Summary

This manual refers to LM10-Firmware 1.09 and FM-Data program version 2.2.0.0.

The current version of the manual is available on the homepage *www.fauser.biz*.

Technical changes reserved; we do not accept liability for any errors.

1. Introduction

The Lightmeter LM10 is an innovative new development for checking the quality of light sources. For this, the parameters such as illumination intensity, flicker frequency and flicker rate are measured. Moreover, the flickering of lamp can be illustrated acoustically in audible as well as ultrasonic range via a loudspeaker.

The infrared and ultraviolet range as well as the colour temperature and colour spectrum can also be measured via optional probes.

Furthermore, the Lightmeter LM10L has an integrated data logger with 1 GB data memory and a real-time clock for an exact time/date specification.

The logger has 2 operation modes: For the long term measurement of duration modes, for punctual recording the single-point measurement.

Reading the stored measured values and the clearly laid-out settings of LM10L functions on PC is done on PC via USB interface. The FM-Data software serves for the processing and documentation of recorded measured values.

1.1. Commissioning

Please carry out the following work steps sequentially before taking first measurement:

- insert the batteries in the battery compartment.
- Insert the desired sensor in the sensor connector.
- Switch on LM10 by pressing the **On/Sound** button for two seconds.
- After the software version is displayed, the updated measured values appear on the display. The LM10 is now ready for operation.

1.2. Device description
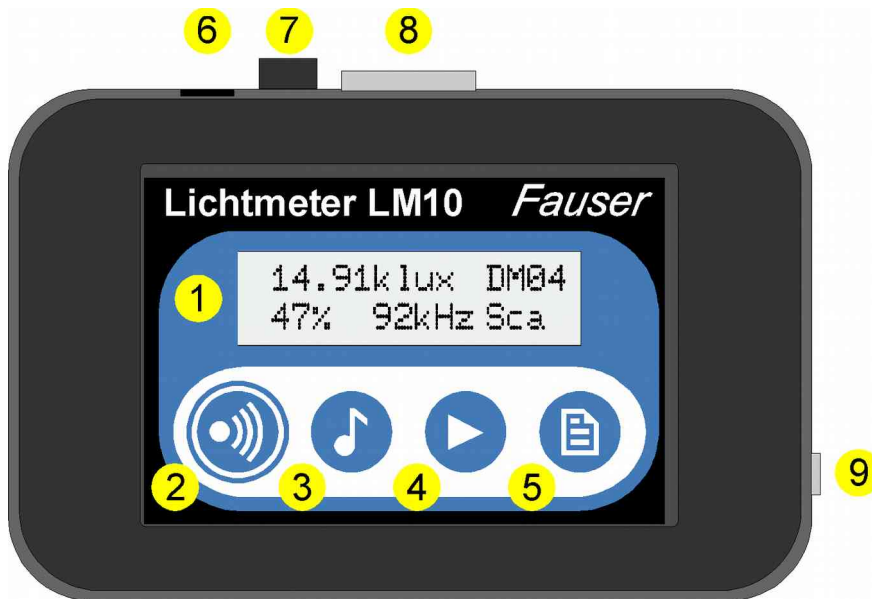
Figure 1: Lightmeter LM10

❶ Display (→ 2)

❷ **On/Sound** button (→ 3.1)

❸ **Audio/USB** button (→ 3.1)

❹ **Selection/Menu** button (→ 3.1)

❺ **Record** button (→ 3.1)

❻ USB port (only LM10L/LS)
  For connecting the Lightmeter FM10L/LS with a PC and for power supply with the USB-power supply (Art.-No. 520) using the attached USB-cable.

❼ Voltage output (→ 8.5) (only LM10S/LS)
  Voltage output of single measured variables

❽ Sensor connector
  For inserting the various measuring probes.

❾ Headphone connector
  A headphone can also be connected for audio functions instead of integrated loudspeaker.
  The loud speaker is then deactivated.

2. Display

The Lightmeter LM10 has a two-line display for presenting measured values, functions and setting menu.

```
Lichtmeter LM10
  Version 1.00
```

The software version is displayed when switched on

2.1. Measured value displays

```
E 13054 lx  DM04
 32%   48kHz Sca
```

```
E 13054 lx  DM04
F24%   48kHz Sca
```

```
ê 16801 lx
 28%   38kHz Sca
```

In the standard display, the illumination intensity in Lux and active recording of a data record is visible in the first line. Below it, the flicker rate in % as well as the highest frequency for flickering can be read. *"Sca"* stands for Scan mode for measuring flicker frequency.
With *"F"* in front of the flicker value, the value is Flicker% otherwise ripple content.
The display can switch between various measuring probes with the **Selection** button:
 - visible light E
 - max value Ê
 - infrared light IR
 - ultraviolet light UV
 - colour temperature TF

2.2. Additional information

```
E  1423 lx
 15%   63kHz   S
```

When *"S"* is displayed in second line, the audio mode for audible range is active.

```
E  5804 lx
 24%   67kHz USa
```

"USa" stands for automatic ultrasonic range, the most distinct ultrasonic frequency is transformed in audible frequency range.

```
E  3468 lx
 27%   55kHz USm
```

"USm" displays the manual ultrasound mode. Here, the ultrasonic frequency, which is transformed in audible frequency range, is set manually via buttons. This is possible in 1 kHz levels in a range from 10 kHz to 400 kHz.

```
E 13054 lx  ))
 32%   48kHz Sca
```

Sound symbol: Displays which function is given the acoustic display.

```
E 13054 lx
 32%   48kHz□Sca
```

Battery symbol: Batteries should be exchanged as soon as possible.

```
E 13054 lx  DM01
 32%   48kHz Sca
```

Logger function: Displays an active logger function.

3. Functions

3.1. Button functions

The four buttons have double functions; the main functions can be called up promptly in the measuring mode. The buttons help in navigation in menu mode. All the button functions are specified in table 1.

On/Sound button:
If this button is pressed for two seconds, the LM10 is switched on or off. When pressed briefly, the acoustic display (→ 3.2) is activated. This button has an *Esc*-function in menu mode.

Audio/USB button:
With this, the various audio functions for audible range and ultrasonic range can be activated with automatic and manual frequency setting.
By pressing the button for two seconds, the LM10 is switched to USB mode (→ 7.7, 7.11). *Back* is selected in the menu mode with this.

