

Operating Manual

TinyTracker

Version 1.1e





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1 General



The radiometer TinyTracker is a handheld instrument for precise measurement of irradiance profile and the dose in a irradiance channel. The dose is calculated by integrating the irradiance values. Different UV and visible spectral ranges can be measured with the respective sensors. The measured values are stored on a SD memory card. The associated PC software allows to evaluate the data.

The unit is battery driven and can be charged by USB or an AC power supply.

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.

1.1 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.

1.2 Practical Hints

The sensor is integrated into the TinyTracker. The design of the TinyTracker housing is optimized so that the sensor does not heat up. The sensor is 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.

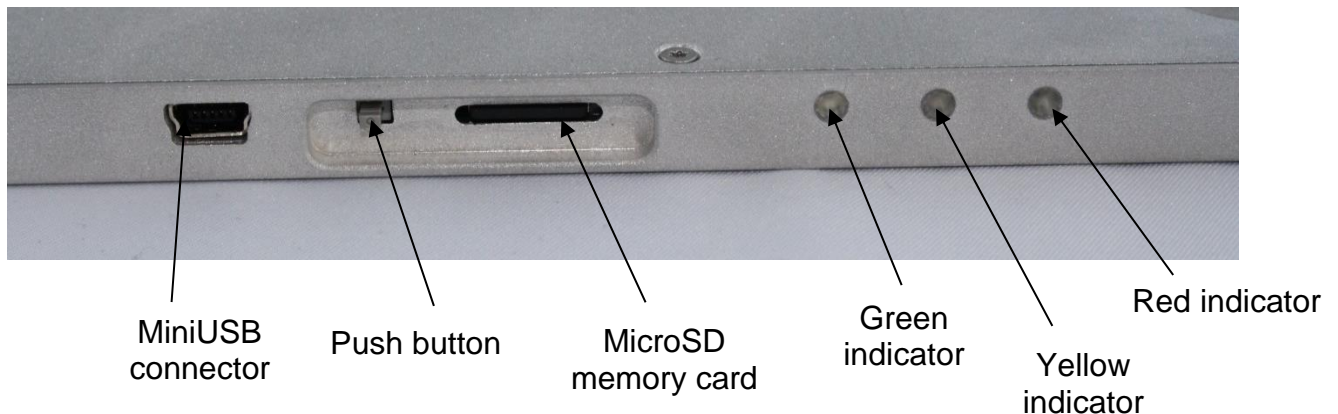
To achieve reproducible results the surrounding, the geometric arrangement, the temperature and the power of the lamp must be controlled. Furthermore, the appropriate sensor must be chosen to fit the particular measurement application. Any sensor is designed to measure radiation over a specified spectral 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} .



2 Operate the TinyTracker

2.1 Controls of the TinyTracker

The TinyTracker has only one button and 3 status lights. Most of the setup is done in the PC software. The lights are showing the status of the TinyTracker. The button is used to switch the TinyTracker on and off.



To switch on the TinyTracker press the button briefly. To switch off the TinyTracker press and hold the button until all three indicators illuminate. Now you can release the button and the TinyTracker is powered down. Switching off during an active measurement stops the measurement and closes the file. The measurement can be evaluated then like any other measurement with the PC software.

2.2 Definition of the status lights

Dependent of the status the TinyTracker status lights are illuminate / flashing in a different pattern. Each status light has 4 different modes: off, flash short, flash long and on.

At a short flash, the light is on for 1/8th and off for 7/8th of the time. In comparison, the long flash has an on : off ratio from 1:1.

The following table helps to indicate the function which belongs to the pattern.



Function	Green	Green Flash Short	Green Flash Long	Yellow	Yellow Flash short	Yellow Flash long	Red	Red Flash Short	Red Flash long
Off									
Power up - TinyTracker testing the hardware				Orange				Red	
TinyTracker ready - Waiting for UV light (for a max. of 10 minutes - then tracker switches off)		Green			Orange				
TinyTracker is collecting data					Orange				
Measurement in TinyTracker finished ready for download the data (for a max. of 10 minutes - then tracker switches off)		dark green							
Switching off - Power Key holded	Green			Orange			Red		
Connected to USB or Power supply (Green flash shows battery state; Yellow is read access to SD card Red is write access to SD card)	Green			Orange			Red		
System Error (missing SD, no space on SD, Battery empty)							Red		

2.3 Name convention for data files

Measurements are automatically saved in a data file. The file format is described in chapter 4: Structure of a data file. The files are stored in a directory according to the date of the measurement. The filename is according to the start time of the measurement.

Example:










Path and filename	Start of measurement
\\20120116\093644.csv	January 16, 2012 at 9:36:44 am
\\20111222\160752.csv	December 22, 2011 at 4:07:52 pm
\\20120110\070000.csv	January 10, 2012 at 7am
\\20111222\104630.csv	December 22, 2011 at 10:46:30 am

2.4 Connecting the TinyTracker to the PC

First time the tracker is connected to a PC, it will be recognized as a new device and the PC installs the driver for the TinyTracker. There is no need for an interaction of the user, because Windows supports all protocols used in the TinyTracker. The only thing to see during the installation is the notify icon in the notification area.

