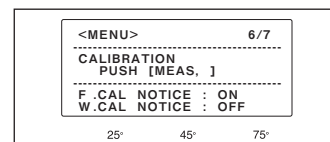
Setting procedure

- If the display presently shows a menu, skip step 1.

- 1 In measuring mode, press MENU. The display will change to one of the menus (the last menu which was exited from).**
- 2 Press DISPLAY repeatedly to select <MENU> 5/7.**
 - The menu displayed will change to the next higher numbered menu each time **DISPLAY** is pressed and will return to **<MENU> 1/7** if **DISPLAY** is pressed while **<MENU> 7/7** is shown.
- 3 Press CURSOR repeatedly to move the cursor to the item to be set**
- 4 Use ▲ or ▼ to select the desired setting. The setting is selected when it is displayed.**
 - To select settings in other menus, press **DISPLAY** to change to that menu.
 - To return to measurement display, press **BREAK**.



<MENU> 6/7 (Calibration)



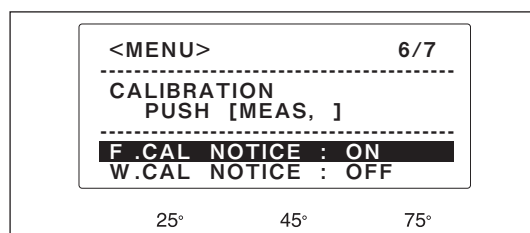
- CALIBRATION:** Press MES. The CALIBRATION menu page will open as shown to the right.
- F.CAL GUIDE:** After approximately one year elapses after the instrument is shipped from the factory or after KONICA MINOLTA SENSING calibration service (or maintenance), a message will be displayed when the power is turned on that recommends annual service recalibration. This feature defaults to ON. When setting it to OFF, you will not see the recommendation message.
- W.CAL GUIDE:** This feature allows a message to be viewed on the display when a specified amount of time has elapsed from the last white calibration, the message recommending that the instrument be subject to calibration. It defaults to ON. Setting it to a value ranging from 1 to 24 enables the feature, and a message will appear on the display when the specified amount of time has elapsed from the last white calibration, recommending that the instrument be subject to white calibration.

Setting procedure

- If the display presently shows a menu, skip step 1.

1 In measuring mode, press MENU. The display will change to one of the menus (the last menu which was exited from).

2 Press DISPLAY repeatedly to select <MENU> 6/7.

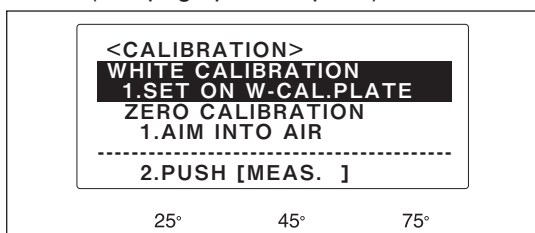


- The menu displayed will change to the next higher numbered menu each time **DISPLAY** is pressed and will return to **<MENU> 1/7** if **DISPLAY** is pressed while **<MENU> 7/7** is shown.
- After the Spectrophotometer changes to **<MENU> 6/7**, the cursor (highlighted area) should be on **F.CAL NOTICE**.

(To access the CALIBRATION screen)

3 Press MES.

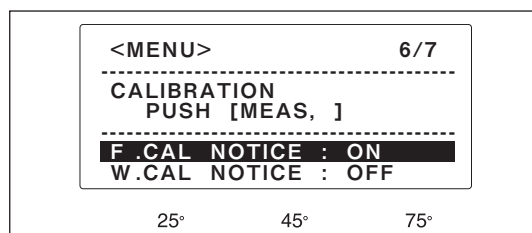
- The CALIBRATION screen will open. This screen allows you to provide zero or white calibration to the instrument (see page p. 17 or p. 18).



- After white calibration has been completed, the display will automatically change to the measurement display.

(To enable or disable the calibration recommendation features)

3 Press CURSOR repeatedly to move the cursor to the item to be set.

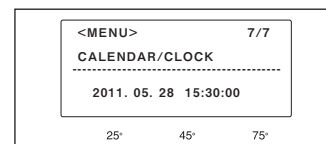


4 Use ▲ or ▼ to select the desired setting. The setting is selected when it is displayed.

- To select settings in other menus, press **DISPLAY** to change to that menu.
- To return to measurement display, press **BREAK**.

<MENU> 7/7 (Calendar/Clock)

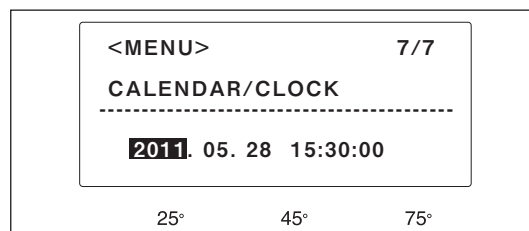
The Spectrophotometer stores the date and time of measurement as the initial comment for measurement data or target color data. For this reason, it is important that the correct date and time be set on the calendar/clock. The date and time can be set by following the procedure below.



Setting procedure

- If the display presently shows a menu, skip step 1.

- 1 In measuring mode, press MENU. The display will change to one of the menus (the last menu which was exited from).**
- 2 Press DISPLAY repeatedly to select <MENU> 7/7.**
 - The menu displayed will change to the next higher numbered menu each time **DISPLAY** is pressed and will return to **<MENU> 1/7** if **DISPLAY** is pressed while **<MENU> 7/7** is shown.
- 3 Press CURSOR repeatedly to move the cursor to the item to be set.**
- 4 Use ▲ or ▼ to set the correct value.**
- 5 Repeat steps 3 and 4 to set other date or time values.**
- 6 Press DISPLAY or BREAK to exit <MENU> 7/7.**
 - The date and time on the calendar/clock should be set and restarted.
 - To select settings in other menus, press **DISPLAY** to change to that menu.
 - To return to measurement display, press **BREAK**



Target Color Data

In order to take color difference measurements, it is necessary to set target color data. Target color data are set by measuring the target color standard with the Spectrophotometer.

Data memory:

The Spectrophotometer has memory space for up to 440 sets of data. This space is shared by target color data and measurement data; how the memory space is divided between the two types of data is not fixed. For example, if 50 sets of target color data have been stored, then up to 390 sets of measurement data can be stored in the remaining space; likewise, if 200 sets of target color data have been stored, then 240 sets of measurement data can be stored in the remaining space. If measurements are taken after the memory has become full, the measurement data will overwrite the data for the highest specimen number.

Setting Target Color Data

- Measurement of target color data should be performed under the same ambient conditions (temperature, etc.) as white calibration and measurements.
- The Specimen measuring aperture of this instrument is equipped with anti-slip rubber. To ensure accuracy of measurement, the Specimen measuring aperture needs to be closely attached perpendicular to the specimen surface.
- Strike the DELETE key while holding DISPLAY and MENU keys down simultaneously. Follow the procedure below:

1 In measurement mode, press TARGET. Display will change to <TARGET> mode.

- To measure target color in a color mode other than the presently displayed one, change the color mode selected in <MENU> 1/7 (see p. 20) before pressing TARGET to enter <TARGET> mode.

<TARGET>		T1	
		2°/D65	U1
		17.07	
L*	27.43	7.10	3.31
a*	-9.43	-3.53	-0.22
b*	-6.82	-5.82	-3.17
[2011.05.28 15:30]			
		25°	45° 75°

2 Press ▲ or ▼ to select the desired target number.

- Only the target numbers for which data has already been set and the next higher target number can be selected ▲.
- ▼ Holding ▲ or ▼ pressed will cause the target number to change more rapidly.

3 Place the Spectrophotometer perpendicular to the surface of the specimen. Hold it steady against the specimen with both hands.

4 After the CHARGE lamp has become lit, press the measuring button to take a measurement. The CHARGE lamp turns off and Xenon lamps turn on. Upon completion of the measurement, the CHARGE lamp blinks and a beep sounds. The CHARGE lamp becomes lit when xenon lamp circuit has completed charging. A beep sounds again when the measured data is saved as the target color data (provided that the buzzer feature is enabled).

- Do not move the instrument until the measurement is complete, the CHARGE lamp blinks.
- If the CHARGE lamp does not light due to the auto power save function, this may be due the fact that it can take time to start the measurement after the measuring button is pressed.
- If target color data have already been set for the selected target number, the display will ask whether the old data should be deleted or not after the measurement has been completed. Press DELETE to delete the old data or BREAK to keep the old data.

If the color space is set to CMC or ΔE_{00} , the coefficient can be set up individually according to each angle of measurement. Follow the procedure below:

- When the color space is set to L^*a^*b , CMC ($\ell : c$) or L^*C^*h , CMC, press MENU to set up the values for ℓ and c of CMC ($\ell : c$).

Press CURSOR to move the cursor in the order of 25° for R, 45° for R, 75° for R, 25° for c, 45° for c, and 75° for c. Set up the values for R and c at each angle of meas ▲ remen ▼ using and .

The default setting for (R: c) is 25°, 45° and 75°, and (4:1), (3:1) and (2:1), respectively.

- When the L^*a^*b , ΔE_{00} or L^*C^*h , or ΔE_{00} color space is selected, press MENU to set up the coefficient of the ΔE_{00} color difference equation.

Press CURSOR to move the cursor in the order of 25° for KR, 45° for KR, 75° for KR, 25° for Kc, 45° for Kc, 75° for Kc, 25° for Kh, 45° for Kh, and 75° for Kh. Set up the values for KR, Kc and Kh at each angle of meas ▲ remen ▼ using and .

The default setting for (KR: Kc: Kh) is 25°, 45° and 75°, and (4:1:1), (3:1:1) and (2:1:1), respectively.

OK TO DELETE OLD DATA?		
YES : PUSH [DELETE]		
NO : PUSH [BREAK]		
25°	45°	75°

<TARGET> T5		
COEFCIENTS		
CMC	ℓ	c
25° =	4.00	1.00
45° =	3.00	1.00
75° =	2.00	1.00
25°	45°	75°

<TARGET> T5			
COEFCIENTS			
ΔE_{00}	k_l	k_c	k_h
25° =	4.00	1.00	1.00
45° =	3.00	1.00	1.00
75° =	2.00	1.00	1.00
25°	45°	75°	

5 Press BREAK to return to measurement mode.

Deleting Target Color Data

All target color data stored in this device can be deleted. The data can be erased individually or entirely.

- Deleted target color data cannot be recovered.
- Strike the DELETE key while holding DISPLAY and MENU keys down simultaneously. Follow the procedure below:

Deleting the target color data individually

1 Press TARGET while in the measurement mode.

- The screen will switch to the target color data mode.

<TARGET>		T1	
	FF	2°/D65	U1
L*	27.43	17.07	
a*	-9.43	7.10	3.31
b*	-6.82	-3.53	-0.22
		-5.82	-3.17
[2011.05.28 15:30]			

25° 45° 75°

2 Press ▲ and ▼ to select the target color data to be erased.

- Hold ▲ and ▼ down to make changes consecutively.

3 Press DELETE.

- The screen will switch to the target color data delete mode.
- The cursor is located at “No.xx DELETE [comment].” upon entering the delete mode. If the cursor is located at “ALL TARGET DELETE”, press CURSOR to move the cursor to “No.xx DELETE [comment]”.

