Portable Spectroradiometer

MS-720

EKO

1.   Index

2. Important User Information

Thank you for using EKO Products

Make sure to read this instruction manual thoroughly and understand the contents before start to operate the instrument.   Keep this manual in safe and handy place for whenever it is needed.
For any questions, please contact us at below:

2-1. Contact Information

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2-2. Warranty and Liability

For the warranty term and condition, contact EKO or distributer for further details.
EKO instruments guarantees that the product delivered to customer has been tested to ensure the instrument meets its published specifications.   The warranty which is included in this condition of delivery is valid only if the product has been installed and used according to the instructions provided in this instruction manual.

In case any manufacturing defect(s) occurs, the defected part(s) will be repaired or replaced under warranty; however, the warranty will not be applicable if:

➢ Any modification or repair done by other than EKO service personnel.
➢ The damage or defect is caused by disrespecting the specifications mentioned on the product brochure or instruction manual.

2-3. About Instruction Manual

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2-4. Environment

1. WEEE Directive 2002/96/EC
(Waste Electrical and Electronic Equipment)

This product is not subjected to WEEE Directive 2002/96/EC however it should not be mixed with general household waste. For proper treatment, recovery and recycling, please take this product(s) to designated collection points.

Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.

2. RoHS Directive 2002/95/EC

EKO Instruments has completed a comprehensive evaluation of its product range to ensure compliance with RoHS Directive 2002/95/EC regarding maximum concentration values for substances. As a result all products are manufactured using raw materials that do not contain any of the restricted substances referred to in the RoHS Directive 2002/95/EC at concentration levels in excess of those permitted under the RoHS Directive 2002/95/EC, or up to levels allowed in excess of these concentrations by the Annex to the RoHS Directive 2002/95/EC.

3. Safety Information

EKO Products are designed and manufactured with consideration for safety; however, please make sure to read and understand this instruction manual thoroughly to be able to operate the instrument safely in the correct manner.

⚠ **WARNING CAUTION**	Attention to user; pay attention to the instructions given on the instruction manual with this sign.
⚡ **HIGH VOLTAGE WARNING**	High voltage is used; pay special attention to instructions given on this instruction manual with this sign to prevent electric leakage and/or electric shocks.

⚠ 3-1. WARNING/CAUTION

Handling
- MS-720 is not water-proof; keep it away from water.
- Dropping MS-720 may lead to not only instrument damage but also accidents or injury.
- Take out the batteries if MS-720 is not in use for several months.   Otherwise, MS-720 could be damaged from electric discharge, short circuit, or liquid leakage.

⚡ 3-2. HIGH VOLTAGE WARNING

Power Supply
- Check if the power voltage and type (AC or DC) is suitable for the instruments then turn on the power.
- In case the batteries are used, set them in the battery box according to the "+" and "-" sign.

4. Introduction

Portable spectroradiometer MS-720 is designed to measure the spectral irradiance in the range from visible to near-infrared irradiance.   MS-720 is used mainly for the data acquisition for geological features, vegetation, oceanography, remote sensing, and others.

MS-720 is a hand-held instrument with an integrated LCD and an internal memory.   Therefore, it is suitable for outdoor stand-alone measurement.

Spectral irradiance is measured by using a diode array of a small-sized grating spectrometer.

The data can be downloaded to PC using the attached software, and the data can be saved and managed with the software.   This software calculates the integrated irradiance and compares the data with the reference data.

4-1. Main Functions

1. Portable

MS-720 is light and compact (W100 x D165 x H60mm, 720g) for portability, thus it is suitable for outdoor measurement.   The integrated LCD display and the tact switch make it easy to operate.

2. Long Stability

The less aging diffuser, grating spectrometer and diode-array are used in MS-720.   MS-720 is durable because there is no moving part to adjust the measurement wavelength.   This is accomplished by the use of diode-array.

MS-720 software automatically determines the optimal shutter opening time for the measurement based on the respective spectral intensity, which allows you to get an accurate measurement.

3. Substantial Software Functions

With the MS-720 analysis software which can display multiple spectral data at one time and view a set of data in detailed mode. Also this software can save the spectral data in 1 or 5nm wavelength interval and compare with other data with measured data set as reference data.

4-2. Package Contents

Check the package contents first; if any missing item or damage is noticed, please contact EKO immediately.

Table4-1. Package Contents

Description	Qty	Remarks
MS-720	1	FOV 180° (Full angle)
AA Batteries	4	Already installed in the MS-720
RS-232C Cable	1	
USB Cable	1	
CD-ROM	1	Software and USB Driver
Instruction Manual	1	CD-ROM

5. Getting Started

5-1. Parts Name and Descriptions

The names of MS-720 components are shown in Figure 5-1 and Figure 5-2, and the functions are described on Table 5-1.
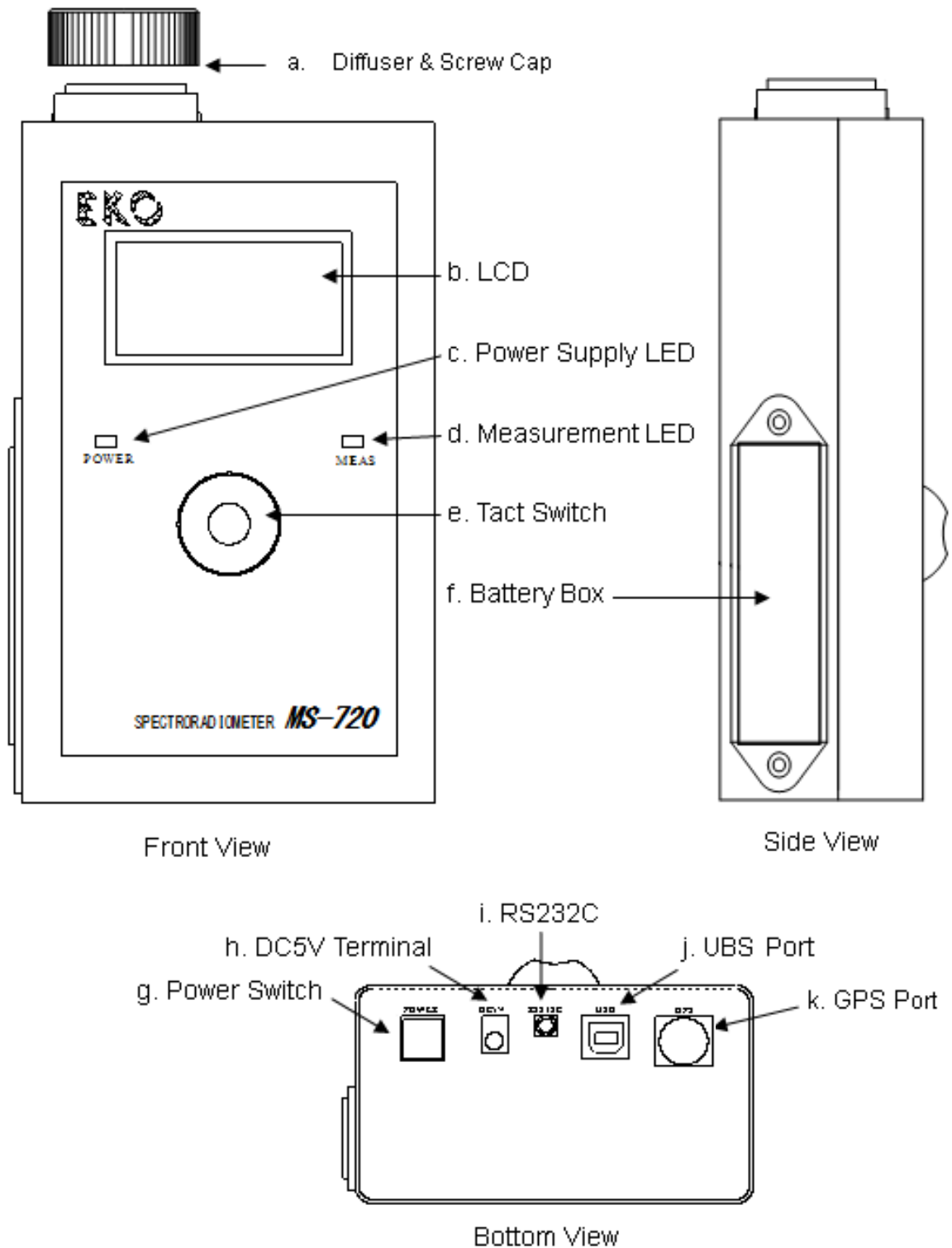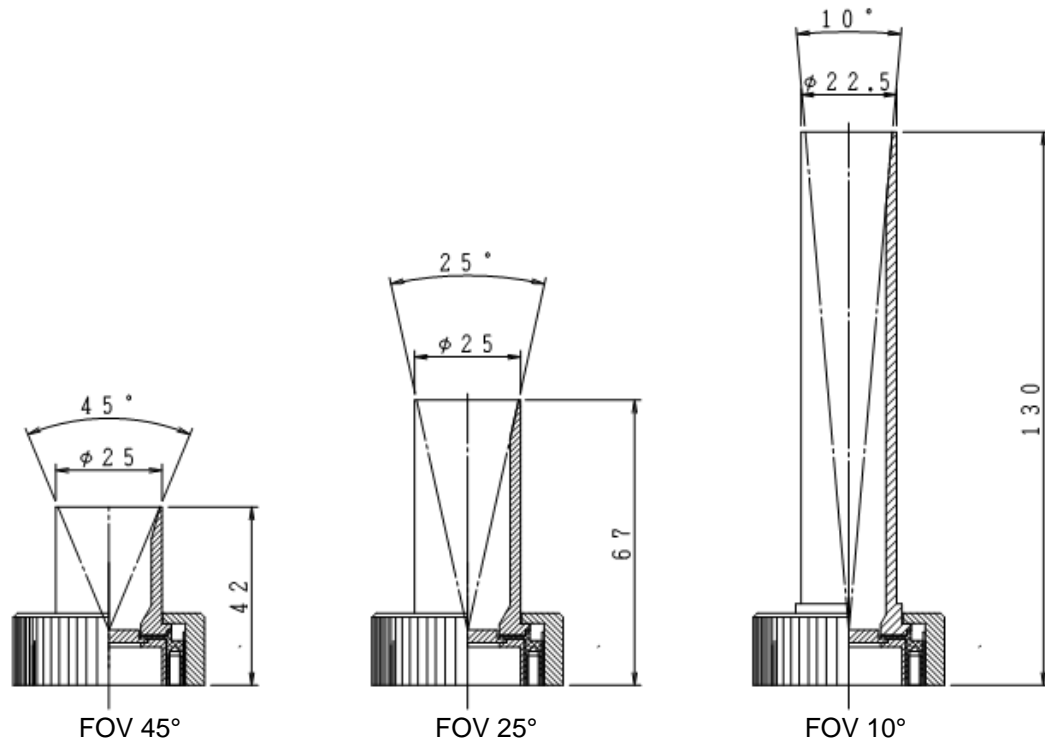

Figure 5-1. Name of Parts

FOV 45°   FOV 25°   FOV 10°

Figure 5-2 Optional View Ports (FOV in full view angle)

Table 5-1 Functions of Components

	Name	Function
a	Diffuser & Screw Cap	The diffuser receives the incident radiation with FOV (full angle) 180°. The screw cap protects the diffuser. The view ports with following angles are available as optional accessories: FOV (full angle) 10°, 25°, and 45°.
b	LCD	Display the spectral data and measurement date etc.
c	LED for Power Supply	Green light will light when the power switch is pressed.
d	LED for Measurement	Red light will turn on when the tact switch is pressed and during the measurement is taken. The light blinks during the interval measurement or self-timer measurement is performed.
e	Tact Switch	The switch is used to start measurements, select the screens, and items, etc. Move the cursor in up/down and right/left direction, then select and decide the items by pressing the center of the switch.
f	Battery Box	For 4 x AA Batteries
g	Power Switch	Turn "on" and "off" the power. *
h	DC5V	DC power is supplied to this inlet from optional AC adapter.
i	RS-232C Port	The data is downloaded to PC via RS-232C cable.
j	USB Port	The data is downloaded to PC via USB cable.
k	GPS Port	Optional GPS unit is available via GPS port.

CAUTION:

When turning the power to "ON", press the power switch for 1 second.

Also when the power switch and the tact switch are pressed at the same time for more than 5 seconds,

all data saved and the setting information will be deleted and reset to the default value.

5-2. Block Diagram

Block diagram of MS-720 is shown below. Stand-alone measurement is also possible with using 4 x AA batteries. Optional AC adaptor is used for the indoor measurement.
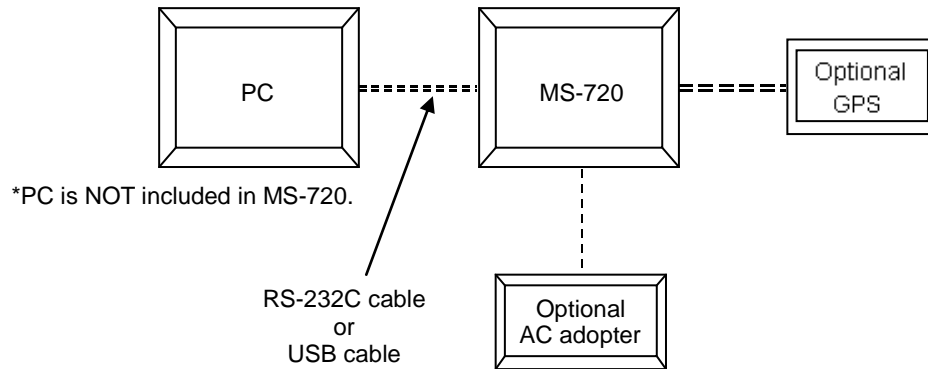

Figure 5-3. Block Diagram (Hardware Configuration)

The incident radiation goes into the spectrometer through the aperture. The spectral data is saved in the internal memory at the measurement board.
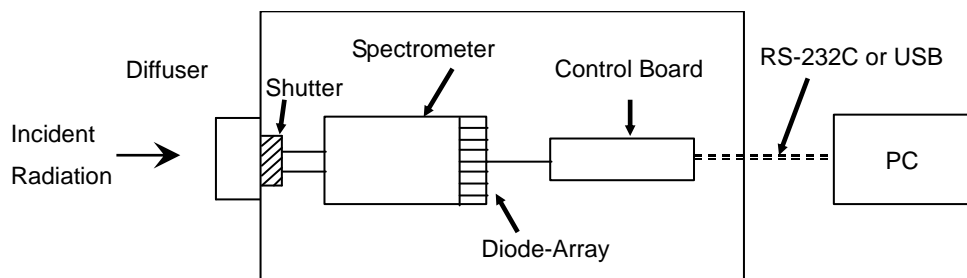The data can be downloaded to PC through RS-232C or USB cable.

Figure 5-4. MS-720 Inside Structure

5-3. Preparations

1. Batteries

Batteries are already installed at the time of shipment.   If the batteries have to be replaced, pull the picks at the both side of the battery box inside; replace with new 4 x AA batteries in the correct direction according to +/- marking.   Insert the battery box back to MS-720.

2. View Port

A protection cap is attached on the view port of the MS-720.   Remove the cap when you take measurements. The full field of view (FOV) angle is 180 degrees (Full angle).

There are optional view ports (10, 25, and 45°, Full angle) available for attachment (purchased separately). When placing the optional view port, fix it with adopter lock nut attached, as shown below.
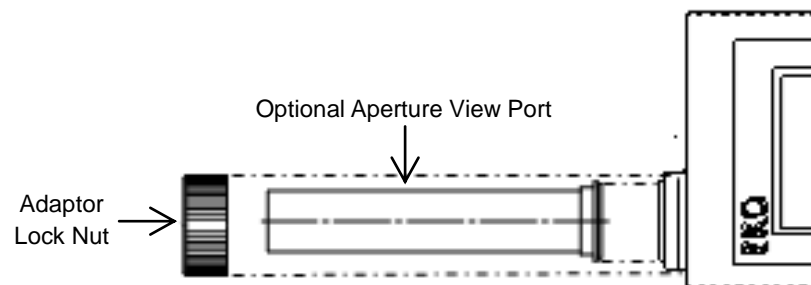

Figure 5-5. How to Attach the Optional Aperture Angle

3. Optional Power Supply Cable

AC adapter is available as optional accessory; to use the AC adapter power supply cable, connect to the DC5V terminal at the bottom of MS-720.   Make sure the input is AC100V~240V, 50/60Hz.

6. Measurement

6-1. Measurement Conditions

1. Surrounding Environment

Since MS-720 measures spectral radiation from the measuring target, remove any obscuring objects in the viewing field.

2. Environmental Protections

MS-720 does not have waterproof function, nor does the PC which to be installed with MS-720 software has waterproof and/or dust proof function in general. Therefore, avoid use in an environment with exposure to water, such as rain, and excess amount of dusts to prevent from damaging the instruments.

3. Measuring Tips for Using View Port

When taking measurement using optional view ports, pay attention to the following; otherwise, you may not get an accurate data depending on the setting and how the incident radiation hitting the sensor.

