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Radiometer RM-22

user manual

Version: 1.03SD

Content

Change log

date	version	Changed by	notes
2011-07-14	1.0	S. Rau	release
2014-06-27	1.02	Paravia	Add. radiance tube
2016-07-04	1.03SD	Paravia	SD card added

1 Symbols Overview

	Meaning: Failure to observe the mentioned instructions can result in an injury of the user.

	Meaning: Failure to observe the mentioned instructions can result in a damage of the device.

	Meaning: Instructions are to be observed for the regular operation.

*	Optional functions, not available for every device

2 Preface

Dear sir or madam,

Congratulations for buying a high precision measuring device.

Handling is easy, please follow enclosed operating instructions to guarantee measuring devices.

To ensure measuring precision over long operating periods we recommend you to send us the device every 12 months. We carry out recalibration and necessary reparations are performed.

We will continuously provide you with information about our latest UV measuring developments. Service for our customers is our request. Further we are glad to support you with technical information and consultation.

Sincerely,

Opsytec Dr. Gröbel GmbH

3 Important Information

Please read the **instruction manual** completely before start-up and operation. The latest version of the instruction manual applies.

STOP Skin oil and contamination are absorbing in the UV spectral range. Finger prints / contamination on the optically active entrance opening are to be avoided. If necessary, clean thoroughly with Isopropanol. Use gloves when cleaning.

STOP **The RM-22 is calibrated.**

ATTENTION: Opening of the sensor housing leads to a loss of calibration.

4 Intended Use

The RM-22 determines, with the attached sensors, the irradiance in the UV and VIS spectral range and indicates these on the integrated display.

Operation is only permitted in a dry environment. If necessary, IP65 protected sensors are available.

When using the sensors light, IR and UV radiation can be reflected. If necessary, protect against radiation.

5 General

The radiometer RM-22 is a handheld instrument for precise measurement of irradiance and dose in two measurement channels. The dose is calculated by integrating the irradiance. Different UV and visible spectral ranges can be measured with the respective sensors. With the ratio of both sensors transmission measurements with a reference are possible. The measured values are outputted continuously on a USB port and can be recorded and analyzed with the software on your computer. The unit can be battery or AC powered.

The diffuser integrated into the sensor provides the necessary exposure for non-normal cosine - correction. The sensors are calibrated with respect to a PTB reference. If required, the sensors are waterproof to IP65 or sensors with special ranges are available.

5.1 UV Safety Information

Unprotected and prolonged exposure to any form of UV light, including UV-A, can result in skin injuries, cataracts and possibly cancer. Even brief exposure can be hazardous, if the UV intensity is very high. Thus, it is advised to always shield the eyes/face. For maximum protection and whenever possible, hands and arms should also be covered with long sleeves and gloves of a non-fluorescent material.

Artificial UV light is often regarded as something completely different from the sun's radiation, which it is not. As a result, recommended hygienic exposure times have been calculated for these types of UV-sources, the aim being to prevent injuries and increase safety awareness when working with artificial UV. Artificial UV, such as that emitted from UV lamps, should be regarded as natural UV, i.e. sunlight, and appropriate safety measures should be taken accordingly. Artificial UV sources are used in many industries for many applications. UV is used in combination with a fluorescent media, which is excited by the UV energy and "reflects" light in the visible range of the electromagnetic spectrum.

Certain individuals are naturally hypersensitive to all forms of UV and should avoid any exposure. In general, if itching, inflammation or other unusual symptoms occur, UV exposure should cease immediately. People using certain drugs that produce photosensitivity should avoid exposure to all UV sources.

Protect yourself! UV is dangerous	
UV Goggles	It is of utter importance to use the UV protection. To protect your eyes – use UV Blocking Goggles. There are different goggles on the market. The best on the market absorbs 99.9 % of all UV up to 385 nm.
Visor	To take extra caution, use a UV block visor that absorbs 99.9 % of all UV up to 385 nm.
Gloves	Be sure to use gloves that protect you not only from chemicals or cuts, but from UV. And make sure that they do not fluoresce
Apron	To protect your body in the best way please use an industry apron with 100 % UV block.

5.2 Practical Hints

The sensors are connected via a 2 m long cable with the RM-22. This guarantees that you can read the values easily, even when measuring in inaccessible places. The sensors are cosine corrected.

