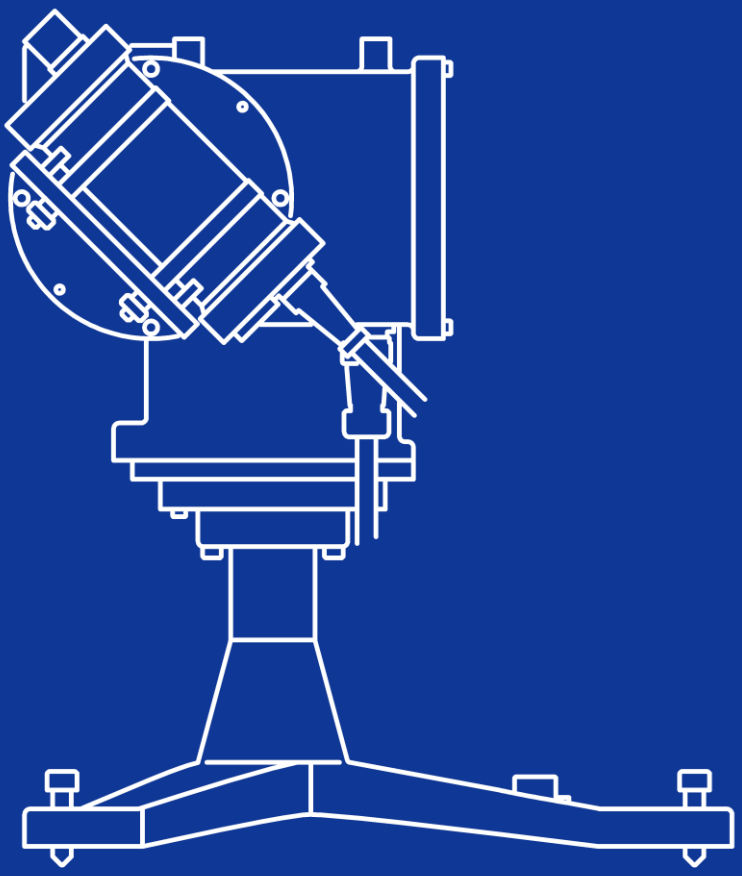
INSTRUCTION MANUAL

Sky Scanner

MS-321LR



EKO

1. Index

2. Important User Information

Thank you for using EKO Products

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

2-1. Contact Information

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2-2. Warranty and Liability

For warranty terms and conditions, contact EKO or your distributor for further details.
EKO guarantees that the product delivered to customer has been verified, checked and tested to ensure that the product meets the appropriate specifications. The product warranty is valid only if the product has been installed and used according to the directives provided in this instruction manual.

In case of any manufacturing defect, the product will be repaired or replaced under warranty. However, the warranty does not apply if:

- Any modification or repair was done by any person or organization other than EKO service personnel.
- The damage or defect is caused by not respecting the instructions of use as given on the product brochure or the instruction manual.

2-3. About Instruction Manual

This manual was issued: 2016/12/05

Version Number: 5

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.

Attention to user; pay attention to the instructions given on the instruction manual with this sign.

3-1. WARNING/CAUTION

1. Setup

- Installation Base or Mast should have enough load capacity to mount the Sky Scanner.
  Fix the main body firmly to the base or mast with bolts and nuts. Instrument may drop by gale and/or earthquake and may invite unexpected accidents and injuries.
- Install the Sky Scanner in a location where it is easy to perform maintenance to avoid any unexpected accidents.

2. Power Supply

Check the power supply voltage and type (AC, DC) to make sure they are appropriate for the Sky Scanner prior to supplying the power to the instrument.

3. Approaching to the Instrument

- Touching and approaching to the Sky Scanner while it is in operation (scanning) may lead to getting your body parts or clothing caught on the instrument, causing unexpected accidents and/or injury.
- During the automatic measurement, the Sky Scanner may start moving (scanning) at unexpected timing; pay close attention to the movement of the Sky Scanner when approaching.

4. Introduction

Sky Scanner MS-321LR is designed to measure luminance and radiance using sensor with 11 degree aperture angle and dual-axis control driving part by dividing the sky hemisphere into 145 points.

4-1. Main Functions

1.

Sky Scanner MS-321LR tracks the sky hemisphere by dividing it into 145 points, measuring luminance and radiance in 4.5 minutes using the sensor with 11 degree aperture angle and dual-axis control driving part.

The measurements of 145 points are based on the CIE108-1994 recommendation. (CIE - International Lighting Commission, IDMP - International Daylight Measurement Programme)

Sensors are calibrated before shipment. Luminance value can be measured in kcd/m^2 and radiance value in $W/m^2 \cdot sr$ for their units.

2. Software

The software specially programmed for the MS-321LR displays the luminance and radiance values in color and text.

Moreover by setting the latitude and longitude of the measurement location prior to the measurement, the sun position (the sun elevation and azimuth) is calculated, displayed, and saved in the data..

4-2. Package Contents

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

Table 4-1 Package Contents

Standard Items	Qty.	Remarks
Driving Part	1	
Sensors	1	With mounting rings
Signal Cab le	1	Cable Length: 80cm
Communication Cable	1	Cable Length: 10m, RS232C
Power Cable	1	Cable Length: 10m
CD-ROM	1	Software (SkyScanner.exe) & Instruction Manual
Instruction Manual	1	
Calibration Report	1	Calibration values for the optical sensors are stated

5. Getting Started

5-1. Parts Name and Descriptions

Each part name and its main functions are described below.