Selection/Menu button:
Various measuring probes are selected with this (→ 3.4.) The sensor for visible light is displayed by default. The frequency scan is restarted in the automatic ultrasonic mode. The frequency is increased in manual ultrasonic mode. By pressing the button for two seconds, LM10 is switched to menu mode (→ 4.3). *Next* is selected in menu mode.

Record button:
Activating logger function in LM10L/LS (→ 5). The measurement recording is started or ended in the duration mode. In the single-spot mode, the measurement is opened and the respective value is taken when the button is kept pressed further. By pressing the button for two seconds, the last measured value is saved and the measurement ends. The function of this button is S*election→Enter* in menu mode.
With this, the frequency is reduced in the manual ultrasonic range.
In Peak-Hold mode, the Peak-Hold display can be reset.

All the functions of various buttons are illustrated in the following table. The buttons saved in light-grey colour are available only in Lightmeter LM10L/LS.

Button:	Sound	Audio	Selection	Record
pressed briefly	sound off	off	illumination intensity E	start recording
	sound illumination intensity	audible range	infrarot IR	end recording
	sound flicker rate		ultraviolet UV	store single-spot
			colour temperature Tf	
			Peak-Hold →	Peak-Hold delete
		ultrasonic automatic →	start scan	
		ultrasonic manually →	increase frequency	decrease frequency
pressed for 2s	on/off	USB-mode	Menu-mode	leave single-spot
in menu	Esc	back	next	selection/enter

Table 1: Button functions of Lightmeter LM10

3.2. Acoustic display

The acoustic display is controlled via the **On/Sound** button. The sound signal proportional to measured values can be allocated to illumination intensity or flicker rate or deactivated. The function is displayed by the symbol ♪.

3.3. Audio functions

The Lightmeter LM10 has three audio functions to show the flickering of lamps acoustically. The various audio modes can be selected by pressing the **Audio** button.

Scan mode
Shows the flicker rate in % and the dominant flicker frequency in kHz. The acoustic reproduction is inactive. This mode is shown by *″Sca″* on display. If the illumination intensity is less than 50 lx or greater than 20 klx, a question mark is displayed in flicker frequency and flicker rate as no distinct specification of values is possible in such conditions. A flicker rate of at least 5% is necessary for displaying frequency.

Audible range
With this, the flickering is reproduced in the frequency range from 50 Hz to 16 kHz directly via the loudspeaker. Flicker rate is displayed in % and the dominant flickering frequency in kHz in scan mode. This mode is signaled with *″S″*.

Automatic ultrasonic
This mode transfers the flickering in frequency range from 10 kHz to 400 kHz in audible frequency range. The LM10 thus scans the dominant flicker frequency and transfers it optimally

in the audible range. If no dominant frequency is available in the range between 10 kHz and 400 kHz, the starting frequency 10 kHz is reproduced. The scan process can be repeated by pressing the **Selection** button. The dominant flicker frequency is displayed, *"USa"* appears on display in this mode.

Manual ultrasonic

A frequency range from 10 kHz to 400 kHz can be run manually at kHz levels. The reproduced frequency is increased with the **Selection** button, decreased with the **Record** button. The currently set frequency is displayed, *"USm"* appears in this mode.

The audio functions are reproduced via the integrated loudspeaker by default. Optionally, a headphone can be connected to the headphone connector; then the loudspeaker becomes inactive. Using a headphone is recommended in noisy surrounding or in case of deeper frequencies as reproduction by loudspeaker is limited here.

3.4. Switching of measurement function

Besides the standard measuring probe, various other measuring probes can be operated on Lightmeter LM10 for the range of visible light. For this, the measurement function corresponding to that probe is selected via **Selection** button.

The function of measuring probes is described in Chapter Measurement (➜ 6).

This additional probe must be activated in menu via the function *Setting➜Probe X* for operation.

Moreover, the peak-value display for standard measuring probes is selected via **Selection** button. The peak values are indicated by the symbol Ê; the peak value can be deleted via the menu function Peak-Hold or **Record** button.

4. Device settings

Here all the setting options of the Lightmeter LM10 are described, the functions of the data logger are available only in the versions LM10L/LS.

The logger settings and device settings can be made directly on LM10 using the settings menu (→ 4.3) and for LM10L/LS settings can be adjusted using the program FM-Data on the PC. For this, connect LM10L with the PC using the USB cable and switch to the USB mode by pressing the **Audio/USB** button for two seconds (→ 7.11).

4.1. Functions of data logger

Display data memory:

The data records saved in the device are presented with data record name and starting time of recording.

Using the **Selection** and **Audio** buttons, the data records can be scrolled through (→ 5.3).

Delete data memory:

Delete all the stored data records.

Logger mode:

Here, one can select one of the two data logger modes – C*ontinuous measurement* and *single-spot measurement* (→ 5).

Measurement interval:

Selection of recording interval for the function *Continuous measurement* of data logger.

USB transfer:

With this, the transfer speed of USB connection can be set. The *Slow* function guarantees a stable connection on most of the computers. With the *Fast* option, up to twenty times faster data transfer is possible. However, this could lead to transfer errors in some computers, especially notebooks.. Then select the *Slow* option.

4.2. Functions of settings

Threshold value %:

Varying threshold values can be selected for flicker rate. An alert sounds when the threshold value is exceeded.

Measuring probe IR:

When this menu function is activated, the infrared spectrum can be displayed via the **Selection** button.

Measuring probe UV:

When this menu function is activated, the ultraviolet spectrum can be displayed via the **Selection** button.

Measuring probe TF:

When this menu function is activated, the colour temperature can be displayed via the **Selection** button.

LCD lighting:

Setting the duration of background light for display. If duration of *1 Minute* is selected, the light extinguishes one minute after the last button press.

Volume:

Two volumes can be selected for audio function.

Tone generator:

Selection of the characteristic of tone signal proportional to field intensity (→ 3.2).

Calculation %:

Calculation type of the light flicker.

Signal tone:

Activate/deactivate a beep sound when pressing the button.

Auto-Power-Off:

If the *Auto-power-off* function is active, the LM10 switches off five minutes after the last button press in order to prolong the battery life.

4.3. Settings menu

When the **Selection/Menu** button is pressed for two seconds, the Lightmeter LM10 is in menu mode. Here logger settings as well as device settings can be adjusted.
For navigation use the buttons as shown in table 1.