Here is an overview about the different notifications:



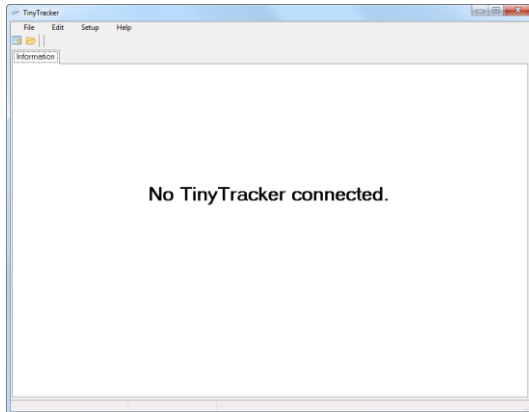
	 <p>USB Composite Device</p>
	 <p>USB - Mass storage device</p>
	
	 <p>Drive</p>
 <p>Your new hardware is installed and ready to use.</p>	<p>The first line is always "Found New Hardware",</p>

Thereafter the TinyTracker is installed and ready to use with the PC software.

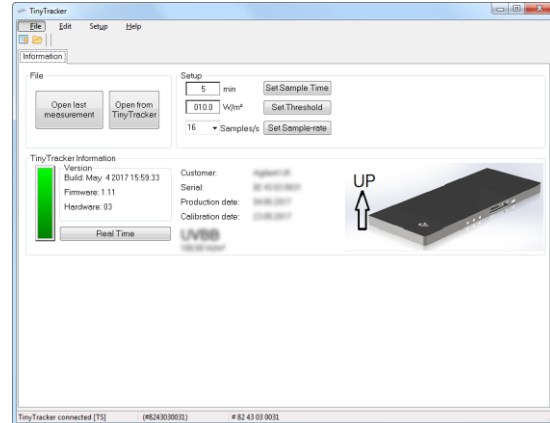


3 Using the PC software

The TinyTracker software comes with a powerful, easy to use PC software. After installation and start of the software you can see one of the following user interfaces:



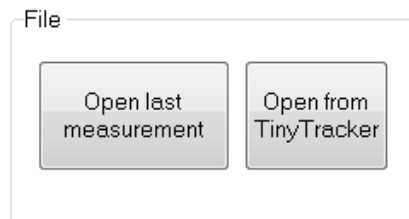
User interface with no tracker connected



User interface with tracker connected

If no tracker is connected the only possibility is to open data files from the local hard drive. This is done using the menu “File -> open”.

3.1 Opening a file



If a TinyTracker is connected you get two buttons to open a file.

3.1.1 Open last measurement

With “open last measurement” the software triggers a communication with the TinyTracker to get the filename of the last measurement and the drive name. Thereafter, this file is loaded into the software.

It could be possible, that no last measurement is stored in the TinyTracker, e.g. after an update or an empty battery. The software will inform you about this with a message.

3.1.2 Open from tracker

The software tries to get the drive name and opens a open window in the root directory of the TinyTracker drive.

3.2 TinyTracker setup

The whole setup is done in the setup box. This box is only visible when a TinyTracker is connected to the computer.



TrackerUSB setup

<input type="text" value="5"/>	min	<input type="button" value="Set Sample Time"/>
<input type="text" value="001.0"/>	mW/cm ²	<input type="button" value="Set Threshold"/>
<input type="text" value="16"/>	Samples/s	<input type="button" value="Set Sample-rate"/>

Each time the TinyTracker is connected and the software is active, the real time clock of the TinyTracker is synchronized with the system clock. The

3.2.1 Setting the sample time

Sample time can be set from 1 to 180 minutes. The sample time is read from the TinyTracker after connection. To transfer the new sample time, press the “set sample time” button.

3.2.2 Setting the Threshold

The threshold can be set between 0.1 and the maximal irradiation value of the TinyTracker. To transfer the threshold, press the “Set threshold” button.

The threshold should be chosen so that the TinyTracker triggers when entering into the channel as early as possible, however, is not triggered earlier by noise.

3.2.3 Setting the sample rate

The sample rate is adjustable from 2 to 25 samples per second. Due to the inner construction of the TinyTracker device not all sample rates are precise. The sample rates of 2, 4, 8 and 16 samples per second are exact and therefore preferable.

The error for the other sample rates is not significant and shown on in the following table:

Sample rate	Error
2	0,000%
3	0,003%
4	0,000%
5	0,006%
6	-0,006%
7	-0,003%
8	0,000%
9	0,003%
10	0,006%
11	0,003%
12	0,012%
13	0,015%

Sample rate	Error
14	0,018%
15	0,021%
16	0,000%
17	0,024%
18	-0,024%
19	0,021%
20	-0,024%
21	-0,024%
22	-0,031%
23	0,021%
24	-0,024%
25	0,021%

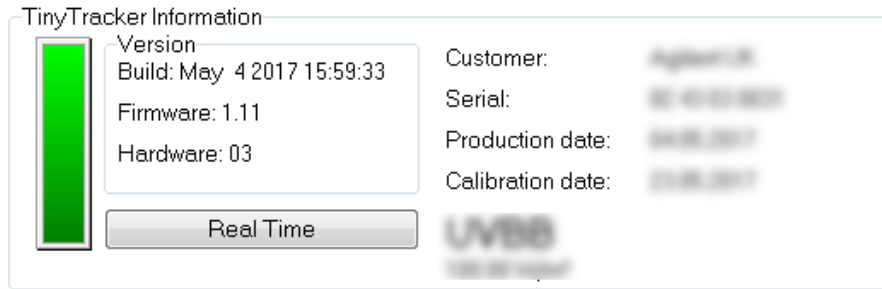
Negative errors result mean a higher sampling frequency and result in a shorter measurement time. The recording is done with no notice of the error.