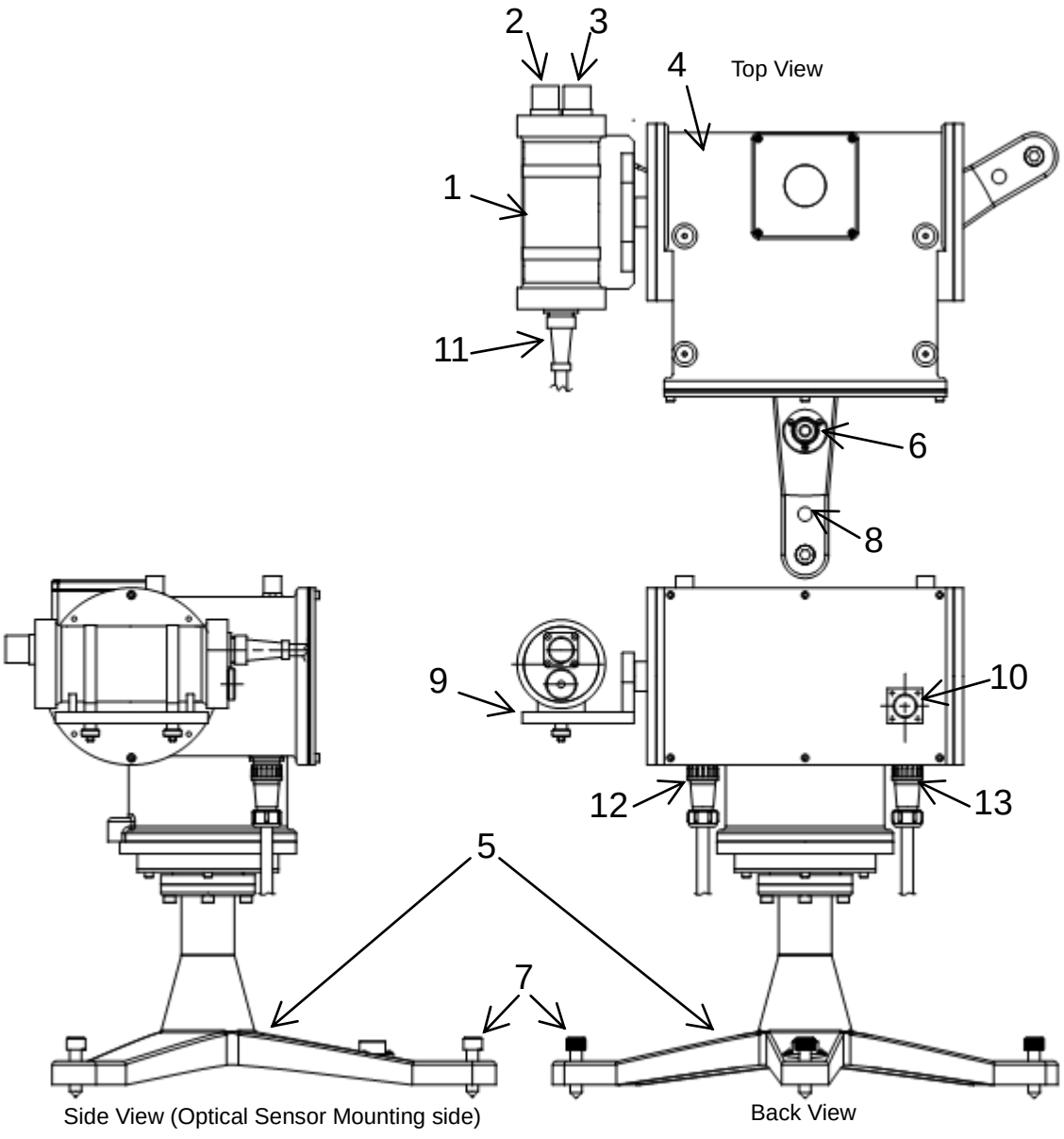


Figure 5-1. Sky Scanner Parts Name and Functions

Table 5-1. Parts Name and Functions

No.	Parts Name	Functions
1	Optical Sensor	Measures both luminance and radiance at each point.
2	Luminance Sensor	Measures luminance.
3	Radiance Sensor	Measures radiance.
4	Driving Part	Directs optical sensor to the 145 measurement points that are defined by altitude and azimuth angle of sky hemisphere.
5	Tripod	Base structure to mount the Sky Scanner.
6	Spirit Level	For leveling the Sky Scanner in a horizontal position.
7	Leveling Screws	Adjustable screws to position the Sky Scanner in horizontal position. Use these screws to bring air bubble to the center of spirit level.
8	Anchor Bolt Fixing Holes	For fixing the tripod on the mounting base. Fix it securely on the mounting base with M8 bolts after the Sky Scanner is adjusted in horizontal level.
9	Optical Sensor Mounting Plate	Mount the Optical Sensor on this plate. Fix the Optical Sensor in position by using the attached mounting rings.
10	Communication Cable Connector	Connector for the data communication cable between PC and the Sky Scanner.
11	Sensor Connector (sensor side)	Connector for communication between the Optical Sensor and the Driving Part.
12	Sensor Connector (Driving Part side)	Connector for communication between the Optical Sensor and the Driving Part.
13	Connector for power supply	Connector for power supply for the Optical Sensor and the Driving Part.

5-2. Sky Scanner Structure

Block diagram of the Sky Scanner MS-321LR structure is as follows:

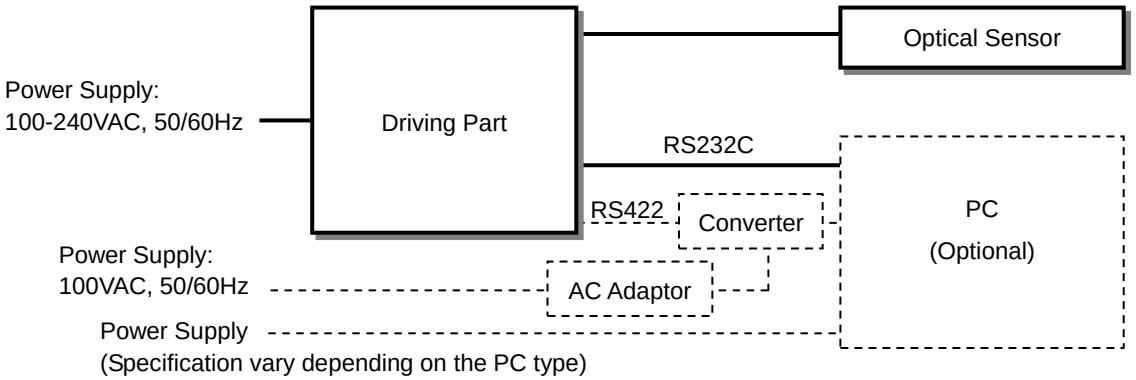


Figure 5-2. Sky Scanner Block Diagram

Note: Dotted lines are optional items

5-3. Installation

1. Preparation

1) Installation Location & Setup Conditions

Install the Sky Scanner in a place where nothing obstructs the view of the sensors.

The ideal mounting position for Sky Scanner is a location which has a free field-of-view without any obstructions (such as buildings, trees, and mountain). In practice, it might be difficult to find such locations; therefore, some practical recommendations on how to minimize undesired effects of reflecting or obstructing surfaces are given next:

- Select a mounting position which it is free from obstructions at 5° above horizon.
- The setup location should be easily accessible for periodic maintenance (Sensor cleaning, check for level and cable condition, etc.) of the Sky Scanner and mounted instrument(s).
- Avoid to place the Sky Scanner in the area of surrounding objects e.g. towers, poles, walls or billboards with bright colors that can reflect solar radiation onto the pyranometer.

2) Checking the Orientation

Sky Scanner must be installed orientated in North / South direction. By determining the direction of north/south, prepare the setup base as instructed in the next step [3) Preparation of Setup Base].

How to determine the True-North/South:

True-North/South is a direction to the North/South Pole of the Earth.

The North/South pointed by magnetic needle of a compass is called magnetic north/south. Magnetic north/south has a few degrees to more than ten degrees of deviation from True-North/South. Since this deviation differs by areas, it is recommended to check the deviation of magnetic north/south at your measurement site in advance. When installing the Sky Scanner, search for True-North/South by correcting the deviation of magnetic north/south.

There are following other methods to setup the Sky Scanner in the True North-South line:

(1) Using a geographical Map (such as Google Map): By referencing a mountain, a building, or a tower which can be seen in far location from the installation site, figure out the direction of the object from the site on an accurate terrain map, the accurate north/south direction can be determined by using protractor.

(2) Determine the south from the sun position at culmination time.

The time Sun passes the true south (culmination time) can be determined from a scientific chronological table. Culmination time is also provided on local astronomical observatory website. Accurate south direction can also be determined by shadow of perpendicularly positioned stick and string with weight.

3) Preparing Installation Base

Prepare a setup base with fixing holes for the anchor bolts (M8) as shown below. Orientation of the installation position will be important, thus carefully check the position of the anchor bolts.

Make sure that the mounting base can hold total weight of the Sky Scanner itself and the sensors mounted on the Sky Scanner.

The anchor bolts must be attached to hold the Sky Scanner on the setup base. To avoid unexpected accidents or damage due to strong wind or gale, make sure to fasten the tripod on the stage or ground securely.

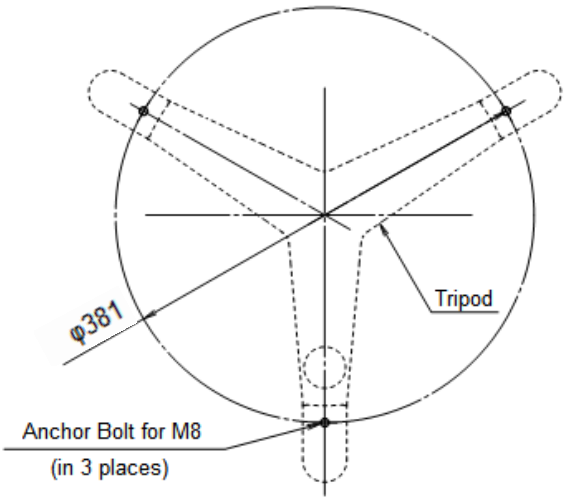


Figure 5-3. Anchor bolt position

2. Installation Procedure

1) Put Sky Scanner on the installation base in the right direction.

You must direct the base with a level should to True-North (True-South when installing the Sky Scanner in Southern Hemisphere). True-North (true-South) is a direction to the North Pole (South Pole) from the measurement site.

The North (South) pointed by magnetic needle of compass is called magnetic north (magnetic south). Magnetic north (south) has a deviation of from several to ten degrees from True-north (true-south). This deviation vary by each area, the deviation of magnetic north (magnetic south) should be checked for your measurement site in advance. When installing Sky Scanner, search for true-north (true-south) by compensating the deviation of magnetic north (magnetic south).

There are other methods to determine the true north (true south), such as using a precise topographic map and point of target and sun position at the time of solar noon time.