Button:	Sound	Audio	Selection	Record
	Esc	Back	Next	Selection/Enter

Table 2: Button functions Lightmeter LM10 in settings menu

All the settings options are specified in the following table 3. The values of standard settings are presented in bold font. The functions saved in light grey are available only for LM10L/LS.

Menu	→	Data logger	→	Data memory	→	Display → Data record
						Delete
				Logger mode	→	**Continuous measurement**
						Single-spot
				Sample interval	→	0,25 seconds
						1 second
						10 seconds
						1 minute
				USB-Transfer	→	**langsam**
						schnell
		Settings	→	Threshold value %	→	**None**
						5%
						10%
						20%
						50%
				Measuring probe IR	→	Activate
						Deactivate
				Measuring probe UV	→	Activate
						Deactivate
				Measuring probe TF	→	Activate
						Deactivate
				LCD lighting	→	off
						1 minute
						permanent
				Volume	→	Low
						High
				Tone generator	→	**Steep**
						Flat
				Calculation	→	**Ripple content**
						Flicker%
				Signal sound	→	**Activate**
						Deactivate
				Auto-Power-Off	→	**Activate**
						Deactivate
		Delete Peak-Hold				

Table 3: Functions in menu mode

5. Data logger

The data logger of the Lightmeter LM10L/LS has two operating modes. These modes can be selected in the device settings under *Data logger→Logger mode*.

5.1. Continuous measurements

In continuous mode the measured values are recorded with the specified measurement interval. The recording can be started and ended using the **Record** button.

```
E 13054 lx  DM01
32%   48kHz Sca
```

The display *"DM"* appears in case of continuous measurement, the following number shows the data set number.

By default the 10 second measurement interval is set, however, the interval can be varied between 0.25 seconds and one minute in the menu using the *Data logger→Sample interval* function. For a measurement interval of one minute, the operating time is extended with the power saving mode to approx. one week.

5.2. Single-spot measurement

In the single-spot mode individual measured value ranges, e.g. for different light sources, can be saved. Per data set a maximum of 20 measuring points can be accepted.
The data set can be opened and the individual measuring points can be accepted using the **Record** button. In the display the number of individual measuring points are displayed. The dataset is closed automatically after the twentieth measuring point or it can be closed early by pressing the **Record** button for two seconds.

```
E 13054 lx  E#05
32%   48kHz Sca
```

"EP" stands for single-spot measurement, followed by the dataset number. After the *"#"*-symbol the number of the measuring point is displayed.

5.3. Data set management

The LM10 gives comprehensive information on all the data sets in the memory.
For this call up the menu *Menu→Data logger→Data memory→Displays*.

```
Anzeigen   DS:14
DM08 15:08 17.09
```

In the first line the number of the datasets in the memory is displayed.
In the second line the recording type *"DM"*, continuous measurement, *"EP"* single-spot measurement and the dataset number, start time and date are displayed.
The statistical values of the data set can be called up using the **Record** button.
The navigation between the different datasets takes place using the **Selection** button *previous* and the **Filter** button *back*.
Leave the display with the **On/Sound** button *Esc.*

5.4. Transferring data sets

By pressing the **Audio/USB** button for two seconds, the LM10L/LS switches to the USB mode and in display appears: *"USB mode: Waiting for PC"*.
Now the communication between the Lightmeter LM10L/LS and the PC is possible through the USB cable.
The communication takes place using the Program FM-Data as described in Chapter 7.7.
You can exit the USB mode using the *Esc* function of the **On/Sound** button.

6. Measurement

6.1. Preparation for measurement

Insert the measuring probe, required for measuring, in the sensor connector of Lightmeter LM10. The measuring probe can also be connected to LM10 via 80 cm long connecting cable. Select the corresponding measurement function via the **Selection** button.

The influences of other light sources should be avoided if a single lamp is to be measured. When measuring the compact fluorescent lights (energy saving lamps), it must be taken into account that they attain their full light intensity after few minutes.

6.2. Measurement of the visible spectrum with the measuring probe VL10

```
E 13054 lx
  32%  48kHz Sca
```

The measuring probe VL10 provided with the Lightmeter LM10 combines the measurement of the illumination intensity E in Lux, the flicker rate in % and the flicker frequency up to 400 kHz using the quick precision amplifier.

The maximum values (peak hold) of illumination intensity and flicker rate can be displayed using the **Selection** button. The maximum values can be reset with the **Record** button.

The measured spectrum covers the visible range from 480 nm to 660 nm.

The spectral sensitivity $V(\lambda)$ of the measuring probe is adjusted to that of the human eye.
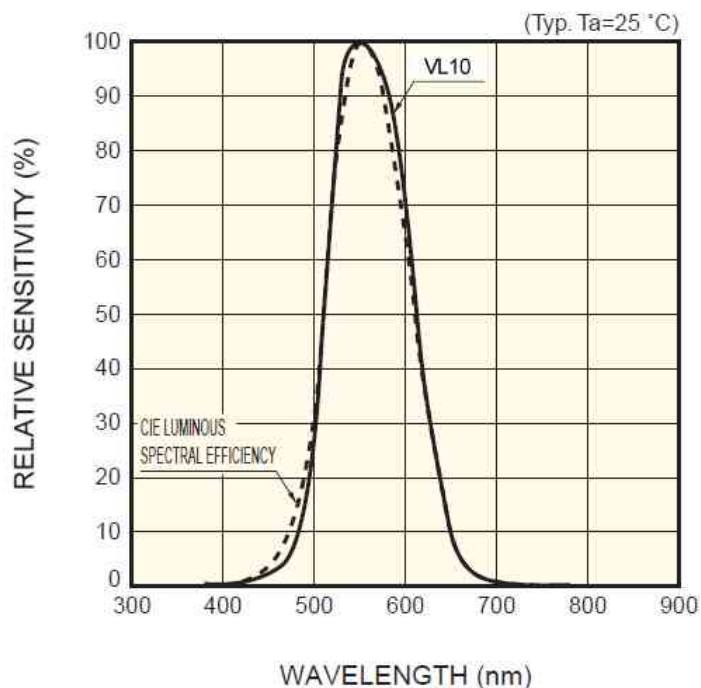
Spectral sensitivity of the measuring probe VL10