1) When setting the sensor with aperture in the direct sun (lamp) light position:

2) When setting the sensor with some angle (the direct sun/lamp light reflecting on the aperture angle inside and not directly hitting the sensor):
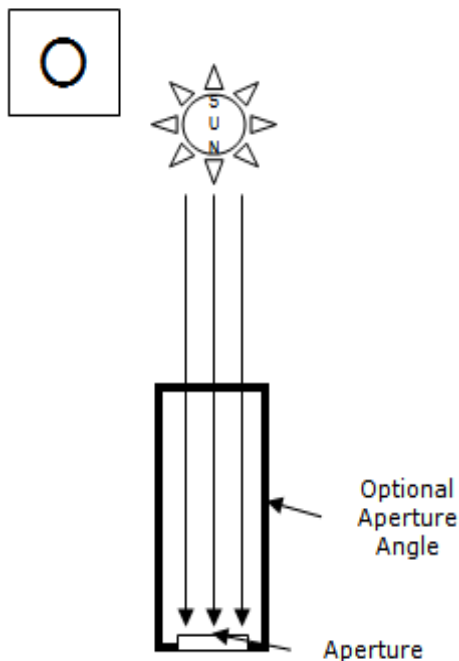

Most of the light will reach the sensor directly, thus accurate measurement can be taken.
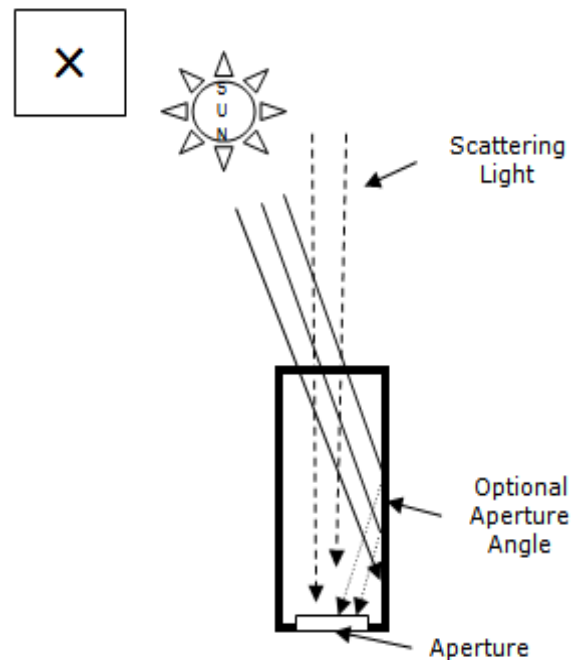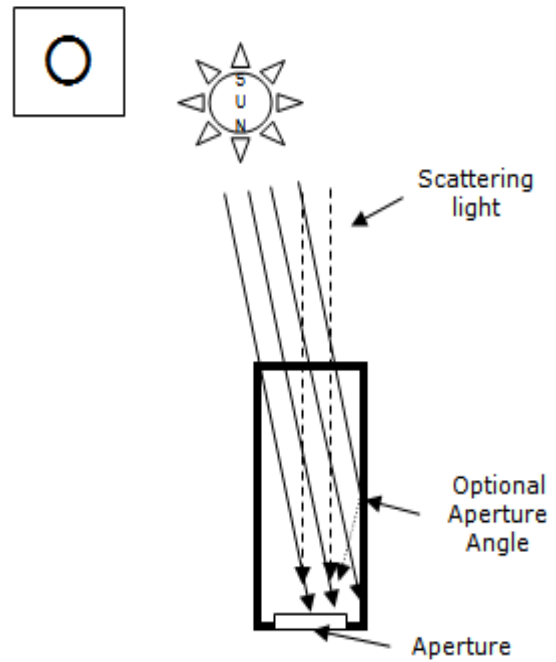
Since the light reflecting on inside of the aperture angle is stronger than the weak scattered light, the data becomes inaccurate due to the reflected light disturbing the scattering light data.

3) When setting the sensor in the opposite direction from the sun (lamp) light:

Aperture

Optional Aperture Angle

Light Reflecting Surface
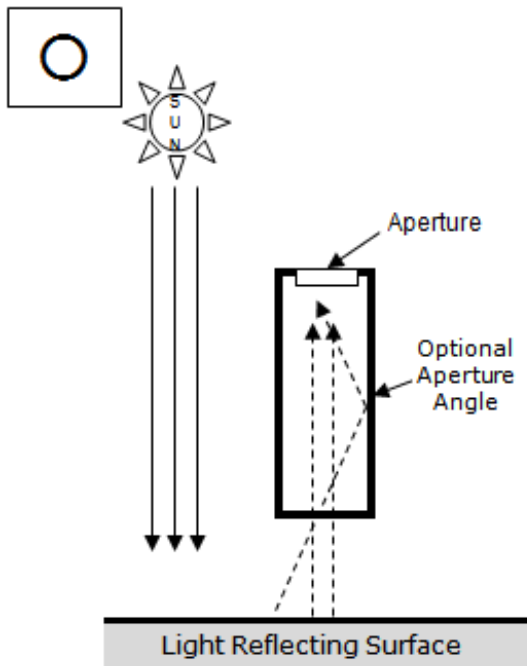
When measuring the weak light which is reflected from the ground and so on, the data gets less effect from the light reflecting inside the aperture angle since it is also a weak light.

4) When setting the sensor with little angle, the direct sun/lamp light reflect on the aperture angle inside but some direct light hit the sensor directly:

Scattering light

Optional Aperture Angle

Aperture

The light directly hits the sensor is stronger than the scattering light and the light reflecting inside the aperture angle, thus the data does not get disturbed as much (Similar to No1. Data)

6-2. MS-720 Setup

1. Main Menu

Press the power supply switch for 1 second; Setup Screen then Menu Screen are displayed when the LCD display turns on. "MEASURE", "SETTING", "DATA", "PC LINK", "SYSTEM", "GPS", date, time and remaining voltage of the batteries in real-time are displayed on the Menu Screen.
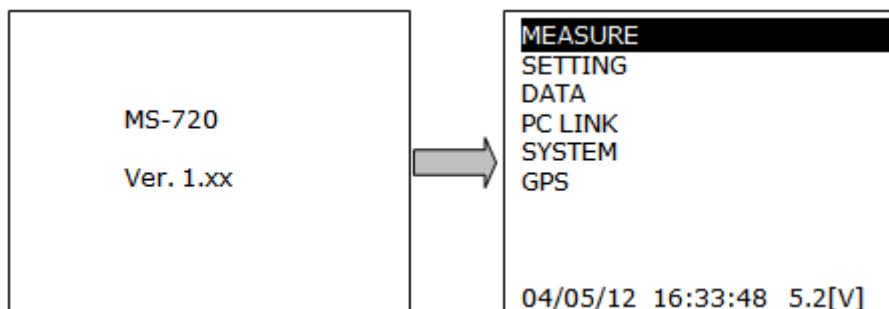

Figure 6-1. Set up/Menu Screen

Table 6-1. Main Menu Screen functions

MEASURE	Perform manual measurement or interval measurement, save the spectral data
SETTING	Input the memorandum and specify the range of spectral data integration
DATA	View the spectral data saved in the internal memory.
PC LINK	Download the spectral data saved in the internal memory to the PC.
SYSTEM	Set the time, LCD contrast, auto-power off function etc.
GPS	Obtain the data like Latitude/Longitude/Height (above sea level) etc. with optional GPS unit.
Date, Time and Battery Status	Dates (MM/DD/YY), time (HH:MM:SS), and remaining battery voltage are displayed at the bottom of LCD display. When the remaining voltage of the batteries reaches 4.0V, LED for power supply starts blinking. When the remaining voltage becomes below 3.6V, the power is automatically turned off. Prepare new batteries for replacement when the voltage becomes less than 5V.

2. [SYSTEM] Settings

Press [SYSTEM] in Menu Screen to display the System Setting Screen. "DATE", "TIME", "TZONE", "CONT", "BEEP" and "P.OFF" are setup on this screen.

```
DATE     2004/05/12
TIME     16:51:09
TZONE    +9
CONT     50
BEEP     ON
P.OFF    ----
EXIT
```

Figure 6-2. System Setting Screen

Table 6-2. System setting parameters

DATE	Set Year/Month/Date. (1) Set "Year", "Month" and "Date" by using the tact switch in right and left, up and down direction. (2) To finish, press the center of the tact switch after setting Year/Month/Date.
TIME	Set Hour/Minute/Second. (1) Set these parameters in the same manner as the [Date] settings. During the cursor is put on each "Hour", "Minute", "Second", the time counting stops. (2) By pressing the center of the tact switch, the cursor returns to [TIME] position and the time counting starts.
TZONE	Change the time zone (1) Change the time zone by the tact switch (up and down direction). MS-720 internal clock is set according to UTC (Coordinated Universal Time). The default time setting is adjusted to Japan time, "+9". (2) To move the cursor back to "TZONE", press center of the tact switch after setting the time zone. ***CAUTION:** **The time for the data taken with MS-720 is saved as UTC; therefore, in case the measured data are downloaded to PC, the data time will be reflected to the time zone setup on the PC. If the MS-720 is used overseas, make sure to setup not only the MS-720 "TZONE" but also the PC time zone.**
BEEP	Turning On/Off the sounds for operations, such as pressing the tact switch, taking interval measurement, and automatic power off. (1) The default "ON" is changed to "OFF" by using the tact switch in up and down direction. (2) To bring the cursor back to [BEEP], press the center of the tact switch after [BEEP] settings.
P.OFF	Set automatic power-off. (1) The power is automatically turned off when there are no operations for a specific time period. The beep sound comes on at 10 seconds before the auto power-off when [BEEP] setting is "ON". The default setting is "----" (automatic power-off setting is OFF). Addition to "----", there are 2 min and 10min settings are available. (2) [P.OFF] settings shall be changed with the tact switch in up and down direction. (3) To move the cursor back to [P.OFF], press the center of the tact switch after [P.OFF] settings.
GPS	Use this function to switch the GPS unit type. The default is setup as RS-355. Select GPS and move the tact button up/down to select either GPS unit type, RS-355 or GEKO210.
EXIT	Goes back to Menu Screen.

3. [SETTING] Measurement Parameter Settings

[MEMO], [AREA], [LON], [LAT], [ALT], [FOV], [CALIB] are displayed after pressing [SETTING] in Menu Screen. The values, which are specified in CSV file with software, are saved in [MEMO], [AREA], [LON], [LAT], [ALT], and [FOV]. (See [7-2. Software Operations], [4. Measurement Display Window])

Figure 6-3. Measurement Setting Screen

Table 6-3. Measurement Parameter Setting

MEMO	This value is reflected in the [MEMO] value in [6-3. Measurement Functions], [4. View Data] (1) Select [MEMO]. (2) The cursor moves to the right side of [MEMO]. (The default value is "blank".) (3) 95 types of characters, such as space, symbols, figures, and alphabets can be entered by using the tact switch in up and down direction. The characters can be entered up to 10 by using the tact switch in right and left direction. (4) To bring the cursor back to the [MEMO], press the center of the tact switch after entering the characters.
AREA	This value is reflected in the [AREA] value in [7-2. Software Operations], [4. Display the Data]. This is the wavelength range to calculate the integrated value (Itg). (1) Select [AREA]. (2) The cursor moves to the lower limit (The default value is "0350"). Set the lower limit value with the tact switch in up and down direction. (3) Set the upper limit (The default value is "1050"). The value can be setup every 1nm. To bring the cursor back to the [AREA], press the center of the tact switch.
LON	Set the longitude. (1) Select [LON]. (2) Set the value and West/East (W or E) using the tact switch in up and down direction. (The default value is "135.00000E".)
LAT	Set the latitude. (1) Select [LAT]. (2) Set the value and North/South (N or S) with the tact switch in up and down direction. (The default value is "35.00000N".)
ALT	Set the height. (1) Select [ALT]. (2) Set the height by the tact switch in up and down direction. (The default value is "0.0".)
FOV	Set aperture angle. This value is reflected in the [FOV] value in [7-2. Software Operations], [4. Display the Data]. (1) Set [FOV] with the tact switch in up and down direction. The default is set at "180°". (2) To make the cursor back to "FOV", press the center of the tact switch.
CALIB	Change the factory set calibration constant. (1) Set [CALIB]. The default value is "CAL1". There are "CAL2", "CAL3", or "CAL4" other than the "CAL1" setting. (2) To bring the cursor back to [CALIB], press the center of the tact switch after setting the calibration constant.
EXIT	To go back to the Menu Screen, press [EXIT]

6-3. Measurement Functions

1. Measure Screen

In Menu Screen, select [MEASURE] by moving the tact switch up and down; the Measure Screen is displayed (Figure 6-4). On Measure Screen, [MEAS], [SAVE], [VIEW], [SELF], [INT] are displayed at the bottom of the screen. Select the triangle at the lower left of [MEAS] to go back to the Menu Screen.
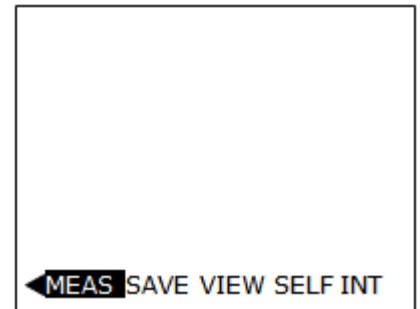
◄MEAS SAVE VIEW SELF INT

Figure 6-4. Measure Screen

2. Manual Measurement

In the Measure Screen, move the cursor to [MEAS] by moving the tact switch right/left. Then press the center of the tact switch.

(1) A sequence of following measurements is performed once. Dark current is measured after the spectral measurement as shown on Measurement Screen (Figure 6-5).

The shutter opening time is automatically controlled according to the objective spectral irradiance. When the spectral irradiance is strong, the shutter opening time is controlled for a short time, and when the spectral irradiance is weak, the shutter opening time is controlled for a long time.

(2) After the measurement, the spectral data is displayed in a graph such as the one shown in Figure 6-6. Full scale of the vertical axis for the spectral irradiance is shown at upper right. The unit of the full scale is $W/m^2/\mu m$. The spectral data, which is obtained at the latest, is displayed on LCD.

(3) To save the data obtained by manual measurement, refer to [6-3. Measurement Functions], [3. Save Data]. These data are NOT automatically saved in the internal memory.
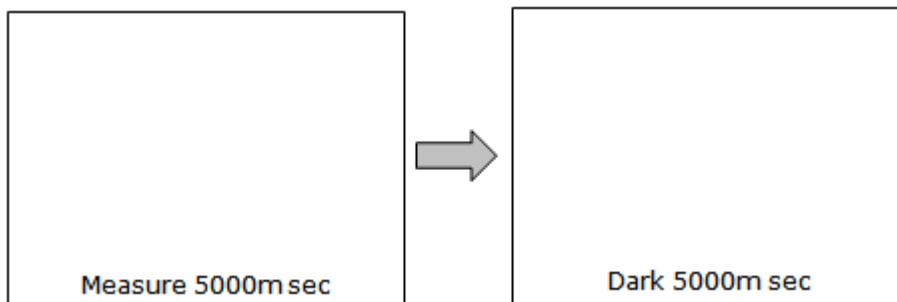
Measure 5000m sec → Dark 5000m sec

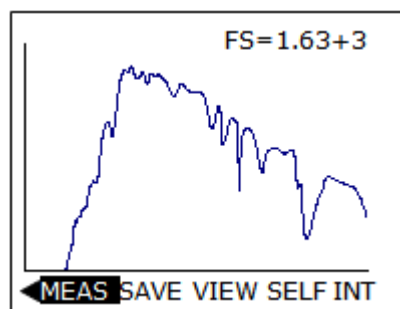Figure 6-5. Measurement Screen

FS=1.63+3

◄MEAS SAVE VIEW SELF INT

Figure 6-6. Spectral Data Display Screen

3. Save Data

[SAVE] saves the spectral data, which was obtained by [MEAS] and [SELF].

(1) After the measurement, select [SAVE].

(2) [BANK XX SAVED] message is temporary displayed at the bottom of the screen. "XX" is the serial number of the saved spectral data.
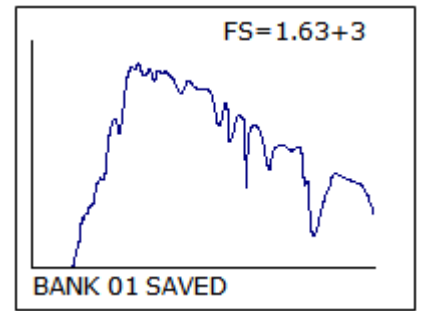
The internal memory saves data up to a maximum of 800 sets. When the internal memory becomes full, "BANK FULL" message is displayed at the bottom of the screen.

Figure 6-7. Save Screen

To additionally save the data, download the data to the PC (refer to [7-2. Software Operations], [3. Measurement Control Window], (3) Download the Data], or select [ALL-CLEAR] (refer to [6-4. Data Functions]) to delete all spectral data in the internal memory.

4. View Data

[VIEW] calculates and displays the measurement day/time, shutter opening time (measurement time), memorandum, latitude/longitude/height, FOV (aperture angle), PAR (W/m^2), photon (μmol/m^2/s), luminance (lux) and the integral value in the specified spectral range.

(1) Select [VIEW] in Measure Screen or Spectral data display Screen.

The information setup in the section [6-2. MS-720 Setup], [3. SYSTEM Setting] are displayed. (Figure 6-8).

(2) Select [VIEW] again in View Screen.

(3) Measurement time, [EXPT] (exposure/shutter opening time), PAR, Photon, Lux and the integral spectral irradiance in the specified spectral range (Itg), which were setup in the section [6-2. MS-720 Setup], are displayed (Figure 6-9). It takes approximately 3 seconds to calculate the contents on Page 2 (Figure 6-9).

(4) To go back to Spectral Data Display Screen, press the center of tact switch at View Screen (Figure 6-9).

[MEAS] and [SELF] functions are also available in View Screen (Figure 6-8). When the measurement is performed in View Screen (Figure 6-9), the same screen is displayed again after the calculation.
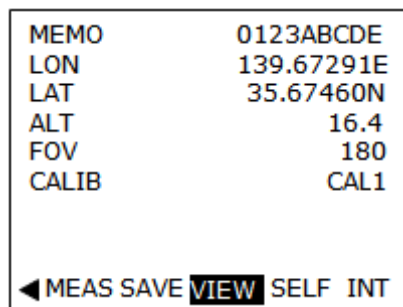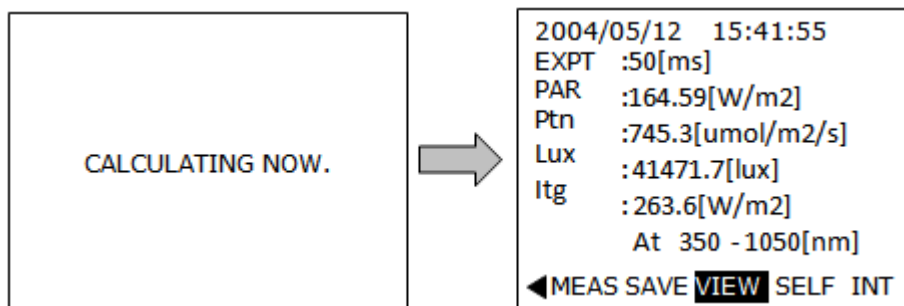

Figure 6-8. View Screen (Page 1)

Figure 6-9. View Screen (Page 2)

5. Self-Timer Measurement

[SELF] performs the self-timer measurement.

(1) Select [SELF] in Measure Screen or Spectral Data Display Screen. Self-timer schedule of 2, 5, and 10 (in seconds) are displayed at the bottom of Self-timer Setting Screen (Figure 6-10).

(2) Select the time from 2, 5, or 10.

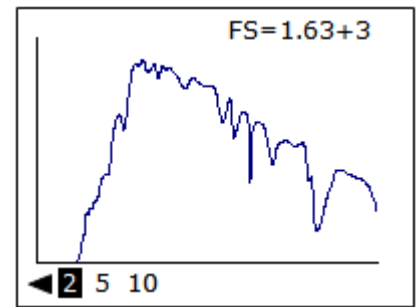(3) The self-timer measurement is performed once according to the scheduled time.

The green LED (measurement) blinks during the measurement.

Figure 6-10.
Self-Timer Measurement Setting Screen

(4) To go back to Spectral Data Display Screen, select the triangle at the lower left.