When the Sky Scanner is powered ON, the Driving Part will point to South (North). Then adjust the true-north (true-south) direction of the Driving Part as mentioned above.

The Sky Scanner determines the azimuth angle references the tripod base with spirit level as the true north (true south), Azimuth angles are defined by true south (true north) as 0°(zero degree) , clockwise rotation as positive and anti-clockwise rotation as negative (-180° to +180°), and these definitions are also used in the software.

2) Adjust the leveling screws to setup the tripod in horizontal position.
   Use the leveling screws to bring the air bubble inside the spirit level in the center of the circle indicated.

3) Once the position and horizontal level for the Sky Scanner has been completed, fix the Sky Scanner securely onto the mounting base using attached M8 bolts.

4) Attach the optical sensor on the mounting plate.
   After placing the optical sensor on the V-block attached on the mounting plate, secure the optical sensor with attached fixing rings.

5) Install personal computer in a safe and suitable area.

5-4. Cable Connections

1. Output Cable Connection

Connect the connectors on the sensor side and Driving Part side with provided signal cable.

Make sure the cables are routed with sufficient length for Sky Scanner movement to prevent cable from getting caught or tangled on the leveling screws, etc.

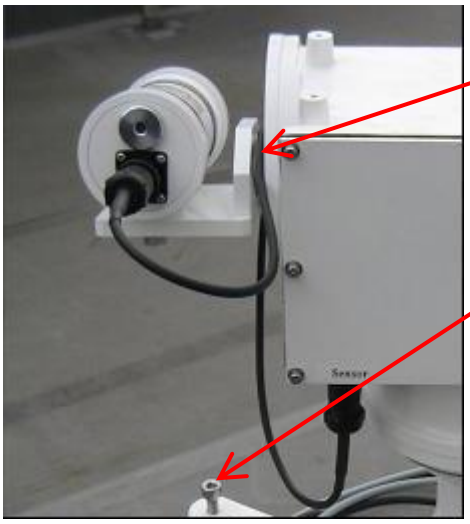


Figure 5-4. Signal Cable Position

2. Communication Cable Connection

Connect the Sky Scanner and the PC RS232C connector with provided communication cable.

Make sure the cables are routed with sufficient length for Sky Scanner movement to prevent cable from getting caught or tangled on the leveling screws, etc.

3. Power Cable Connection

Connect between the power connector and AC power supply with the power cable.

Make sure the cables are routed with sufficient length for Sky Scanner movement to prevent cable from getting caught or tangled on the leveling screws, etc.

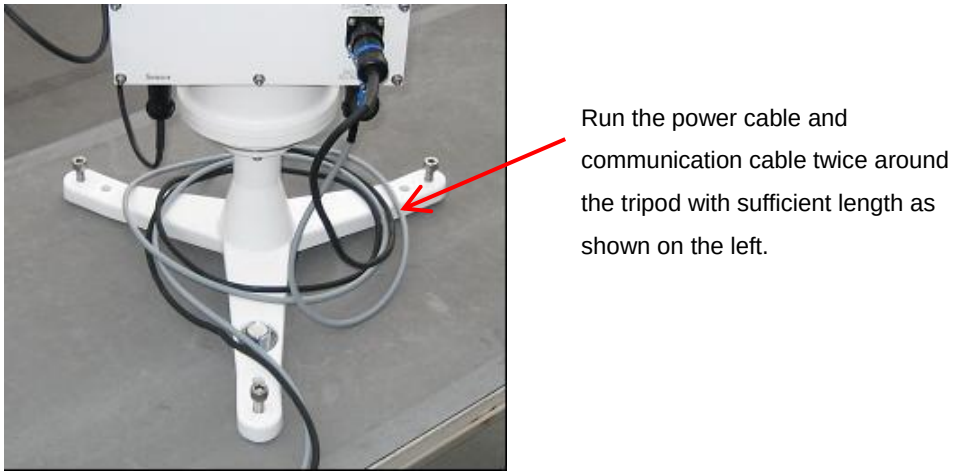


Figure 5-5. Power Cable and Communication Cable

4. Extension Cable Connection (Optional)

For the connection with the optional communication cable longer than 20m, connect RS422/RS232C exchanger as shown in the following Fig.3.

Standard communication cable is RS232C, but the extended communication cable is RS422. In this case, RS422/RS232C exchanger is necessary.

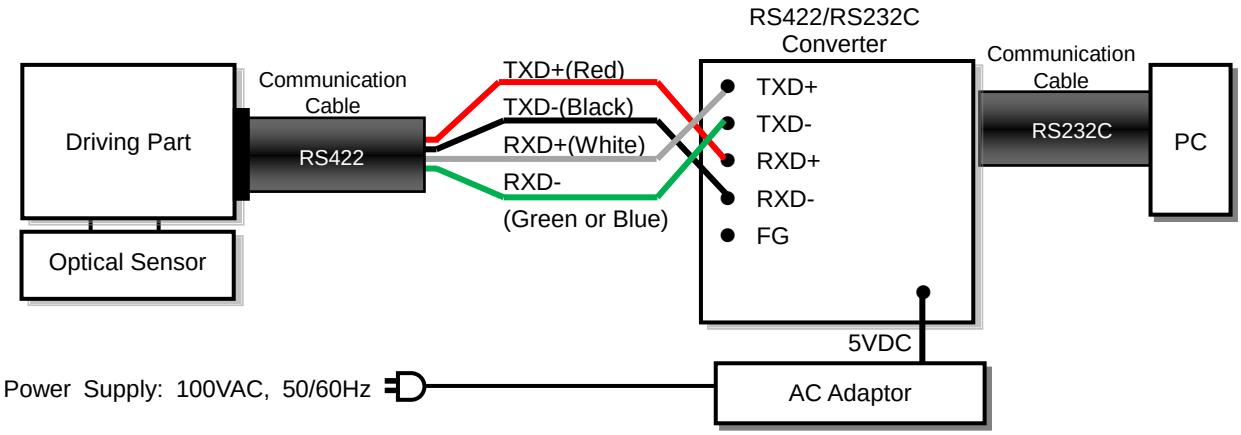


Figure 5-6. RS422/RS232C Converter Connection for Using Extension Cable

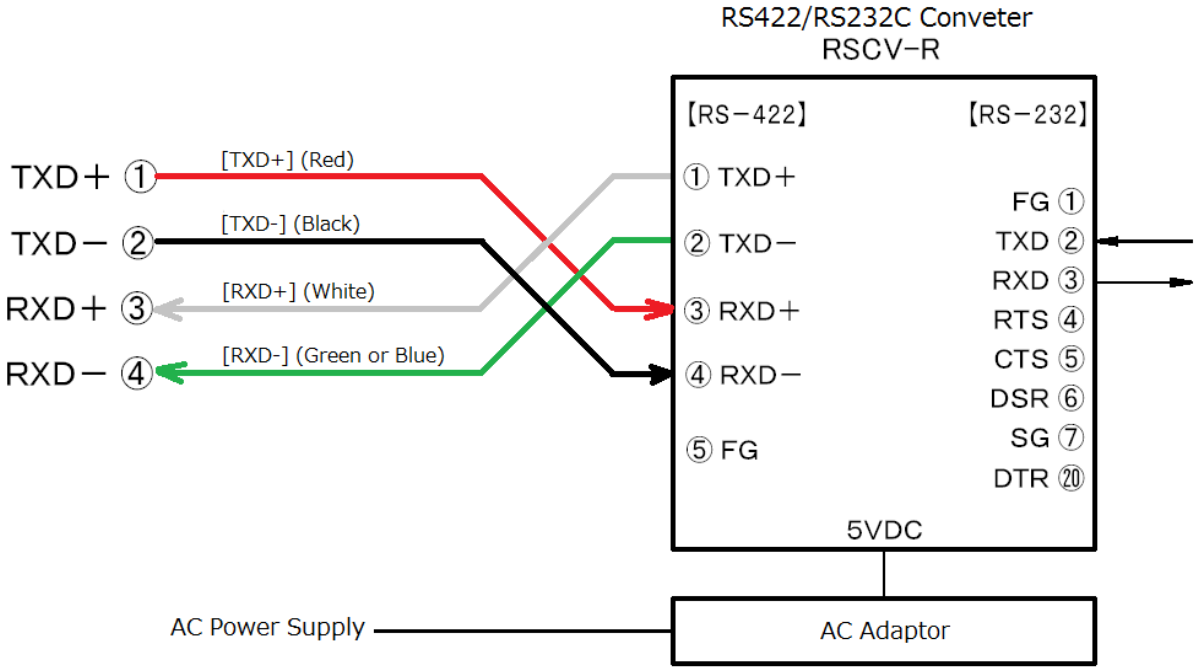


Figure 5-7. Signal Flow Diagram

Note) The labels are the types of MS-321LR side signal.