TARGET DELETE	
EXE : PUSH [DELETE]	
ESC : PUSH [BREAK]	

No.10	DELETE
[2011. 05. 28 16:00]	
ALL TARGET DELETE	

25° 45° 75°

4 Press DELETE.

- The target color data selected in the step 2 is deleted, returning to TARGET mode.
- The target color data number will move up by one for those registered after the deleted data.
- All measured data linked with the deleted data in color difference measurement, shall be expressed in an absolute value due to the absence of the reference color.

No.10	
DELETED	

25° 45° 75°

Press **BREAK** to return to the measurement mode.

Deleting ALL TARGET COLOR DATA

- 1** In measurement mode, press **TARGET**.
Display will change to <TARGET> mode.
- 2** Press **DELETE**. The display will change to **TARGET DELETE**.
- 3** Press **CURSOR** to move the cursor to **ALL TARGET DELETE**.
- 4** Press **DELETE** again to complete deletion of target color data. All target color data stored in the Spectrophotometer will be deleted and the display will return to <TARGET> mode.
- 5** Press **BREAK** to return to measurement mode.

<TARGET>		T1	
	FF	2°/D65	U1
L*	27.43	17.07	
a*	-9.43	7.10	3.31
b*	-6.82	-3.53	-0.22
		-5.82	-3.17
[2011.05.28 15:30]			
25°		45°	75°

TARGET DELETE	
EXE : PUSH [DELETE]	
ESC : PUSH [BREAK]	

No.10	DELETE
[2011. 05. 28 16:00]	
ALL TARGET DELETE	
25°	
45°	
75°	

ALL TARGET	
DELETED	
25°	
45°	
75°	

TAKING MEASUREMENTS

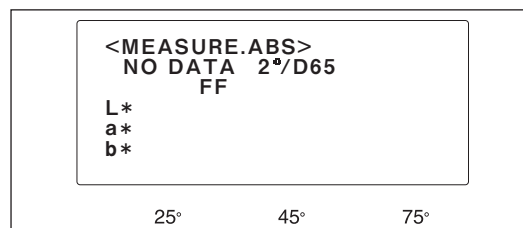
- White calibration should be performed before taking measurements.
- Measurements should be performed under the same ambient conditions (temperature, etc.) as white calibration and setting of target color data.
- Fluorescent colors cannot be measured accurately.
- The Specimen measuring aperture of this instrument is equipped with anti-slip rubber. To ensure accuracy of measurement, the Specimen measuring aperture needs to be closely attached perpendicular to the specimen surface.
- Before making a color difference measurement, set up the target color data (see p. 27) and select the target color data according to the procedure below. The measured data will be stored in the memory in connection with the predetermined target color data.

Data memory:

The Spectrophotometer has memory space for up to 440 sets of data. This space is shared by target color data and measurement data; how the memory space is divided between the two types of data is not fixed. For example, if 50 sets of target color data have been stored, then up to 390 sets of measurement data can be stored in the remaining space; likewise, if 200 sets of target color data have been stored, then 240 sets of measurement data can be stored in the remaining space. If measurements are taken after the memory has become full, the measurement data will overwrite the data for the highest specimen number.

Measurement Procedure

- If color difference measurements will be taken, target color data must be set before taking measurements (see p. 27). If target color data have already been stored in the Spectrophotometer's memory, the desired target color to be used by pressing **TARGET** to change to **<TARGET>** and selecting the desired target color using **▲** or **▼**.



Measurement of Colorimetric Data (Absolute Color Data)

1 Press **BREAK** repeatedly until Spectrophotometer is in measurement mode.

- Press **DISPLAY** if the instrument is in the line plot mode.

2 Place the Spectrophotometer perpendicular to the surface of the specimen. Hold it steady against the specimen with both hands .

3 After the **CHARGE** lamp has become lit, press the measuring button to take a measurement. The **CHARGE** lamp turns off and Xenon lamps turn on. Upon completion of the measurement, the **CHARGE** lamp blinks and a beep sounds. The **CHARGE** lamp becomes lit when xenon lamp circuit has completed charging. A beep sounds again when the measured data is saved as the target color data (provided that the buzzer feature is enabled).

- Do not move the instrument until the measurement is complete, the **CHARGE** lamp blinks.
- If the **CHARGE** lamp does not light due to the auto power save function, this may be due the fact that it can take time to start the measurement after the measuring button is pressed.
- The date and time of measurement will be stored as the comment.

Measurement of Color Difference

1 Press TARGET while in the measurement mode.

- The screen will switch to **TARGET** mode.

<TARGET>			
	T1		
	2°/D65	U1	
	FF	17.07	
L*	27.43	7.10	3.31
a*	-9.43	-3.53	-0.22
b*	-6.82	-5.82	-3.17
[2011.05.28 15:30]			
	25°	45°	75°

2 Press ▲ and ▼ to select the target color data.

- Hold ▲ or ▼ down to make changes consecutively.

3 Press BREAK repeatedly until Spectrophotometer is in measurement mode.

- Press DISPLAY if the instrument is in the line plot mode.

4 Place the Spectrophotometer perpendicular to the surface of the specimen. Hold it steady against the specimen with both hands.

<MEASURE.DIFF>			
	NO DATA	2°/D65	T15
	ΔFF		
ΔL*			
Δa*			
Δb*			
ΔE*			
	25°	45°	75°

5 After the CHARGE lamp has become lit, press the measuring button to take a measurement. The CHARGE lamp turns off and Xenon lamps turn on. Upon completion of the measurement, the CHARGE lamp blinks and a beep sounds. The CHARGE lamp becomes lit when xenon lamp circuit has completed charging. A beep sounds again when the measured data is saved as the target color data (provided that the buzzer feature is enabled).

- Do not move the instrument until the measurement is complete, the CHARGE lamp blinks.
- If the CHARGE lamp does not light due to the auto power save function, this may be due the fact that it can take time to start the measurement after the measuring button is pressed.
- The date and time of measurement will be stored as the comment.

- Measurement display examples are shown on p. 33.
- Previously measured specimen data can be recalled to the display using ▲ and ▼ . Pressing ▲ causes the data for the next higher specimen number to be shown in the display; pressing ▼ causes the data for the next lower specimen number to be shown in the display. Holding ▲ or ▼ pressed causes the specimen numbers to change more rapidly.

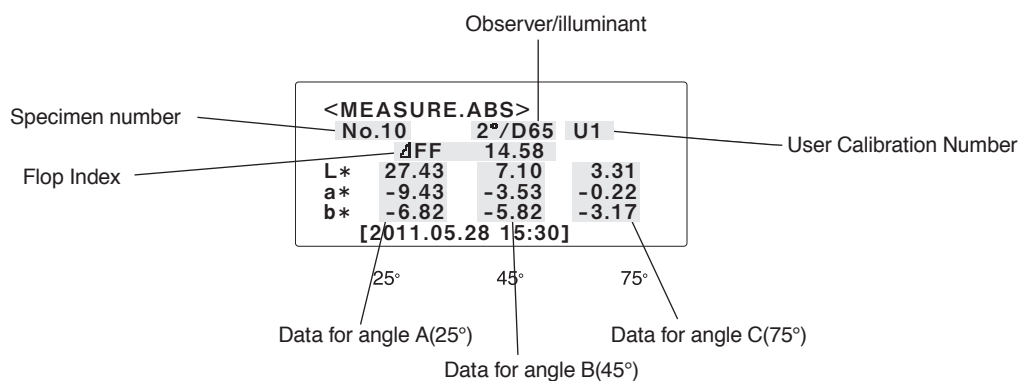
Measurement Displays

Some settings of **DISPLAY** in **<MENU> 1/7** have two different measurement displays; the displays available and the contents of each display are described in the table below. The desired display can be selected by pressing **DISPLAY**.

Measurement display		<div> <div>Measurement display 1</div> <div> <div>DISPLAY</div> <div>← ● ● ● →</div> </div> <div>Measurement display 2</div> </div>	
DISPLAY setting			
DIFF & ABS		Color difference under	Absolute color under ILLUMINANT 1
METAMERISM		Metamerism index	(None)
DIFF 1 & 2		Color difference under	Color difference under ILLUMINANT 2
ABS 1 & 2		Absolute color under ILLUMINANT 1	Absolute color under ILLUMINANT 2
PASS/FAIL		Judgement under ILLUMINANT 1	(None)
	With ILLUMINANT	Judgement under ILLUMINANT 1	Judgement under ILLUMINANT 2
GRAPH&DIFF		Displays the color difference data under the ILLUMINANT	Color difference under
GRAPH&ABS		Displays the absolute color data under ILLUMINANT 1 using line plot	Absolute color under ILLUMINANT 1

- Absolute color and color difference will be displayed according to the setting of **MODE** in **<MENU> 1/7**.

Display Examples Absolute Color Data

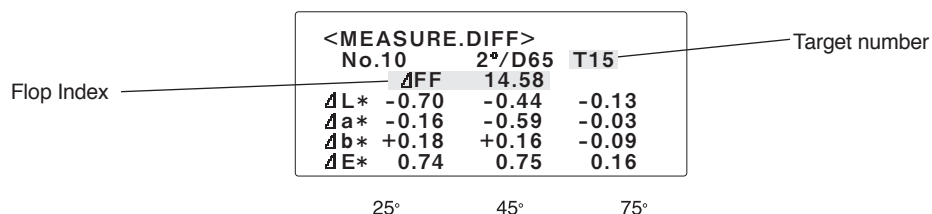


- Flop Index is the measurement on the change in luminosity detected through a range of viewing angles. It is calculated according to the equation below:

$$FF = \frac{L^* \text{ for Highlight (25°)}}{L^* \text{ for Shade (75°)}}$$

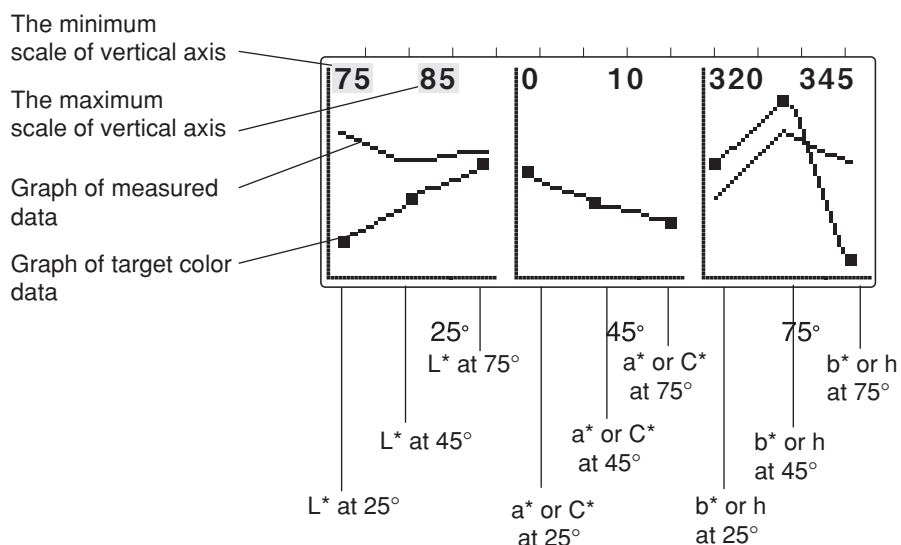
For example, Flop Index will become higher when aluminum flakes contained in a metallic coating have a better light distributing property.