The maximum error is between -1.1 seconds to short up to +0.9 seconds to long, per one hour measurement.

To set the sample rate choose the rate and press the transfer button.



3.3 TinyTracker Information



If a TinyTracker is connected the Tracker Information box is displayed. This box contains all hardware information about the TinyTracker.

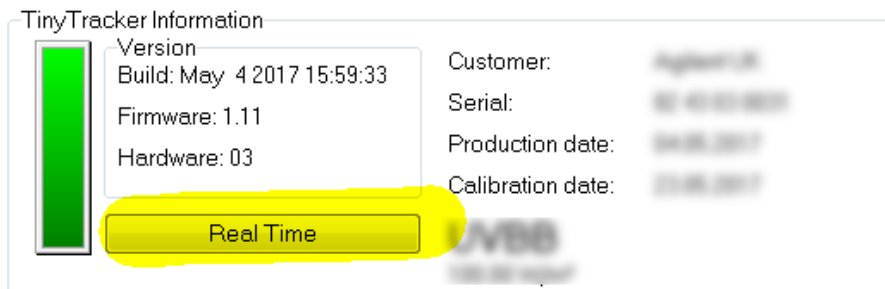
First thing is a colored bar. This bar is the battery indicator. It changes the color in dependence of the energy level. The TinyTracker is automatically loaded when connected to the PC. Alternatively you can use the power supply.

Next to the battery indicator there is the Version box. This box contains information about the Firmware version of the TinyTracker. This information is used for the Firmware update function.

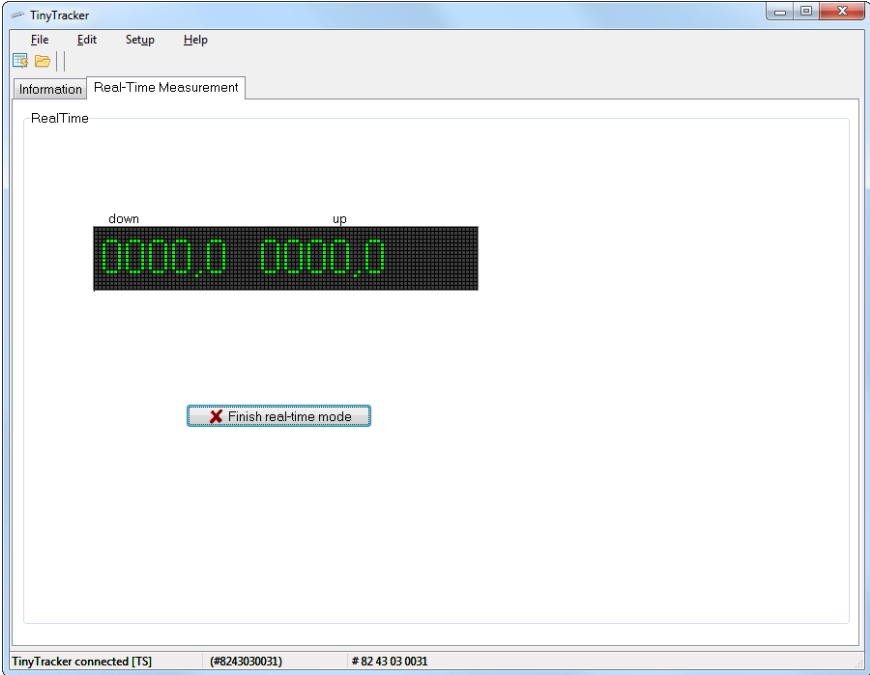
At least there is the TinyTracker information. Here you can find the serial number, build date, calibration date and the included sensor typ. Also the customer is stored inside the tracker.

3.4 Real-time measurement

In the Tracker Information box there is also a button called "Real Time".



After pressing this button, a new tab is displayed and the TinyTracker is functioning as a standard radiometer. The TinyTracker is measuring the irradiance and transfers the value to the software.