6. Software

6-1. Installation and Uninstallation

1. Installation

Create a folder and name it as you like on hard disk. Copy the program files named SkyScanner.exe (hereinafter called the software) and paste them on the created folder. The floppy disk labeled “SkyScanner MS-321LR Software SkyScanner.exe” contains this file.

2. Uninstallation

To uninstall the software, delete the program files named “SkyScanner.exe”. Since this software does not use system files such as DLL (Dynamic Link Library), just deleting the program file will uninstall the program.

6-2. Start-up Screen

When the software “SkyScanner.exe” is started, following window will appear on the PC screen.

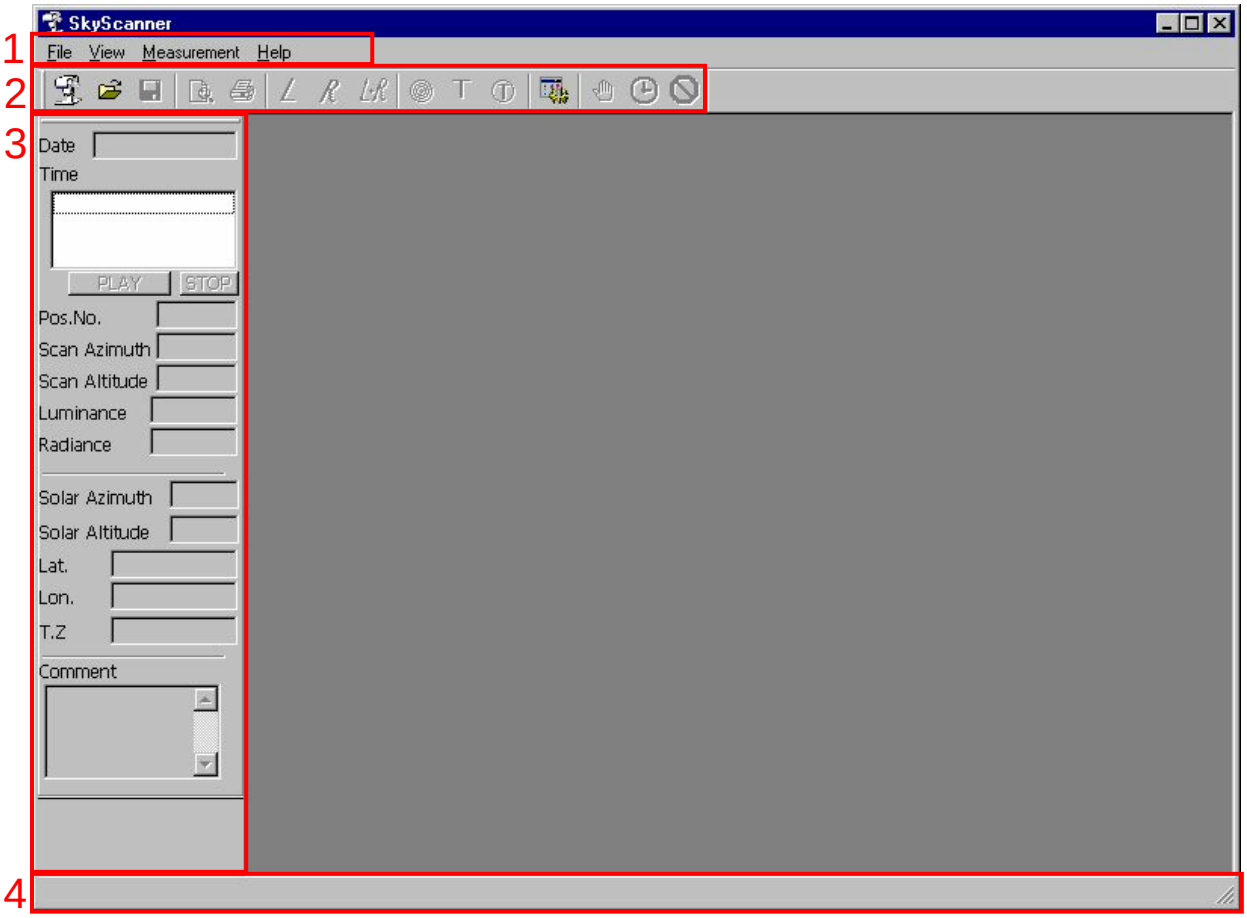


Figure 6-1. Start-up Screen

1. Menu Bar

All available commands are accessible and executed from the menu bar.

All available commands and their functions, and shortcut key operations are provided in below table.

Table 6-1. Menu Bar Commands

Command (1)	Command (2)	Shortcut Key	Functions
File (F)			
Measurement (N)		Ctrl+N	Open a measurement window
Open (O)		Ctrl+O	Select a data file and open view window
Save (S)		Ctrl+S	Save the data displayed on measurement window
Close (C)			Close the active window
Print (P)		Ctrl+P	Print the data displayed on the active window
Print Preview (V)			Show print preview image of the data displayed on the active window
Printer Setup (R)			Open the printer setup dialog window
Exit Application (X)			Exit the Sky Scanner application
View (V)			
Toolbar (T)			Show/not show the Toolbar
Status Bar (S)			Show/not show the Status Bar
Control Bar (B)			Show/not show the Control Bar
Value (V)	Luminance (L)	Ctrl+L	View only Luminance data on measurement & view window
	Radiance (R)	Ctrl+R	View only Radiance data on measurement & view window
	Luminance + Radiance (W)	Ctrl+W	View Luminance & Radiance data on measurement & view window
Format (F)	Color (C)	Ctrl+C	View only color distribution on measurement & view window
	Value (V)	Ctrl+V	View only text distribution on measurement & view window
	Value + Color (B)	Ctrl+B	View color and text distribution on measurement & view window
Measurement (O)			
Setting (P)			Open measurement setup dialog window
Start Manual Measurement (M)			Start manual measurement
Start Auto Measurement (A)			Start auto measurement according to the setting on measurement setup dialog window
Stop Measurement (S)			Terminate a measurement

Table 6-1. Menu Bar Commands - Continued

Command (1)	Command (2)	Short Cut Key	Functions
Window (W)			
Superimpose (C)			Show opened windows by superimposing
Layout (T)			Layout opened windows
Align (A)			Align icons
Measurement Window			Show the opened window names
Help (H)			
Sky Scanner Version Information (A)			Show software version information

2. Toolbar

Toolbar is laid out with functions used frequently for easy operation.

By click of a button, following operations can be executed.

Figure 6-2. Toolbar

Table 6-2. Button Functions

Button No.	Menu Bar Operation	Button No.	Menu Bar Operation
1	File (F) - Measurement (N)	9	View (V) - Format (F) - Color(C)
2	File (F) -Open (O)	10	View (V) - Format (F) -Value (V)
3	File (F) -Save (S)	11	View (V) - Format (F) -Value + Color (B)
4	File (F) - Print Preview (V)	12	Measurement (O) -Setup (P)
5	File (F) -Print (P)	13	Measurement (O) - Start Manual Measurement (M)
6	View (V) -Value (V) -Luminance (L)	14	Measurement (O) - Start Auto Measurement (A)
7	View (V) - Value (V) -Radiance(R)	15	Measurement (O) -Stop Measurement (S)
8	View (V) - Value (V) -Luminance + Radiance (W)		

3. Control Bar

Control Bar contains various informations related to the data displayed on an active window.