Color Difference Data

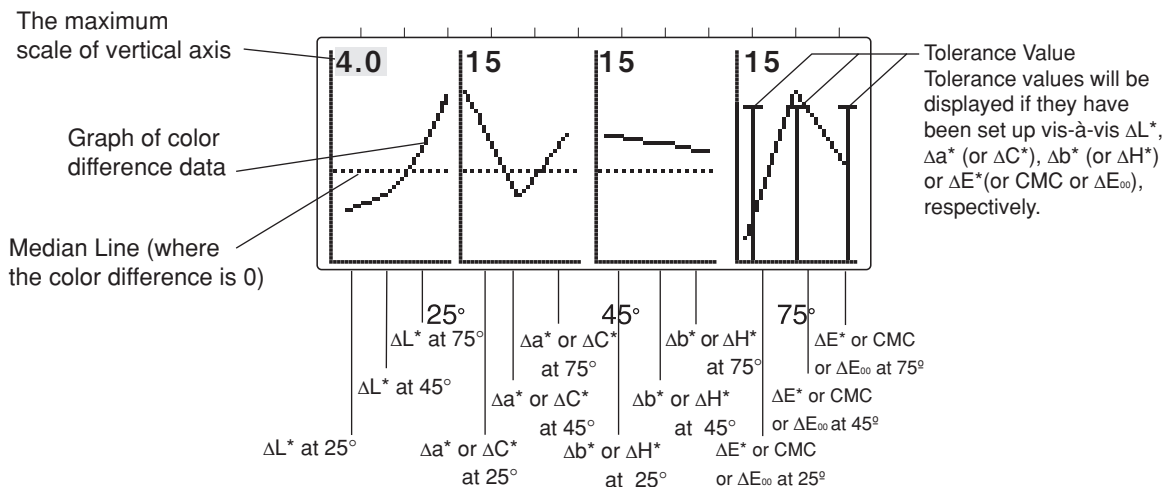


- ΔFF measures the difference in the Flop Index between a measurement data and a target color data.

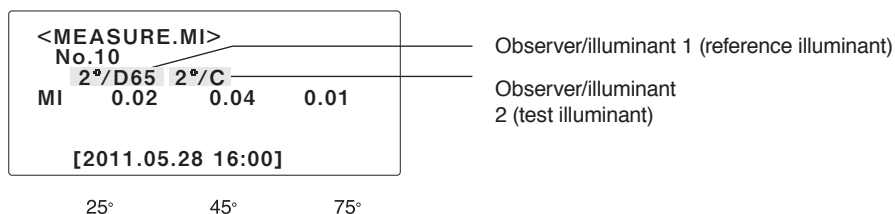
LINE PLOT <absolute> mode



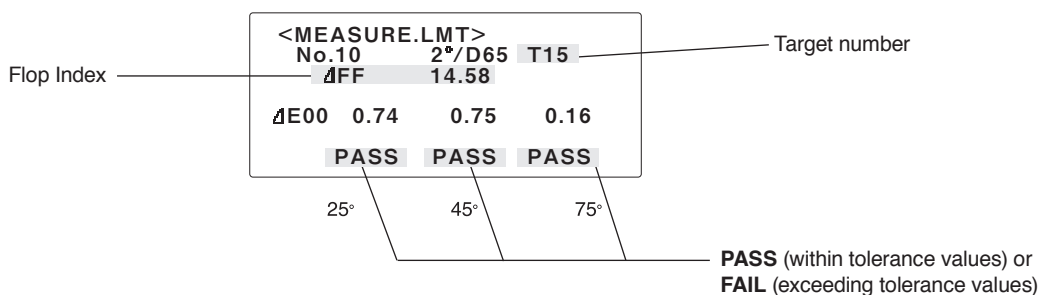
LINE PLOT <color difference> mode



Metamerism Index



PASS/FAIL



- If tolerance values have been set, measured values which exceed the tolerance values will be highlighted (unless the instrument is in the line plot mode).
- If a measured value for color difference has more than two integer places, the value will be displayed as **xx.xx**.

Changing the vertical scale of the line plot

The vertical scale of the line plot is automatically adjusted so that all data is visible on the screen (AUTOSCALE). The user can change this setting so that the line plot is displayed with a fixed scale of choice.

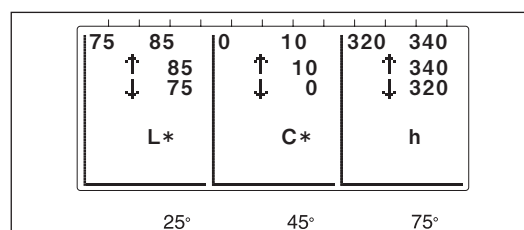
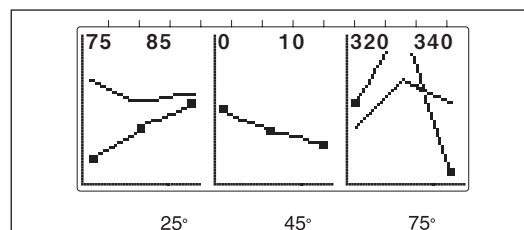
- Strike the DELETE key while holding DISPLAY and MENU keys down simultaneously. Follow the procedure below:

Changing the vertical scale

1 Press BREAK in the absolute color data or color difference data line plot mode.

- The screen will switch to the vertical scale setup mode for the absolute color data or color difference data line plot.

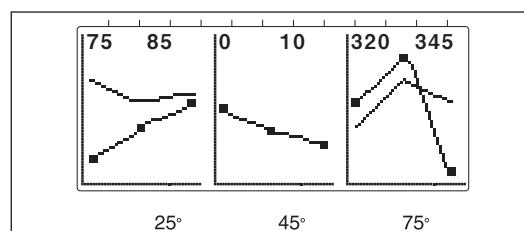
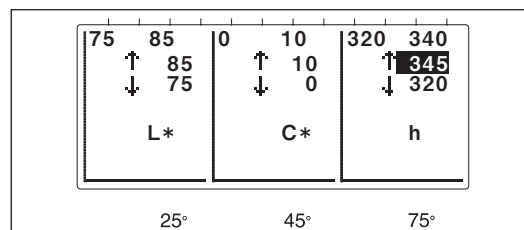
LINE PLOT <absolute> mode



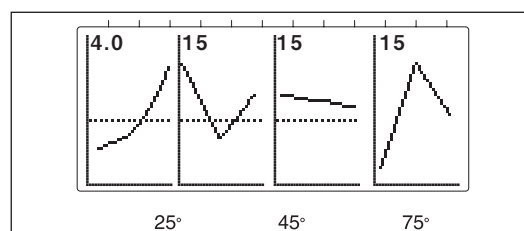
2 Press CURSOR to select the item to be set up. Set up the value by pressing ▲ and ▼. Repeat this process to set up (change) all values that need to be changed.

- Hold ▲ and ▼ down to make changes consecutively.

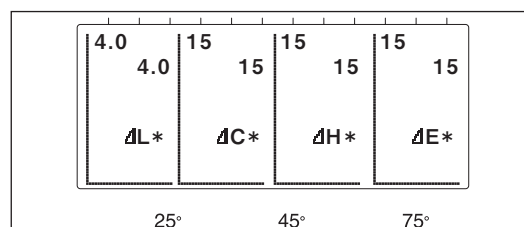
The process of changing the vertical scale of the line plot is now complete. Press BREAK to return to the measurement mode (the absolute color data or color difference data line plot mode).



LINE PLOT <color difference> mode



Press DELETE to undo the change and reactivate AUTOSCALE.



Deleting Measurement Data

Data for a single specimen measurement or all measurement data in memory can be deleted if desired.

- Measurement data which have been deleted cannot be recovered.
- Strike the DELETE key while holding DISPLAY and MENU keys down simultaneously. Follow the procedure below:

Deleting Data for a Single Specimen Measurement

1 Press BREAK repeatedly until Spectrophotometer is in measurement mode.

- Press DISPLAY if the instrument is in the line plot mode.

<MEASURE.ABS>			
No.10	2°/D65	U1	
	FF	17.07	
L*	27.43	7.10	3.31
a*	-9.43	-3.53	-0.22
b*	-6.82	-5.82	-3.17
[2011.05.28 15:30]			
25° 45° 75°			

2 Press ▲ or ▼ to recall the specimen data to be deleted to the display. Pressing ▲ causes the data for the next higher specimen number to be displayed; pressing ▼ causes the data for the next lower specimen number to be displayed. Holding ▲ or ▼ pressed causes the specimen numbers to change more rapidly.

3 Press DELETE. The display will change to DATA DELETE.

- Be sure that the cursor (highlighted area) is on **No.xx DELETE** [comment]. If it is on **ALL DATA DELETE**, press **CURSOR** to move the cursor to **No.xx DELETE** [comment].

DATA DELETE	
EXE : PUSH [DELETE]	
ESC : PUSH [BREAK]	

No.10	DELETE
[2011. 05. 28 16:00]	
ALL DATA DELETE	
25° 45° 75°	

4 Press DELETE again. The data for the selected specimen number will be deleted and the remaining specimen measurement data will be renumbered to fill the space left by the deletion. For example, if data for Specimen 9 is deleted, data for Specimen 10 will become data for Specimen 9, data for Specimen 11 will become data for Specimen 10, etc. The Spectrophotometer will return to measurement mode.

No.10	
DELETED	
25° 45° 75°	

- To return to measurement mode without deleting the data for the selected specimen number, press **BREAK** instead of **DELETE** in step 4.

Deleting All Measurement Data

1 Press BREAK repeatedly until Spectrophotometer is in measurement mode.

- Press DISPLAY if the instrument is in the line plot mode.

<MEASURE.ABS>			
No.10	2°/D65	U1	
	FF	17.07	
L*	27.43	7.10	3.31
a*	-9.43	-3.53	-0.22
b*	-6.82	-5.82	-3.17
[2011.05.28 15:30]			
25°	45°	75°	

2 Press DELETE. The display will change to DATA DELETE.

DATA DELETE			
EXE : PUSH [DELETE]			
ESC : PUSH [BREAK]			

No.10	DELETE		
[2011. 05. 28 16:00]			
ALL DATA DELETE			
25°	45°	75°	

3 Press CURSOR to move the cursor to ALL DATA DELETE.

DATA DELETE			
EXE : PUSH [DELETE]			
ESC : PUSH [BREAK]			

No.10	DELETE		
[2011. 05. 28 16:00]			
ALL DATA DELETE			
25°	45°	75°	

4 Press DELETE again. All specimen measurement data will be deleted and the Spectrophotometer will return to measurement mode.

- To return to measurement mode without deleting all specimen measurement data, press **BREAK** instead of **DELETE** in step 4.

ALL DATA			
DELETED			
25°	45°	75°	

Additional Functions

In addition to the basic functions described so far, the Spectrophotometer has the following functions:

Measurement averaging: Averages a series of measurements and uses the average as a single set of measurement or target color data. Either automatic averaging, in which a series of 3, 5, or 8 measurements are automatically taken and averaged when the measuring button is pressed once, or manual averaging, in which each measurement in the series is taken by pressing the measuring button, can be performed. See p. 40.

Deletion of outlying data during averaging: Deletes the maximum and minimum data and recalculates the average to improve accuracy when automatic averaging of 3, 5, or 8 measurements is performed. See p. 42.

User calibration: This process maximizes the inter-instrument agreement when two or more instruments of this model are used for strict control of the color difference. See p. 43.

Tolerance checking: Automatically determines whether or not a measurement is within previously set tolerance limits from the target color when color difference measurements are performed. See p. 45.