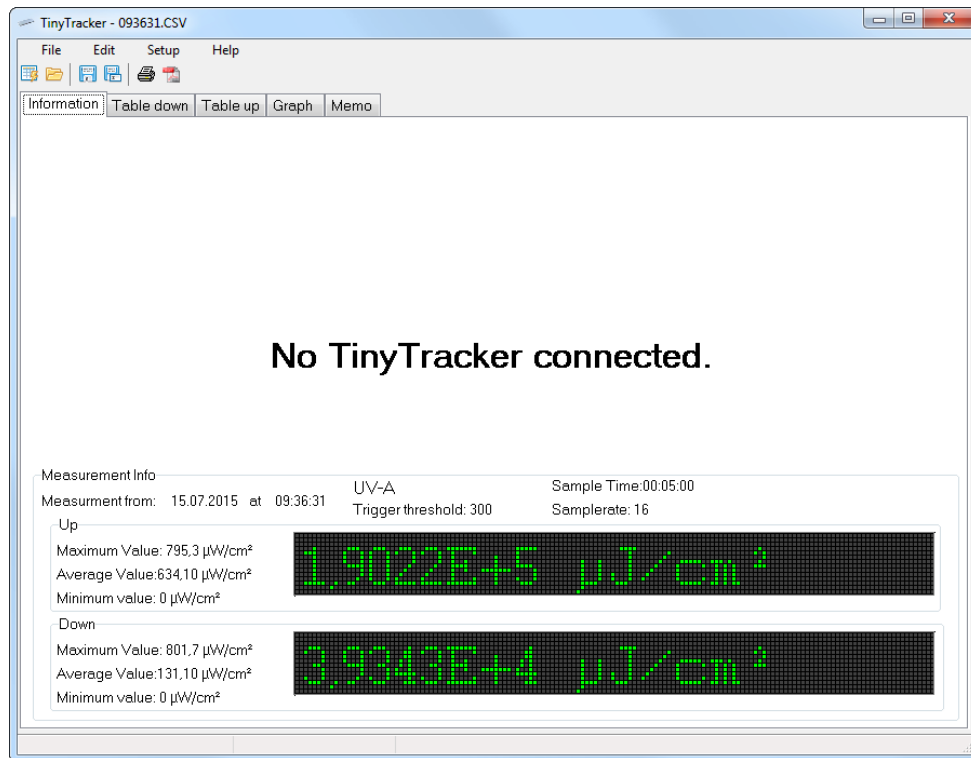


To exit the real time measurement press the “Finish real-time mode” button.

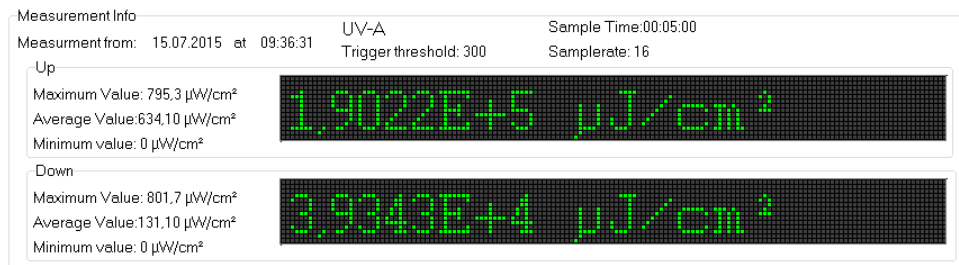


3.5 Evaluating the data

After loading a data file the measurement info box and three additional tabs appear.



3.5.1 The Measurement Info



In the measurement info box you get a short overview about the measurement.

First off all the measurement date and time is displayed. Also the setup for the measurement is shown. The main result is the dose measured, which is shown in big letters. Additionally, the maximum, minimum and average values are shown.