(5) To save the data obtained by self-timer measurement, refer to [6-3. Measurement Functions], [3. Save Data].   This data is NOT saved automatically.

6. Interval Measurement

[INT] performs the interval measurement.

(1) Select [INT] in MEASURE Screen or Spectral Data Display Screen.

(2) Measurement interval time is displayed at the bottom of Interval Measurement Setting Screen (Figure 6-11).   The interval measurement is taken at the multiplied seconds of the selected interval time.
Example)   15 sec interval setting: takes measurement at 00sec/15sec/30sec/45sec…

Table 6-4 Interval Measurement

Seconds	Operation
15	The measurement is taken every 15 seconds.
30	The measurement is taken every 30 seconds.
60	The measurement is taken every 60 seconds.
120	The measurement is taken every 120 seconds.
300	The measurement is taken every 300 seconds (5 minutes).
600	The measurement is taken every 600 seconds (10 minutes).

(3) The data obtained by the interval measurement is automatically saved in sequential order in the internal memory.   The green LED (Measurement) blinks during the hold time before the next measurement.

(4) The interval measurement is stopped with [BANK-FULL] message when the internal memory is full.

(5) To finish the interval measurement in the halfway, press the center of the tact switch.   Then, the screen is switched to the Spectral Data Display Screen.   Otherwise, select the triangle at the lower left to go back to Spectral Data Display Screen.
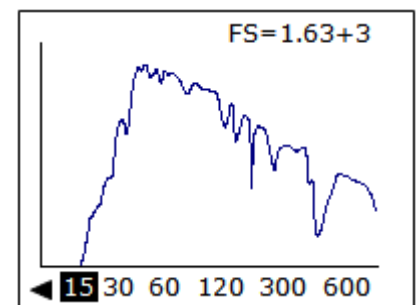

Figure 6-11.
Interval Measurement Setting Screen

6-4. Data Functions

To view the spectral data in the internal memory, move the cursor to [DATA] in Menu Screen.   The measured date and time are displayed as shown on Data List Screen (Figure 6-12).

Table 6-5. Saved Data Operation

| SEL	To view the random data in the catalogue view, move the cursor to a data. Press [SEL] on the data. The selected spectral data is displayed.
-100/-10/+10/+100	For the quick search of the specific data from the numerous data, use the [-100/-10/+10/+100] command for easy operation. Selecting these command will jump to data that is 100 or 10 sequent numbers smaller (-) or bigger (+) than the data where the cursor is currently indicating, each time the tact switch is pushed.
ALL-CLEAR	This is displayed on the Data List Screen by selecting the triangle at the lower right of the screen. This function deletes all data saved in the internal memory.
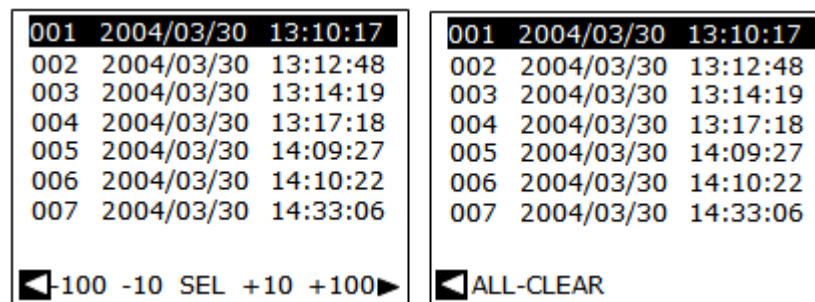
Figure 6-12. Data List Screen

To go back to Menu Screen, move the cursor to the triangle at the lower left of the screen, and press the center of the tact switch. "NO DATA" is displayed when there is no data in the internal memory.
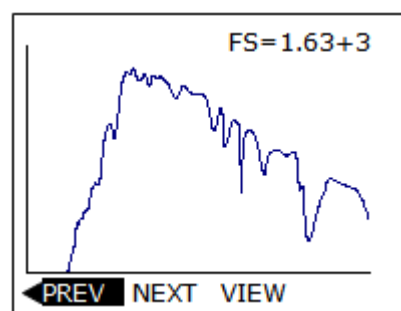

Figure 6-13. Detailed View Data Screen

Table 6-6. Saved Data Operation

PREV	Displays catalogue view data which was obtained previously to the data currently viewing.
NEXT	Displays the data, which was obtained just after the data currently viewing.
VIEW	Displays the detailed information of the currently selected data. "PREV" and "NEXT" are also available when the "View" screen is opened.

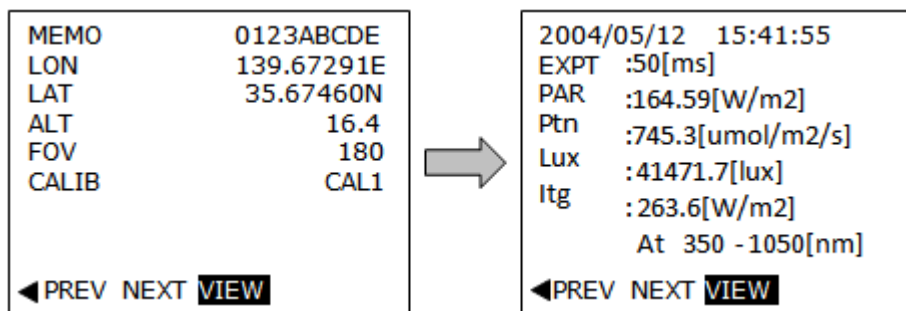To go back to List View Data Screen, select the triangle.

MEMO	0123ABCDE
LON	139.67291E
LAT	35.67460N
ALT	16.4
FOV	180
CALIB	CAL1

◀PREV NEXT VIEW

2004/05/12 15:41:55	
EXPT	:50[ms]
PAR	:164.59[W/m2]
Ptn	:745.3[umol/m2/s]
Lux	:41471.7[lux]
Itg	:263.6[W/m2]
	At 350 - 1050[nm]

◀PREV NEXT VIEW

Figure 6-14. Data Display Screen (Left: Page 1, Right: Page 2)

6-5. PC Communication

To download the acquired data to PC, connect PC COM port and MS-720 RS-232C port at the bottom side of MS-720 via RS-232C cable.   The data can be downloaded from USB port via USB cable.   However the USB connection is not available for PC using Windows Vista or Windows 7 as operation system (OS); therefore, use RS-232C connection.

The communication between MS-720 and PC is available while the message "PC LINK NOW" is blinking after selecting "PC LINK" in the Menu Screen.   This function is used to download the data from the internal memory to PC with the software.

To stop the communication, press the center of the tact switch on the PC Communication Screen (Figure 6-15). Then, the screen automatically goes back to Menu Screen.

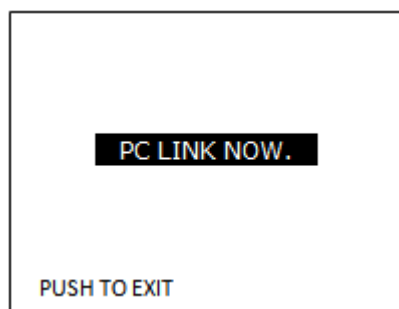Stop the PC communication before powering off the MS-720.

PC LINK NOW.

PUSH TO EXIT

Figure 6-15. PC Communication Screen

6-6. GPS Functions

To obtain the data of date/time/latitude/longitude/height from the optional GPS unit:

(1)   While the MS-720 turned OFF, connect the GPS unit to MS-720 with the communication cable.

(2)   Turn on the power of GPS unit after pressing [GPS] in "Menu window".

(3)   "Fig.6-15. Default setting window" is displayed after the data is automatically transferred to MS-720.

(4)   [DATE], [TIME], [LON], [LAT] and [ALT] display the data transferred from GPS unit.

(5)   [CLK] date is the set value at [SYSTEM] in "Menu window".

No value is set before the data transferred from GPS unit.   The data is transferred every 2 seconds.

In case the GPS communication gets disconnected due to climate and environmental conditions while it is acquiring data, display will show "----" for a while.   When GPS communication comes back and starts to acquire data, the values are displayed again.   (GPS unit does not communicate in the bad communication environment, such as inside a building.)

NOTE: After inserting the GPS unit connector while the MS-720 power is turned ON, large amount of current flows into the GPS unit and it may turn OFF the power.   To prevent such operation error, always make sure the power is turned OFF when connecting the GPS unit.

(The GPS data will not be transferred unless the GPS unit is connected.   Always use the GPS unit designated for MS-720 which is offered as an optional unit by EKO.   General GPS units which are commercially available are not compatible with MS-720.)

➢ **[COPY POS]**
This function copies the "LON"/"LAT"/"ALT" data acquired from GPS unit to "7. Measurement settings" screen described in "6-2. Measurement parameter".

"LON" and "LAT" is converted "degrees/minutes/seconds" as follows;
  ex) "LON" "139.6729E" in "Fig.6-16. Default setting window"
   (1)   Multiply 60 by 0.67291(below a decimal point). $0.67291 \times 60 = 40.3746$
   (2)   Multiply 60 by above result value 0.3746 (below a DC). $0.3746 \times 60 = 22.476$

"Minutes" is "40", the whole number calculated from formula (1).   →   "40 minutes"
"Seconds" is "22", the whole number calculated from formula (2).   →   "22 seconds".

Therefore, "139.6729E" is "139 degrees 40 minutes 22 seconds of east longitude".
"LAT" is converted "degrees/minutes/seconds" as well.

➢ **[ADJ. TIME]**
This function copies the "DATE/TIME" data acquired from GPS unit to [CLK] which is shown on the display at the lower side..

```
DATE           2004/05/12
TIME           15 : 55 : 28
LON            139.67291E
LAT             35.67460N
ALT              16.4[m]

CLK 2004/05/12 15:55:29
◀ COPY  POS  ADJ  TIME
```
Figure 6-16. Default Setting Window

6-7. Power Off

The red LED for the power supply blinks when batteries are almost out.
The red LED blinks after the batteries voltage decreases to below 4.0V.   The power is automatically turned off after the batteries voltage is less than 3.6V.
If the power is turned off during the measurement, it could cause damages.

7. Software

The Portable Spectroradiometer MS-720 comes with software for data analysis. The software names are "MS720_x64.exe" for 64bit version and "MS720_x86.exe" for 32bit version. The structural concept is shown below.
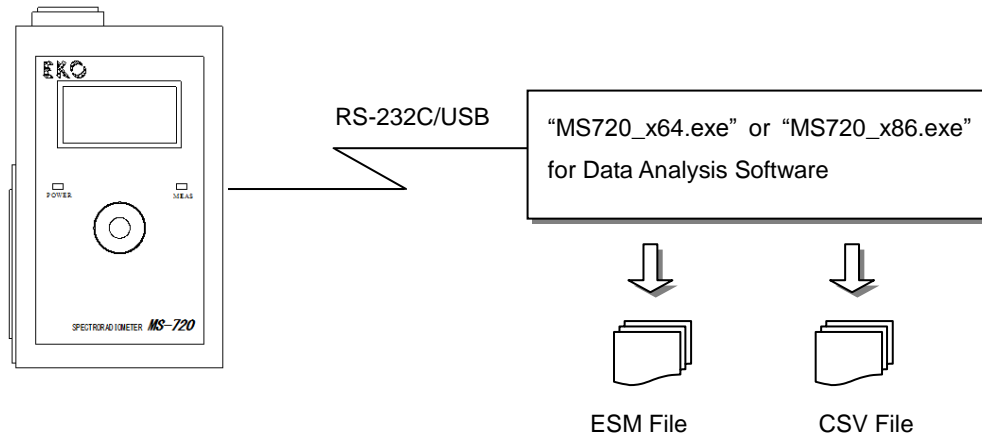

Figure 7-1. "MS720_xXX.exe" Structural Concept

7-1. Installation and Uninstallation

1. Installation of MS-720 Software

(1) Power ON the PC and insert the installation disc in the CD drive while Windows desk top window shown on the screen.

(2) For PC with 64bits OS, select "MS-720_X64_Software_Ver1.0.1.x" → "English" then click "Setup.exe" to start up the installer. For PC with 32bit OS, select "MS-720_X86_Software_Ver1.0.1.x_Installer"

(3) Installation Wizard window appears; click [Next] button to proceed.

Figure 7-1-1. Installation Wizard Startup Window

(4) Software License Agreement window appears.   Select "Agree a software license" in the License Agreement Window then click [Next] to proceed.
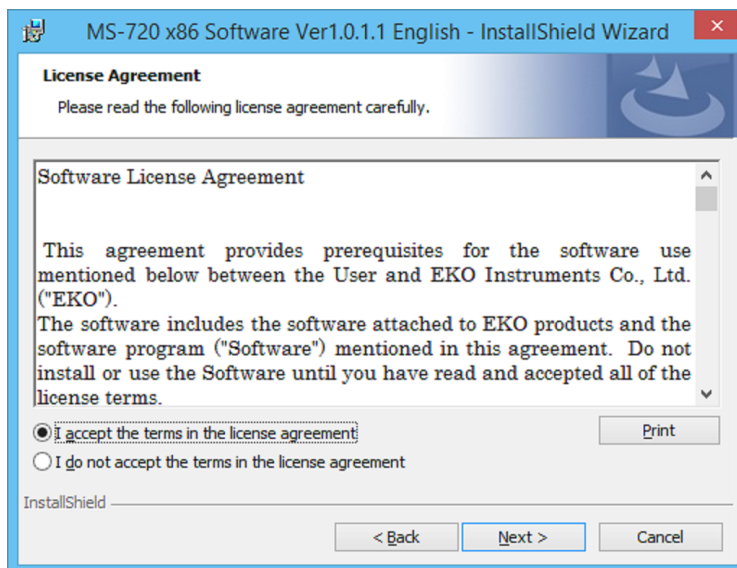
Figure 7-1-2. License Agreement Window

(5) "Installation Folder" appears on the window.   To install in the "C:¥EKO¥MS-720¥" folder, click [Next] button to proceed.   To change the installation folder, click [Change] button.
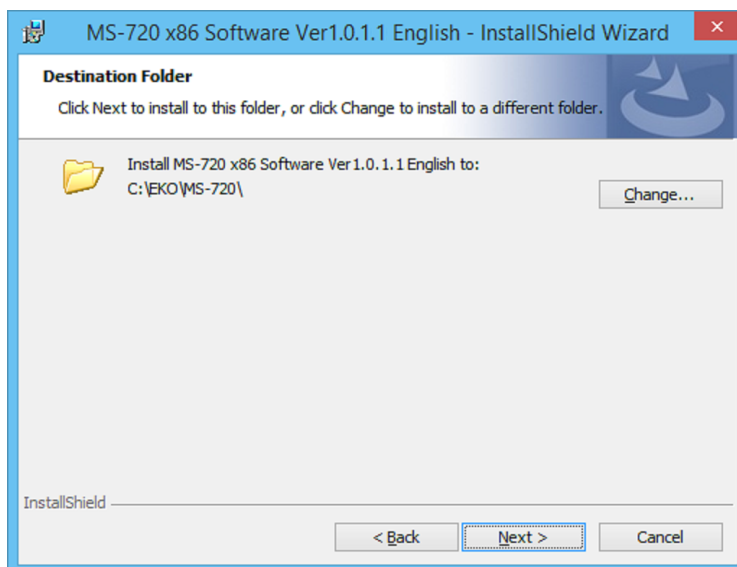
Figure 7-1-3. Select Folder for Installation

NOTE: When changing the installation folder and OS for PC is Windows Vista or newer version, UAC (User Account Control) function becomes effective.   Installing and/or data writing into a folder which access is controlled by OS, all sorts of errors occur.   There are folders with such limitation, such as "C:¥Program Files", "C:¥ProgramData", "C:¥Windows",   System Drive Route Folder "C:¥". Thus select other than these folders when installation folder is changed.

(6) Confirmation window appears.   Confirm the installed program and settings, and click [Installing] button to proceed.
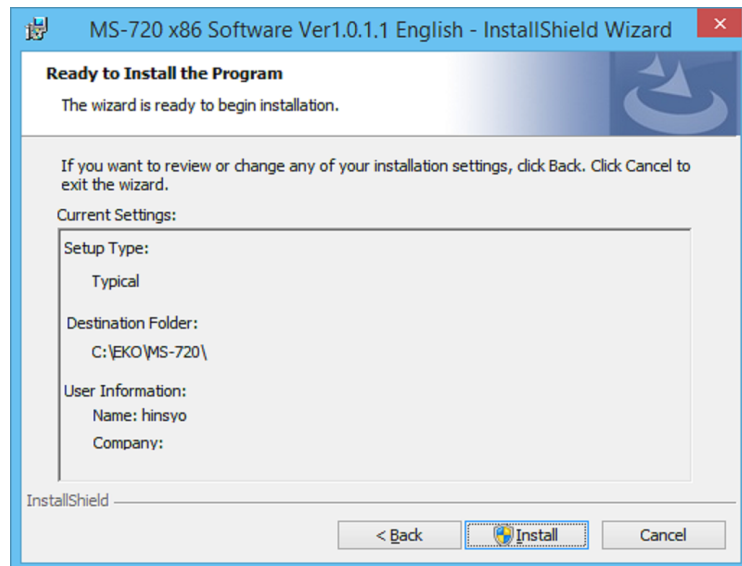
Figure 7-1-4. Confirmation Window

(7) After a while, display becomes dark, and [User Account Control" window appears.   Click [Yes] button to start the installation.
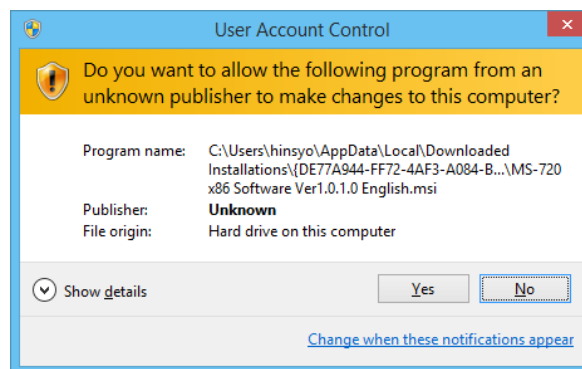

Figure 7-1-5. User Account Control

(8) Once the installation is completed, following window appears.   Click [Finish] button to close the Installer window.
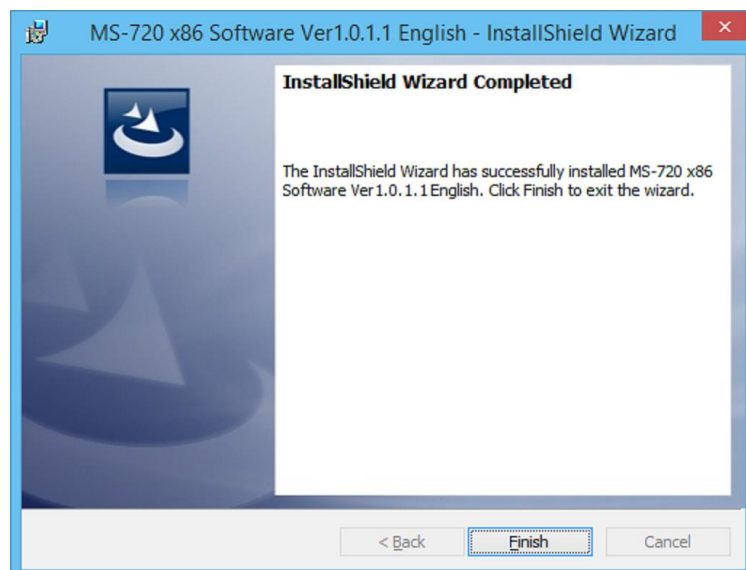

Figure 7-1-6. Installation Complete Window

(9) When the installation is completed, [MS720_x64.exe] is registered in the "Start" menu under "All Programs" → EKO → MS-720 x64 Software Ver1.0.1.x. Also the following shortcut icon is created on the desk top.