Target color comment: Allows a comment to be stored along with the target color data so that target color data can be easily identified. See p. 46.

Measurement Averaging

Averaging a series of measurements when measuring a specimen or target color provides higher accuracy. The Spectrophotometer offers two different ways of taking a series of measurements for averaging: a series of measurements of a single area can be taken automatically with one press of the measuring button according to the setting of **AUTO AVERAGE** in **<MENU> 3/7**, or the user can take the series of measurements manually, repositioning the Spectrophotometer and pressing the measuring button each time. The automatic series of measurements of a single spot is used mainly to improve accuracy. In addition, to further improve accuracy, the two measurements furthest from the average can be automatically deleted and the average recalculated by using the **DELETE OUTLIER** function (see p. 42).

The manual series of measurements is used mainly for taking a series of measurements of randomly selected areas of a specimen or target color to reduce the effect of slight variations of color within the specimen or target color and thus provide more accurate measurement data for the overall specimen or target color.

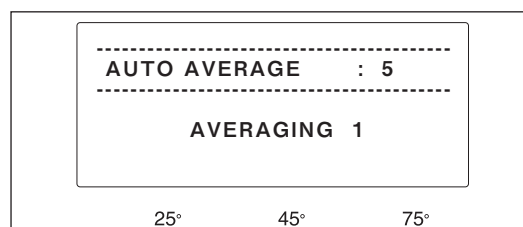
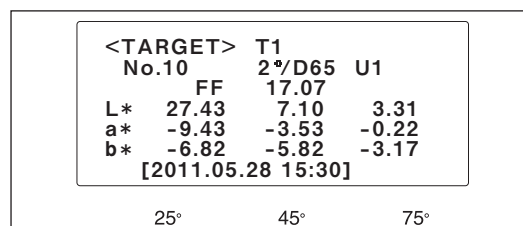
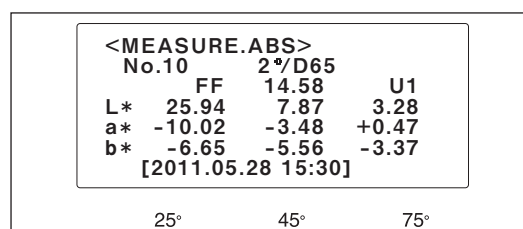
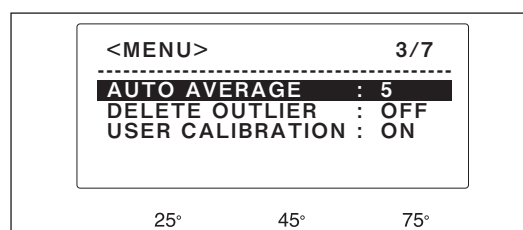
Automatic and manual series of measurements can also be used together to further improve accuracy.

Automatic series of measurements (AUTO AVERAGE)

- 1** In measuring mode, press **MENU**. The display will change to one of the menus (the last menu which was exited from).
- 2** Press **DISPLAY** repeatedly to select **<MENU> 3/7**.
- 3** Press **CURSOR** repeatedly to move the cursor to **AUTO AVERAGE**.
- 4** Use **▲** or **▼** to set the desired number of measurements (1, 3, 5, or 8).
 - If 1 is set, only a single measurement will be taken when the measuring button is pressed.
- 5** Press **BREAK** to return to measurement mode.
- 6** If color difference measurements will be taken, press **TARGET** to change to **<TARGET>** and select the desired target color using **▲** or **▼**.
- 7** Take measurements according to the procedure on p. 31.

The xenon lamp will fire six times for each measurement. Do not move the instrument until the **CHARGE** lamp blinks.

- While measurements are being performed, **AUTO AVERAGE:** (number set in step 4) **AVERAGING** (number of present measurement) will be shown in the display.



MANUAL series of measurements

- If **AUTO AVERAGE** will be used together with manually taking a series of measurements, select the desired number for **AUTO AVERAGE** before performing the following procedure.

1 Press **BREAK** repeatedly to return to measurement mode.

- Press **DISPLAY** if the instrument is in the line plot mode.

<MEASURE.ABS>			
No.10	FF	2*/D65	
L*	25.94	14.58	U1
a*	-10.02	7.87	3.28
b*	-6.65	-3.48	+0.47
		-5.56	-3.37
[2011.05.28 15:30]			
25° 45° 75°			

2 If color difference measurements will be taken, press **TARGET** to change to <TARGET> and select the desired target color using ▲ or ▼ .

3 Press **AVG. (CURSOR)**. The Spectrophotometer will change to manual averaging mode.

AVERAGING: Number of measurements already taken.

DEVIATION: Standard deviation (in terms of ΔE^*_{ab}) for measurements already taken.

No.10	2*/D65

AVERAGING :	
SD	

<CONT.> : [MEAS.]BUTTON	
<END> : [AVERAGE]KEY	
25° 45° 75°	

4 Take measurements according to the procedure on p. 31.

- The xenon lamp will fire six times for each measurement. Do not move the instrument until the **CHARGE** lamp blinks.
- If **AUTO AVERAGE** in <MENU> 3/7 is set to **3**, **5**, or **8**, the Spectrophotometer will take the corresponding number of measurements when the measuring button is pressed.

5 Continue taking measurements until the desired number of measurements have been taken.

6 After the desired number of measurements have been taken, press **AVG (CURSOR)** again. The average of the measurements will be calculated and the results displayed and stored in memory as the measurement data.

- If **BREAK** is pressed while manually taking a series of measurements for averaging, the previous measurements in the series will be deleted and manual averaging mode will be canceled.

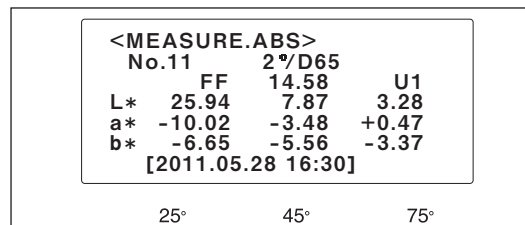
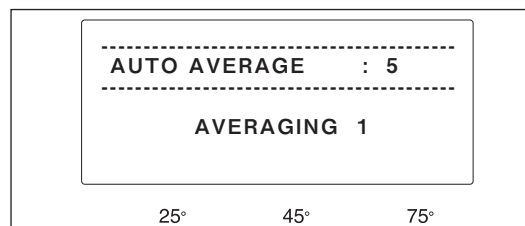
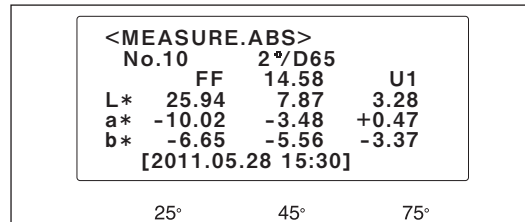
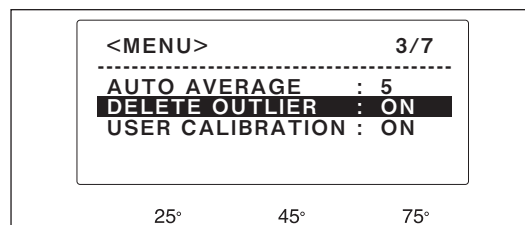
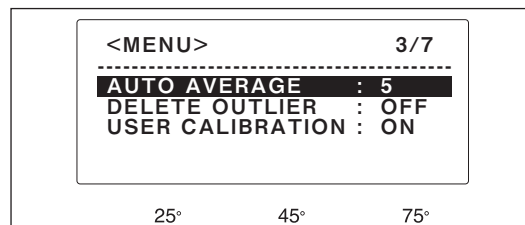
Deletion of Outlying Data (DELETE OUTLIER)

To further improve measurement accuracy when using the Spectrophotometer with **AUTO AVERAGE** in **<MENU> 3/7** (see p. 22) set to **3**, **5**, or **8**, the Spectrophotometer can be set to automatically delete the two measurements of maximum and minimum and then recalculate the average without these data.

- If this function is selected when **AUTO AVERAGE** in **<MENU> 3/7** is set to **3**, data for only one measurement will remain after the two outlying measurements have been deleted. Thus, the results will not be an average.
- If this function is selected when **AUTO AVERAGE** in **<MENU> 3/7** is set to **1**, the **DELETE OUTLIER** feature is disabled.

- 1** In measuring mode, press **MENU**. The display will change to one of the menus (the last menu which was exited from).
- 2** Press **DISPLAY** repeatedly to select **<MENU> 3/5**.
- 3** Press **CURSOR** repeatedly to move the cursor to **AUTO AVERAGE** ▲ and ▼ use or to set the desired number of measurements (**3**, **5**, or **8**).
- 4** Press **CURSOR** to move the cursor to **DELETE OUTLIER**
- 5** Use ▲ or ▼ to set **DELETE OUTLIER** to **ON**.
- 6** Press **BREAK** to return to measurement mode.
- 7** If color difference measurements will be taken, press **TARGET** to change to **<TARGET>** and select the desired target color using ▲ or ▼.
- 8** Take measurements according to the procedure on p. 31.

- The xenon lamp will fire six times for each measurement. Do not move the instrument until the **CHARGE** lamp turns on and the measurement results appear on the display.
- While measurements are being performed, **AUTO AVERAGE**: (number set in step 4) **AVERAGING** (number of present measurement) will be shown in the display.



User calibration

When you wish to use two or more instruments of this model for strict control of the color difference, the user calibration feature allows you to predetermine a color correction coefficient for each instrument relative to a standard instrument selected among them, thereby maximizing the inter-instrument agreement and providing highly accurate data.

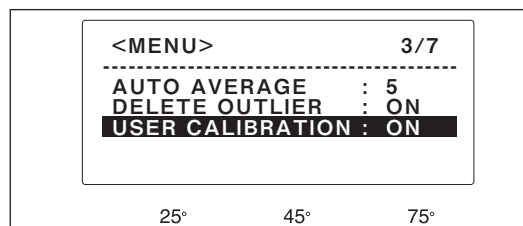
When the user calibration feature is enabled, an appropriate color correction coefficient is automatically applied to every measurement result.

User calibration software CM-S20w, a standard accessory, makes it possible to determine a correction coefficient for each color and store it in the instrument.

See the CM-S20w instruction manual for how to use the software.

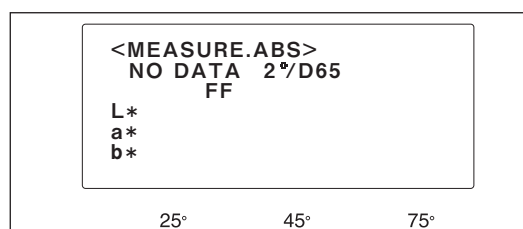
<How to use the user calibration feature>

1. Set USER CALIBRATION to ON on menu page 3/7. See .



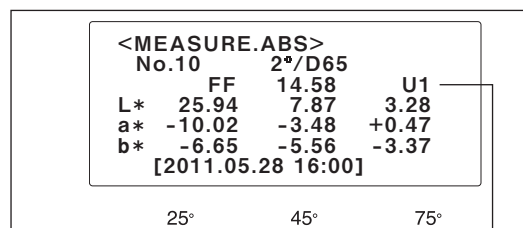
2. Press BREAK.

- The MEASURE.ABS screen will open.



3. Press MES. to measure the sample.

- The measurement result will be corrected by a correction coefficient and displayed on the LCD along with the selected user calibration No.
- Pay attention not to move the instrument during measurement (while the CHARGE lamp is off).