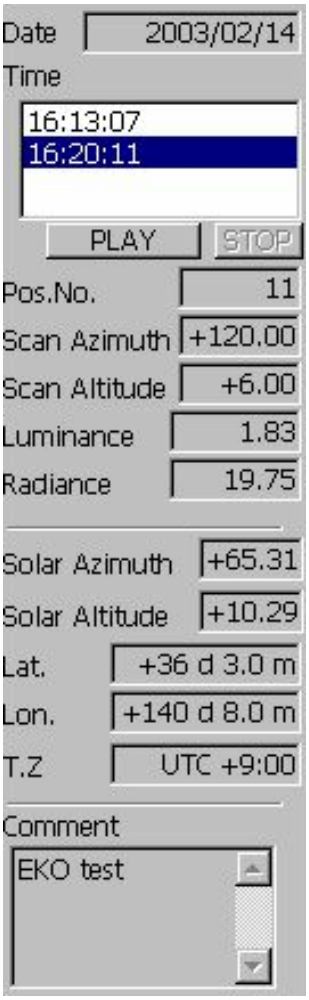


Figure 6-3. Control Bar

Table 6-3. Control Bar Functions

No	Items	Functions
1	Date	Measurement date of a data displayed on the active window
2	Time	List of measurement time of data displayed on the active window. Data time showing the measurement value distribution is highlighted.
3	PLAY	Each data is automatically displayed every 1sec. on the active window in the sequence of the measurement time.
4	STOP	Top the automatic display
5	Position Number	Channel number to be displayed on the control bar. Change the position number by clicking the cell displaying the distribution.
6	Scan Azimuth	Azimuth angle of the specified channel
7	Scan Altitude	Altitude of the specified channel
8	Luminance	Luminance of the specified channel
9	Radiance	Radiance of the specified channel
10	Solar Azimuth	Solar azimuth angle at the time of measurement for the data displayed by latitude and longitude of measurement site.
11	Solar Altitude	Solar elevation at the time of measurement for the data displayed by latitude and longitude of measurement site
12	Latitude	Latitude of the measurement site setup in the Measurement Settings Dialog.
13	Longitude	Longitude of the measurement site setup in the Measurement Settings Dialog.
14	Time Zone	Time zone differences of the system clock in the PC
15	Comment	Comment setup in the Measurement Settings Dialog

- ✧ Azimuth Angle: When South (North) is defined as 0°, angles in clockwise direction are expressed with positive values, and angles in anti-clockwise angles are expressed with negative values (-180° ~ 0° ~ +180°)
- ✧ Altitude: When horizontal surface is defined as 0°, angle in the perpendicular upward direction to the horizontal surface is expressed with positives (0°～90°)

4. Status Bar

Operation statuses are indicated on this bar as necessary.

6-3. Measurement Procedure

Start up the SkyScanner.exe software and follow below procedure:

1. Setting

To setup the measurement configuration, open the Measurement settings dialog window (Figure 6-4) either from [Measure (O)] → [Setting (P)] from the File Menu, or click the [Setup (12)] button from the Toolbar.
Each setting items are described in the table below.

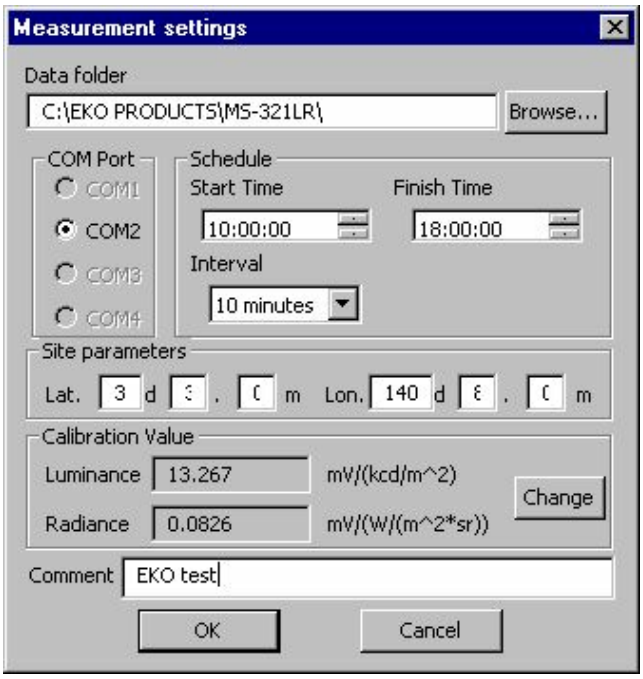


Figure 6-4. Measurement Setting Dialog Window

Table 6-4. Setting items in the Measurement Settings Dialog Window

Items	Functions
Data Folder	Select a folder for data files to be saved
Browse… button	Click this button when selecting a folder for data files to be saved to simplify the operation. Browse dialog window appears and folder can be selected easily and accurately.
COM Port	Setup the COM number which the Sky Scanner is connected to RS232C interface
Start Time	Specify the start time, finish time, and interval for automatic measurement schedule. Interval can be selected from 10, 15, 20, 30min, and 1 hour.
Finish Time	
Interval	
Latitude	Enter the latitude and longitude for the measurement site North latitude and East longitude are entered with positive (+) values South latitude and West longitude are entered with negative (-) values
Longitude	
Change button	Dialog window for changing the sensor sensitivity value appears. Change the sensitivity value provided by EKO whenever necessary. See next section for details.
Comment	Enter comment which will be recorded in the header part of the data file
OK button	Save the configuration setup in the Measurement Setting dialog window.
Cancel button	Cancel the measurement setting and return to the main window.

2. Entering (Changing) Sensitivity Value

The sensitivity value is a unique value for the optical sensors, luminance sensor and radiance sensor, and it is a constant value for converting the optical sensor output voltage into physical quantities (luminance: kcd/m^2, radiance: W/m^2/sr)

Below dialog window appears by clicking the “Change” button on the Measurement Setting dialog window (Figure 6-4).

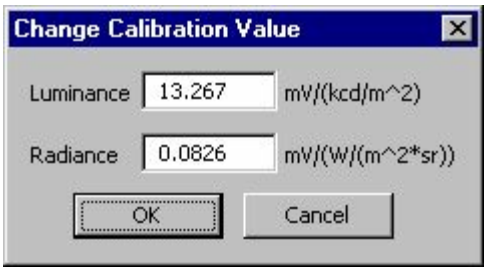


Figure 6-5. Change Calibration Value Dialog Window

Enter each sensitivity value in their text boxes for luminance and radiance.

Both sensitivity values are saved as new/updated value by clicking the [OK] button.

By clicking the [Cancel] button will close this dialog window.

Sensitivity value is stated on the inspection report provided by EKO.

These values are important constant values for the Sky Scanner measurement; make sure to enter the correct values.

Do not change the sensitivity value in normal measurements.

The entered sensitivity will be written on the registry in the PC and they should be entered or changed in the following cases. If the incorrect sensitivity values are entered, the data will be converted into inaccurate physical quantities (luminance and radiance).

Sensitivity value should be entered or changed when:

- using the Sky Scanner for the first time after the purchase
- PC to be used with Sky Scanner has been replaced
- sensitivity value has changed after the recalibration by EKO

3. Measurement Window

To take measurements, either select [File (F)] → [Measurement (N)] from the File Menu or click the [Measure (1)] button from the Toolbar to open the “Measurement” window. The measurement window will be in “Standby” condition.

Displaying data can be selected from [Luminance (6)], [Radiance (7)], or [Luminance + Radiance (8)] buttons on the Toolbar.

Also the data can be displayed in [Color (9)], [Value (10)], or [Color + Value (11)] button on the Toolbar.

Now the Sky Scanner is ready to start a measurement.

1) Manual Measurement

To start a manual measurement, go to File Menu and select [Measure (O)] → [Start Manual Measurement (M)], or click the [Start Manual Measurement (13)] button from the Toolbar.

Measurement values are displayed on the window in real time during the measurement as shown below.