Figure 7-1-7. Shortcut on Desktop

2. Uninstallation of MS-720 Software

To uninstall the software, there are following 2 methods.

(1) To Uninstall from [Programs and Functions]

Click [Control Panel] → [Programs and Functions]. Select the program to be deleted, right click the program with mouse. A popup menu appears; select [Uninstall].
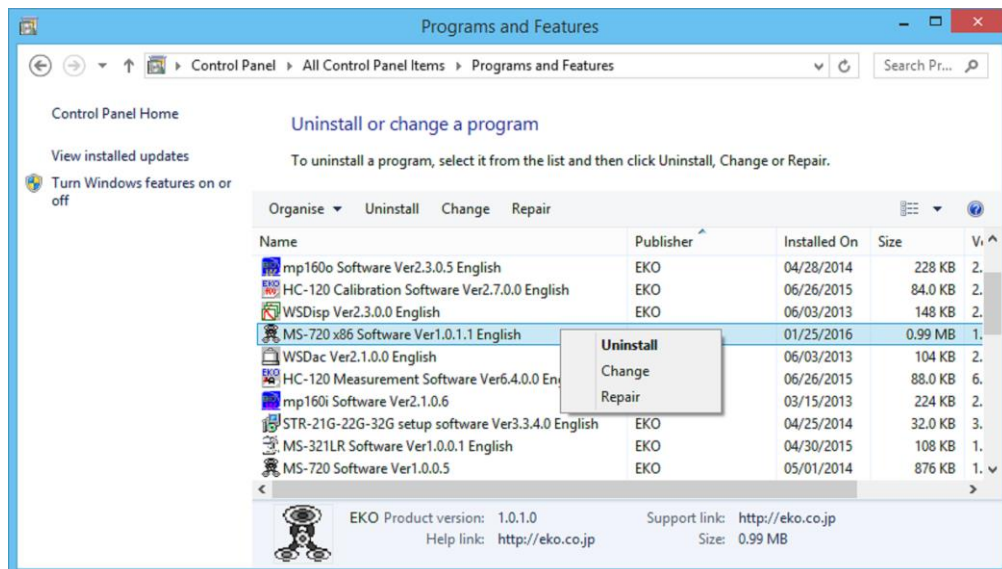
Figure 7-1-8. Uninstalling from "Programs and Functions]

Below confirmation message appears. To actually uninstall the program click [Yes] button. Uninstallation can be confirmed as the program disappeared from the list.
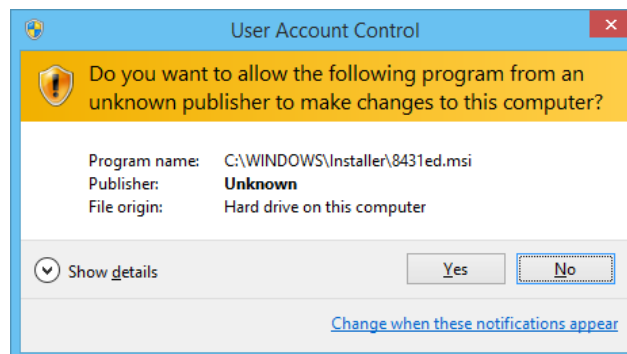

Figure 7-1-9. User Account Control

(2)   Uninstalling from the Installation Disk

Just like when the program was installed, start up the Setup.exe for the software which to be uninstalled. Follow the uninstallation process according to the instruction given on the window; when the software is already installed, selecting window for "Modify", "Restore" or "Remove".   Select "Remove" and click [Next] button on this window.   Follow the instruction provided on the window; the installed software is removed as the result.
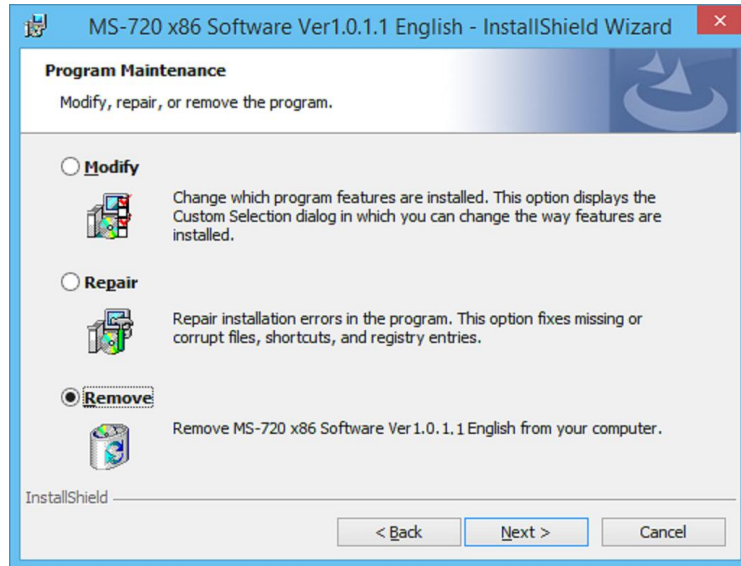

Figure 7-1-10. Uninstallation by CD-ROM

3. Installation of USB Driver

(1) From the PC Start Menu, right click the [Computer] icon → click [Property] to open the control panel. Click [Device Manager] and open the [Device Manager] window.
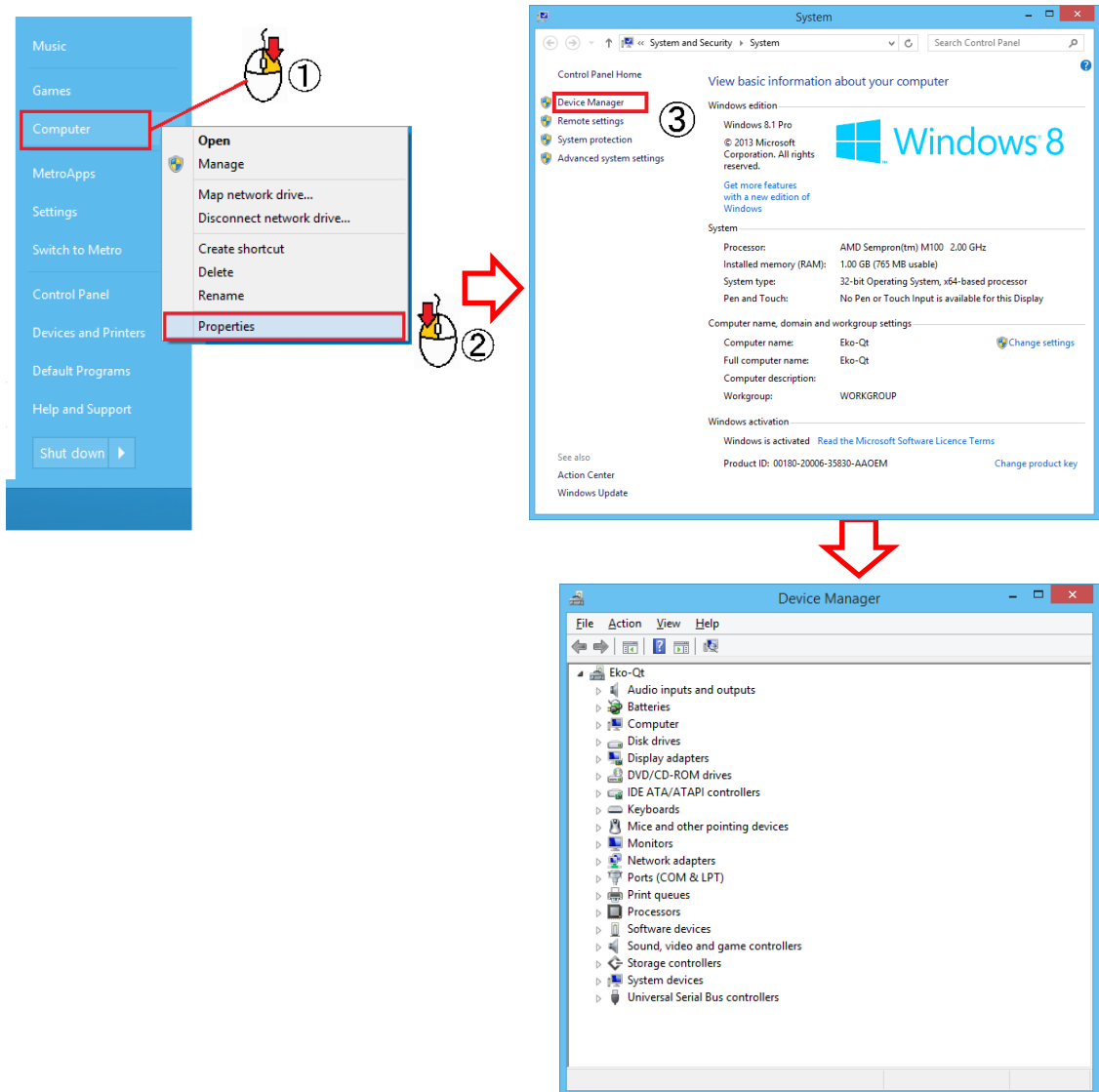
Figure 7-1-11. Starting Up the Device Manager

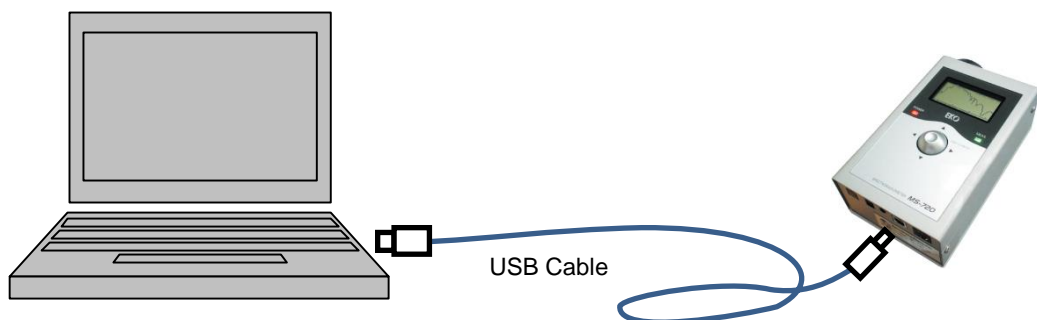(2) Connect the MS-720 to PC with USB cable and turn on the MS-720 power.

USB Cable

Figure 7-1-12. USB Cable connection Between PC and MS-720

(3)   From the MS-720 LCD menu display, move the cursor to "PC LINK" and press the ENTER button.
       "PC LINK NOW." Appears, and the condition MS-720 is linked with PC is indicated by the words displayed
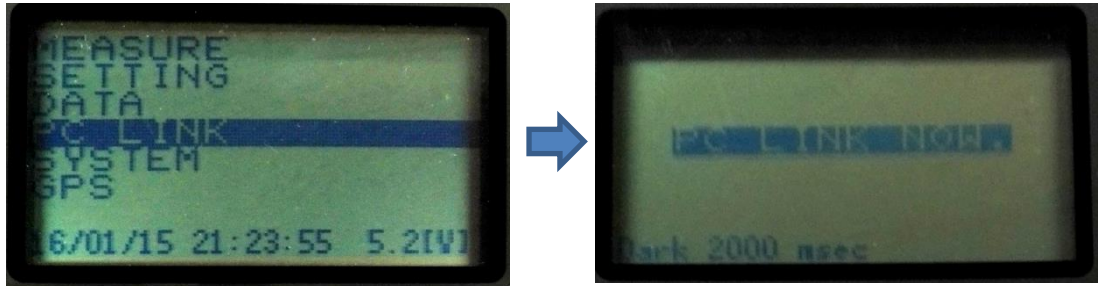   on the LCD blinking.

Figure 7-1-13. PC Connection Setting on MS-720

(4)   On the Device Manager, "Unknown device" appears.   Right click the "Unknown device" then left click the
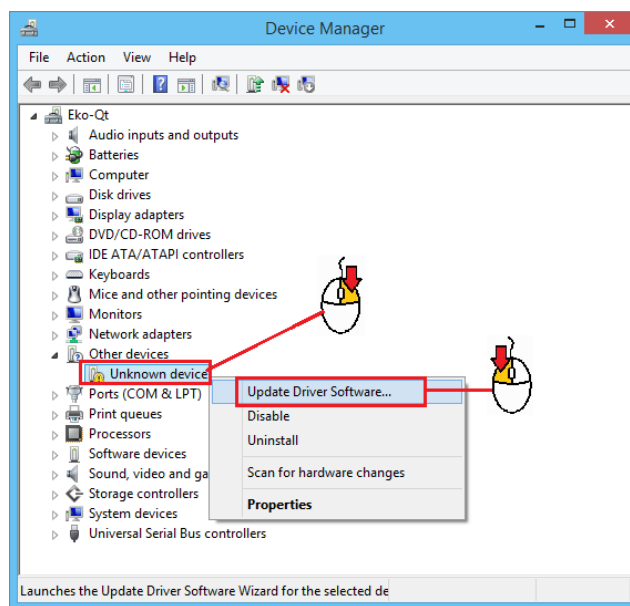   "Update Driver Software…"

Figure 7-1-14. Updating Driver Software

(5)   [Updating Driver Software – Unknown Device] dialog window appears.   It asks "How do you want to
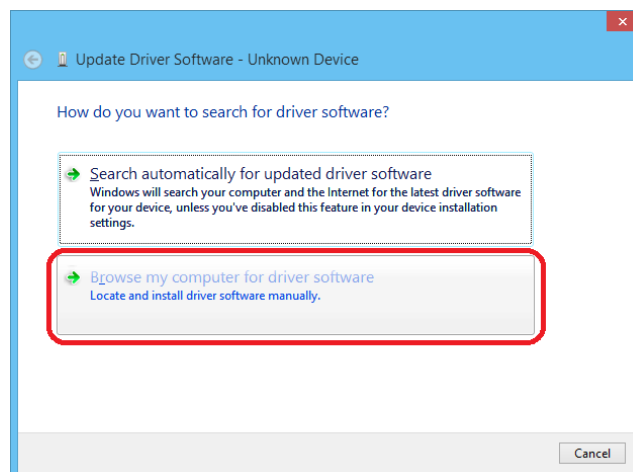   search for driver software?" so select "Browse my computer for driver software"

Figure 7-1-15. Searching Driver Software

(6) Next, it instructs as "Browse for driver software on your computer"; select "→Let me pic from a list of device drivers on my computer."

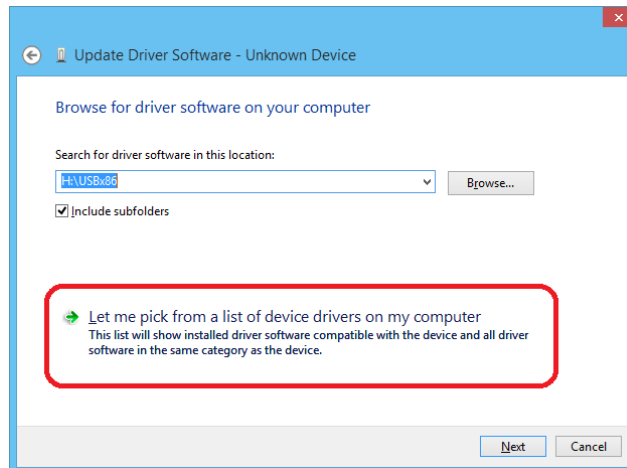

Figure 7-1-16. Selecting from a List of Device Driver on Computer

(7) It instructs next as "Select your device's type from the list below." Move the scroll bar and select the "Universal Serial Bus Controller" from the list of common hardware types, then click [Next] button.
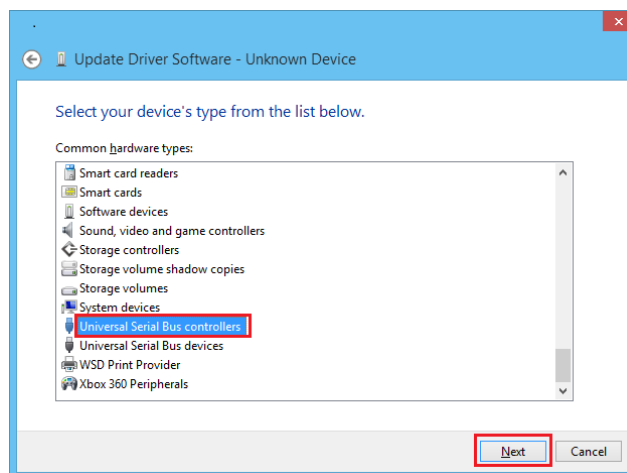

Figure 7-1-17. Selecting Common Hardware Type

(8) The instruction "Select the device driver you want to install for this hardware." appears. Move the scroll bar to find the manufacturer, and select "(Standard USB Host Controller)". Find and select "Unknown Device" from the Model list by moving the scroll bar. Then insert the attached CD-ROM to CD drive and click the [Have Disk…] button.