User Calibration Number

Though the above description refers to the measurement of colorimetric data (absolute color data), it also applies to the measurement of color difference.

The same also applies to the determination of target color (when the user calibration is enabled, the resulting target color data has been corrected).

<User calibration numbers>

U1 - U30: When the measurement was made with the user calibration feature being enabled. A number is automatically assigned.

U 0 : When the measurement was made with the user calibration feature being enabled and a correction coefficient was not automatically selected

U - - : When a correction coefficient corresponding to an auto-selected user calibration No. was deleted via CM-S20w

None: When the measurement was made with the user calibration feature being disabled

How to view the user calibration data

You can view the user calibration data stored in the instrument.

<Procedure>

1. Press TARGET when you are on the MEASURE.ABS screen.

- The TARGET T1 screen will open.

<TARGET>			
	FF	T1 2°/D65	U1
L*	27.43	17.07	3.31
a*	-9.43	-3.53	-0.22
b*	-6.82	-5.82	-3.17
[2011.05.28 15:30]			
25° 45° 75°			

2. Press TARGET.

- The USER CALIBRATION 1 screen will open.

<USER CALIBRATION1>			
	FF	U3 2°/D65	
L*	25.94	14.58	3.28
a*	-10.02	-3.48	+0.47
b*	-6.65	-5.56	-3.37
[1234567890123456]			
25° 45° 75°			

3. Use ▲ or ▼ to select an item you wish to view.

- Holding ▲ or ▼ down allows rapid selection of the item.

4. Press DISPLAY.

- Each time you press this key, the display will change as shown below:

USER CALIBRATION 1 screen (color under ILLUMINANT 1)

USER CALIBRATION 2 screen (color under ILLUMINANT 2)

USER CALIBRATION 3 screen (ID of the target instrument, comment, measured date)

Press BREAK to return to <TARGET> mode, and then press BREAK again to return to measurement mode.

Tolerance Checking

When taking color-difference measurements, the Spectrophotometer can automatically check whether or not the measured color is within previously set tolerance limits from the target color.

Different positive and negative tolerance limits can be set for each target color. If target number T3 is selected, the tolerance limits for target number T2 will be ignored.

1 In measuring mode, press **TARGET**.

The Spectrophotometer will change to **<TARGET>** mode.

<TARGET>		T1	
		2°/D65	
		FF	17.07
L*	27.43	7.10	3.31
a*	-9.43	-3.53	-0.22
b*	-6.82	-5.82	-3.17
[2011.05.28 15:30]			
		25°	45° 75°

2 Press **▲** or **▼** to select the desired target number.

- Holding **▲** or **▼** pressed will cause the target number to change more rapidly.

3 Press **DISPLAY** to change to **<TARGET>** **+TOLERANCE** (the display for inputting positive tolerance values). The display will change in the following order:

<TARGET>		T10	
		+TOLERANCE	2°/D65
		ΔFF	+17.07
ΔL*	+----	+----	+----
Δa*	+----	+----	+----
Δb*	+----	+----	+----
ΔE*	----	----	----
		25°	45° 75°

... → **<TARGET>** **+TOLERANCE** → **<TARGET>** **-TOLERANCE** → **<TARGET>** **INPUT COMMENT** → **<TARGET>** **INPUT TARGET** → **<TARGET>** → **<TARGET>** **+TOLERANCE** → ...

- If **ILLUMINANT 2** in **<MENU>** 2/5 has also been set, the order of the display change will be as follows:

... → **<TARGET>** **+TOLERANCE** (for **ILLUMINANT 1**) → **<TARGET>** **-TOLERANCE** (for **ILLUMINANT 1**) → **<TARGET>** **+TOLERANCE** (for **ILLUMINANT 2**) → **<TARGET>** **-TOLERANCE** (for **ILLUMINANT 2**) → **<TARGET>** **INPUT COMMENT** → **<TARGET>** **INPUT TARGET** → **<TARGET>** → **<TARGET>** **+TOLERANCE** (for **ILLUMINANT 1**) → ...

4 Press **CURSOR** to move the cursor to the value to be set, **▲** and **▼** use **▲** and **▼** to set the desired value.

- Tolerance values can be set from **0.0** to **20.0**; ---- (no tolerance limits) appears between **0.0** and **20.0**. Pressing **▲** causes the values to increase; pressing **▼** causes the values to decrease.
- Holding **▲** or **▼** pressed will cause the value to change more rapidly.
- Pressing **DELETE** causes ---- (no tolerance limits) to appear.

5 Repeat step 4 to set other positive tolerance values.

6 Repeat steps 3 through 5 to set negative tolerance values.

- If **ILLUMINANT 2** in **<MENU>** 2/7 has also been set, repeat steps 3 through 6 to set tolerance values under **ILLUMINANT 2**.

7 After all tolerance values have been set for the selected target number, press **DISPLAY** repeatedly to return to **<TARGET>** mode, or press **BREAK** to return to measurement mode.

Once tolerance limits have been set, tolerance checking will be performed when measurements are taken using the target color for which the tolerance limits were set. If the measured color is outside of any of the tolerance limits, the value which is outside the limits will be highlighted in the display (and a buzzer will sound if **BUZZER** in **<MENU>** 4/7 is set to **ON**. Also, if **DISP.** in **<MENU>** 1/7 is set to **PASS/FAIL**, the results of tolerance checking will be displayed as **PASS** (if measured color is within tolerance limits) or **FAIL** (if measured color is outside tolerance limits).

Target Color Comment

A comment of up to 16 characters can be set for each target color after the target color data have been measured or set. This enables users to clearly identify target colors and makes it easier to find the desired target color from among all of those stored in the Spectrophotometer's memory.

1 In measuring mode, press **TARGET**.

The Spectrophotometer will change to **<TARGET>** mode.

2 Press **▲** or **▼** to select the desired target number.

- Holding **▲** or **▼** pressed will cause the target number to change more rapidly.

<TARGET>		T1		
		2°/D65		
		FF 17.07		
L*	27.43	7.10	3.31	
a*	-9.43	-3.53	-0.22	
b*	-6.82	-5.82	-3.17	
[2011.05.28 15:30]				
		25°	45°	75°

3 Press **DISPLAY** three times (six times if **ILLUMINANT 2** has also been set) to change to the **INPUT COMMENT** display. The display will change in the following order:

... → <TARGET> +TOLERANCE → <TARGET>
-TOLERANCE → <TARGET> INPUT COMMENT
→ <TARGET> INPUT TARGET → <TARGET> →
<TARGET> +TOLERANCE → ...

- If **ILLUMINANT 2** in **<MENU> 2/5** has also been set, the order of the display change will be as follows:
... → <TARGET> +TOLERANCE (for ILLUMINANT 1) → <TARGET> -TOLERANCE (for ILLUMINANT 1) → <TARGET> +TOLERANCE (for ILLUMINANT 2) → <TARGET> -TOLERANCE (for ILLUMINANT 2) → <TARGET> INPUT COMMENT → <TARGET> INPUT TARGET → <TARGET> → <TARGET> +TOLERANCE (for ILLUMINANT 1) → ...

<div><div><TARGET> T1</div><div>INPUT COMMENT</div><div>-----</div><div>[2011.05.28 16:00]</div></div>		
25°	45°	75°

4 Press **CURSOR** to move the cursor to the character location to be set, **▲** and **▼** use and to set the desired character.

- Holding **▲** or **▼** pressed will cause the value to change more rapidly.
- Characters will change in alphabetical and numerical order as follows when is pressed:
... → (letters A through Z) → (numbers 0 through 9)
→ : → . → (space) → (letters A through Z) → ...

When is pressed, characters will change in reverse order.

5 After the desired comment has been set, press **DISPLAY** repeatedly to return to **<TARGET>** mode, or press **BREAK** to return to measurement mode.

Printing Data Using a Printer

By connecting a printer directly to the Spectrophotometer via the Spectrophotometer's RS-232C terminal, measurement data can be printed at the time of measurement, a selected series of measurement data in memory can be printed out, or the Spectrophotometer's display can be printed out (except same screens).

Suitable Printers

Printers which can be used with the Spectrophotometer must meet the following specifications:

Number of printed columns:	At least 24
Data input:	RS-232C standard
Data control:	BUSY
Baud rate:	1200, 2400, 4800, 9600, or 19200bps
Character length:	8 bits
Parity	None
Number of stop bits:	1
Basic operating codes:	Carriage return CR (0D hexadecimal)

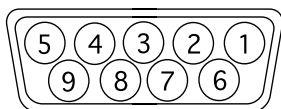
Examples of printers which meet these specifications include Seiko Instruments Inc. Standalone Thermal Printer Unit models DPU-H245 (serial connection/metric screw type)

Communication parameters of Spectrophotometer

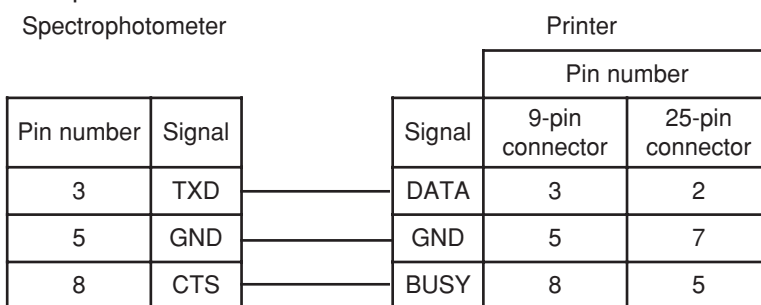
Baud rate:	1200, 2400, 4800, 9600, or 19200bps (set in <MENU> 5/7)
Character length:	8 bits
Parity	None
Number of stop bits:	1

RS-232C Terminal Pin Diagram and Connections

The pin diagram of the Spectrophotometer's RS-232C terminal is shown below. A D-subminiature 9-pin male connector (such as Hirose Connector HDEB-9P) should be used for connection to this terminal.



Connection with a printer would be as follows:



- When connecting the Spectrophotometer to a printer, be sure that the power of both the Spectrophotometer and the printer are switched off.
- Check that the connector and the terminal are correctly positioned in relation to each other before connecting. They can be connected in only one position.
- Do not touch the pins or sockets of the connecting cable or the terminal of the Spectrophotometer or printer, get them dirty, or apply excessive force to them.
- Be sure that the length of the connecting cable is sufficient. If the cord is slightly short or if there is strain on the cable, the connection may not be good or an internal wire may break.
- When disconnecting the cable, be sure that the power of both the Spectrophotometer and printer are switched off. Pull on the plug, not on the cable, when disconnecting.
- Never pull on the cable itself, apply excessive force to the cable, or bend it sharply.

Automatic Printout After Each Measurement (AUTO PRINT)

1 Switch off power of both Spectrophotometer and printer, and connect Spectrophotometer to printer.

- Internal connections of the connecting cable should be as shown on p. 47.

2 Switch on power of both Spectrophotometer and printer, and perform white calibration (see p. 18).

3 In measuring mode, press MENU. The display will change to one of the menus (the last menu which was exited from).

4 Press DISPLAY repeatedly to select <MENU> 5/7.

- The menu displayed will change to the next higher numbered menu each time DISPLAY is pressed and will return to <MENU> 1/5 if DISPLAY is pressed while <MENU> 5/5 is shown.