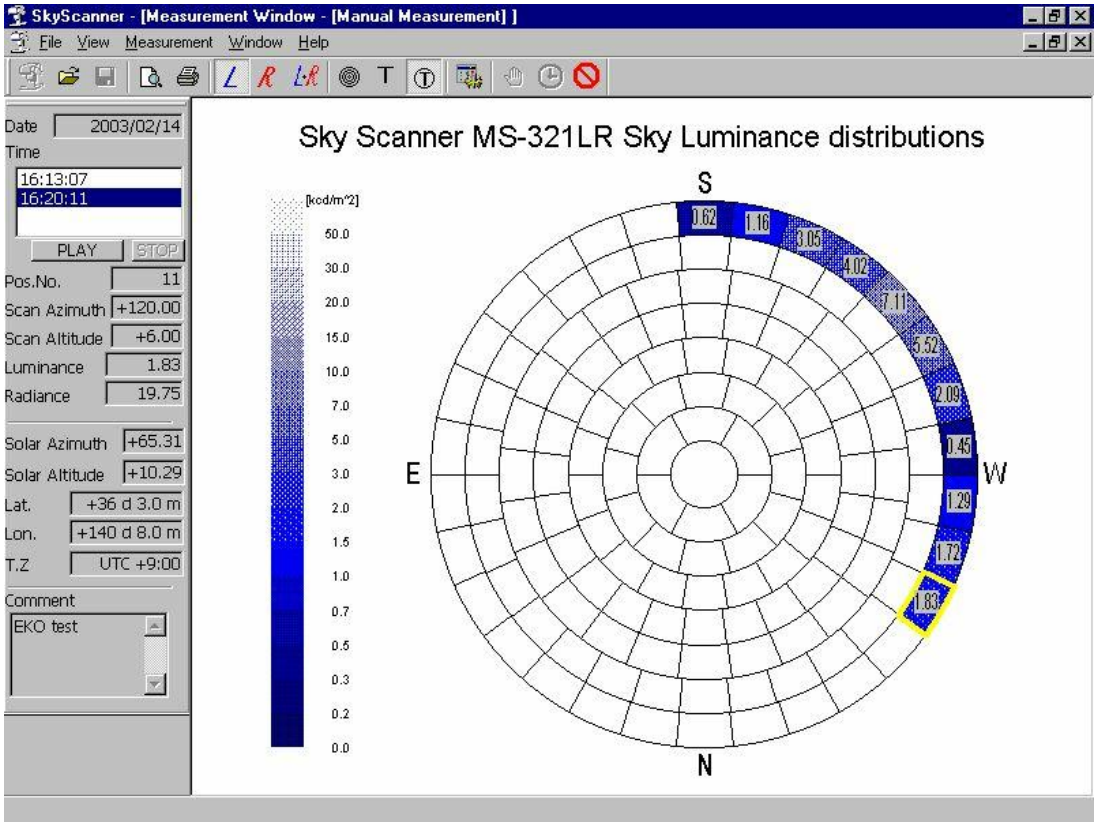


Figure 6-6. Display during Measurement

※Image shows the measurement with “Only Luminance” and “Color and Text Distribution”.

To save the measurement data after the measurement is completed, go to File Menu, and select [File (F)] → [Save (S)] or click the [Save (3)] button from the Toolbar. Save the data according to the instructions provided in the process.

2) Auto Measurement

To start an auto measurement, go to File Menu and select [Measure (O)] → [Start Auto Measurement (A)] or click [Start Auto Measurement (14)] button from the Toolbar.

Measurement data is automatically saved with the data file name according to the name described in [6-5. Data File Format] for the auto measurement mode.

Auto measurement takes measurement automatically according to the measurement interval from start time to finish time, which is setup in the Measurement Setting dialog window.

During the auto measurement, the measurement time is displayed on the status bar.

4. Stop Measurement

To stop the measurement, either go to File Menu and select [Measure (O)] → [Stop Measurement (S)] or click the [Stop measurement (15)] button on the toolbar.

Following message appears; click either [Yes] or [No] according to the instruction provided.

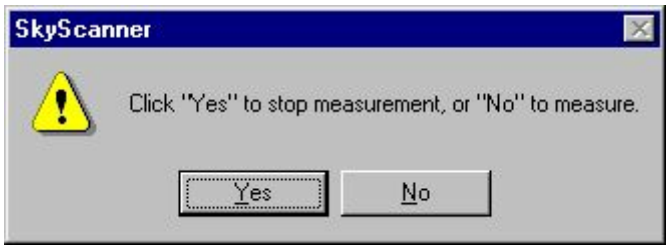


Figure 6-7. Stop Measurement Dialog Box

5. Other Functions

Even during the manual/auto measurement, measurements modes can be changed, such as [Luminance Only], [Radiance Only], or [both Luminance and Radiance], as well as [Color Distribution Only], [Text Distribution Only], or [both Color and Text Distribution]. Select the items which are suitable for your measurement purpose.

The Control Bar displays all sorts of up-to-date information of the data.

By clicking the distribution cell, its channel number and measurement value can be displayed on the control bar.

In case of power outage, Driving Part power shuts down by power cable disconnection, or disconnection of signal cable and communication cable causing miscommunications, the software title bar will indicate that there is a communication error. When such condition occurs, the data will be saved in the file as missed measurement.

6. Print

To print the data displayed on the measurement window, go to File Menu and select [File (F)] → [Print (P)], or click [Print (5)] button from the Toolbar: the printer dialog window appears to allow printing.

Print Preview can also be viewed by selecting [File (F)] → [Print Preview (V)] from the File Menu, or clicking [Print Preview (4)] button from the Toolbar.

7. Finish Application

To finish the application and exit, go to File Menu and select [File (F)] → [Finish Application (X)].

6-4. Data View

To display the measurement data, start up the SkyScanner.exe software and follow below procedure

1. Open Data File

To open a data file, either go to File Menu and select [File (F)] → [Open (O)] or click [Open (2)] button from the Toolbar and click the data file name which to be opened.

Data view window appears as following image.

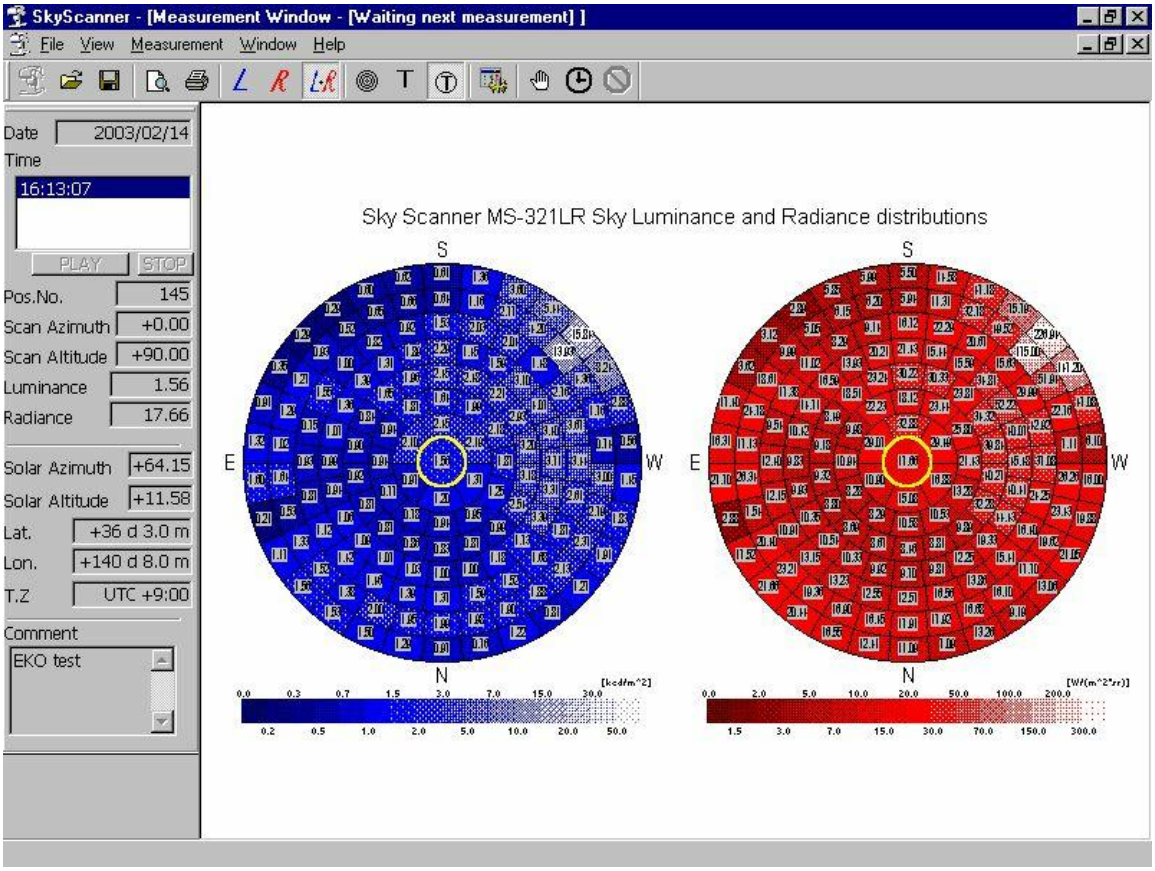


Figure 6-8. Example of Display during Measurement

※ The image shown above is an example of [Luminance and Radiance] displayed by [Only Color Distribution].