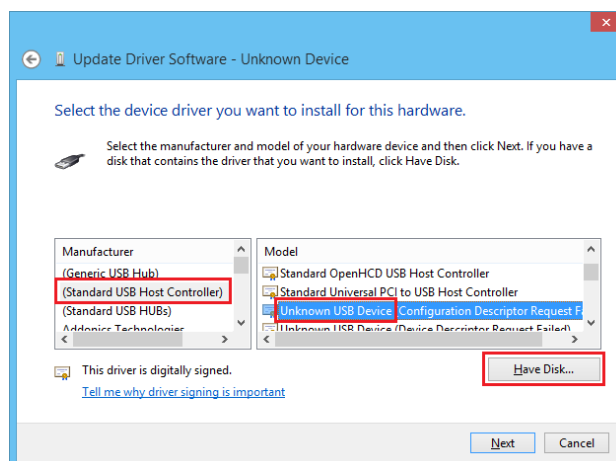

Figure 7-1-18. Select Device Driver

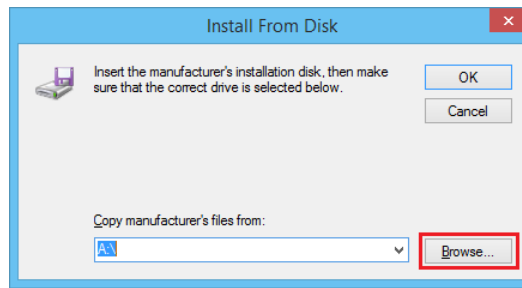(9) "Install From Disk" dialog window appears. Click the [Browse] button

Figure 7-1-19. Assigning Device Driver Folder

(10) When installing to PC with 64bit OS, select "USBx64_Driver" folder in the attached CD-ROM. Select "EkoUSB.inf" file is in the "USBx64_Driver" folder; and click [Open] button. When installing to PC with 32bit OS, select "USBx86_Drive" folder.
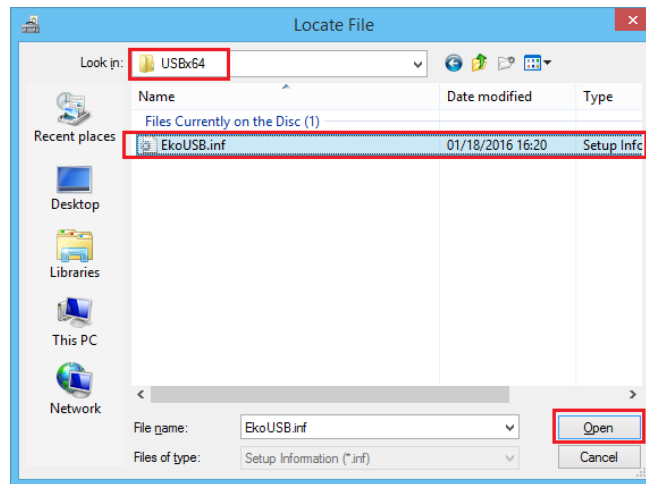

Figure 7-1-20. Assigning EKOUSB.inf File

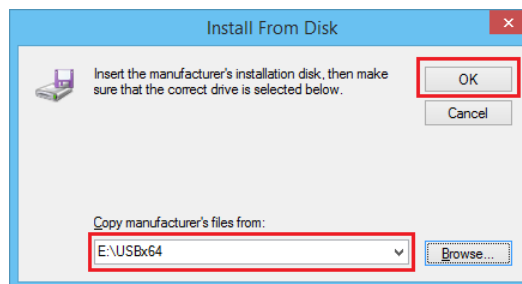(11) Confirm that "?:¥USBx64_Driver" is setup in the original manufacturer file copy then click [OK] button.

Figure 7-1-21. Copy Manufacturer's Files

(12) After a while, window returns to the initial display; the manufacturer disappears, and only the model name remains.　In the case of 64bit OS, it is displayed as "Eko 64bit USB Device"; in case of 32bit OS, it is displayed as "Eko 32bit USB Device".　Click [Next] button.

NOTE:　Under Model section, check the indication "This driver has Authenticode (tm) signature." In case of Windows7 with 64bit OS and notified as there is no signature, OS update may be old. Try again after updating to the latest version by Windows Update.　In case of 32bit OS, when there is not signature, warning message will appear; however, it will not affect the operation, so it can be used.
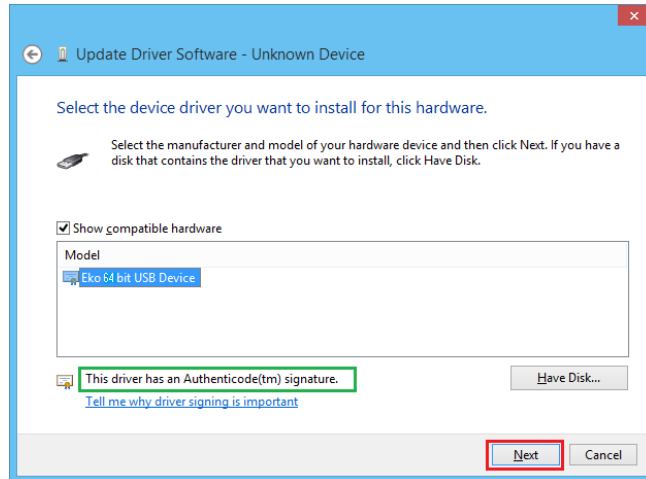

Figure 7-1-22. Confirming the USB Device

(13) Next, it asks "Would you like to install this device software?"　Check the checkbox for [Always trust the software from EKO Instruments Co., Ltd." and click [Install] button.
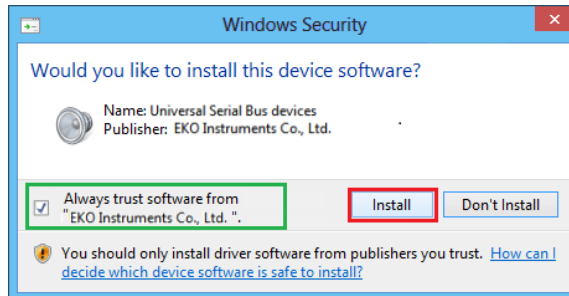

Figure 7-1-23. Confirming the Installation
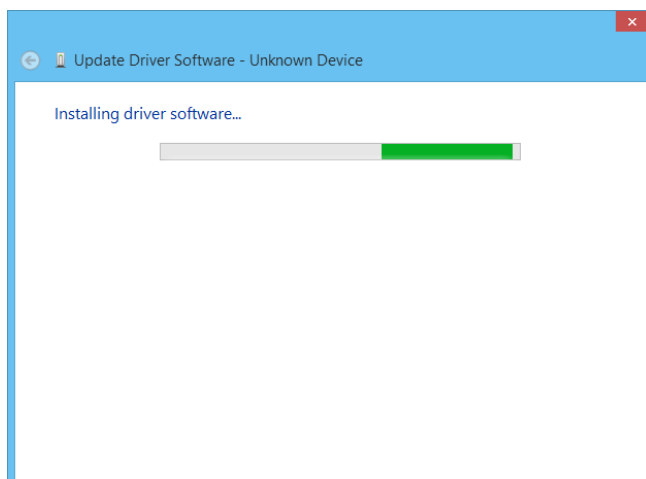

(14) Driver installation starts.

Figure 7-1-24. Installing Driver Software

(15) When the installation successfully completed, following window is displayed.　Click [Close] button.
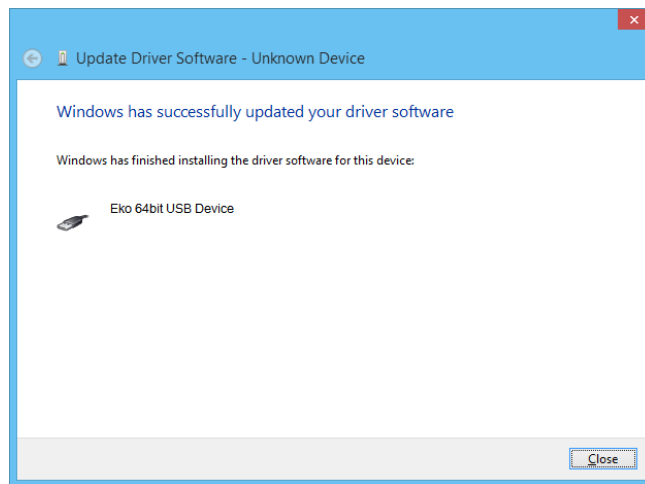
Figure 7-1-25. Successfully Updated Driver Software

Following error for example may occur.
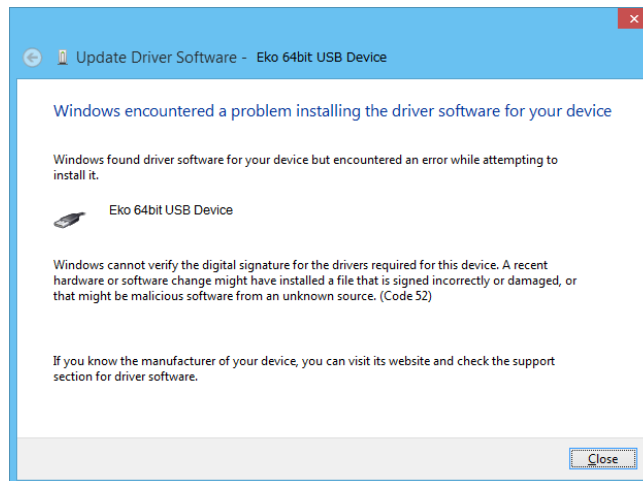
Figure 7-1-26. Example of Driver Installation Error

When this error occurred on Windows7 with 64bit OS, it is considered the OS may not be updated or update was unsuccessful.　If the OS can be updated to the latest version by Windows Update, try again after updating the OS.　If Windows Update does not function correctly, receive the support service from the PC manufacturer then update the OS.　Either method will take a long time; to quickly setup, PC can be started up with disabled digital signature. (See following section "Starting Up the PC with Disabled Digital Signature").　In case of 32bit OS, when signature cannot be verified, warning message will appear; however, it will not affect the operation, so it can be used.

(16) Confirm "Eko 64bit USB Device" is shown under "Universal Serial Bus devices" in the Device Manager window.   Close the Device Manager window if it is confirmed.
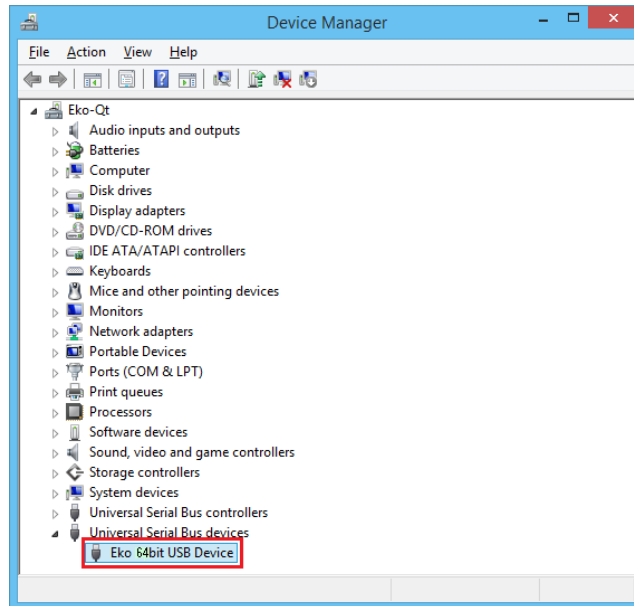
Figure 7-1-27. Confirming Identification of EKO USB Driver

4. Starting Up the PC with Disabled Digital Signature

With 64bits OS, basically the device driver without digital signature cannot operate; however, press [F8] key at the time of OS startup as test to display the detailed boot menu.   From this menu, the mode to ignore the forced device driver signature can be selected.   Use this method for the PC that Windows Update does not function.

Figure 7-1-28. Mode to Disable the Forced Driver Signature

7-2. Software Operations

"MS720_xXX.exe" is analysis software for MS-720; it is also possible to take measurement using this software while the MS-720 is connected to the PC and create graphs and convert the data formats.

This software is setup with a purpose to control only <u>ONE</u> MS-720. If one PC is to be used for multiple MS-720, make sure to restart the software each time the MS-720 is connected.

CAUTION:

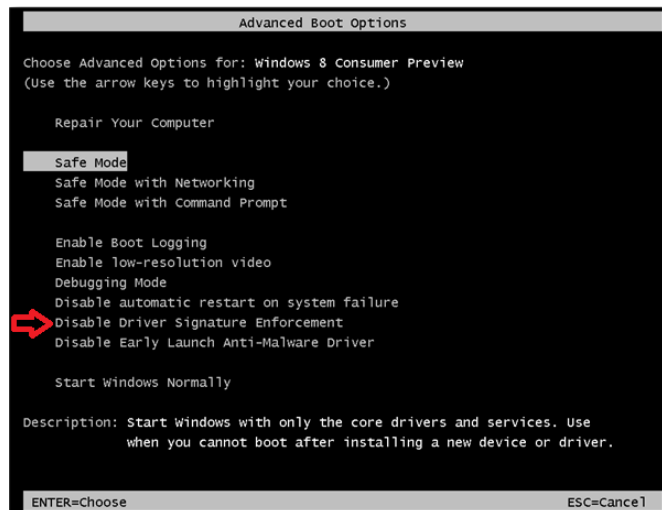**This software will read and register the calibration value from the MS-720 which is connected when the software is started.   Thus when using multiple MS-720, the software need to be restarted each time the MS-720 are switched; otherwise, accurate measurement cannot be taken due to the calibration value registered from the first MS-720 is used for the other measurements.**

1. Start-Up

Start "MS-720_xXX.exe" after checking the connection between MS-720 and PC. The "MS-720_xXX.exe" Window is displayed (Figure 7-2-1).
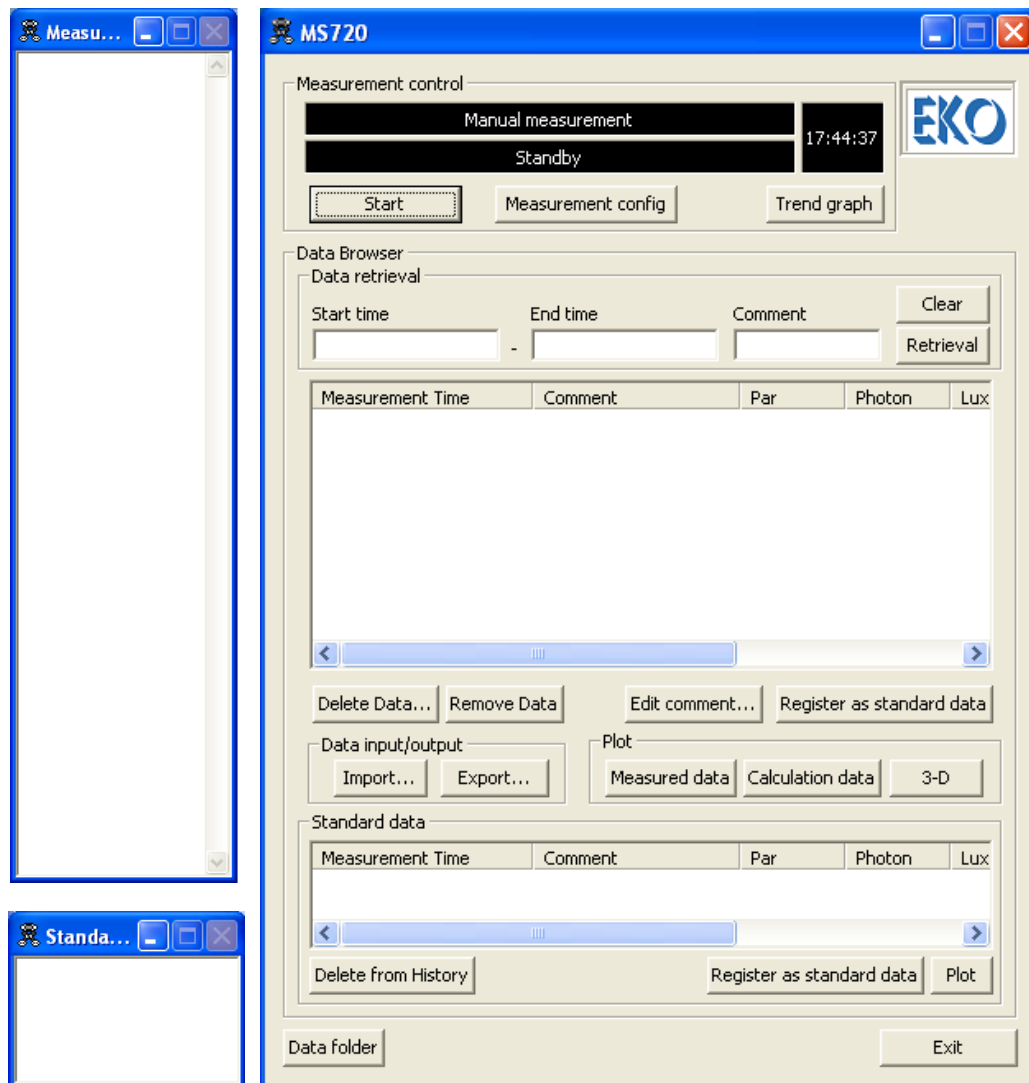

Figure 7-2-1. MS720_xXX.exe Window

In Figure 7-2-1, the right window shows the Main Window, the upper left window is a thumbnail window showing measurement data, and the lower left window is a thumbnail window showing standard data.

2. Before Starting Measurement

Assign the folder for data to be saved before starting measurement. The Data Folder Configuration Window is shown by clicking "Data Folder" button at the lower left of main window on Figure 7-2-1.

Click "Ref." to specify the saved data folder. "Filename ID" is the ID to be put at the top of the ESM file name. The default is "SPC".
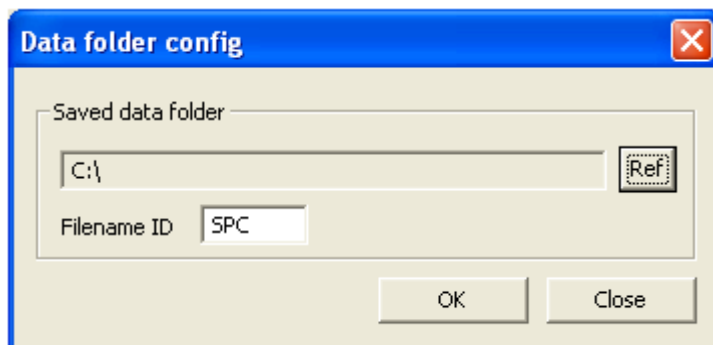
Figure 7-2-2. Data Folder Configuration Window

When measurement is taken, "measurement date" is placed at the end of file name: "Filename ID_yyyymmdd.esm". Allows to organize files by changing the Filename IDs.

3. Measurement Control Window

Measurement settings shall be input in the Measurement Control Window of main window.

(1) Measurement Control

Figure 7-2-3 shows the Measurement Control Window. The settings related to measurement start/stop and display the trend graph on this window.
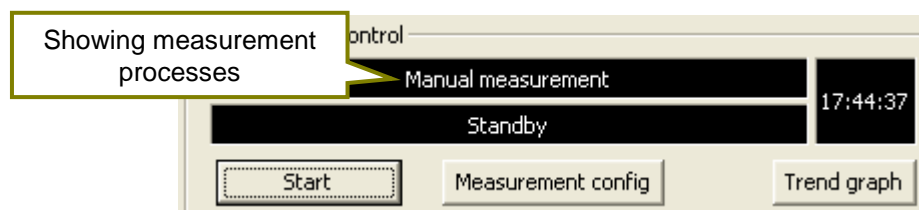
Figure 7-2-3. Measurement Control Window

(2) Measurement Configuration

When the "Measurement config" is clicked, below window will be shown (Figure 7-2-4), and the measurement related configurations can be setup.