6.3. Calculation of flicker component

LM10 calculates the flicker component according to the following selectible procedures:

Ripple content:

$$W = \frac{\Phi max - \Phi min}{\Phi max} * 100\%$$

In accordance with the *Standard of Building Biology Testing Methods SBM-2015.*

Flicker%:

$$F\% = \frac{\Phi max - \Phi min}{\Phi max + \Phi min} * 100\%$$

In accordance with *IESNA.*
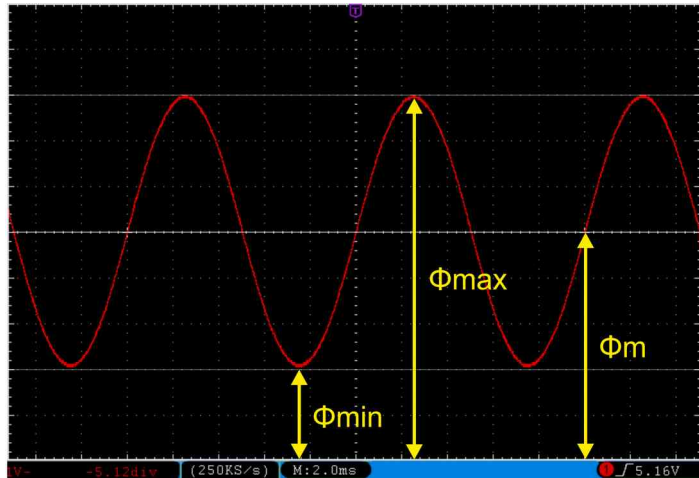
Luminous flux ϕ in Lumen (lm)

6.4. Measuring the flickering rate and flickering frequency

The visible spectrum must be measured using the measuring probe VL10.
To precisely measure the flicker rate and flicker frequency of a lamp, the influence of other light sources including daylight must be avoided. The measurement must therefore be carried out in a dark room.
The LM10 must be aligned directly to the lamp using the measuring probe VL10 and get it closer till the measured values are stable.
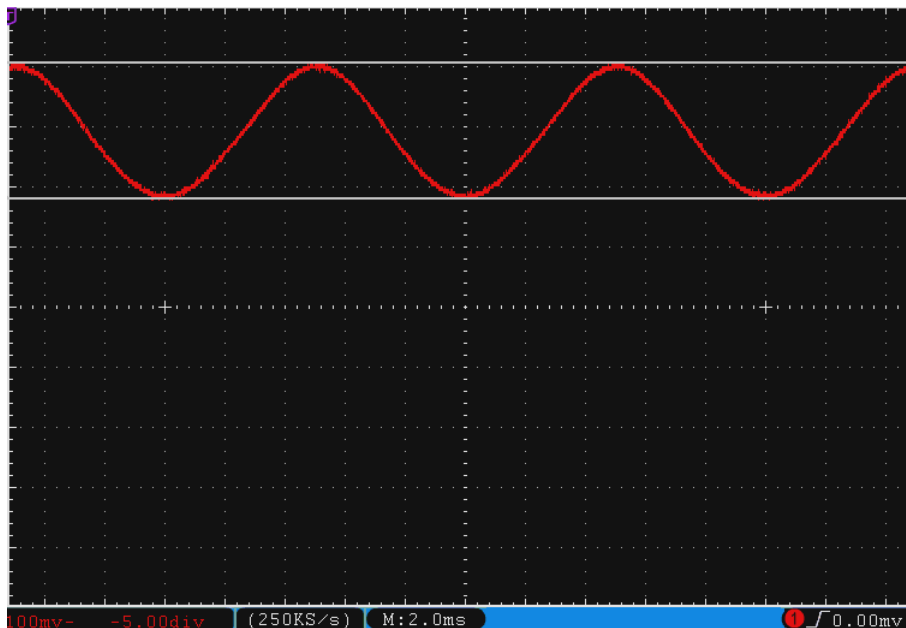
Brightness of an incandescent lamp (Flicker rate 23%, flicker frequency 100 Hz)

In case of incandescent lamps and halogen lamps, the flicker frequency is always 100 Hz and the flickering rate is from 15% to 25%. Low-volt halogen lamps with electronic power supply are an exception.
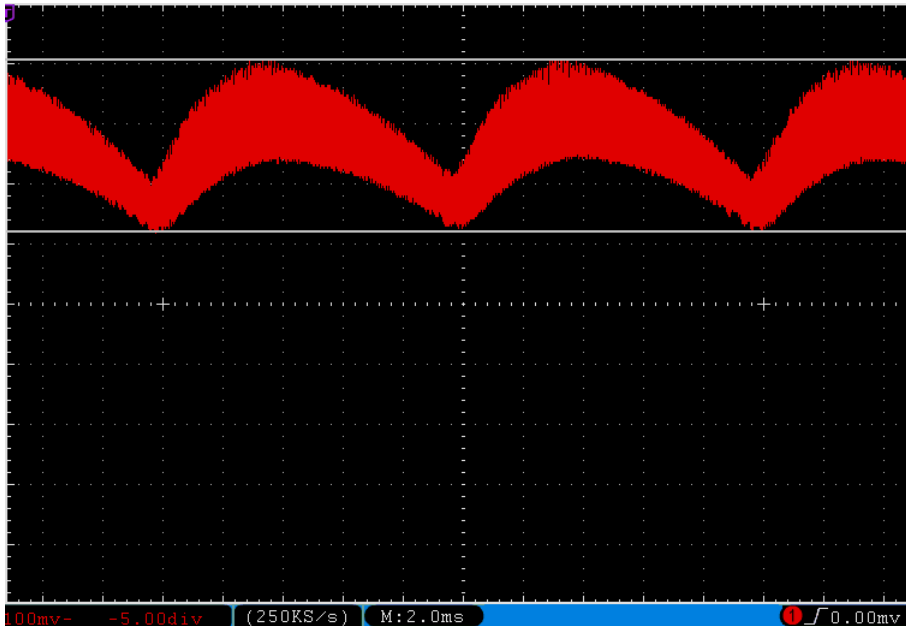
Brightness of a compact fluorescent lamp (Flicker rate 31%, flicker frequency 49 Hz)