5 Use CURSOR, ▲, and ▼ to set the following settings:

DATA DUMP: NO
AUTO PRINT: ON
BAUD RATE: (same as baud rate set on printer)
COMMUNICATION: 232C

6 Press BREAK to return to measurement display.

After the settings above have been set, measurement data will be automatically output to the printer after each measurement.

<MENU>		5/7

REMOTE	:	NO
DATA DUMP	:	NO
AUTO PRINT	:	ON
BAUD RATE	:	9600

25° 45° 75°

Print Sample

<TARGET> T2
10°/D65
FF 1.11
L 32.91 32.75 29.60
a 51.43 51.67 47.96
b 39.00 39.67 36.74
[2011.06.08 15:54]
=====

<MEASURE.DIFF>
No.2 10°/D65 T2
dFF 0.00 dE00
L -0.08 -0.10 -0.02
a -0.21 -0.11 -0.07
b -0.48 -0.25 0.00
E 0.19 0.10 0.03
=====

<MEASURE.ABS>
No.2 10°/D65
FF 1.11
L 32.83 32.65 29.58
a 51.22 51.56 47.89
b 38.52 39.42 36.74
[2011.06.08 15:55]
=====

Printing Data from Memory (DATA DUMP)

1 Switch off power of both Spectrophotometer and printer, and connect Spectrophotometer to printer.

- Internal connections of the connecting cable should be as shown on p. 47.

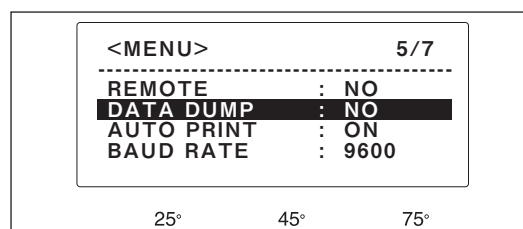
2 Switch on power of both Spectrophotometer and printer.

- If measurements have not yet been performed, perform white calibration (see p. 18) and then perform measurements (see p. 31).

3 In measuring mode, press MENU. The display will change to one of the menus (the last menu which was exited from).

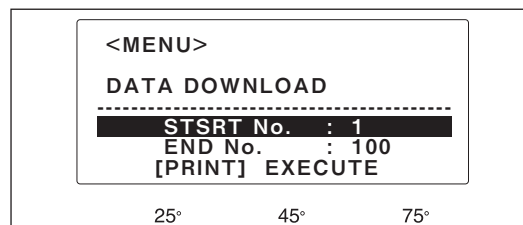
4 Press DISPLAY repeatedly to select <MENU> 5/7 and check that the baud rate is set to the same baud rate as the printer.

- The menu displayed will change to the next higher numbered menu each time **DISPLAY** is pressed and will return to <MENU> 1/7 if **DISPLAY** is pressed while <MENU> 7/7 is shown.



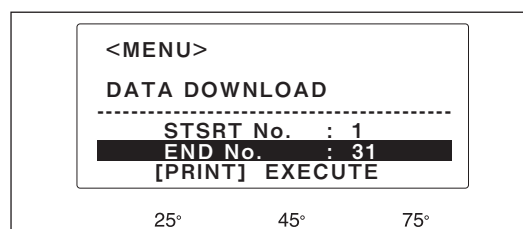
5 Press CURSOR to move cursor to DATA DUMP and use ▲ or ▼ to change setting to YES. The display will change to DATA DOWNLOAD mode.

6 Press CURSOR to move cursor to START No. and use ▲ or ▼ to set the specimen number of the first measurement data to be output.



7 Press CURSOR to move cursor to END No. and use ▲ or ▼ to set the specimen number of the last measurement data to be output.

8 Press PRINT (▲ and ▼ together). Data will be printed out from the specimen number set for START No. to the specimen number set for END No.



Printing Display

The display of the Spectrophotometer can be printed out exactly as it appears by pressing **PRINT** (▲ and ▼ together).

- <MENU> 7/7 (calendar/clock) cannot be printed out.
- **BAUD RATE** must be set to the same baud rate as the printer in <MENU> 5/7.

Connection to a Separate Computer

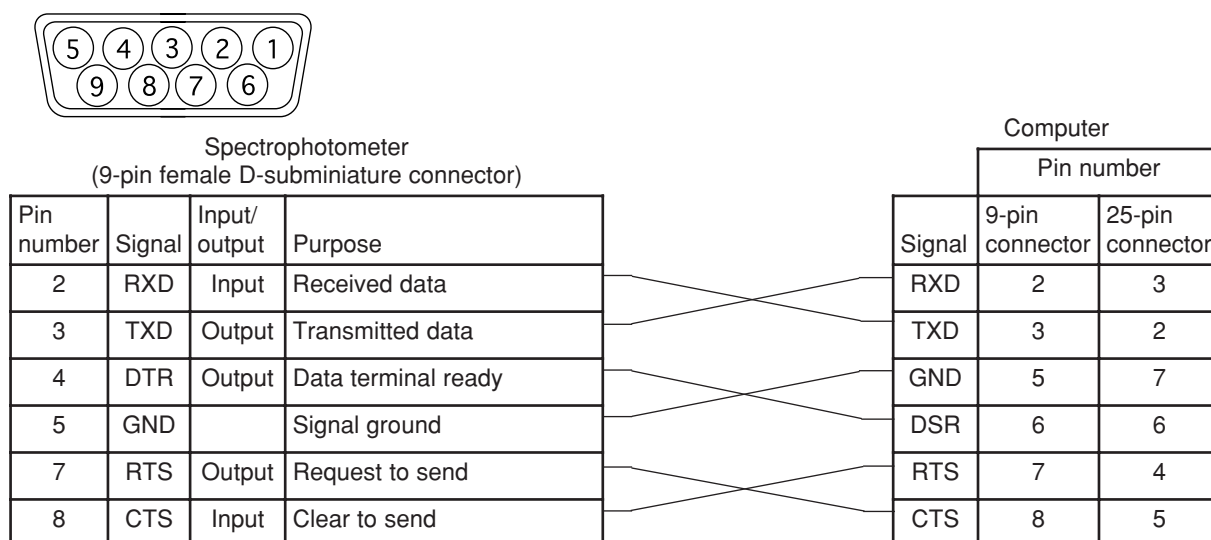
To connect the Spectrophotometer with a computer, it is recommended that you use software that enables connection and operation of the Spectrophotometer (such as the optional Color Data Software SpectraMagic™ NX).

Bi-directional communication between the instrument and a host computer allows you to operate the instrument including measurement, white calibration, white calibration data setting and other parameter setting.

- When connecting the Spectrophotometer to a computer, be sure that the power of both the Spectrophotometer and the computer are switched off.
- Check that the connector and the terminal are correctly positioned in relation to each other before connecting. They can be connected in only one position.
- Do not touch the pins or sockets of the connecting cable or the terminal of the Spectrophotometer or computer, get them dirty, or apply excessive force to them.
- Be sure that the length of the connecting cable is sufficient. If the cord is slightly short or if there is strain on the cable, the connection may not be good or an internal wire may break.
- When disconnecting the cable, be sure that the power of both the Spectrophotometer and computer are switched off. Pull on the plug, not on the cable, when disconnecting.
- Never pull on the cable itself, apply excessive force to the cable, or bend it sharply.
- If a cable other than one of the RS-232C Cables available as accessories is used to connect the Spectrophotometer to the computer, check that the internal connections of the cable are as shown below. If the connections are not as shown below, data communication may not be possible and damage to the Spectrophotometer or the computer may occur.

RS-232C Terminal Pin Diagram and Connections

The pin diagram of the Spectrophotometer's RS-232C terminal is shown below. A D-subminiature 9-pin male connector (such as Hirose Connector HDEB-9P) should be used for connection to this terminal.



Communication Parameters of Spectrophotometer

Baud rate: 1200, 2400, 4800, 9600, or 19200bps (set in <MENU> 5/7)

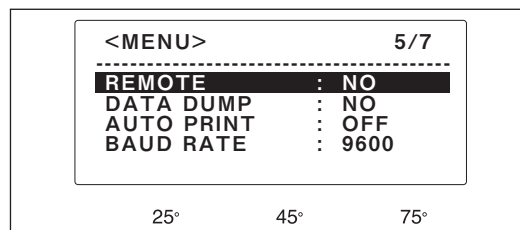
Character length: 8 bits

Parity: None

Number of stop bits: 1

Communication Settings

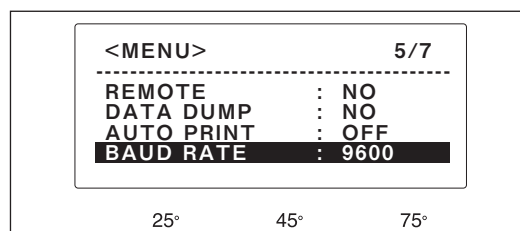
1 In measuring mode, press **MENU**. The display will change to one of the menus (the last menu which was exited from).



2 Press **DISPLAY** repeatedly to select **<MENU> 5/7**.

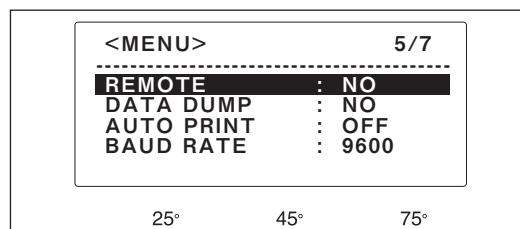
- The menu displayed will change to the next higher numbered menu each time **DISPLAY** is pressed and will return to **<MENU> 1/7** if **DISPLAY** is pressed while **<MENU> 5/7** is shown.

3 Press **CURSOR** repeatedly to move the cursor to **BAUD RATE**.



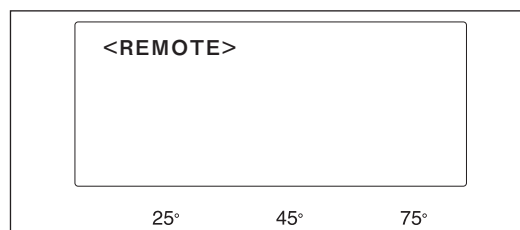
4 Use **▲** or **▼** to set the baud rate to the baud rate which will be used by the computer.

5 Press **CURSOR** repeatedly to move the cursor to **REMOTE**.



6 Use **▲** or **▼** to change the setting to **YES**. The Spectrophotometer will immediately change to **REMOTE** mode and **<REMOTE>** will be shown in the upper left corner of the display.

- To exit from **REMOTE** mode, press **BREAK**. **REMOTE** in **<MENU> 5/7** will automatically be reset to **NO**.