Select "Manual measurement" or "Interval measurement" for the "Type" section.

Set measurement start time and measurement end time for "Interval measurement".

NOTE: These configurations are setup while MS-720 and PC are connected with USB or RS-232C cable.
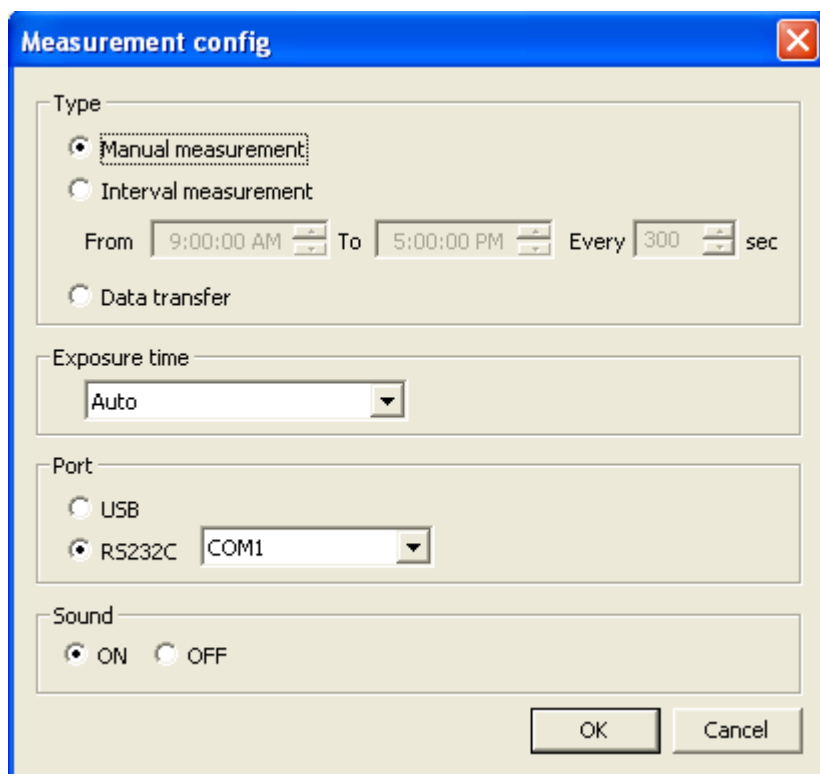
Figure 7-2-4. Measurement Configuration Window

1) Manual Measurement

Click "Measurement config" to display Measurement Configuration Window (Figure 7-2-3.).

When "Manual measurement" is selected by clicking the "Start" button, "Standby" status becomes "Measuring", and "Start" status becomes "Stop", as a measurement taken only once..

When the status indicating "Measuring", it means the light source measurement is taken; when "Dark measuring" is indicated as status, it means the dark current measurement is taken with the light source being blocked.

Figure 7-2-5. Measuring Status Window

Figure 7-2-6. Dark Measuring Status Window

2) Interval Measurement

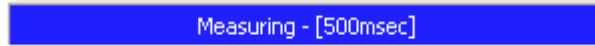When "Interval measurement" is selected, the measuring start-time (From) and the measuring end-time (To), and the interval can be setup. When the "Start" button on the Measurement Control Window, the Interval Measurement Standby Window is displayed (Figure 7-2-7). When the time reaches the start time, the window indication changes to measuring, then once the measurement is finished, window goes back to the standby window. To stop the "Interval Measurement", click the "Stop" button and the measurement is stopped.
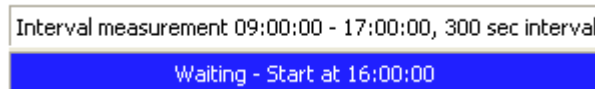
Figure 7-2-7. Interval Measurement Standby Window

The time interval for the interval measurement keeps time with "0:00:00" as the starting point every day, and it will start from the time interval nearest after the set time has passed. Figure 7-2-8 shows an example of when interval measurement start is setup at 8:00:00, and measurement interval is 70 seconds.
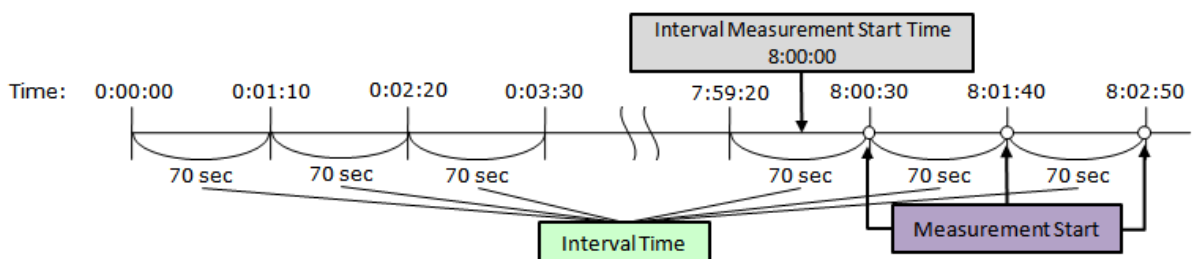
Figure 7-2-8. Example of Interval Measurement Settings

Also, if the actual measurement time is longer than the setup time the time interval will be different. Figure 7-2-9 shows an example of an interval measurement when the start time set at "8:00:00", measurement interval is 3 seconds, and the light source measurement time is 2 seconds.

MS-720's measurement time is the light source measurement time (shutter open), dark measurement time (shutter close), and the processing time of the measured data, all added together. The light source measurement time is automatically determined according to the intensity of irradiance. Dark measurement time will be the same time as the light source measurement time. The time which would take to perform one time measurement is described as follow:

$$
\begin{array}{rl}
& \textbf{Light source measurement time (shutter open)} \\
+ & \textbf{Dark measurement time (shutter close)} \\
+ & \textbf{Data processing time (<1 second)} \\
\hline
= & \textbf{One measurement time}
\end{array}
$$

* Measurement start time is set at "8:00:00", and measurement interval is 3 seconds.
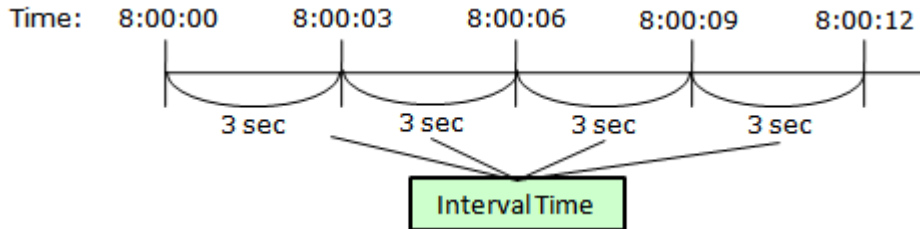
* When the light source measurement time takes 2 seconds with the above measurement setting.
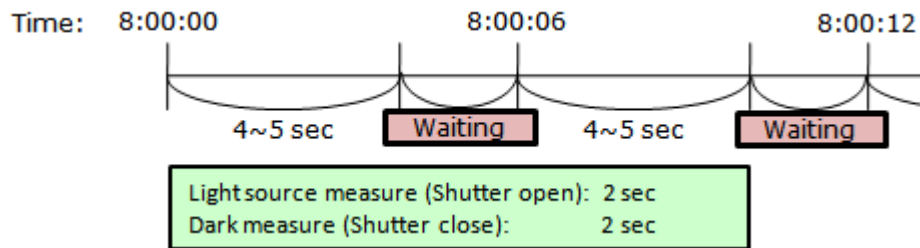
Figure 7-2-9. Example of Interval Measurement
(When the measurement interval is longer than actual measurement time)

(3) Download the Data

To download the measured data to PC, select "Data transfer". Connect MS-720 to the PC with USB or RS-232C cable, and click the "Start" button in the Measurement Control Window. (Caution!: When using multiple MS-720, the software need to be restarted each time the MS-720 are switched)

To display the downloaded data, click the "Retrieval" button as shown on Measured Data Display Window. Then, all data in Data View List are displayed.
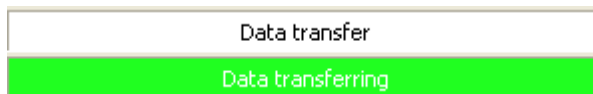
Figure 7-2-10. Data Transfer Window

Shutter open time is automatically controlled according to intensity of irradiance. (It cannot be manually controlled.)

For the Port, select either USB or RS-232C.   If the RS-232C is selected, enter the COM number which is used on the PC side.

Measurement sound at completion of each measurement can be set either "ON" or "OFF".

Once the above settings are done, click "OK" to close the Measurement Settings Window.

When the "Trend Graph" button is clicked right after a measurement is taken, the latest measured data is displayed.

Also, if the "Start" button is clicked or the interval measurement is started while the Trend Graph Window is displayed, the latest measured data after the each measurement is displayed.

4. Measurement Display Window

Data retrieval, graph display, file output, etc. can be operated on the Measured Data Display Window from the Main Window.   In addition to that, an outline graph is displayed in the Data Thumbnail Window according to the data displayed in Data View List.

Figure 7-2-11 Measured Data Display Window

(1) Retrieve the Data

The "Data retrieval" is used to search the data, which are obtained in the past, to be displayed. Enter the date and time of the data to be retrieved on the "Start time" and "End time" field, and click "Retrieval". The date and time can be entered as YYYY/MM/DD HH:MM:SS; it is also possible to enter the shorter format, such as YYYY/MM/DD and YYYY/MM.   However, same date or month cannot be entered for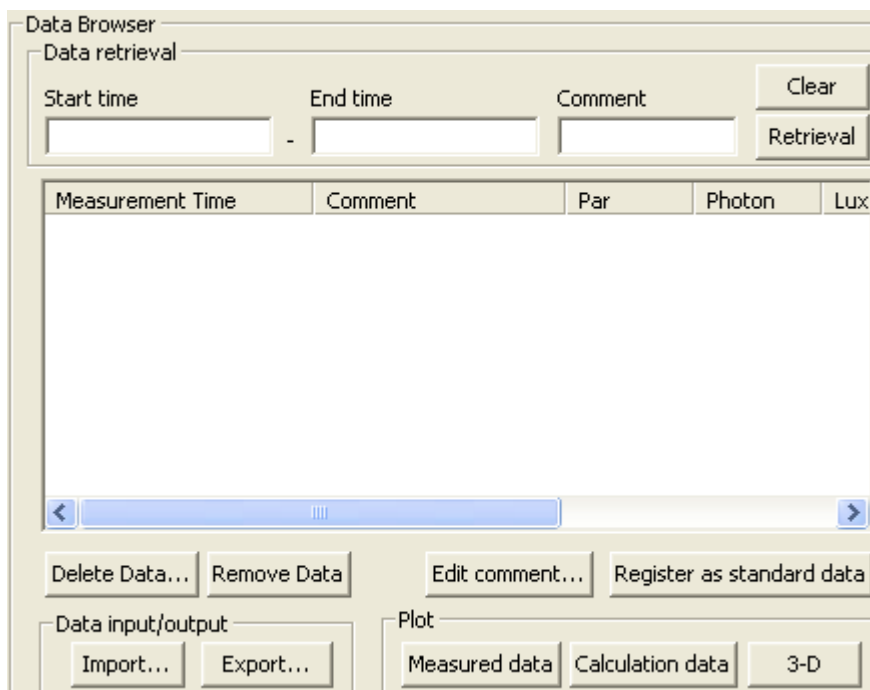 both "Start Time" and "End Time".   When entering as "YYYY/MM/DD", the End Time must be the date which is more than one day later than the Start Time. When entering as "YYYY/MM", the End Time must be the month which is more than one month later.

The data can be retrieved based on comment also if the data contains comment.   Enter key word in the field and click "Retrieval"; only the data containing the specific comment will be listed on the Data View List.

Clicking "Retrieval" button with the "Start time", "End time", and "Comment" fields as blank will retrieve all measured data in ESM files, which meet the file saved location (Ref) and "Filename ID" conditions setup at the Data Folder Configuration Window (Figure 7-2-2).

To delete the numbers and characters in the "Start time", "End time", and/or "Comment" fields, click the "Clear" button.

When the numbers and characters left entered in the fields and the program is finished, the entered date and comments will be kept as default for the next time software is opened.

NOTE: PC operation may slow down when large amounts of data are listed in the data view list, which creating more loads reading the data on the software   In that case, either to reduce the displaying data quantity which are searched after entering the "Start Time" or the "End Time" on the data search field, or reduce the displaying data quantity on the Data View List by changing the "Filename ID" on the Data Folder Configuration Window (Figure 7-2-2) and divide the data into several files.

(2) Deleting Data

To delete a specific data, select the specific data to be deleted from the Data View List, and click "Delete Data…" button. Then, Delete Confirmation Window (Figure 7-2-12) is displayed, and the data is completely deleted by clicking "Yes".

When selecting data, multiple data in a section can be selected by holding "Shift" key as selecting a section of data with mouse. Also, multiple data can be

Figure 7-2-12. Delete Confirmation Window

selected randomly by holding "Ctrl" button as selecting the multiple data with mouse.

Pushing "Ctrl + A" will select all the data listed on the Data View List.

NOTE: **Please note the deleted data cannot be displayed again on Data View List, although the data in ESM file are still saved at the specified folder in PC, after deleting all the data listed on Data View List.**

(3) Excluding Data

To exclude excess data for data analyzing, select the data to be excluded from the Data View List and click "Remove Data…" button. After the button is clicked, the data selected are removed from the Data View List.

When selecting data, multiple data in a section can be selected by holding "Shift" key as selecting a section of data with mouse. Also, multiple data can be selected randomly by holding "Ctrl" button as selecting the multiple data with mouse.

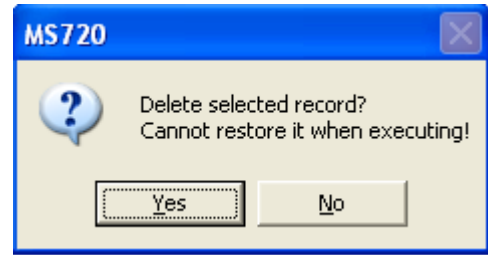Pushing "Ctrl + A" will select all the data listed on the Data View List.

NOTE: **To display the excluded data on Data View List again, retrieve the data again by searching the data from Retrieving Displaying Data procedure.**

(4) Edit Comment

To add any comments for measured data, click the "Edit comment" button after selecting one or multiple data from the Data View List; comments can be added to the data selected. When characters are entered in the "Edit comment…" window as shown in Figure 7-2-13, the comments are shown in the Data View List and the CSV File.

When multiple data are selected and edited, the added comments are shown in all selected data.
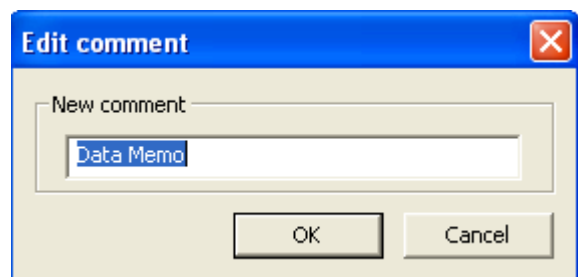

Figure 7-2-13. Edit Comment

(5) Registering Standard Data

To register the standard data, select one of measured data, and click "Register as standard data" button. The registered data is added to the "Standard Data View List" as shown on Figure 7-2-26, at the same time, the standard data graph is displayed in the Standard Data Thumbnail Window.

(6) Display the Data Graph

To display the data graph window, select the one or multiple data from the Data View List and click the "Measured data" button in "Plot" on the Measured Data Display Window or double click the data. Also, graphs can be displayed by double clicking the data on the Display Data Thumbnail Window next to the Main Window.

1) When One Data is Selected

When one data is selected and the graph is displayed, below Figure 7-2-14 window is displayed.
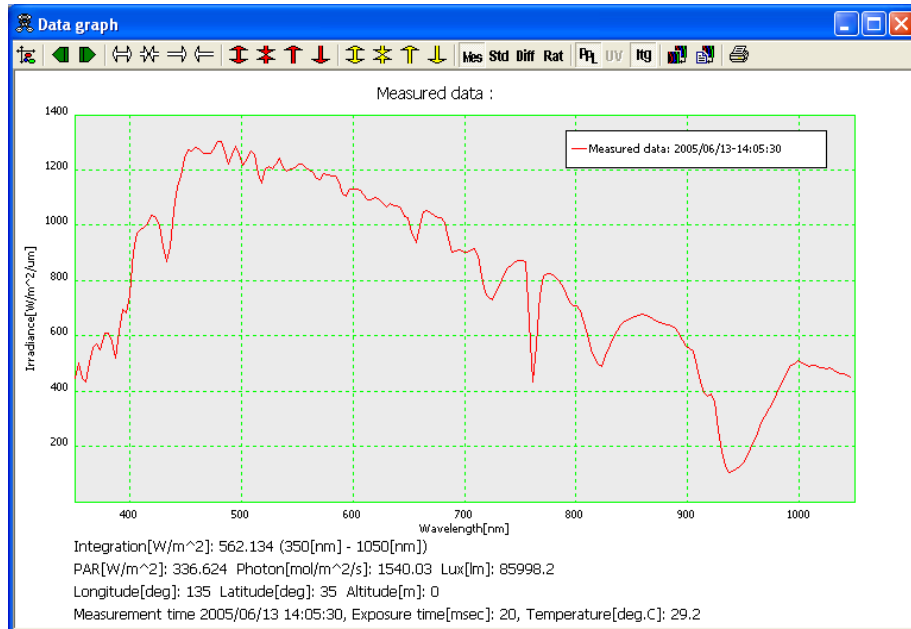
Figure 7-2-14. Data Graph Display Window

There is a tool bar above the Data Graph Display, and the graph settings, graph zoom in/out and data display on/off can be edited.   The following functions are available with the Tool Bar (Figure 7-24).
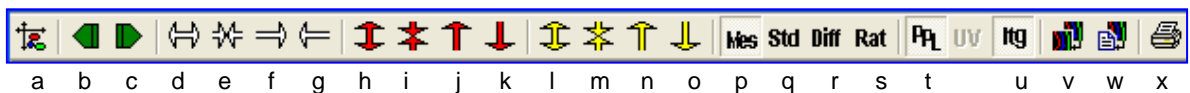
Figure 7-2-15. Tool Bar

Table 7-1 Tool Bar Functions

a	Graph Configuration	When this button is clicked, the Graph Configuration Window will appear, as shown on Figure 7-2-16
b	Previous Data	Shows the data taken previous to the currently displaying data.
c	Next Data	Shows the data taken next to the currently displaying data.
d	Zoom-in Wavelength	Show zoomed in data graph in x-axis direction
e	Zoom-out Wavelength	Show zoomed out data graph in x-axis direction
f	Shift Right-Wavelength	Shift graph to right in X-axis direction. This button can be used after the graph is zoomed in with "Zoom-in Wavelength" button.
g	Shift Left-Wavelength	Shift graph to left in X-axis direction. This button can be used after the graph is zoomed in with "Zoom-in Wavelength" button.