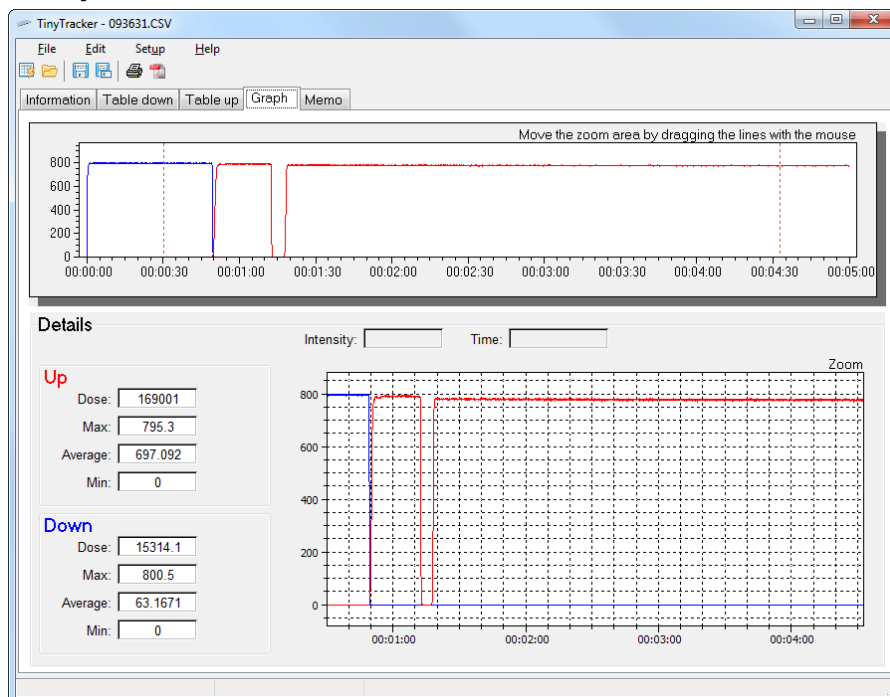


3.5.2 The Table tab

Time	+0.0000	+0.0625	+0.1250	+0.1875	+0.2500	+0.3125	+0.3750	+0.4375	+0.5000	+0.5625	+0.6250	+0.6875	+0.7500	+0.8125
00:00:00	0378.8	0515.5	0602.6	0657.3	0687.3	0709.9	0728.7	0742.3	0756.4	0766.9	0777.1	0784.8	0791.7	0791.1
00:00:01	0795.1	0798.9	0796.3	0798.1	0796.7	0796.3	0796.2	0793.9	0793.1	0797.1	0794.3	0796.3	0796.1	0796.1
00:00:02	0796.4	0797.8	0796.4	0795.2	0796.4	0797.5	0798.3	0796.5	0798.7	0799.4	0798.8	0797.2	0797.9	0797.7
00:00:03	0797.0	0797.8	0798.1	0792.8	0797.8	0799.6	0798.0	0798.7	0798.6	0792.8	0800.5	0797.8	0797.5	0798.1
00:00:04	0797.5	0793.9	0800.5	0796.8	0797.7	0797.5	0796.6	0796.6	0798.5	0797.2	0798.5	0797.6	0798.0	0794.1
00:00:05	0798.7	0796.1	0798.7	0799.1	0797.2	0794.9	0798.8	0799.9	0799.8	0798.0	0796.6	0796.7	0799.4	0799.1
00:00:06	0798.1	0797.2	0798.1	0797.2	0797.6	0798.0	0798.6	0795.6	0797.6	0795.1	0796.2	0800.7	0798.7	0797.7
00:00:07	0799.4	0798.2	0798.0	0797.7	0797.5	0801.4	0797.6	0798.6	0795.9	0798.1	0797.5	0796.6	0799.6	0796.6
00:00:08	0797.8	0800.0	0797.7	0795.6	0798.2	0798.0	0798.3	0797.4	0797.9	0801.0	0797.8	0798.7	0798.3	0798.1
00:00:09	0796.0	0797.8	0796.0	0797.7	0799.4	0798.1	0796.5	0797.8	0797.5	0798.5	0799.5	0797.3	0796.7	0798.1
00:00:10	0798.8	0796.5	0798.2	0797.7	0799.1	0797.4	0798.1	0795.5	0798.5	0798.4	0799.6	0795.9	0799.0	0797.7
00:00:11	0798.6	0794.9	0799.3	0797.7	0796.6	0797.4	0796.0	0798.0	0798.2	0797.8	0796.4	0794.9	0796.2	0796.1
00:00:12	0797.4	0797.7	0797.0	0796.5	0798.1	0797.9	0795.5	0797.3	0797.7	0799.3	0800.8	0797.0	0799.2	0797.7
00:00:13	0798.6	0795.2	0797.6	0797.5	0797.8	0796.2	0798.4	0798.1	0799.3	0796.7	0800.8	0798.1	0798.9	0797.7
00:00:14	0798.0	0797.4	0798.8	0795.6	0798.3	0797.4	0799.4	0798.1	0797.6	0796.9	0796.3	0797.8	0798.7	0796.6
00:00:15	0798.3	0794.8	0797.8	0797.9	0797.0	0801.2	0796.7	0798.3	0798.4	0798.3	0798.3	0799.2	0797.3	0796.1
00:00:16	0798.3	0796.7	0797.4	0793.7	0797.2	0797.2	0797.5	0797.6	0792.6	0796.4	0796.1	0798.9	0797.6	0797.7
00:00:17	0796.2	0796.8	0798.9	0795.1	0795.1	0798.1	0797.4	0797.3	0796.4	0797.7	0798.6	0797.6	0797.1	0797.7
00:00:18	0797.9	0796.9	0797.0	0796.2	0797.2	0798.5	0797.2	0795.1	0797.4	0797.6	0799.2	0799.6	0798.7	0797.7
00:00:19	0797.8	0797.1	0799.3	0797.0	0799.6	0797.2	0795.9	0798.2	0798.4	0796.0	0797.2	0797.7	0795.3	0799.1

In the table tab the data table is displayed. You can scroll using the trackbars. Editing the data is not possible.

3.5.3 The Graph tab



In the graph tab the data is shown as two graphs. The top graph shows the whole measurement. The second graph is inside the details box.

Inside the first graph you can see two red lines. These lines define the range for the second graph – the detail graph. You can move the crosshair lines with the mouse.