It should be noted that radiometric measurements are not as simple as, for example, measuring distances in a room. Although the meter gives a value, this value is highly dependent on the position of the lamp to the sensor and the reflective behavior of the surrounding. If the sensor is tilted with respect to the lamp, it will result in a cosine-like reduction of the value.

To achieve reproducible results the surrounding, the geometric arrangement, the temperature and the power of the lamp must be controlled. Furthermore, the appropriate sensor must be chosen to fit the particular measurement application. Any sensor is designed to measure radiation over a specified spectral range. Although our sensors are highly insensitive to other spectral regions, than those they are designed for, there is a physical limitation for integral measuring equipment caused by steepness of the filter wings and the width of the sensitive region. The limitation results in an error factor of 10^{-4} to 10^{-2} .

6 Operate the RM-22

6.1 Controls

The operation of the RM-22 is menu-driven. For the menu control three buttons are provided. These keys are called soft-keys, i.e. the function of each button is displayed on the bottom line of the display.

Two more buttons have a fixed function. The ⏻ button is for switching on / off the device. With the 💡 key, the backlight is turned on. Depending on the chosen mode, the backlight turns off automatically or must be switched off again by pressing the 💡 button.

	Avoid long operating times off the backlight. The demand for electricity with lighting is much higher and thus reduces the operating time of the RM-22. To conserve battery power, the RM-22 automatic switches off, when no key is pressed for a preset idle time in menu mode.

6.2 Operating

6.2.1 Switch on / off

To turn on the RM-22 press the ⏻ button briefly. The RM-22 responds with the startup screen followed by the version screen.

To turn off the RM-22 press and hold the ⏻ button for about 2 seconds.

7 Using the menus

After the version screen the menu is issued.

Use the soft keys Z and z to browse through the menu. To select a menu item, use the OK soft key.

7.1 Measurement

By selecting the menu item "Measurement" you succeeded in the sub-menu for measurements. Here you have the following choices:
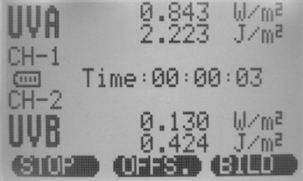
	OK starts a measurement of the irradiance

		OK starts a measurement of the transmission. The first measurement is automatically set to 100%. Subsequent setting of the 100% reference is always possible.
		This menu item is only available when two sensors are connected to the RM-22. By pressing the button **OK** the relationship between the two sensor signals is determined. At runtime, it is possible set the reference or exchange the channels.
		OK brings you back to the main menu.

7.1.1 Report design for the measurement of irradiance

During the measurement of irradiance, there are five to seven different report forms when two sensors are connected. Whit only one sensor connected you get only the reports for this channel. The reports can be changed with the soft key DSPLY .
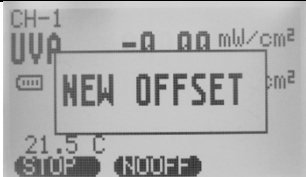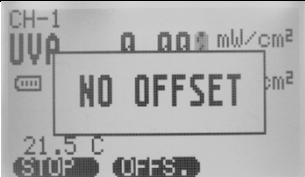
CH-1 UVA 0.698 W/m² CH-2 UVB 0.127 W/m² STOP OFFS. BILD		**Irradiance report** In this display mode only the irradiance is shown. The upper value is for channel-1, the lower for channel-2.
CH-1 UVA 10.650 J/m² Time:00:00:13 CH-2 UVB 1.816 J/m² STOP OFFS. BILD		**Dose report** The calculated dose and the measurement time are shown in this report.
UVA 0.843 W/m² 2.223 J/m² CH-1 CH-2 Time:00:00:03 UVB 0.130 W/m² 0.424 J/m² STOP OFFS. BILD		**Full report** In the upper half of the display is the information for the sensor at channel-1. First the sensor type is displayed, followed by the irradiance at the top and the dose below. The irradiance is displayed in mW/cm² or W/m² (photo). In the middle of the display are the battery symbol and the measurement time. In the lower half is the information for the sensor connected to channel-2.
CH-1 UVA 1.091 W/m² 14.756 J/m² Time:00:00:17 26.5 C STOP OFFS. BILD		**Channel-1 report** All information for the sensor at channel-1 is shown. The irradiance and the dose are shown, followed by the measurement time and the kernel temperature of the sensor. This report is also used, if only a sensor at channel-1 is connected.