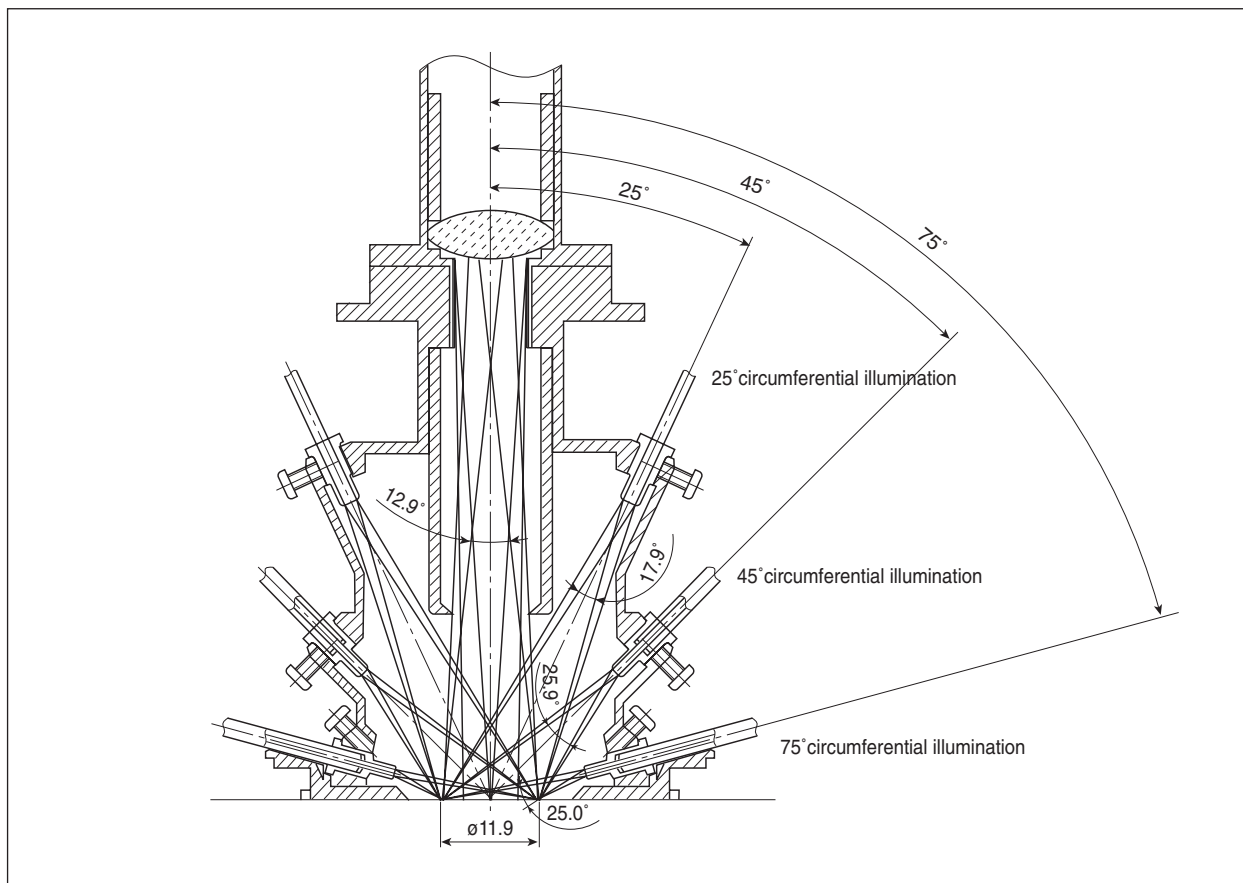


Measuring Principle

Illuminating / Viewing System

For measurement of metallic paints, a single measurement angle was found to be inadequate for specifying the color due to the fact that the color of a metallic paint varies according to the angle from which it is viewed. A variety of multi-angle geometries have therefore been proposed; Spectrophotometers CM-512m3A uses three-angle illumination/single-angle viewing geometries.

The CM-512m3A utilizes the geometry with illumination angles of 25°, 45°, and 75° from the angle which would produce specular reflection at the viewing angle; the viewing angle is the normal to the specimen surface.



Measurement Process

- 1 Pre-flash (see below) is performed for light source 1 to determine the suitable intensity of light for measurement at that angle.
- 2 Light of this intensity is then produced by the 3 pulsed xenon arc lamps in sequence, illuminating the specimen surface.
- 3 For each flash of the lamps, the light reflected from the specimen normal to the surface enters the optical fiber cable for taking measurements and is transmitted to spectral sensor 1. At the same time, light direct from the lamp (the light which illuminates the specimen surface) enters the optical fiber cable for monitoring illumination and is transmitted to spectral sensor 2.
- 4 The light from each optical fiber cable is divided by wavelength (from 400 nm to 700 nm at 20 nm intervals) by the corresponding spectral sensor. The segments of the sensors convert the received light into electrical currents proportional to the intensity of the light; these electrical currents are then passed to the analog control circuits.
- 5 The analog control circuits convert the currents into proportional electrical voltages, and then into digital signals.
- 6 The digital signals are input to the CPU, which performs various calculations to determine the spectral reflectance values. These values are stored in the Spectrophotometer's memory, and the process is repeated from step 1 for the remaining two light sources.
- 7 After all spectral values have been determined, the CPU performs further calculations according to the menu settings of the Spectrophotometer and the results are displayed.

PRE-FLASH FUNCTION

The Spectrophotometer is equipped with a pre-flash function which determines the light intensity suitable for measurement according to the reflectance of the specimen surface. During a measurement cycle, before the actual measurement for the illumination angle is taken, the pulsed xenon lamp is fired at low intensity (2% of maximum intensity). The light reflected from the specimen surface as a result of this low-intensity pre-flash is used by the Spectrophotometer to determine the maximum spectral reflectance and the wavelength at which this occurs. The xenon lamp is then fired again to take the actual measurement, with the intensity of the light from the xenon lamp adjusted based on the pre-flash results so that a specific amount of light will be reflected from the specimen surface at the wavelength determined by the pre-flash process. In this way, only the necessary amount of light is used for measurements: High-reflectance specimens are measured using a small amount of light, and low-reflectance specimens are measured using a large amount of light. As a result, repeatability for low-reflectance specimens is improved and power consumption is reduced.

The pre-flash process is performed for each illumination angle, resulting in the xenon lamp being fired a total of six times [(1 pre-flash + 1 measurement) × 3 angles] for each measurement cycle.

ERROR MESSAGES

If any of the following messages continue to appear and normal operation cannot be resumed, contact the nearest Konica Minolta Sensing authorized service facility.

Error message	Meaning	Solution
A/D ERROR	Error in Spectrophotometer's A/D converters.	Set POWER switch to ○ (off) for a moment, then set it back to I (on). If this message reappears, contact the nearest Konica Minolta Sensing authorized service facility.
CHARGE ERROR	Illumination circuit has not finished charging.	Wait until the Spectrophotometer's CHARGE lamp is lit before performing measurement or calibration. (If this message appears with BATTERY OUT, replace batteries first.)
EEPROM ERROR	Data in Spectrophotometer's EEPROM were destroyed.	Contact the nearest Konica Minolta Sensing authorized facility.
FLASH ERROR	The Spectrophotometer's pulsed xenon arc lamp did not flash.	Perform measurement or calibration again. If this message reappears, contact the nearest Konica Minolta Sensing authorized service facility. (If this message appears with BATTERY OUT, replace batteries first.)
LOW BATTERY	Battery power is becoming low.	Prepare for new batteries or use AC Adapter.
BATTERY OUT	Battery power is low.	Replace batteries with new ones or use AC adapter.
LOW ILLUMINANT	Monitored illumination inside integrating sphere is low.	Contact the nearest Konica Minolta Sensing authorized service facility. (If this message appears with BATTERY OUT, replace batteries first.)
SRAM ERROR	Error in Spectrophotometer's SRAM.	Contact the nearest Konica Minolta Sensing authorized service facility.
TIME OUT	Data could not be output because the CTS input of the Spectrophotometer is OFF.	Connect RS-232C cable correctly.
		Check CTS input and status of receiving device.

Troubleshooting Guide

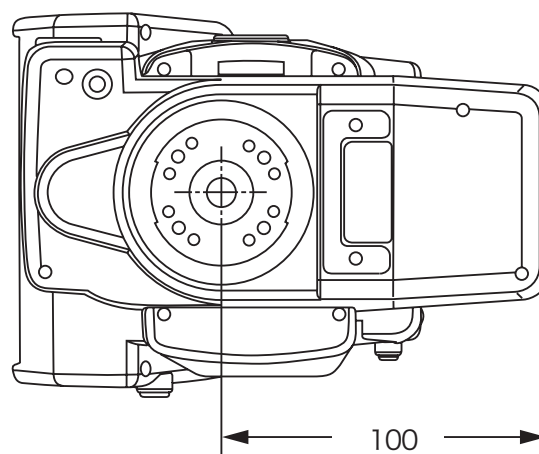
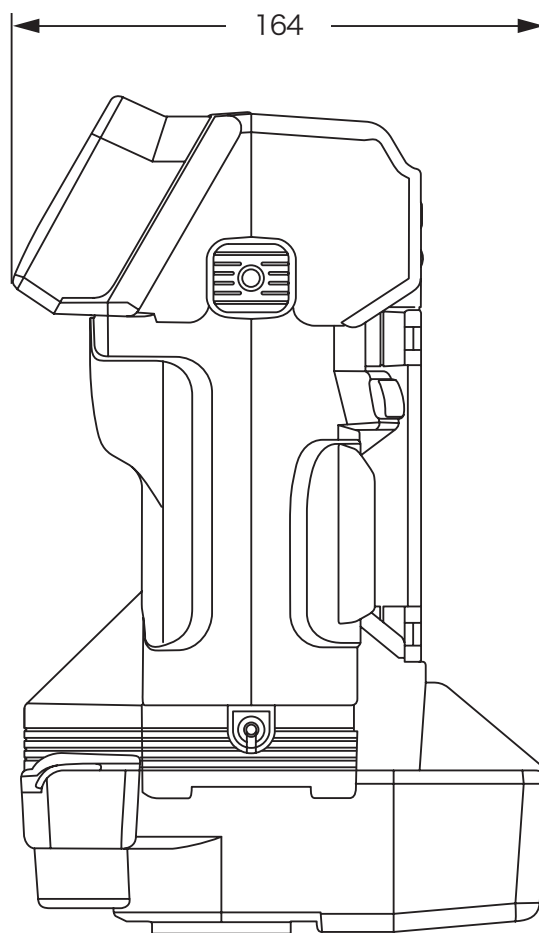
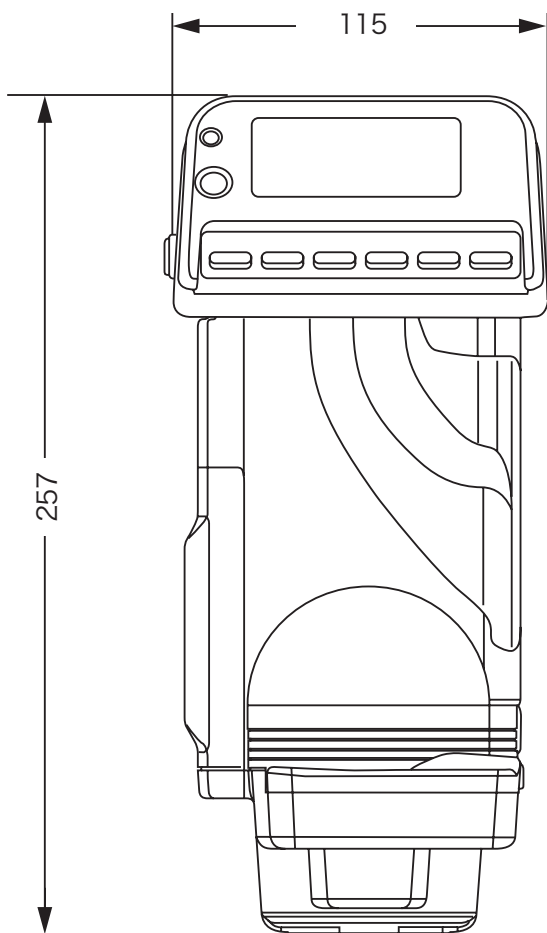
If a problem occurs with the Spectrophotometer, please check the following points before requesting service. If the problem continues to occur even after the suggested corrective actions have been taken, contact the nearest Konica Minolta Sensing authorized service facility.