Compact fluorescent lamps also known as energy-saving lamps have a flicker frequency in the range from approx. 20 kHz to 150 kHz due to the integrated electronic power supply. The flickering rate is typically from 20% to 40%.
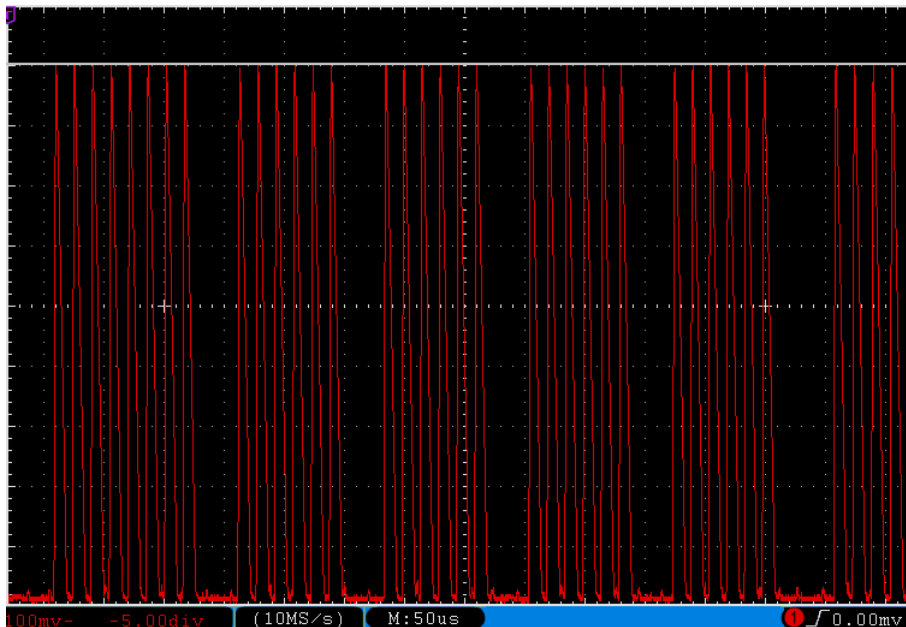
Brightness of an LED lamp (Flicker rate 100%, flicker frequency 49 Hz)

As the brightness of an LED responds almost without lag to its operating current, a general statement on the flicker rate and flicker frequency for these lamps is not possible.The flicker rate can lie between 0% to 100%, depending on the voltage source used (power supply). Flickering frequecies of 50 Hz to a few 100 kHz are possible. Hence, the quality of the voltage source is of greater importance in LED lamps.

6.5. Measurement of the infrared spectrum with the measuring probe IR10

```
IR 70.17 W
  ?%    ? Hz Sca
```
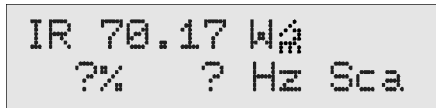
With the measuring probe IR10 (Article no. 263), the infrared spectrum can be measured in the range ($\lambda_{0.5}$) from 790 nm to 1050 nm. The unit is W/m². Select the *IR* unit for the infrared range using the **Selection** button. For this, the function *Settings→Measuring Probe IR* must be activated. The display of the flicker frequency and the ultrasound audio functions are possible in a frequency range up to 400 kHz.
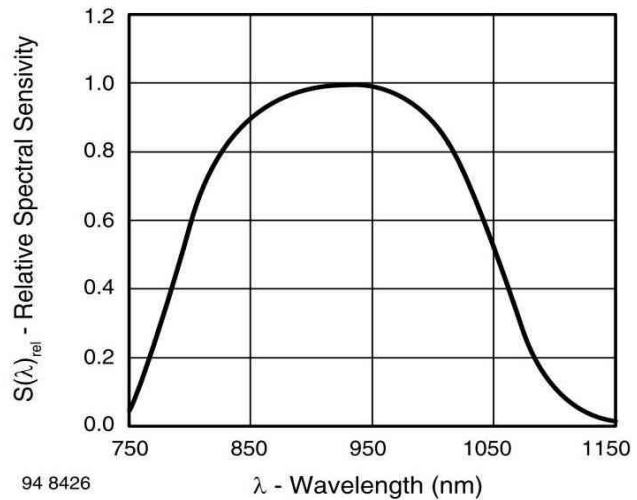
Spectral sensitivity of the measuring probe IR10

6.6. Measurement of the ultraviolet spectrum with the measuring probe UV10

```
UV 5961 mW
  ?%    ? Hz Sca
```
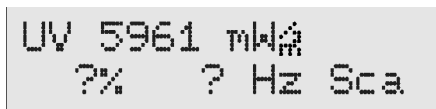
With the measuring probe UV10 (Article no. 265), the ultraviolet spectrum can be measured in the range ($\lambda_{0.5}$) from 220 nm to 365 nm. The unit is mW/m². Select the *UV* unit for the ultraviolet range using the selection button. For this, the function *Settings→Measuring Probe UV* must be activated.
Display of flicker frequency is not possible and the ultrasound audio functions are inactive.

Spectral sensitivity of the measuring probe IR10

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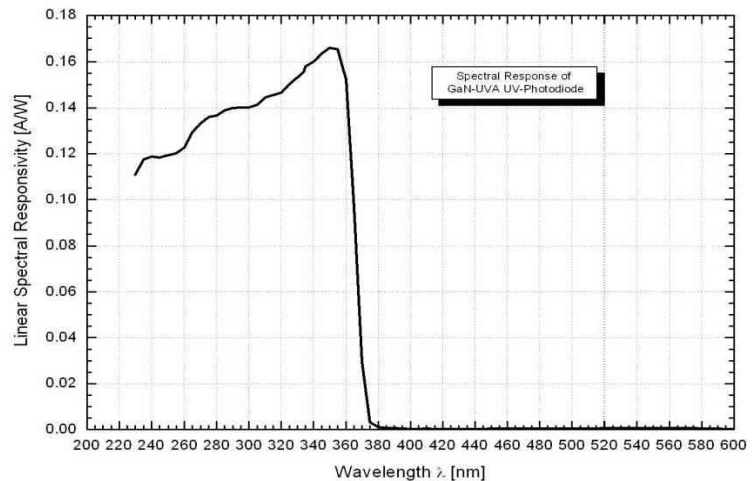
6.7. Measurement of the colour temperature with the measuring probe TF10

```
Tf   2856 K
  ?%    ? Hz Sca
```
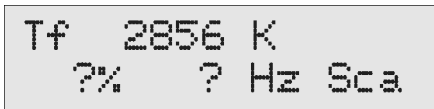
For this, the measuring probe TF (Article no. 266) must be used and the Tf unit for the colour temperature must be selected using the selection button.
For this, the function *Settings→Measuring Probe TF10* must be activated.
The unit for the colour temperature is K (Kelvin). The measurement range is from 2000 K to 3500 K.
The display of the flicker rate, the flicker frequency and the audio functions are not available.