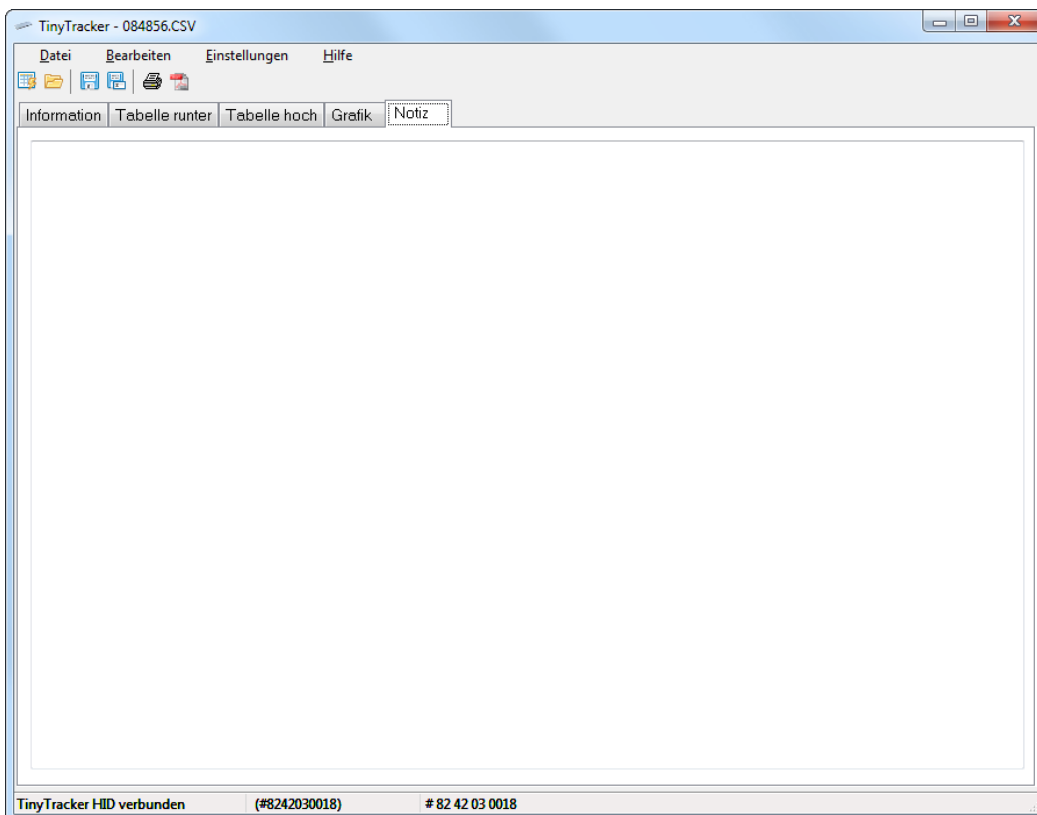


To move the whole details area, you can move it with the middle button of the mouse.

The details box displays additionally to the detail graph also the detail dose, max, min and average value for the chosen detail. If the mouse is inside the graph, the data point next to the mouse is highlighted with a crosshair and the intensity and time for this data point is shown.

The detail graph can also be moved with the middle button. Using the mouse wheel results in a zoom in or out function. While pressing the CTRL key and the left mouse button, you can open a zoom window.

3.5.4 The Memo Tab



The Memo tab is a memo field to add comments to the measurement. The memo text can be stored in the original data file.



3.6 Creating a report

The report can be printed or saved as a PDF file.



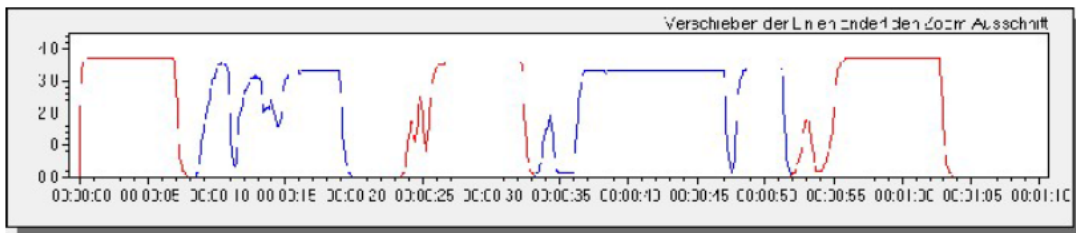
TinyTracker Messung

Info:

Messung vom: 08.10.2015 um 08:48:56
UV-B

Abtastrate: 16
Schwelle: 1
Messdauer: 00:01:10

Grafik



Up:
Dosis: 8,5288E+1 J/m²
Maximalwert: 3,7 W/m²
Mittelwert: 1,22 W/m²
Minimalwert: 0 W/m²

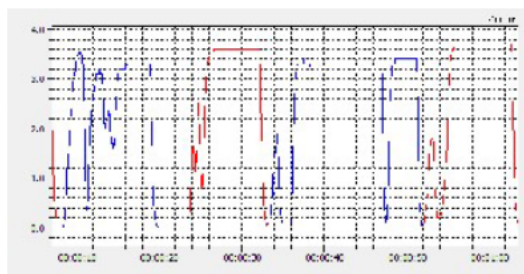
Down:
Dosis: 7,8294E+1 J/m²
Maximalwert: 3,6 W/m²
Mittelwert: 1,12 W/m²
Minimalwert: 0 W/m²

Memo:

Detail:

Up:
Dosis: 5,9513E+1 J/m²
Max.: 3,7000E+0W/m²
Mittelwert: 1,0522E+0W/m²
Min.: 0,0000E+0W/m²

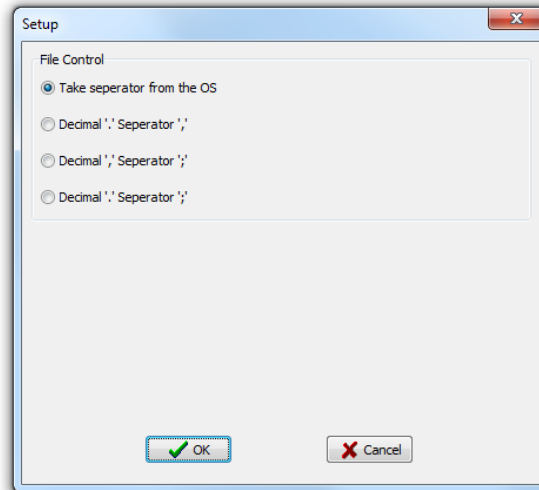
Down:
Dosis: 7,8294E+1 J/m²
Max.: 3,6000E+0W/m²
Mittelwert: 1,3842E+0W/m²
Min.: 0,0000E+0W/m²



The report includes all data including the detail view of the measurement.