2. Changing Display Mode

Measurement data can be displayed in [Luminance Only], [Radiance Only], [both Luminance and Radiance] mode by clicking one of the buttons from the Toolbar

Also, [Only Color Distribution], [Only Text Distribution], or [both Color and Text Distribution] button can be selected from the Toolbar.

3. Checking Data Information

While data view window is displayed, channel number and measurement values are displayed on the control bar by clicking on the cell. For further details of the control bar, see [6-2. Software Operation], [1. Startup], [3) Control Bar]。

6-5. Data File Format

1. Data File Name

The data file will be stored by the software after automatic measurement and named “SSyymmdd.csv”.

“SS” stands for Sky Scanner, “yy” stands for year (ex. 03 means the year of 2003), “mm” stands for month and “dd” stands for day. For example, the data obtained on February 23, 2003 will be stores in the data file named SS030223.CSV.

Besides, the users can freely select the file name when storing data files of manual measurement.

2. Data File Format

The data files of measurement and positioning created by the software will be stored in CSV (Comma Separated Value) format of ASCII form. This format can be easily loaded by spreadsheet software such as EXCEL of Microsoft.

Figure 2 below shows format of the data.

Table 6-5. Data File Format

Line	Contents	Format (Example Data)
1	Title Line	Title, Sky Scanner MS-321LR Sky Luminance and Radiance distributions
2	Firmware Version	Firmware, 1.00
3	Measurement Date	Date, 2002/12/25
4	Comment	Comment, test measurement
5	Longitude	Longitude, +140 d 8.0 m
6	Latitude	Latitude, +36 d 3.0 m
7	Time Zone	Timezone, UTC +9:00
8	Unit	Unit, kcd/m^2, W/(sr*m^2)
9	Channel Number	, , , 1, 2, ･･･, 145, ,
10	1st Data: Luminance Value	L, 10:20:00, 10:24:18, 0.01, 0.03, ･･･, 0.02, -20.56, +27.67
11	1st Data: Radiance Value	R, 10:20:00, 10:24:18, 0.00, 0.00, ･･･, 0.00, -20.56, +27.67
12	2nd Data: Luminance Value	L, 10:40:00, 10:24:18, 0.01, 0.03, ･･･, 0.02, -20.56, +27.67
13	2nd Data: Radiance Value	R, 10:40:00, 10:24:18, 0.00, 0.00, ･･･, 0.00, -20.56, +27.67

Header part is stated in the rows from 1 to 9, and data part is added sequentially from the row 10.

In the header part, the title, firmware version, measurement date, comment, latitude of the measurement site, longitude of the measurement site, time frame, units and channel numbers are provided.

In the data part, the 10th row is provided with the first luminance data information such as measurement date, time, measurement values from channel numbers 1~145, solar direction and solar elevation sequentially. Same for 11th row, the first radiance data information is provided in same order, and followed by the second and third data with luminance value and Radiance values in orders.

7. Maintenance & Troubleshooting

7-1. Maintenance

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

1. Check and Adjust Driving Part Position

Check the Driving Part and make sure it is in horizontal level and in appropriate direction.

To adjust the position, see the section [5-2. Setting].

2. Check and Clean Optical Sensor

Check the glass window for the optical sensor.

To clean, use blower or soft cloth with alcohol and wipe the optical sensor window.

3. Check Sensor Cable Condition

Check the sensor cable, communication cable, and power supply cable routing; make sure the cables are not caught on somewhere or pulled. Also check for any ware and tare.

4. Check and Replace Silica Gel

Check the silica gel color from the drying cartridge window located at the back of the sensor.

If the silica gel is discolored, replace with new silica gel.

5. Check PC Operation, Rebooting

If the PC performance is getting lower, reboot the PC.

Reboot the PC at least once per month for optimal performance.

7-2. 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
Sky Scanner does not operate	Check the power supply.
	Check the cable connections; make sure the cables are connected properly and securely.
	Check for any damages on the cables.
	Check and make sure the software is properly operated.
Measurement data is abnormal	Check and make sure there are no dirt or contamination on the objective lens for optical sensor.
	Check for any damages on the cables.
	Check and make sure the sensitivity value is properly setup.
Cable is broken	Replace the cable (s)
Optical Sensor is stopped at position looking up/down.	Check the cable condition Replace the cable if necessary.
Specific direction and elevation angle data are abnormal (such as zero)	Check the cable condition Replace the cable if necessary.
[Communication Error] occurs frequently	Check the cable condition Replace the cable if necessary.

8. Specification

8-1. Main Unit

Table 8-1. Hardware Specification

<table>
<tr><th>Characteristics</th><th>Details</th></tr>
<tr><td>Scanning time</td><td>within 4.5 minutes, Total 145 points for both radiance and luminance</td></tr>
<tr><td>Scanning method</td><td>Stepwise</td></tr>
<tr><td>Scanning point</td><td>Scan the following 145 points:
<table>
<tr><th>Altitude</th><th>Azimuth Angle Width</th><th>Azimuth Points</th><th>Remarks</th></tr>
<tr><td>6</td><td>12</td><td>30</td><td>From azimuth angle 0° Ch1 to Ch30 in a clockwise direction</td></tr>
<tr><td>18</td><td>12</td><td>30</td><td>From azimuth angle -12° Ch31 to Ch60 in a counterclockwise direction</td></tr>
<tr><td>30</td><td>15</td><td>24</td><td>From azimuth angle 0° Ch61 to Ch84 in a clockwise direction</td></tr>
<tr><td>42</td><td>15</td><td>24</td><td>From azimuth angle -15° Ch85 to Ch108 in a counterclockwise direction</td></tr>
<tr><td>54</td><td>20</td><td>18</td><td>From azimuth angle 0° Ch109 to Ch126 in a clockwise direction</td></tr>
<tr><td>66</td><td>30</td><td>12</td><td>From azimuth angle -30° Ch127 to Ch138 in a counterclockwise direction</td></tr>
<tr><td>78</td><td>60</td><td>6</td><td>From azimuth angle 0° Ch139 to Ch144 in a clockwise direction</td></tr>
<tr><td>90</td><td>-</td><td>1</td><td>Zenith Ch145</td></tr>
<tr><td></td><td>Total</td><td>145</td><td></td></tr>
</table></td></tr>
</table>

Table 8-2. Driving Part Specification

Characteristics	Details
Motor	Stepping Motor
Motor Drive	Half Step
Drive	Harmonic Drive ®
Accuracy	<0.01°
Resolution	0.009°
Torque	12Nm
Payload	7kg balanced
Operating Temperature Range	-40 to +50℃
Communication	RS422/RS232C、9600bps、8N1 (Standard communication cable is RS232C)
Power Supply	100 to 240V, 50/60Hz, 50VA
Dimension	430(W) x 380(D) x×440(H) mm
Weight	12.5kg

Table 8-3. Sensor Part Specification

Characteristics	Details
Sensor Part (Common)	
A/D Conversion	16bit
Sampling Method	To remove the power supply noise, taking 20 samples per 1 cycle of the power frequency, and calculating the average value of 5 cycles as one data.
Dimension	75(φ) x 185(L) mm
Weight	1.2kg
Luminance Sensor	
Aperture Angle	11° (Full Angle)
Tilt Angle	1°
V-much V(λ) f‘	2.5%
UV Blocking u’	0.2% (Against the full scale)
IR Blocking r	0.2% (Against the full scale)
Temperature Dependency α	0.1%
Linearity f_3	0.3%
Calibration Error	2%
Measurement Range	0 to 50kcd/m^2
Radiance Sensor	
Aperture Angle	11° (Full Angle)
Tilt Angle	1°
Temperature Dependency α	0.1%
Measurement Range	0 to 300W/m^2·sr