6.8. Signal analysis at the voltage output

The Lightmeter LM10S/LS has a voltage output for signal analysis (→ 8.5).

The entire measurement signal (AC and DC) is at connection no. 1 and only the AC signal is at connection no. 2. The AC voltage signal has auto range and is boosted by the factor ten under 1000 lx.

The brightness of a lamp can be made visible on the entire signal with an oscilloscope. The frequency spectrum of the flicker frequencies are seen with a frequency analyser.
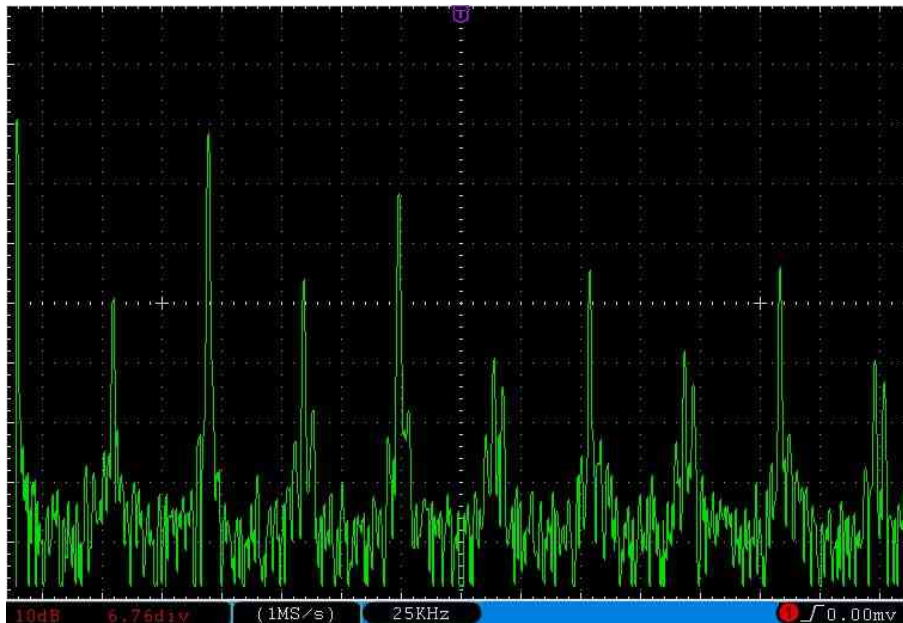
Frequency range of a compact fluorescent lamp

7. Software FM-Data

7.1. The program FM-Data

The Lightmeter LM10L possesses a data logger which provides the storage of measurement values over a long period. The program FM-Data enables the transfer of the recorded data to the PC as well as their graphic illustration and printing. Moreover, FM-Data allows to readout and change the settings of the Lightmeter LM10L and the Fieldmeter FM10L as well as the transfer of the new setup to the LM10L.

The latest version can be ordered at our homepage *www.fauser.biz*. FM-Data is constantly developed to adapt to the needs of our customers, and this service is available to you in the form of free of charge updates.

7.2. Installing FM-Data on Windows 2000/XP

The software CD bundled with the Fieldmeter FM 10 contains the installation program *setup.exe*, which installs the program FM-Data on your PC.

You should close all other applications before starting the installation. After that start *setup.exe* and follow the instructions of the installation program.

7.3. Installing FM-Data on Windows Vista/7/8/10

You should close all other applications before starting the installation. After that start setup.exe on the software CD FM-Data and follow the instructions of the installation program.

After the installation, open the windows explorer and choose the folder *C:\programme(x86) \Fauser Elektrotechnik\FM-Data*. Right-click on the application FM-Data and choose the menu point attributes.
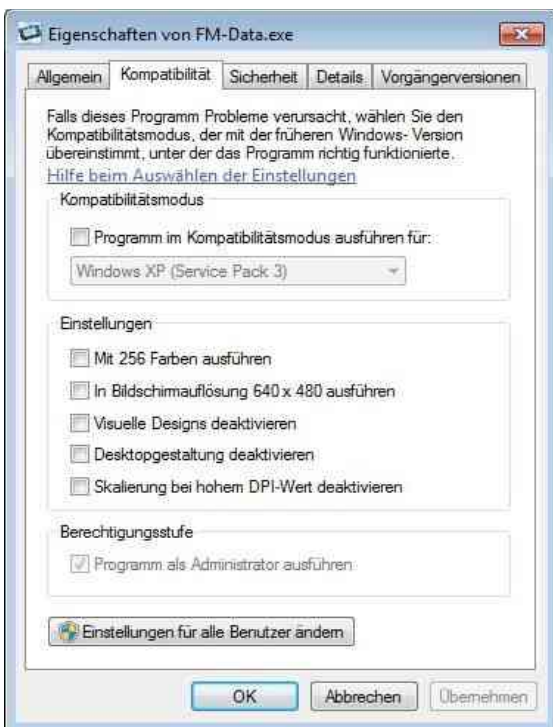
Now select *compatibility*.
Klick the button *settings for all users*.