3.7 Setup

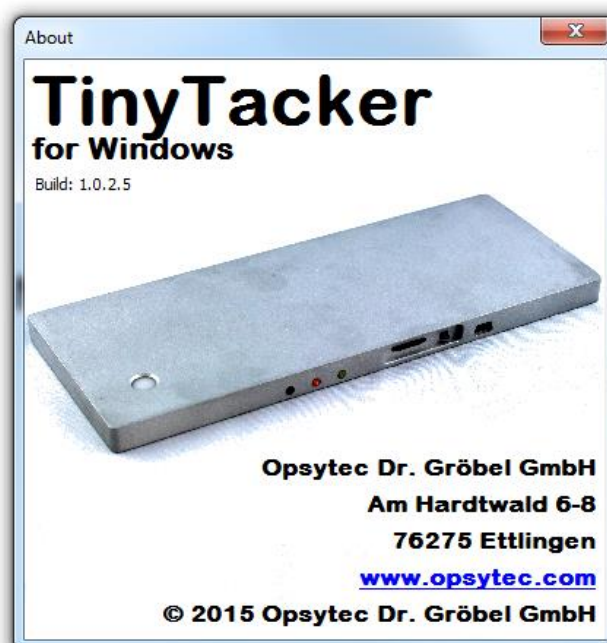
The setup menu allows you to change the separators in the data file. The data file is described in chapter 4: Structure of a data file.



You can change the decimal separator and value separator in dependence of your needs. In most cases the “take separator from the OS” is the best choice. This allows you to open the file with a spreadsheet program without the need of any adjustments.

The separator setup is written in any data file and the software reads this setup before trying to read the data. So the PC software can read data with every setup.

3.8 The About window



The About window shows the build version of the PC software.



4 Structure of a data file

The data files are stored as CSV files. A **comma-separated values** (CSV) file stores tabular data (numbers and text) in plain-text form. As a result, such a file is easily human-readable (e.g., in a text editor).

CSV is a simple file format that is widely supported by consumer, business, and scientific applications. Among its most common uses is to move tabular data between programs that naturally operate on a more efficient or complete proprietary format.

The CSV format was chosen because the files can easily be loaded in a spreadsheet software like Microsoft Excel or OpenOffice.org Calc.

The following part of a file explains the content of the different lines:

Explanation	Sample file
Marking as TinyTracker data file	USB-Tracker Data File
Homepage	www.uv-groebel.de
Original Filename used for date and time in the software	Filename: 20111222\104630.csv
Sensor type and measurement range of the TinyTracker	Measurement range: UV-A 2500 $\mu\text{W}/\text{cm}^2$
Trigger threshold used for this measurement	Trigger threshold: 100
Sample rate at this measurement	Sample Rate: 16 Samples per Second
Decimal separator for this file	Decimal: ,
Value separator for this file	Seperator: ;
Marking for Start of Memo:	SOM:
Memo text (variable number of lines)	Calibration at 580 $\mu\text{W}/\text{cm}^2$
Marking for End of Memo	EOM
Start of data array 1 st Line: Time for split second for each value	Time;+0,0000;+0,0625;+0,1250;+0,1875;+0,2500;+0,3125;+0,3750;...
2 nd row to end: 1 st Value is the time, followed by sample rate count values	00:00:00;0146,1;0566,0;0579,4;0579,4;0579,9;0578,2;0578,8;0580,1;... 00:00:01;0579,1;0579,6;0579,7;0579,6;0577,7;0579,3;0577,9;0578,7;... 00:00:02;0582,2;0580,1;0577,1;0578,1;0578,3;0578,9;0579,9;0580,7;... 00:00:03;0580,6;0578,8;0578,3;0579,4;0579,3;...
Number of lines is dependent on the measurement duration	...



Excel will import the TinyTracker data file to the following format:

USB-Tracker Data File							
www.uv-groebel.de							
Filename: 20111222\104630.csv							
Measurement range: UV-A 2500 $\mu\text{W}/\text{cm}^2$							
Trigger threshold: 100							
Sample Rate: 16 Samples per Second							
Decimal: ,							
Seperator:							
SOM:							
Calibration at 580 $\mu\text{W}/\text{cm}^2$							
EOM							
Time	0	0,0625	0,125	0,1875	0,25	0,3125	0,375
00:00:00	146,1	566	579,4	579,4	579,9	578,2	578,8
00:00:01	579,1	579,6	579,7	579,6	577,7	579,3	577,9
00:00:02	582,2	580,1	577,1	578,1	578,3	578,9	579,9
00:00:03	580,6	578,8	578,3	579,4	579,3	579,3	579,4

OpenOffice.org Calc will look like this:

USB-Tracker Data File								
www.uv-groebel.de								
Filename: 20111222\104630.csv								
Measurement range: UV-A 2500 $\mu\text{W}/\text{cm}^2$								
Trigger threshold: 100								
Sample Rate: 16 Samples per Second								
Decimal: ,								
Seperator:								
SOM:								
Calibration at 580 $\mu\text{W}/\text{cm}^2$								
EOM								
Time		0	0,0625	0,125	0,1875	0,25	0,3125	0,375
00:00:00		146,1	566	579,4	579,4	579,9	578,2	578,8
00:00:01		579,1	579,6	579,7	579,6	577,7	579,3	577,9
00:00:02		582,2	580,1	577,1	578,1	578,3	578,9	579,9
00:00:03		580,6	578,8	578,3	579,4	579,3	579,3	579,4