CH-1 UVA+ 0.001 mW/cm² EII 0.024 mJ/cm² Time:00:00:26 STOP OFFS. DSPLY	**Channel-1 actinic report*** It is possible to add an optional actinic calibration to the RM-22 sensor. A calibration factor and a short description are stored inside the sensor. Using this function we have the possibility to evaluate the irradiance with a weighting to a given lamp. The actinic irradiance and the actinic dose are shown, followed by the measurement time. This report is only displayed if an actinic calibration is stored inside the sensor.
CH-2 UVB 0.138 W/m² 0.778 J/m² Time:00:00:07 26.5 C STOP OFFS. DSPLY	**Channel-2 report** All information for the sensor at channel-2 is shown. The irradiance and the dose are shown, followed by the measurement time and the kernel temperature of the sensor. This report is also used if only a sensor at channel-2 is connected.
CH-2 UVA+ 0.001 mW/cm² EII 0.019 mJ/cm² Time:00:00:23 STOP OFFS. DSPLY	**Channel-2 actinic report*** It is possible to add an optional actinic calibration to the RM-22 sensor. A calibration factor and a short description are stored inside the sensor. . Using this function we have the possibility to evaluate the irradiance with a weighting to a given lamp. The actinic irradiance and the actinic dose are shown, followed by the measurement time. This report is only displayed if an actinic calibration is stored inside the sensor.

Pressing the soft key OFFS. during a measurement takes the current reading into the offset memory. This value will be subtracted from subsequent measurements. Another press of the button N-OFF ends the offset subtraction. Both operations are confirmed by message. These messages are printed below.

CH-1 UVA -0.00 mW/cm² NEW OFFSET cm² 21.5 C STOP NOOFF	CH-1 UVA 0.000 mW/cm² NO OFFSET cm² 21.5 C STOP OFFS.

To stop the measurement the soft key STOP is used. By pressing the button the measurement is cancelled, the measurement values are still visible and the various reports can be switched using the DSPLY soft key.

UVA 0.077 mW/cm²
2.247 mJ/cm²
CH-1
Time:00:00:46
CH-2
UVB 0.014 mW/cm²
0.316 mJ/cm²
ENDE BILD
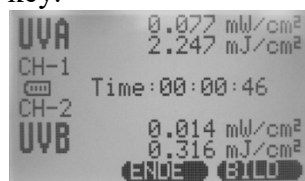
Pressing the EXIT soft key brings you back to the main menu.

7.1.2 Report design for measuring the transmission

During the transmission measurement, the two transmission values are displayed. If only on sensor is connected with the RM-22, only one value will appear on the display. With the 100 % soft key, the current intensity will be set to 100%.

CH-1
UVA 120.000 %

CH-2
UVB 131.229 %
STOP   100 %
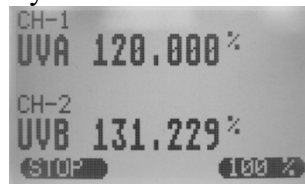
7.1.3 Report design for measuring the relation

The ratio measurement is only possible, when two sensors are connected with the RM-22. By default, after starting the measurement the ration CH-1/CH-2 is calculated. By pressing the <=> soft key the ratio can be rotated. By pressing the soft key 100 % the current ratio is set to 100%.

CH-1/CH-2
UVA / UVB

59.250 %
STOP 100 % <=>

CH-2/CH-1
UVB / UVA

12.545 %
STOP 100 % <=>
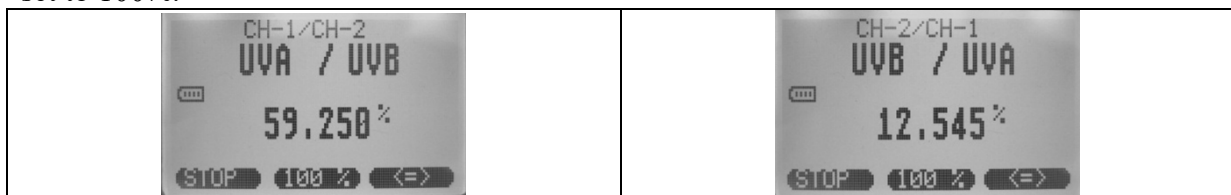
7.2 Parameter Measurement

This menu allows you to change parameter settings, which directly affects the measurement.