Activate the authorisation level: *Execute program as administrator.*
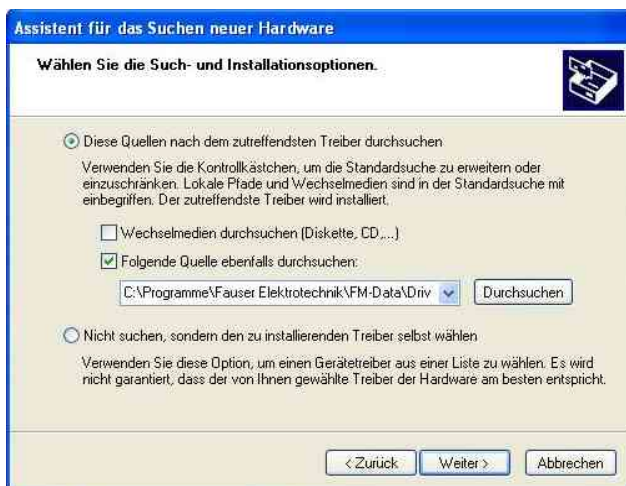
7.4. Installation of the USB-Driver for the Lightmeter LM10 on Windows 2000/XP

Connect the Lightmeter LM10L to your PC via the USB-cable. Turn on the LM10L and activate USB-mode (→ 3.1). The window of the hardware assistant appears on the screen. Choose the answer *No not this time* to the question for a Windows-update. Click on *continue.*

Now, choose *install software from a list or certain source* and click on *continue*.

Enter the source of the driver:
C:\programs\Fauser Elektrotechnik\FM-Data \driver.
If the FM-Data CD is in the drive you can also enter *search* or *CD-ROM drive.*
Click on continue.

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If the following warning message appears, you choose *continue installation.*
The data necessary for the driver are copied now; after that you click on *finish.*
Now, the USB-driver is installed and the program FM-Data is ready for use

7.5. Installation of the USB-Driver for the Lightmeter LM10 on Windows Vista/7/8/10
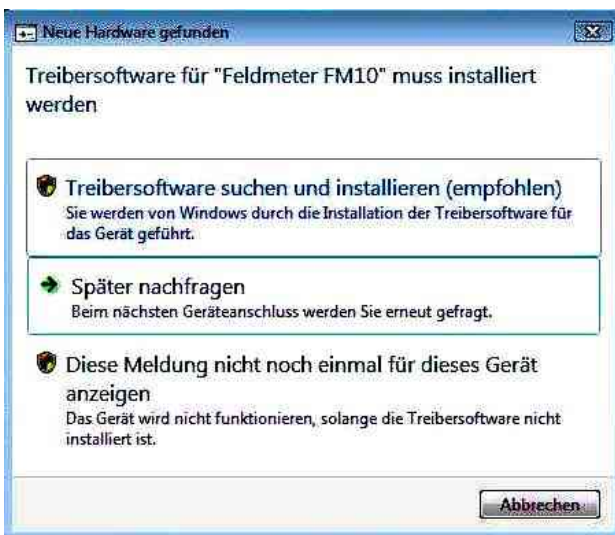
Connect the Lightmeter LM10L to your PC via the USB-cable. Turn on the LM10L and activate USB-mode (→ 3.1).
The window of the hardware assistant appears on the screen. Choose the answer *No not this time* to the question for a Windows-update. Click on *search for drivers and install.*

Now, choose D*o not search online.*

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The following message appears: *Insert the storage for "Fieldmeter FM10".*
If the software CD FM-Data is not in the drive, insert it. Now, the USB-driver of the Lightmeter LM10 is installed.
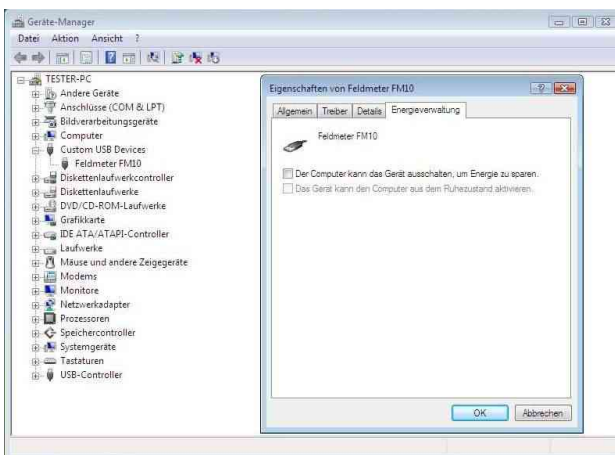
If the message *USB Cummunication Error* appears when loading datasets, the computer can use power down mode, as is usual used by notebooks, it is required that you carry out the following adjustments:
If the computer can use power down mode, as usually used by notebooks, it is required that you carry out the following adjustments:
Please select Control Panel from *Windows/Start*, and there select *Hardware and Sound*. Start the *device manager* and select Custom USB Devices from the list of available hardware. Click on *Fieldmeter FM10* to open the properties dialog of the Fieldmeter FM10. Then click on the tab *Energy settings* and deactivate the function: *The computer can shut down the device to save energy*.

7.6. Running FM-Data

After the installation, you can start FM-Data via the taskbar using *Start/Programmes/FM-Data* or via the programme-icon ▱ on the desktop.
While the application is loading a starting screen appears which shows the version number of the software.

In the program window you see the menu-bar and the toolbar of FM-Data.
The following icons are available in the toolbar:

    📂   Open dataset

    💾   Save dataset

    🖨   Printing a measurement diagram

    🖨   Printing a measurement diagram as Bitmap

    📄   Printing a measurement protocol

    ⬇   Loading datasets from the FM10L

    ✖   Deleting datasets on the FM10L

    ⚙   Loading device settings from the FM10L

   ❓   Program information about FM-Data

7.7. Transferring and Displaying Datasets

In order to load the recorded measurement data from the Lightmeter LM10 to the PC, you connect the LM10L with the bundled USB-cable with one of the PC's USB-slots.
Turn on the LM10L and switch to the USB-mode by pressing the `Audio/USB` button for two seconds; on the display appears the message: *"USB-mode: waiting for PC"*.
Choose *Device/Load Dataset* in the menu-bar or click on the icon *Load* .