Table 7-1 Tool Bar Functions - Continued

h	Zoom-in Irradiance	Show zoomed in data graph in Y-axis direction. This is valid when the "Auto" checkbox for Y-axis setting on Graph Configuration Window is unchecked.
i	Zoom-out Irradiance	Show zoomed out data graph in Y-axis direction. This is valid when the "Auto" checkbox for Y-axis setting on Graph Configuration Window is unchecked.
j	Shift Up Irradiance	Shift graph up in Y-axis direction. This is valid when the "Auto" checkbox for Y-axis setting on Graph Configuration Window is unchecked.
k	Shift Down Irradiance	Shift graph down in Y-axis direction. This is valid when the "Auto" checkbox for Y-axis setting on Graph Configuration Window is unchecked.
l	Zoom-in Ratio data	Show zoomed in ratio data graph. This is available when the "Auto" checkbox for Ratio data on Graph Configuration Window is unchecked.
m	Zoom-out Ratio data	Show zoomed out ratio data graph. This is available when the "Auto" checkbox for the Ratio data on the Graph Configuration Window is unchecked.
n	Shift Up Ratio Data	Shift ratio data graph up. This is available when the "Auto" checkbox for the Ratio data on the Graph Configuration Window is unchecked.
o	Shift Down Ratio Data	Shift ratio data graph down. This is available when the "Auto" checkbox for the Ratio data on the Graph Configuration Window is unchecked.
p	Plot Measured Data	Shows the measured data; this function is usually turned on.
q	Plot Standard Data	The graph of standard data, which is registered in the Standard Data List, is displayed. When the button is clicked once again, it is turned off, and the standard data graph disappears.
r	Plot Difference Data	Graph difference against standard data is displayed.
s	Plot Ratio Data	Graph of ratio (%) against standard data is displayed.
t	Show PAR/Photon/LUX	Calculated value of spectral data, which is obtained by MS-720
u	Show Integration	When this is turned on, the integrated values which are calculated according to the settings on the Graph Configuration Window will be shown at the bottom of the graph
v	Copy to Clipboard	The displaying graph is copied to clip bard. The copied graph can be pasted to Excel or Word.
w	Save as Bitmap File	The graph is saved as Bitmap
x	Print	The displaying graph is printed.

On the Graph Configuration, it is used when the X-axis, Y-axis, sectional integration, color of the measured data settings as shown on the Figure 7-2-14.   When the Graph Configuration button is clicked on the Tool Bar, the Graph Configuration Window will appear, as shown on Figure 7-2-16.
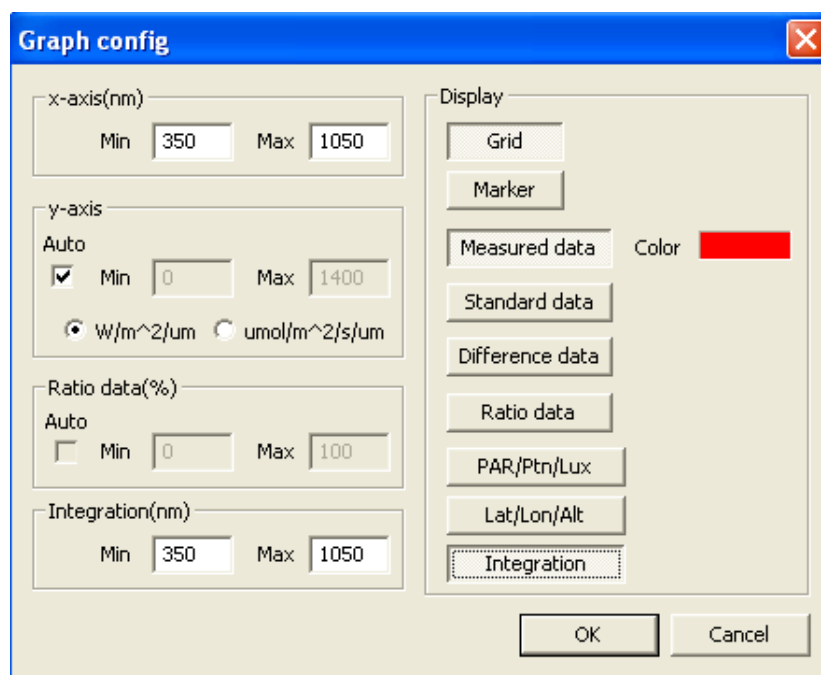

Figure 7-2-16. Graph Configuration Window (When only one data is selected.)

Table 7-2. Graph Configuration Window Functions

X-axis	Setup the min. and max. values for X-axis to be displayed on graph. The min. is 350nm and max. is 1050nm for setup.
Y-axis	The min and max value scale for Y-axis can be automatically setup when the "Auto" checkbox is checked. When "Auto" is unchecked, any scale can be entered in the textbox on the right side of Min and Max Values. The default unit for the spectral irradiance is selected as $W/m^2/\mu m$. Also $umol/m^2/s/\mu m$ can be selected to display spectral photon irradiance.
Ratio data (%)	This is used to set the scale of ratio data between the standard data and the measured data. This function becomes valid when "Ratio Data" button is clicked. When the "Auto" checkbox is checked, the Y-axis min and max scales are automatically setup. Also when this is unchecked, any scale can be entered in the textbox.
Integration (nm)	The interval integration function is available when "Show Integration" button on "Display" menu is clicked. In this condition, any wavelength range to be integrated can be setup. The integrated value is displayed at the bottom of the graph, and the unit is W/m^2.
Grid Button	Show the grid lines. The number of grid lines is automatically determined.
Marker Button	When this button is on, markers (dots) of the data values are displayed along with the line on the spectral display.
"Measured data" Color	Default colors are setup as following.
	Measured data Red Difference data Violet
	Standard data Green Ratio data Blue.
	To change the color or each data, click "Color" button for each item.
Standard Data	Show a graph for a data that is registered in the standard data. Click this button again to hide the standard data graph.
Difference Data	Displays the difference between standard and measured data.
PAR/Photon/LUX Button	This shows calculated value of spectral data obtained by MS-720.

Once the "OK" button is clicked, the configurations are reflected and the "Graph Configuration" is completed.

2) When Multiple Data are Selected
When multiple data are selected from the Data View List, the graphs can be overwritten and displayed up to 10 data.   The operation of the Graph Configuration Window is basically the same as above; however, the data which can be displayed on graph is only one of "Measured Data", "Difference Data", or "Ratio Data".   Also it is possible to show or no show the any of the graphs from 1 to 10.
In order to not display any graph, turn off the button of the data shown in Figure 7-2-18 Graph Configuration Window.
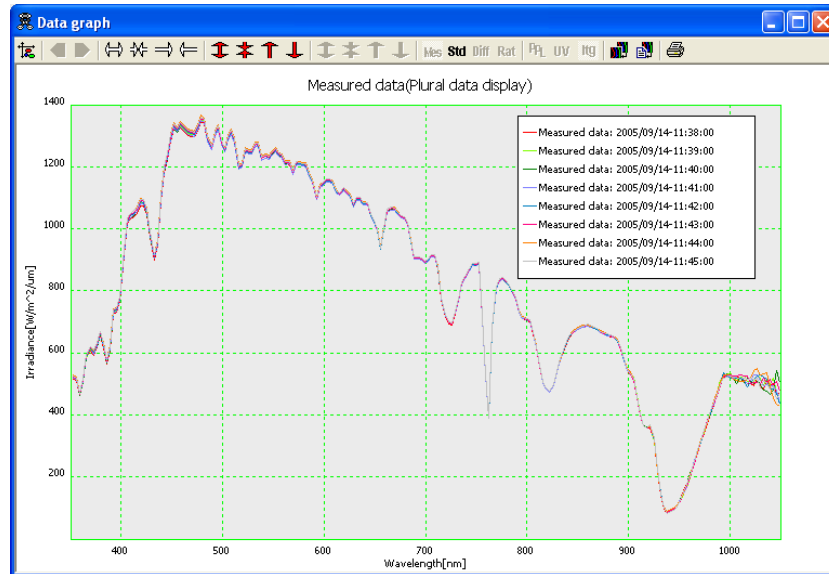

Figure 7-2-17. Data Graph Display Window
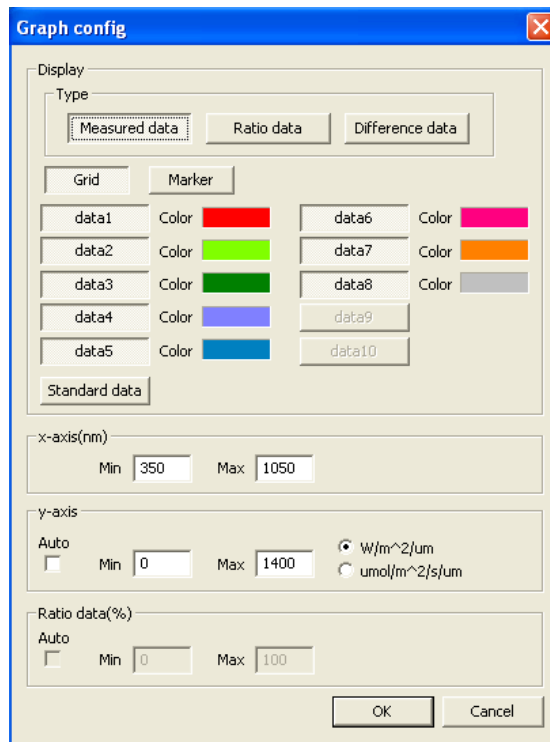(When multiple data are selected)

Figure 7-2-18. Graph Configuration Window
(When multiple data are selected)

(7) Display Calculation Data Graph

   To display the Calculation Data Window (Figure 7-2-19), select multiple data from the data View List, and click "Calculation data" button on the Measured Data Display Window.

   Calculation of the data graph indicates PAR/Photon/LUX/Integration Value in Y-axis and the time in X-axis, and the each integrated value of the measured data checked in time series.

   Also, dragging the mouse near the data obtained on the graph, the data that are dragged are indicated in red line, and the measurement time and the integrated value are displayed.

Figure 7-2-19 Calculation Data Graph Window

Calculation Data Graph Configuration Window operation is basically the same as the Data Configuration Window, but only one out of "Measured Data", "Difference Data", or "Ratio Data" can be selected for displaying in the Calculation Data Graph.

There are "Time series" or "Equal interval" for Time Axis Type.

The "Time series" is based on the very old and new time of the multiple data selected from the Data View List, and the graph is shown with X-axis setup according to that time interval.

The "Equal interval" button plots the data at even intervals regardless of the measurement time.
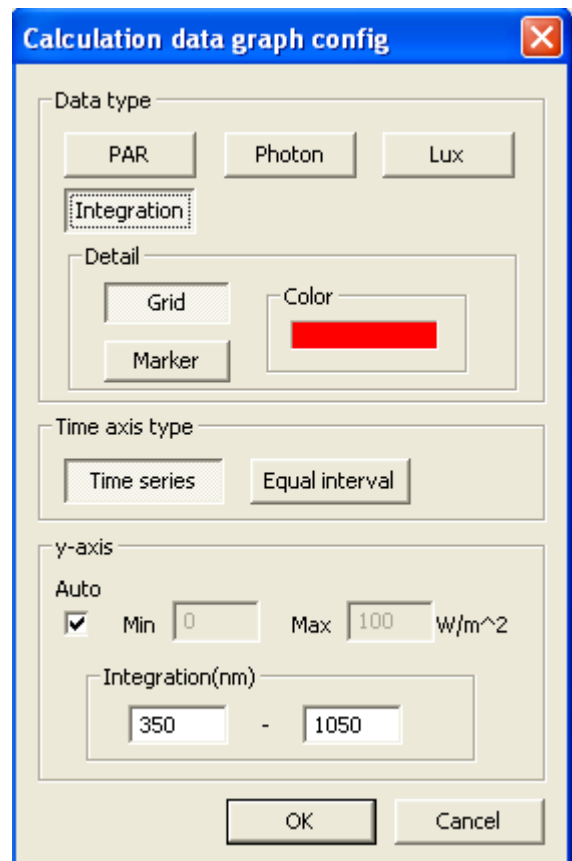

Figure 7-2-20 Calculation Data Graph Configuration Window

(8)   3-D Graph Display

To display a 3-D graph, click the "3-D" button in the Measurement Data Display Window.

In the 3-D graph it is shown as the Y-axis is for Spectral Irradiance, the X-axis is for Wavelength, and the Z-axis is for time (see Figure 7-2-21 and 7-2-22).

The Argument Θ shows the horizontal plane angle (0-90°) of Wavelength (X axis) and Time (Z axis), and the Argument Φ shows the vertical plane angle (0-90°) of Time (Z axis) and Irradiance (Y axis).

To change the viewpoint, drag the graph with the mouse in the desired direction.

There is a tool bar at the top of the 3-D Graph Window, it allows to edit the graph settings and zoom in/out of graphs just as same as the Data Graph Display Window.
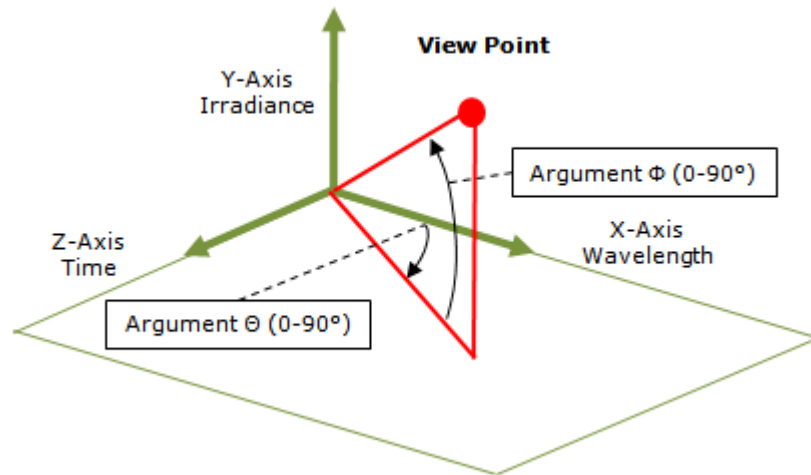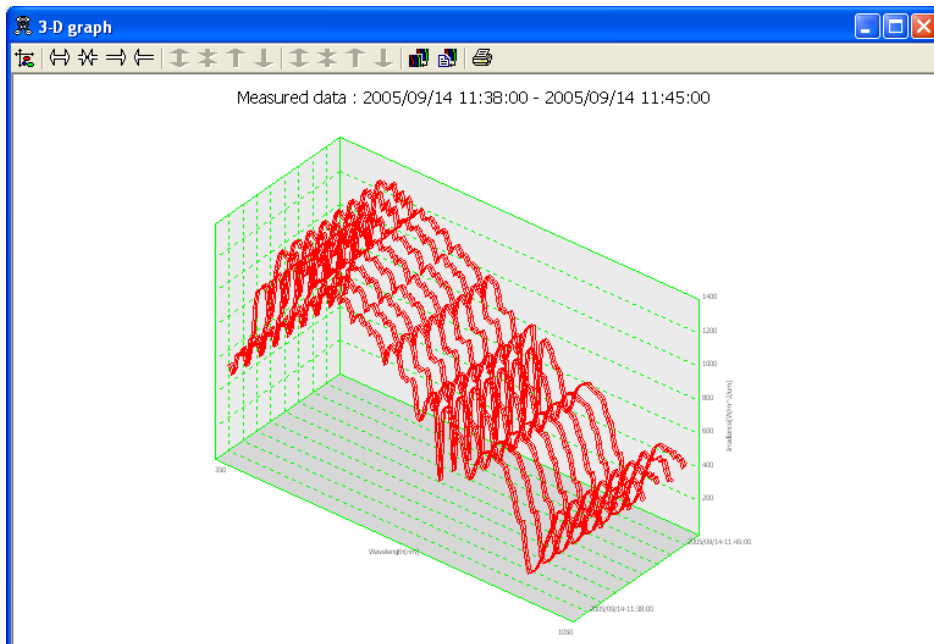

Figure 7-2-21. 3-D Data Description

Figure 7-2-22. 3-D Graph Display Window

The basic operation of the 3-D Data Graph Window is almost same as the Data Configuration Window; however, the settings of Argument Θ (0~90°) and Argument Φ (0~90°) can be the user's "Viewpoint" entered directly. The range is from 0 to 90°.
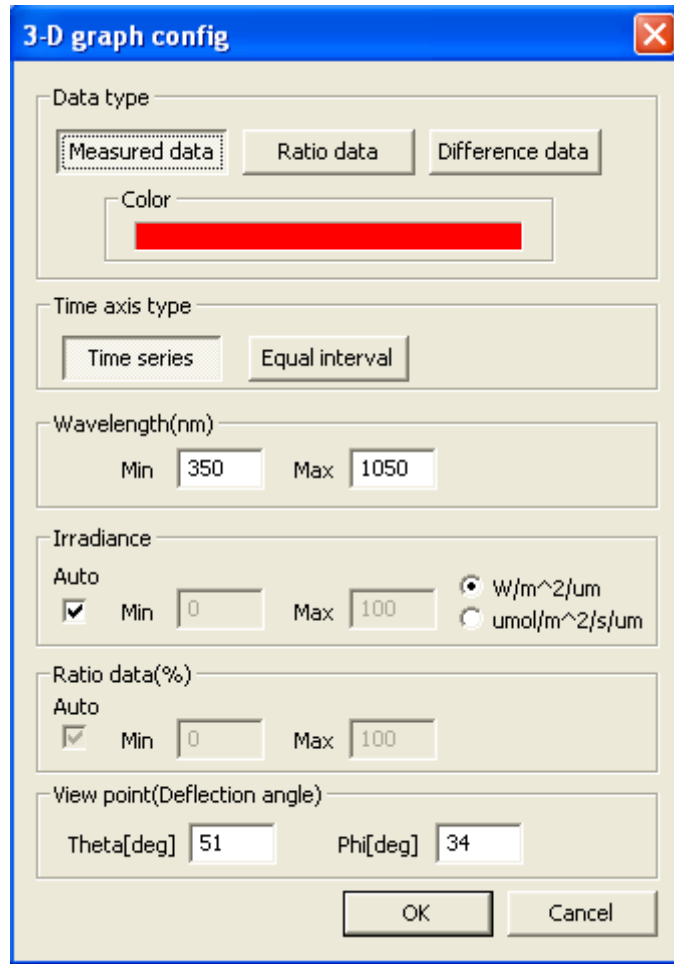
Figure 7-2-23. 3-D Graph Setting Window

(9)　Import

　　　The "Import" is used to import SRD files (Binary Data) from the old version software "720Man.exe". Imported data is converted to ESM file (Binary Data).