Measurement para
↑   ↓   OK
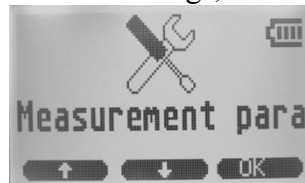
7.2.1 Units

This menu item allows you to switch the unit from mW/cm² to W/m².

Units m² <-> cm²
↑   ↓   OK

The conversion is done according to the formula:
$$10 \ W/m^2 = 1 \ mW/cm^2$$

7.2.2 Gain control

The RM-22 is equipped internally with a gain switching unit. The sensor signal is amplified in steps of 1, 10 and 100. With this menu item you can switch of this amplification.

Gain Control
↑   ↓   OK

There are applications where it can be an advantage, if the gain of a lower signal is not increase. However, this has the consequence that low radiation levels are not that good resolved. It is therefore recommended to set this function to ON.

7.2.3 Factor Channel 1 and Channel 2

With the RM-22, it is possible to multiply the measured sensor value by a factor. This function can be used for example to calculate the irradiance at a different position than the sensor position.

The input is done in an exponential format. This numerical representation has the advantage that the factor can be between 9.999E+9 (9.9 billion) and 0.001E-9 (0.000000000001). Each digit of the factor is entered individually. With the Z soft key, the current digit is increased. With the NEXT soft key you go to the next digit. The OK soft key takes the value as new factor. The entered value is stored for this sensor inside the RM-22. Thus, the factor is always used in the future, if the sensor is connected with the RM-22. It does not matter to which channel of the RM-22 the sensor is connected.

If the factor should not be used, the factor must be set back to 1.000E +0.

Numerical examples for the exponential format:

1.000E-1	=	0.1
1.000E+0	=	1
1.000E+1	=	10
4.567E+1	=	45.67

7.3 System setup

This submenu allows changing system settings. For example, it is possible to change the language or the display lighting behavior.

7.3.1 Change language

With this menu it is possible to change the language of the RM-22 between German and English.

7.3.2 LCD contrast

This menu item is used to customize the display contrast. This can be used to improve the readability of the display.

Using the arrow keys, the contrast can be changed. Holding down these buttons has no function. To adjust the contrast they have to be press several times. The **OK** button accepts the current contrast setting.

7.3.3 LCD backlight
This menu item allows you to customize the behavior of the 💡 button.

There are three different options:
- never

- Lighting for a specified period of 5, 10, 20 or 30 seconds.

- Operation as on / off switch

1.1.1 Auto power off
This menu item determines how the RM-22 handles idle times within the menu.
There are the following possibilities after witch idle time the RM-22 will turn off automatically:
- never
- after 30 seconds
- after 60 seconds
- after 90 seconds
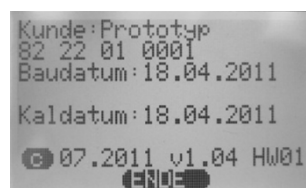- after 120 seconds
- reset
-

The "reset" option resets the RM-22 after pressing the OK button.

7.4 System Info
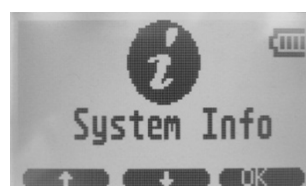
The submenu System Info allows viewing system parameter. In addition, you can see and reset (after entering the system code) the calibration factors stored in the RM-22.

7.4.1 RM-22 Info

Information about the RM-22 is displayed.

7.4.2 SD status

Here name of Sd card and free memory are displayed.

7.4.3 Channel 1 Info

Information about the sensor connected to channel 1. If no sensor is connected to channel 1 this menu point will not appear.

7.4.4 Channel 2 Info

Information about the sensor connected to channel 2. If no sensor is connected to channel 2 this menu point will not appear.

7.4.5 Calibration table

All calibration factors stored in the RM-22 are shown. The RM-22 has the capacity to save 8 calibration factors. After entering the system code, it is possible to delete the entire list.

7.4.6 Battery status

Report of the battery voltage, capacity, charge / discharge current and temperature.

7.4.7 System code

The system code is needed to delete all stored calibration factors. Entering the system code is carried out separately for each of the four digits. After successfully entering the system code the menu point is changed to "System code ok". Now, it is possible to delete the calibration factors in the menu. By switching off the RM-22 the release is disabled.

Systemcode: 1234

8 Software

8.1 Installation

For the installation, please proceed as follows:

1.) If necessary, disconnect the connection of the RM-22 from the PC.