8-2. Software

Table 8-4 Software Specifications

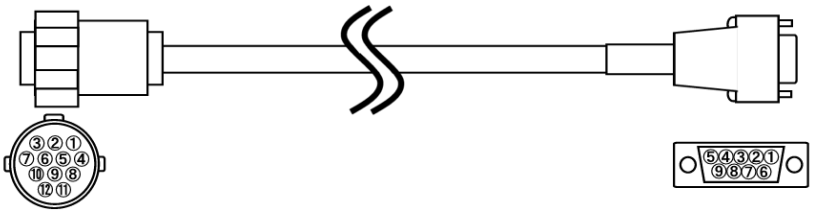
	Details	
Software Version	Ver1.0.0.1	
Firmware Version	Ver1.10	
Applicable OS	Microsoft Windows XP/Vista/7/8/8.1/10	
Operation Environment	CPU:	More than Pentium 200MHz
	Memory:	More than 32MB
	HHD Capacity:	More than 10GB
	Display Resolution:	More than 1024 x 768
	Interface:	CD-ROM Drive, RS232C, 9600bps, 8N1
Measurement Items	SkyScanner.exe	
Applicable OS	Data measurements, data graph display (displaying luminance and radiance graph, data value), data saving (CSV format), solar position calculation	

8-3. Cables

Table 8-5 Cable Specifications

Cables		Details	
Output Cable		Material:	MVVS
		Diameter:	0.3mm^2 x 4pins
		Outer Diameter:	Φ6mm
		Cable end	See below figure
Power Cable	AC Type	Material:	OE-100
		Diameter:	0.75mm^2 x 3pins
		Outer Diameter:	Φ5.7mm
		Cable end	See below figure
	DC Type	Material:	MVVS
		Diameter:	0.75mm^2 x 2pins
		Outer Diameter:	Φ5.7mm
		Cable end	See below figure
Communication Cable		RS-232C, 4pins, 0.3m^2	

1. Communication Cable (RS-232C, 4pins, 0.3m^2)



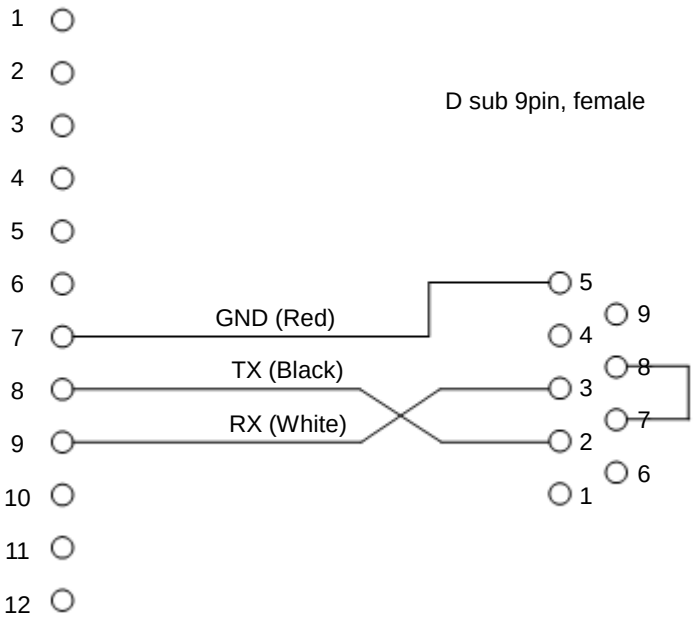
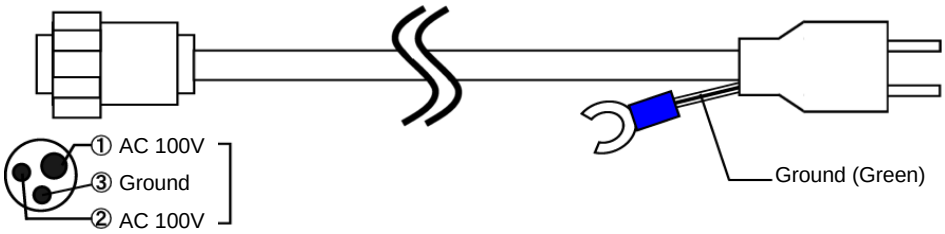


Figure 8-1. Communication cable & Pin Assignment

*Communication cable can be extended to 15m.

2. AC Power Supply Cable



3. DC Power Supply Cable

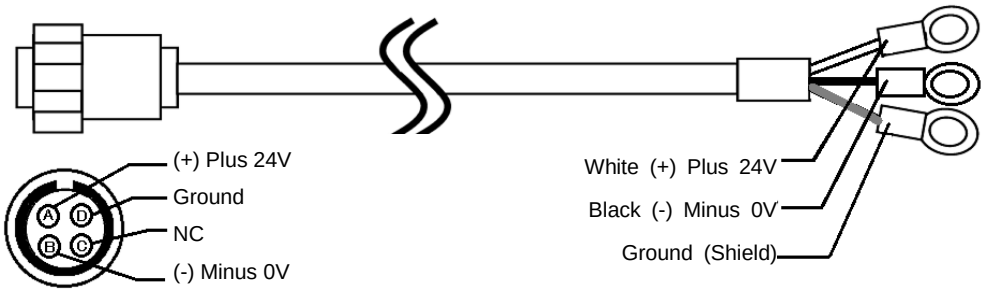


Figure 8-2. Cable Diagrams

8-4. Dimensions

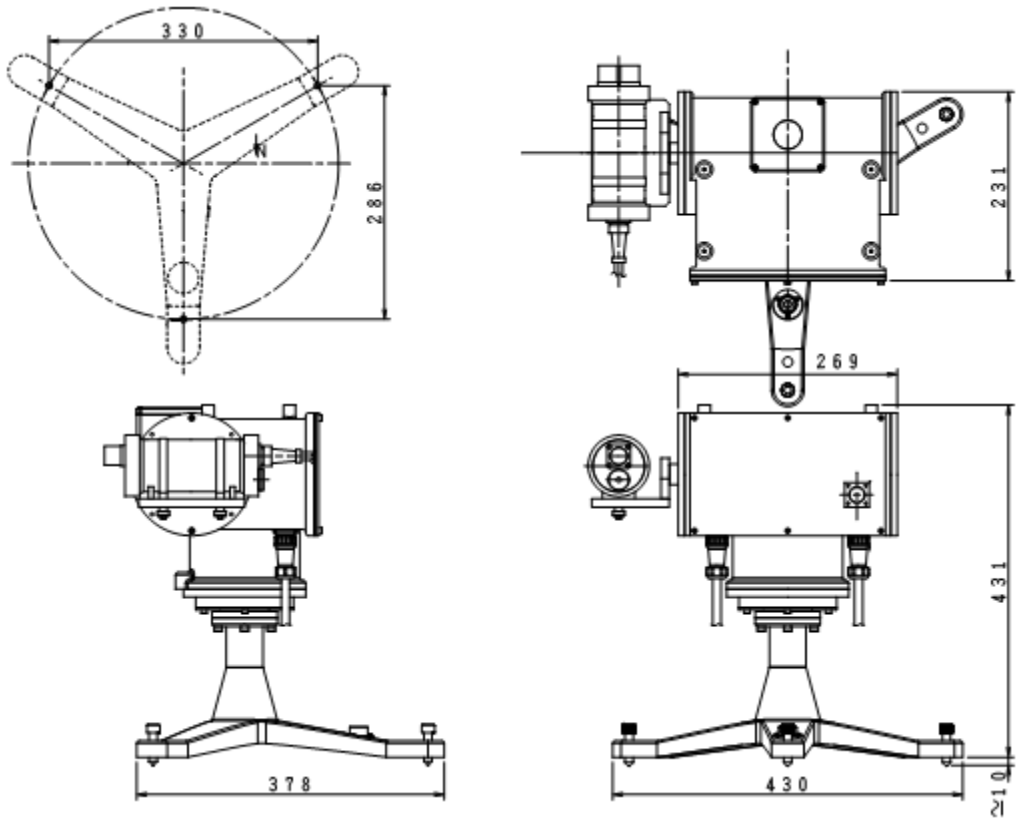


Figure 8-3. Dimensions

8-5. Accessories List

Table 9-6. Accessories List

Option Items	Remarks
Communication Cable	Maximum of 100m For RS422 version, RS422/RS232C converter is required.
Power Supply Cable	Maximum of 100m
RS232C/RS422 Converter	Required when communication cable is more than 20m

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