5 Technical data

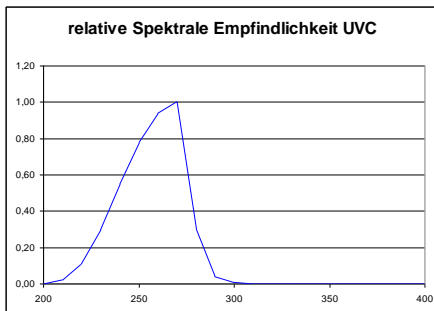
5.1 Device data

Dimensions:	195 x 78.5 x 10 mm
Weight:	250 g
Power supply:	internal Li-Ion battery
	Capacity: 1250mAh
Battery life:	up to 80 hours
Operation temperature:	0 to 40 °C
Storage temperature:	-10 to 40 °C
Humidity:	< 80% not condensing
Interface:	MiniUSB 2.0
Integration time:	1 – 180 minutes
Sample rate:	2 – 25 Samples per Second

5.2 Sensor data

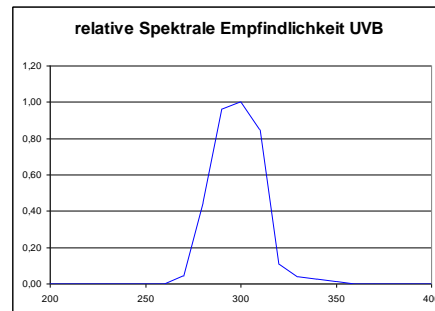
This is an overview over our standard sensors. Custom calibrations are available.

UVC Sensors



Measurement range: 200 mW/cm²
 Resolution: 0,001 mW/cm²
 Spectral range: UVC 200 to 280 nm

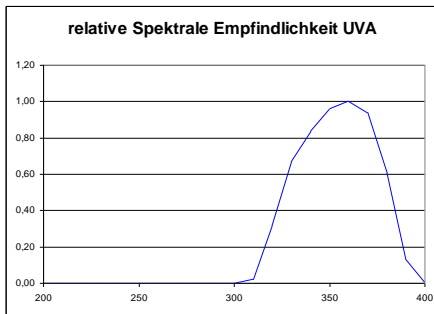
UVB Sensors



Measurement range: 20 mW/cm²
 Resolution: 0,001 mW/cm²
 Spectral range: UVB 280 to 315 nm

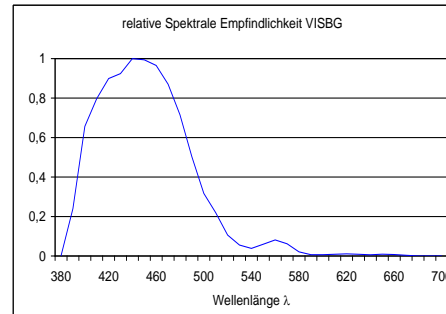


UVA Sensors



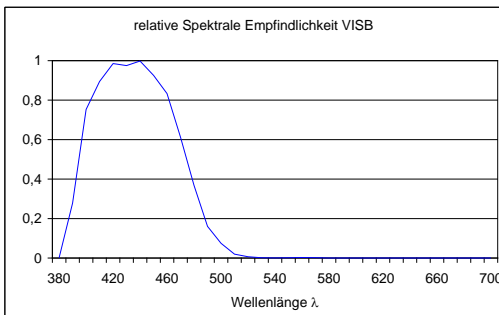
Measurement range: 200 mW/cm²
 Resolution: 0,001 mW/cm²
 Spectral range: UVB 280 to 315 nm

VISBG Sensors



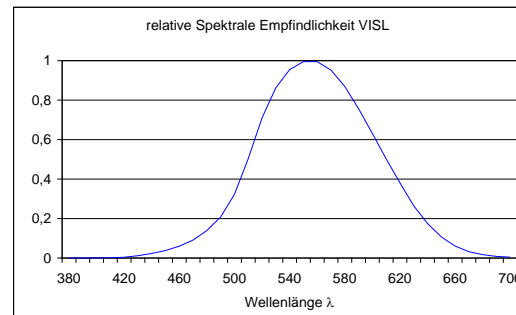
Measurement range: 200 mW/cm²
 Resolution: 0,001 mW/cm²
 Spectral range: VISBG 400 to 570 nm

VISB Sensors



Measurement range: 200 mW/cm²
 Resolution: 0,001 mW/cm²
 Spectral range: VISB 400 to 480 nm

VISL Sensors



Measurement range: 200 klx
 Resolution: 0,001 klx = 1 Lux
 Spectral range: VISL V(λ)

5.3 Calibration lamps

The calibration of the sensors is done at the following lamps (spectras). For custom calibrations, we can provide our optics laboratory.

Sensor type	Lamp name
UV-A	Osram L 100W / 79
UV-B	Helarium B1-12-100W / BIPIN
UV-C, UV-C tlb.	Osram HNS 15W OFR
VIS-B, VIS-BG, VIS-L	Tungsten FEL 1000 W