2.) Start the installation with "RM22setup.exe" in the master data of the memory stick. Follow the instructions of the installation program.

3.) After completing the installation, connect the RM with the PC. The driver installation is taken out automatically under Windows 7.

8.2 Operation

The RM-22 software is divided into four tabs.

- Informationens to RM-22 and sensors
- measurements
- measurement table
- measurement graph

At the bottom of the software measurements can be started and stopped, and the settings for the measurements can be made.
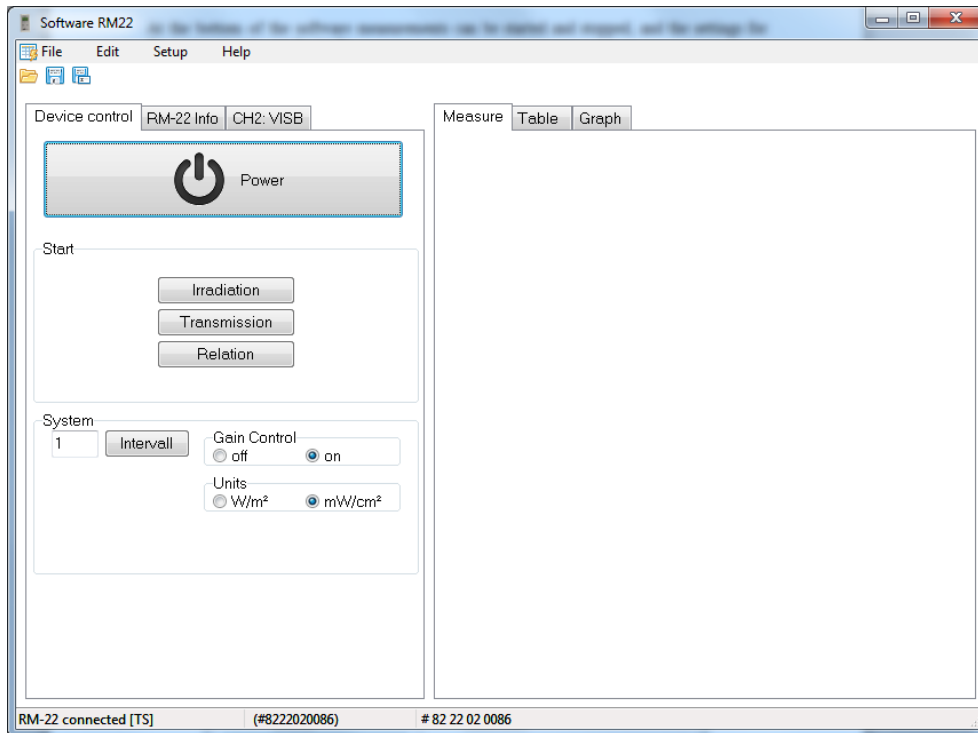
> The language can be easily changed via File menu.
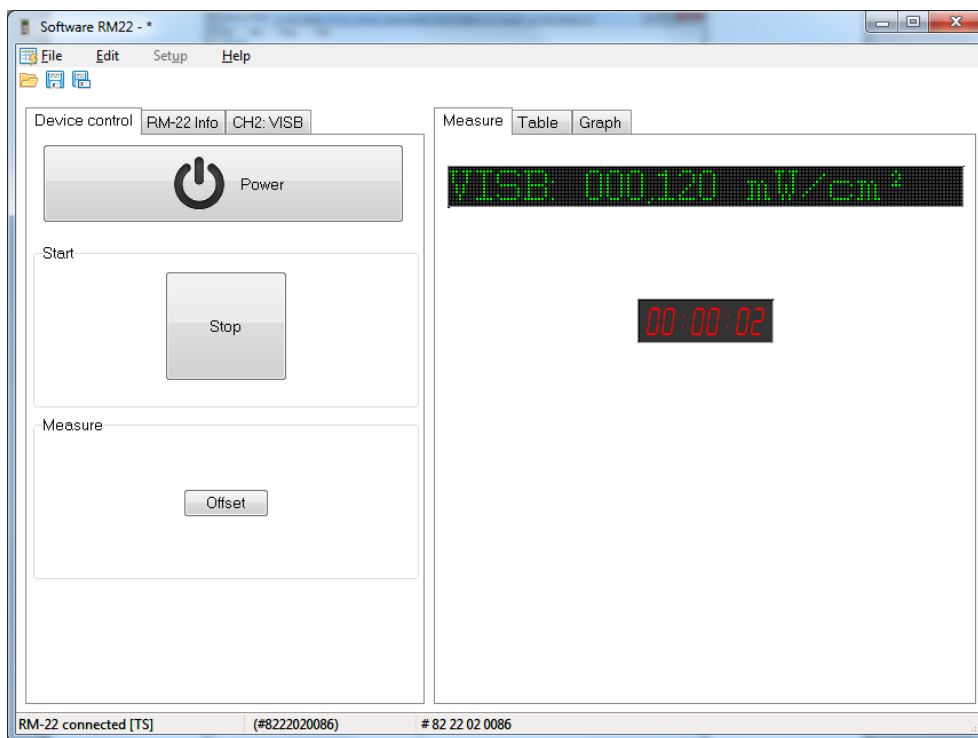
8.2.1 Informationen