　　　When the "Import" button on the Measured Data Display Window is clicked, below window appears (Figure 7-2-24); select the SRD file by clicking the "Ref" button.　After selecting the SRD file, click on the "Import" button on the Import Window (Figure 7-2-24) will convert the SRD file into ESM file, and the imported file is named as Filename ID_yyyymmdd.esm, and saved at the folder, which is specified in Data Folder Configuration Window (Figure 7-2-2).

　　　If the checkbox for "Overwrite same time record" is checked and click "Import", the data that have same time data already exist in the Data View List while importing, the same time data file in the Data View List are overwritten.
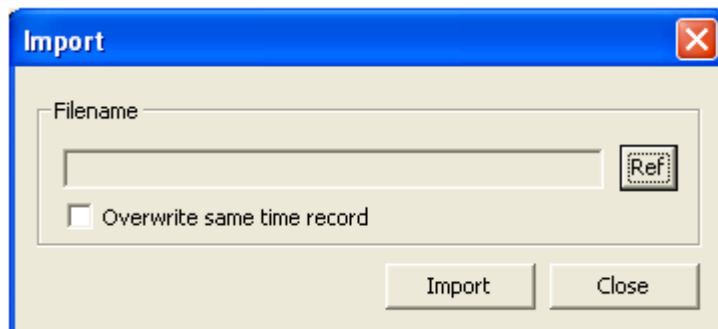

Figure 7-2-24. Import Window

(10) Export

"Export" is used to convert the measured data into CSV files. Selecting one or more data from the data View List and click the "Export" button, the Export Window (Figure 7-2-25) is displayed.
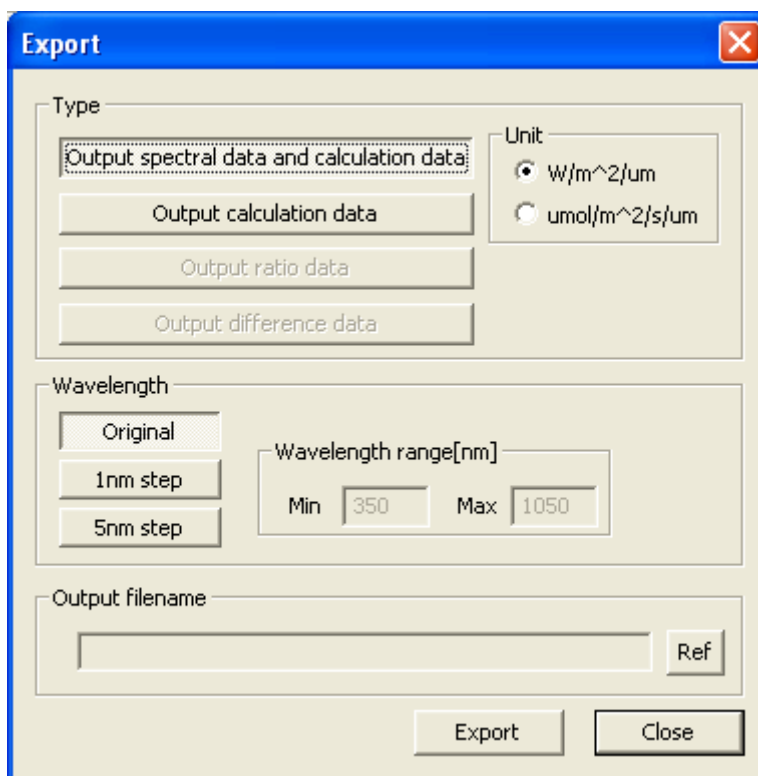

Figure 7-2-25 Export Window

Table 7-3. Export Window Functions

[Output spectral data and calculation data] Button	Measured time, comment, PAR/Photon/LUX, Lat/Lon/Alt, and the spectral data per each specified wavelength pitch are converted into CSV file.
[Output calculation data] Button	Measured time, comment, PAR/Photon/LUX, and Lat/Lon/Alt are converted into CSV file.
[Output ratio data] Button	Measured time, comment, and the spectral ratio data per each specified wavelength pitch are converted into CSV file.
[Output difference data] Button	Measured time, comment, and the spectral difference data per each specified wavelength pitch are converted into CSV file.
Unit	Select either $W/m^2/\mu m$ or $umol/m^2/s/\mu m$.
Wavelength section	Select from "Original", "1nm step" or "5nm step". When "1nm step" or "5nm step" is selected, the wavelength range can be selected. The data for "1nm step" and "5nm step" are the data linearized to straight line from the measurement data based on the "Original" wavelength pitch.
"Output filename	Assign the location and the file name of the file which is to be converted into CSV. Click "Export" button, then the CSV file is created. ***When more than 256 data are selected and converted into CSV files, an error message will popup as the data is opened with MS Excel. Please be noted that due to the cell arrangement of the MS Excel, the data above 256th cannot be converted into CSV file.**

5. Standard Data Display

On the Standard Data Display Window in the Main window, the Standard Data View List shows the measured data that are registered as standard data (Figure 7-2-26).

It can also display standard data graph and manage the history. At the same time with the data displayed on the Standard Data View List, a simple graph is displayed on the Standard Data Thumbnail Window.
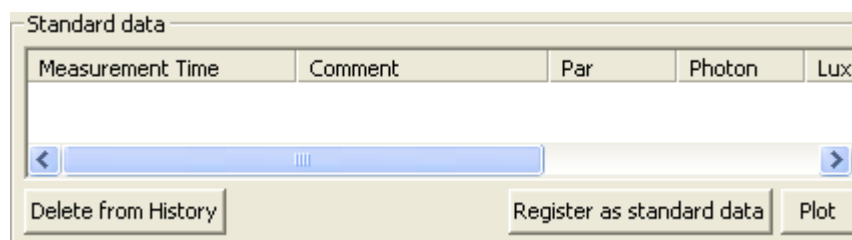

Figure 7-2-26. Standard Data Display Window

Table 7-4. Standard data display window functions

Register Standard Data Button	Selecting one data registered in the past from the Standard Data View List and click the "Register as standard data", the selected data becomes the newest standard data and shown at the top of the view list. Also, the newest standard data is displayed with a simple graph on the Standard Data Thumbnail Window.
Plot Button	Displays a data graph which is in the Standard Data View List. Select one data from the view list and click the "Plot" button; the standard data graph is displayed.
Delete from History Button	Unnecessary data can be deleted from the Standard Data View List, which contains multiple data. The data is deleted from the view list by selecting specific data and click "Delete from History" button. This function deletes the data from the history, but the data itself is not deleted from the memory.

6. Data File Format

The following data file formats are available for use with the MS-720 software.

Table 6-1 File Format

Symbol	File type	Binary/ASCII	Wavelength Interval
A	ESM file	Binary	According to MS-720 specifications
B	CSV file	ASCII	According to MS-720 specifications
C			1nm or 5nm interval

(1) ESM File (Binary Data)

ESM file is composed with binary data. The spectral radiation of the wavelength interval, according to MS-720 specifications, is saved in the ESM file.

(2) CSV (Comma Separation Variable) File (ASCII Data)

CSV file is composed with ASCII data. In CSV file, the spectral radiation of the wavelength interval, according to MS-720 specifications is saved in CSV file as well as ESM file.

The spectral radiation of the 1nm or 5nm interval can be saved in CSV file.

CSV files can be easily converted to other formats, including Microsoft Excel.

7. Others

(1) Version

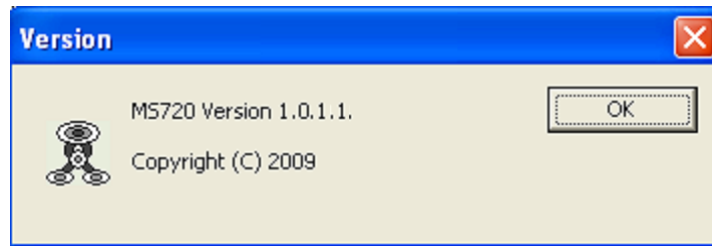To check the software version, right click the top tab of the Main window and select "Version".

Figure 7-2-27. Software Version Window

(2) EKO Website

If the PC is connected to the Internet, EKO home page can be displayed by clicking on the "EKO" logo on the right top on the Main window.

Figure 7-2-28. EKO Home Page

8. Maintenance & Troubleshooting

8-1. Maintenance

To maintain accurate measurement, it is recommended to check and do the following:

1. Cleaning Diffuser

If the diffuser is dirty, incident light decreases, thus keep it clean by wiping with a soft cloth gently and so on before measurement. If hard cloth is used, it could damage the surface of the diffuser; therefore, please be careful with handling.

2. Battery Replacements

Although the power is supplied either with 4 x AA batteries and/or optional AC adopter for this product, batteries have life time. Prepare new set of batteries when the voltage shown at the bottom of the LCD Menu becomes less than 5V.

8-2. Troubleshooting

Check the following items in case of trouble with the instrument.   If any questions should remain, contact EKO for further technical support.

Table 8-1. Troubleshooting

Failure	Action
-MS-720 does not turn on.	1) Check if the batteries are dead. Replace the batteries with new ones, and check if the power turns on. 2) The PCB inside the MS-720 could be damaged. Please contact EKO Instruments.
-Cannot take measurement. -The obtained data cannot be downloaded.	1) Check if both PC and MS-720 are on. 2) Check if the COM port connected to PC is setup correctly. 3) Check if PC and MS-720 are in the communicative condition by selecting [PC LINK] from the Menu on the LCD of MS-720.
-Abnormal measurement results	1) The diffuser maybe dirty or something is blocking the incident light; clean the aperture before start measuring. 2) The PCB, shutter, or spectrometer may be damaged. Please contact EKO Instruments. 3) If one PC is to be used for multiple MS-720, make sure to restart the software each time the MS-720 is connected.
- Abnormal software operation	Please reboot the PC. The PC or software operation maybe abnormal.
- LCD does not display characters. - Key operation does not work.	The internal circuit board maybe damaged. Please contact EKO Instruments.

9. Specification

9-1. Main Unit

Table 9-1. MS-720 Specification

Items	Specifications
Wavelength Range	350 to 1,050nm
Wavelength Interval	3.3nm
Wavelength Resolution	10nm
Wavelength Accuracy	Less than 0.3nm
Field of View	180° (Full Angle)
Stray Light	Less than 0.15%
Temperature Dependency	±5%
Unit of the Output	$W/m^2/\mu m$, $\mu mol/ m^2/s/\mu m$
Measurement Time	0.005 to 5 sec/Automatic Controlled Time
Maximum Data Quantity	800 (Approximately 2 minutes for download)
Power Supply	AA Battery x 4 Optional AC Adapter AC100-240V, 50/60Hz, DC5V
Size	W100 x D165 x H60 (mm)
Weight	720g (Including Batteries and aperture)
Interface	RS-232C / USB
Working conditions	Temperature: -10 to +40, Humidity: 0 to 90%RH (no condensation)

9-2. Software

Table 9-2. Software Specification

Items	Specifications	
Software Version	1.0.1.x	
Firmware Version	1.5.3	
Program	Analysis Software: For 64bit: MS720_x64.exe For 32bit: MS720_x86.exe	
OS	Microsoft Windows 7 / 8.0 / 8.1	
Interface	RS-232C / USB	
Functions	Display data (List View/Detailed View) Data measurement (Binary data saving) Save data (CSV Format) Analyze data (Data Comparison)	
PC Requirements	CPU	Better than Pentium 500MHz
	Memory	256MB or more
	Hard Disc	10GB or more
	Screen Resolution	1024×768 or more
	Other	CD-ROM Drive, RS-232C Port, USB Port

9-3. Dimensions

1. MS-720 Main Unit

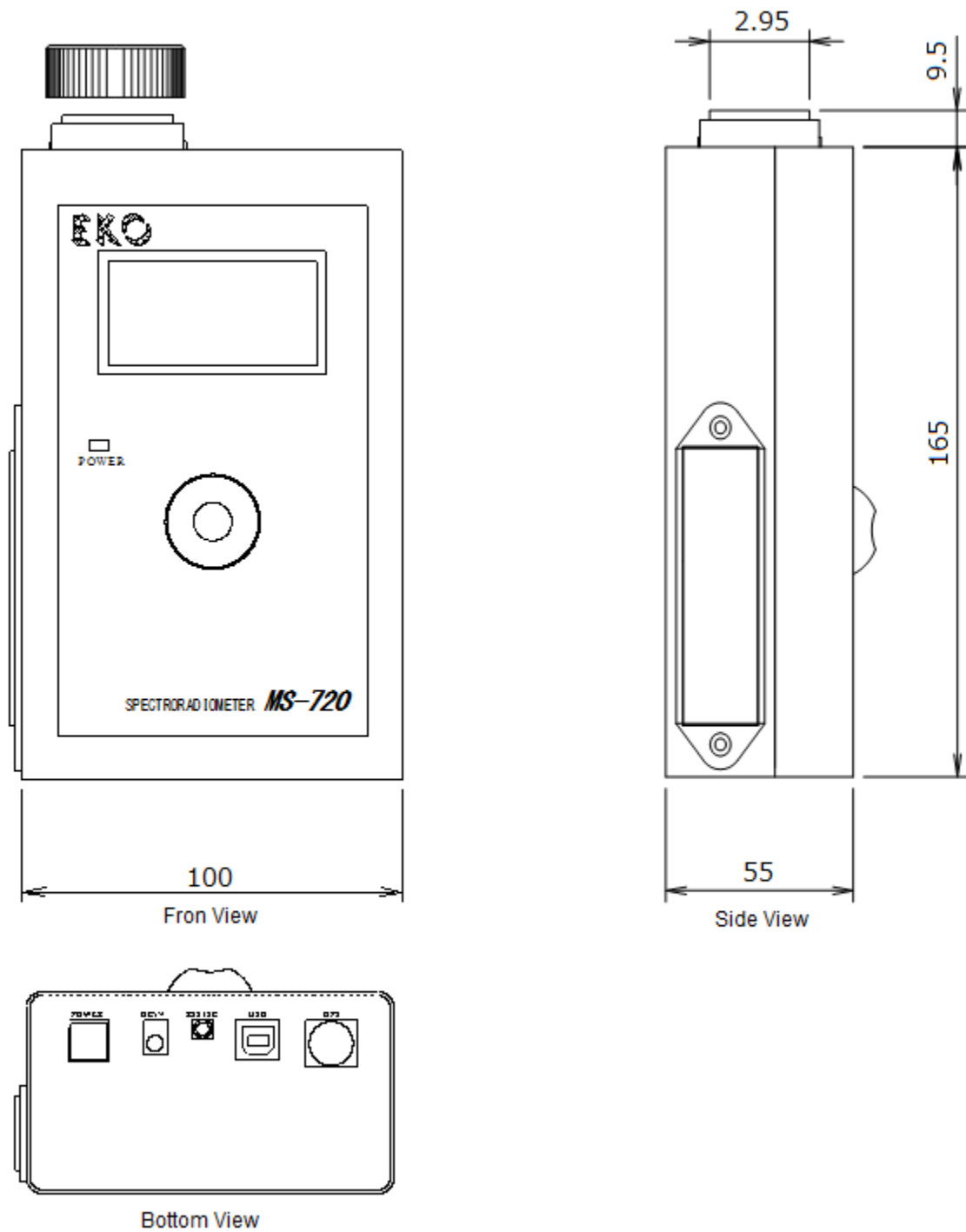
Figure 9-1. MS-720E Main Unit Dimension
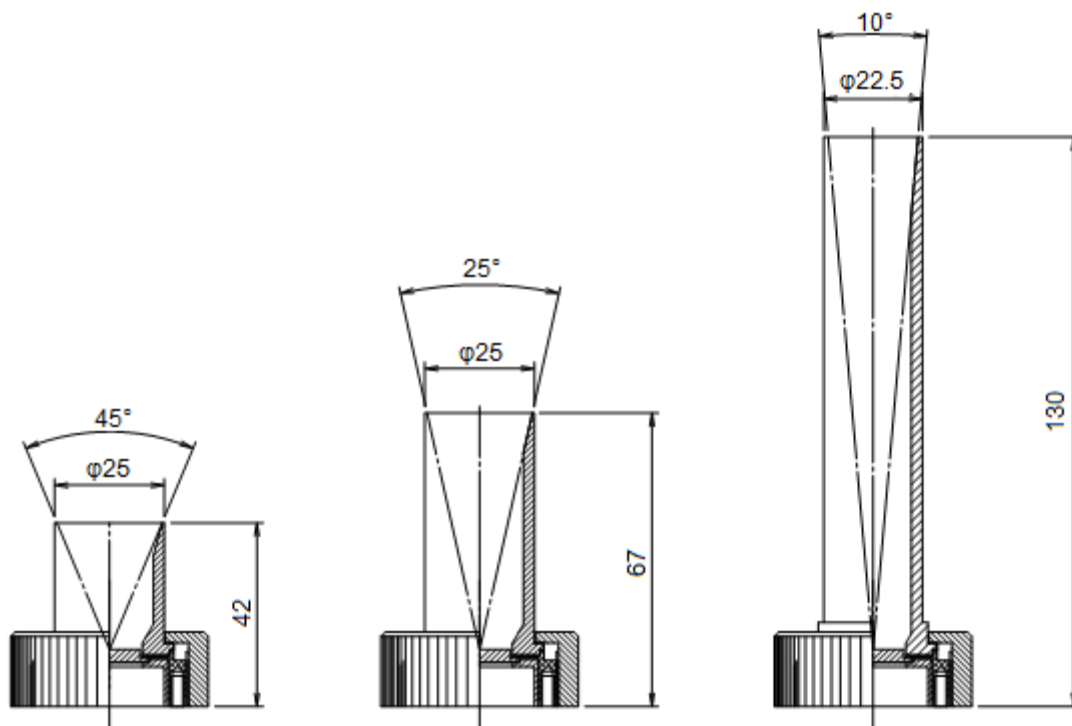
2. Optional View Ports Dimensions

Figure 9-2. Optional View Ports Dimensions

9-4. Accessories List

Table 9-3 Accessories List

Items	Remarks
AC Adapter	AC100 to 120V、50/60Hz, 20VA
View Port	FOV 45° (Full angle)
View Port	FOV 25° (Full angle)
View Port	FOV 10° (Full angle)
GPS Unit	
Sensitivity Data for Halogen Lamp*	

*Standard MS-720 unit is installed with outdoor measurement sensitivity; when using MS-720 to measure halogen lamp, sensitivity data for halogen lamp is required.

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