Condition	Checkpoint	Corrective action	Refer to page
Nothing is shown in the display.	Are batteries installed correctly or is AC adapter connected correctly to both Spectrophotometer and AC wall outlet?	Install batteries correctly or connect AC adapter correctly.	12
	Is battery power exhausted?	Replace batteries with new ones.	13
	Is display contrast adjusted correctly?	Move contrast adjustment slide for easiest viewing.	14
Charge lamp does not light.	Are batteries installed correctly or is AC adapter connected correctly to both Spectrophotometer and AC wall outlet?	Install batteries correctly or connect AC adapter correctly.	12
	Is battery power exhausted?	Replace batteries with new ones.	13
Nothing happens when a key is pressed.	Does the key have a function in the present mode?	Press a key which has a function in the present mode.	--
	Was the command KEN input and is the program set up to handle the key codes?	Input the command KEN and set the program so that it handles the key codes.	--
Nothing happens when the measuring button is pressed.	Is the xenon lamp circuit in the middle of charging after the previous measurement?	After a measurement has been taken, wait until the CHARGE lamp is lit before pressing the measuring button to take the next measurement.	11
	Is the Spectrophotometer in measuring mode?	Set Spectrophotometer to measuring mode before pressing measuring button.	33
	Was the command KEN input and is the program set up to handle the measuring button's key code?	Input the command KEN and set the program so that it handles the key code BTN08.	--
	Was the measuring switch selector set correctly?	Set the measuring switch selector correctly	12
Buzzer does not sound when a key is pressed.	Is BUZZER in <MENU> 4 / 7 set to ON?	Set BUZZER in <MENU> 4 / 7 to ON.	23
Measurement results seem strange.	Was the Spectrophotometer held correctly against the specimen surface, with the measurement aperture flat against the surface and the Spectrophotometer perpendicular to the surface?	Hold the Spectrophotometer correctly against the specimen surface.	31
	Are white calibration data correct?	Set correct white calibration data for white calibration cap used for white calibration.	19
	Was white calibration performed correctly?	Perform white calibration correctly.	18
	Was zero calibration performed correctly?	Perform zero calibration correctly.	17

Condition	Checkpoint	Corrective action	Refer to page
Measurement values vary widely, even when measuring the same specimen.	Was the Spectrophotometer held correctly against the specimen surface, with the measurement aperture flat against the surface and the Spectrophotometer perpendicular to the surface?	Hold the Spectrophotometer correctly against the specimen surface.	31
	Was the Spectrophotometer moved during measurement?	Do not move the Spectrophotometer until the measurement has been completed.	31
FAIL appears in the display and data are highlighted even though tolerance values for the selected target color are not set.	Are tolerance values set to 0.0?	If tolerance checking is not desired, set tolerance values to ----.	45
Data input/output between the Spectrophotometer and a computer cannot be performed. Commands cannot be input to the Spectrophotometer from a computer.	Is the RS-232C cable connected correctly to both the Spectrophotometer and the computer?	Connect the RS-232C cable correctly to both the Spectrophotometer and the computer.	50
	Are the internal connections of the RS-232C cable correct?	The internal connections should be the same as those in this manual.	50
	Are the communication parameters set on the computer the same as those of the Spectrophotometer?	Set the communication parameters of the computer to those of the Spectrophotometer.	50
	Is the program correct?	Check operation using the program.	--
	Is the command being input when the RTS output of the Spectrophotometer is OFF?	Input a command only when the Spectrophotometer's RTS output (the computer's CTS input) is ON.	--
The input command was not received correctly.	Are lower-case characters being input for the command?	Commands must be input using only upper-case letters.	--
BREAK does not function in <REMOTE> mode.		Set POWER switch of Spectrophotometer to ○ (off) and then set it back to (on).	--

DIMENSIONS

(Units: mm)



SPECIFICATIONS

Model	CM-512m3A
Illumination/viewing system	3-angle circumferential illumination / 1-angle perpendicular viewing: 25°c: 0°, 45°c: 0°, 75°c: 0°
Detector	Silicon photodiode array with continuous interference filter
Wavelength range	400 to 700 nm
Wavelength pitch	20 nm
Reflectance range	25°: 0% to 300%, 45° and 75°: 0% to 200% (Resolution: 0.01%)
Light source	Three pulsed xenon lamps
Minimum measurement interval	7 seconds (when measuring a white calibration plate at 23°C)
Battery life	Approx. 400 measurements at 10-second intervals (when a dark color is measured with alkaline batteries at 23°C)
Measurement / Illumination area	ø12 mm / ø20 mm
Repeatability	Spectral reflectance: Within 0.3% (standard deviation) Chromaticity value: Within E*ab 0.05 (standard deviation) (When a white calibration plate is measured 30 times at 10-second intervals after white calibration) ; When AC adapter is used
Interface	RS-232C; Terminal: D-Sub 9-pin (female)
Display	Dot-matrix reflective LCD with 26 characters x 7 lines (240 x 96 dots) With adjustable contrast
Displayed data	Colorimetric data: L*a*b*, L*C*h Color difference data: (L*a*b*), (L*C*H*), E*ab, CMC(l:c), E _∞ (CIEDE2000) Other data display: FF value, line graph
Display languages	English, Chinese
Storable data sets	440 data sets max. (total of sample and target data)
Illuminant /Observer conditions	Light source: A, C, D50, D65, F2, F6, F7, F8, F10, F11, F12 Observer: 2°, 10°
Operating temperature / humidity range (*1)	0°C to 40°C, relative humidity 85% or less (at 35°C) with no condensation
Storage temperature / humidity range	-20°C to 45°C, relative humidity 85% or less (at 35°C) with no condensation
Power	4 AA-size alkaline or Ni-MH batteries or special AC adapter
Size	115 (W) x 257 (H) x 164 (D) mm
Weight	Approx. 1.4 kg (without batteries)

*1 Operating temperature/humidity range of products for North America : 5 to 40 °C; less than 80% relative humidity at 31°C with no condensation

- Specifications are subject to change without notice.

MENU Structure

When taking measurements or selecting a display mode in which the result of a measurement is shown, it is required that the keys on this instrument be operated to choose and execute a menu or item, while monitoring the status on the LCD screen.

The following is the MENU structure chart for this Spectrophotometer. This chart is a hierarchical representation of the relationships between displays and selectable menus and items.

How to read the MENU structure chart

- in the chart shows displays on the screen. The code below indicates menus and items that can be selected while the display is on.
- Next to the code (denoting a certain menu or item) is a description of actions to take if the code is selected.
- For the details of each display or menu code, refer to the relevant pages in this manual. The page numbers are written in parentheses next to the display or code.
- In the example below, choosing “DISP*” in the <MENU> offers a list of display modes to be used in relation to the measurement mode.
- Strike the DELETE key while holding both DISPLAY and MENU keys down simultaneously. Similarly, strike the PRINT key while holding both ▲ and ▼ keys down simultaneously.

[Codes in the Menu structure chart]

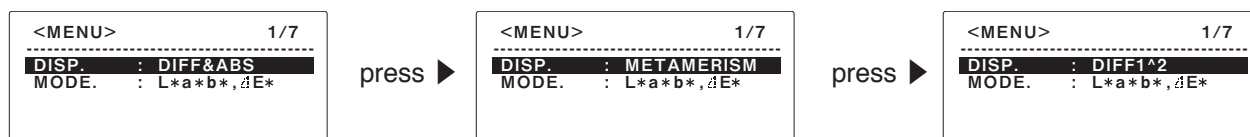
MENU SETTINGS

1/7

DISP.

DIFF&ABS
METAMERISM
DIFF1&2
ABS1&2
PASS/FAIL
.
.
.

[Example of actual display]



MENU STRUCTURE CHART

CALIBRATION mode

Set up values for white calibration, zero calibration, and white calibration tile

BREAK key : Measurement mode (p. 31, p. 32)
Measuring button : White calibration or zero calibration (p. 17, p. 18)
MENU key : Set up the values for white calibration tile (p. 19)

MEASUREMENT mode

DISPLAY key : Switch between displays
MENU key : Set up various settings
TARGET key : TARGET mode (p. 27, p. 28)
CURSOR (AVERAGE) key : Manual averaging mode (p. 41)
▲▼ keys : Data scroll
DELETE key : Measurement data delete mode (p. 37)
PRINT key : Print screen (p. 49)

MENU SETTINGS

1/7(P.20)	2/7(P.21)	3/7(P.22)	4/7(P.23)	5/7(P.24)	6/7(P.25)	7/7(P.26)
DISP.	OBSERVER	AUTO AVERAGE	BUZZER	REMOTE	CALIBRATION:	CALENDER
DIFF&ABS	2°	1	OFF	NO	CALIBRATION screen (p.17-19)	CLOCK
METAMERISM	10°	3	ON	YES	F.CAL.NOTICE	
DIFF1&2	ILLUMINANT1	5	LANGUAGE	DATA DUMP	ON	
ABS1&2	D65	8	ENGLISH	NO	OFF	
PASS/FAIL	D50	DELETE OUTLIER	CHINESE	YES	W.CAL.NOTICE	
GRAPH&DIFF	C	OFF	CONTRAST	AUTO PRINT	OFF	
GRAPH&ABS	A	ON	1	OFF	1	
MODE.	F2	USER CALIBRATION	2	ON	2	
L*a*b*, ΔE*	F6	OFF	3	BAUD RATE	3	
L*C*h, ΔE*	F7	ON	4	1200	4	
L*a*b*,CMC	F8		5	2400	5	
L*C*h,CMC	F10		6	4800	6	
L*a*b*, ΔE00	F11		7	9600	7	
L*C*h, ΔE00	F12		8	19200	8	
	ILLUMINANT2		9		9	
	---		10		10	
	D65				11	
	D50				12	
	C				13	
	A				14	
	F2				15	
	F6				16	
	F7				17	
	F8				18	
	F10				19	
	F11				20	
	F12				21	
					22	
					23	
					24	

Measurement data delete mode

- No. ** DELETE** : Delete one data (p. 37)
ALL DATA DELETE : Delete all data (p. 37)

TARGET mode

- DISPLAY key** : Switch between displays (for entering tolerance or comments) (p. 45, p. 46)
CURSOR (AVERAGE) key : Manual averaging mode (p. 41)
▲▼ keys : Data scroll (p. 28)
BREAK key : Measurement mode (p. 31, p. 32)
DELETE key : Target data delete mode (p. 29)
MENU key : CMC and ΔE₀₀ coefficients setup mode (p. 28)
PRINT key : Print screen (p. 49)
TARGET key : User Calibration mode (p. 43)

TARGET DELETE mode

- No. ** TARGET DELETE** : Delete target color data (p. 29)
ALL TARGET DELETE : Delete all target color data (p. 29)

COEFFICIENT ENTRY mode

- Enter coefficients** (p. 28)

TOLERANCE ENTRY mode

- Enter tolerance** (p. 45)

TARGET COLOR COMMENT ENTRY mode

- Enter comments on target color** (p. 46)

USER CALIBRATION mode

- DISPLAY key** : Switch between displays (p. 44)
▲▼ keys : Data scroll
BREAK key : TARGET mode (p. 27, p. 28)
PRINT key : Print screen (p. 49)



KONICA MINOLTA