The figure below shows the "Information" tab with information about the sensors and the radiometer RM-22
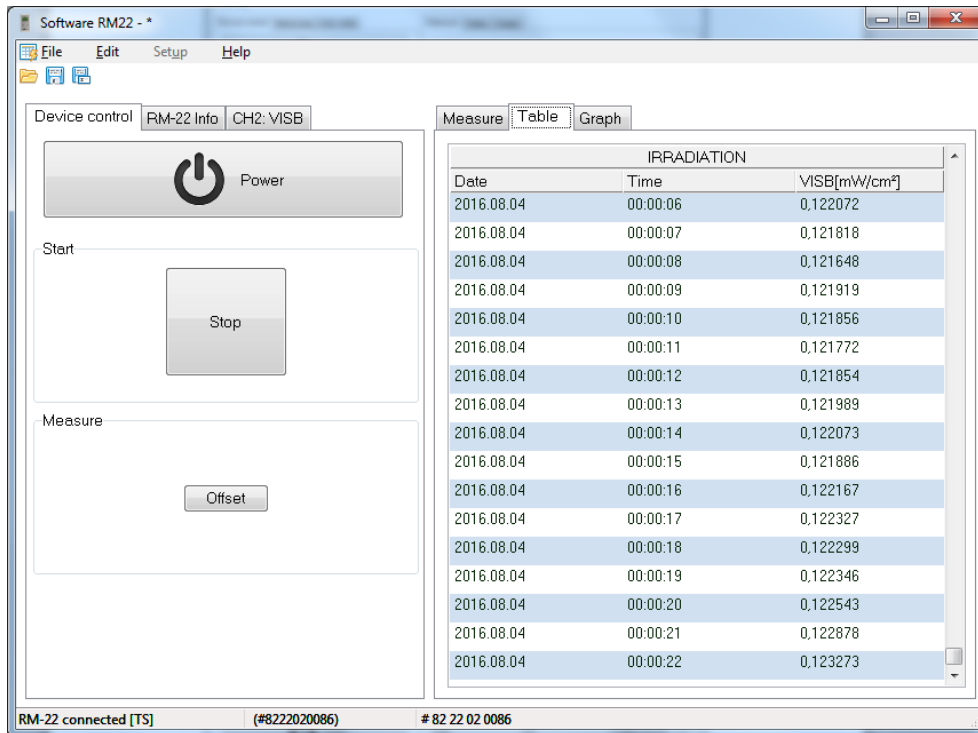
8.2.2 measurements

The figure below shows the "measure" tab with the current measured value.
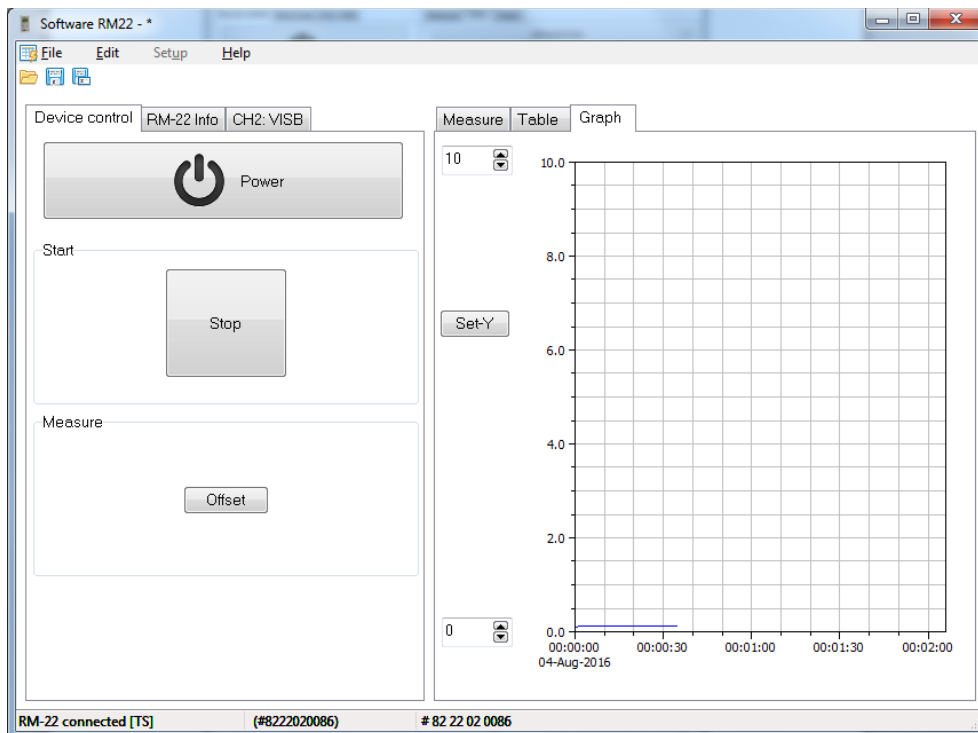

8.2.3 table view

The figure below shows the "table" with the last measured values.

8.2.4 Diagramm

The figure below shows the "graph" view.

8.3 SD-Card and data export

Measurements are stored on the internal SD card. If RM-22 is connected to PC it's recognized as a drive.

The data files are saved as CSV files (comma-separated-values). A CSV file stores tabular data (numbers and text) in plain text. This makes a CSV file easily readable (for example, in a text editor). CSV is a simple file format that is supported by many programs. It the file format was chosen because it can be easily opened with a spreadsheet like Microsoft Excel or OpenOffice.org.

Below the line is explained to a file Extract the contents:

```
RM22 Data File
www.opsytec.de

[RM22 Info]
RM22 Customer=KUNDE
RM22 Serialnumer=82 22 02 0080
RM22 Build date=22.04.2016
RM22 Calibration date=227.05.2016

[CH1 Info]
Sensortyp=UVB
Customer= KUNDE
Serial=81 23 12 0004
Production date=30.04.2016
Calibration date=30.04.2016
Calibration factor=+1,00000E+00
Sensor Offset=+0,00000E+00
Range High=400
Range Low=230

[Measurement Info]
Measurement Mode=Irradiance
Filename=20160430\081520.csv
Sample Rate=15 s save intervall
Decimal=,
Seperator=;

[IRRADIANCE]
Date;Time;UVB[mW/cm²];UVB Dose [mJ/cm²];;
2016.04.30;08:15:20;0;0;
2016.04.30;08:15:32;0,00003;0,00029;

File closed at: 2016.06.30;08:15:32
```

Measurements can alternatively be exported via the function Save / Save As, or as CSV data. Import format can be adapted in the "Settings" menu.

9 Failure handling

Is your RM-22 not responding or not operating as expected? This troubleshooting assistant can help you resolve these most common issues:

- Display remains black or blank
- Keys not responding
- Application unexpectedly closes or freezes
- No USB connection to the PC

9.1 My device doesn't start. What should I do?

If the screen remains black after pressing the power, the following steps may resolve the issue.

1. Connect the RM-22 to the power supply and wait for at least 30 seconds.
2. Press the ⏻ button to test the function.
3. If the RM-22 is still not responding, press the reset button.
4. If there is still no responds, disconnect the power supply, wait some seconds and start over.

9.2 How do I reset my device if it freezes?

In rare cases, your RM-22 may not start correctly or may stop responding. If this happens, try resetting your device. The only information lost on your device is the clock setting.

9.3 Where can I find the reset button?

The reset button is on the back side of the RM-22. It is located on the right side of the type plate. You have to use a straightened paper clip to press the button. A successful reset is indicated by a short flash of the backlight.

> After every reset:
> Please connect the RM-22 to the PC and start the RM-22 software. The PC software will set the real-time clock of the RM-22.