Now, the dataset window shows the datasets stored on the LM10L.
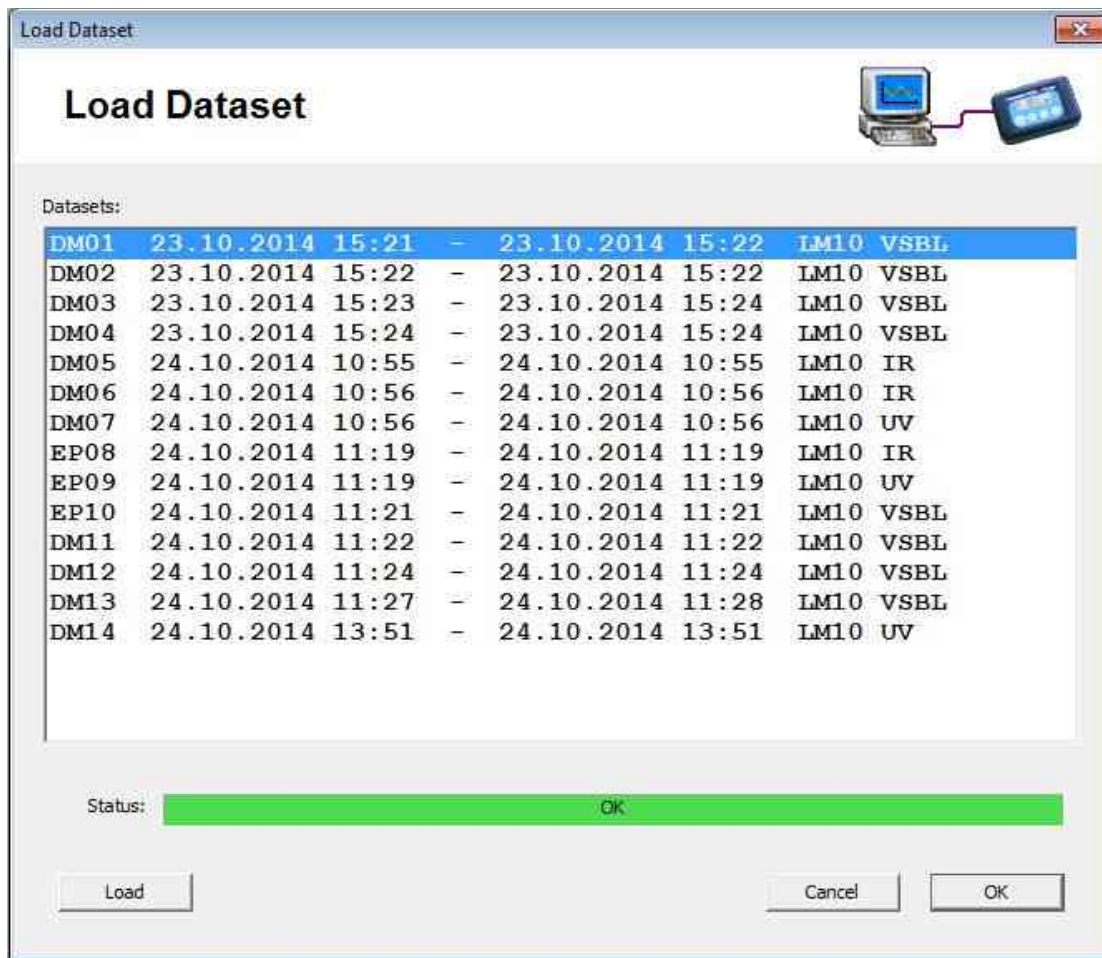
The name of the dataset, start and end time of the record and the filter function are to see. The name of the dataset is composed of *"DM"* for *Continuous measurement* and *"EP"* for *Single-spot* followed by the number of the dataset.
Double-click the dataset with the mouse pointer to mark it and using the button *Load* transfers the dataset from the LM10L to the PC.
The datasets remain stored in the LM10L after the transfer. If all datasets should be deleted, this can be achieve this by *Delete data* or the icon *Delete* . Alternatively, the datasets stored on the LM10L can be deleted with the menu function *Data logger→Data storage→Delete.* While deleting the data storage, all stored datasets are deleted.

7.8. Graph and report

After loading the dataset of a long-term measurement the graphic window related to the dataset opens.
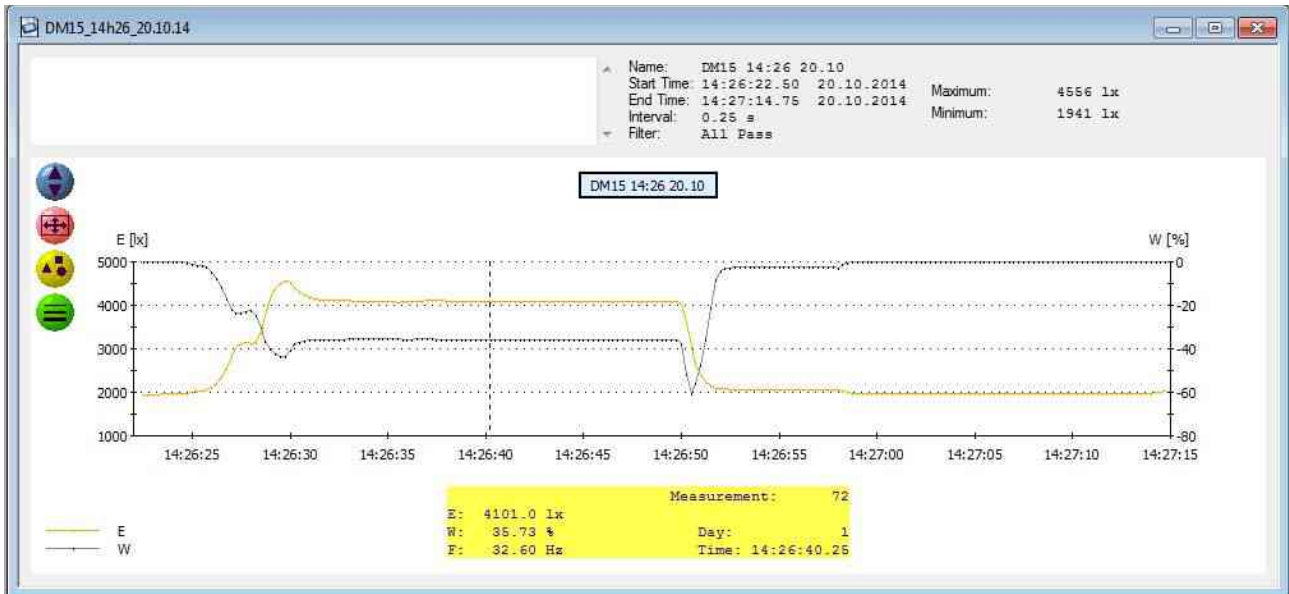
On the right side in the top grey field, the most important information like the name of the dataset, starting and ending time of the record, the measurement interval and the used probe are shown. In addition, the maximum and minimum value are determined.

On the top left side, the text window serves to enter an own comment on the measurement like the customer's name, place of the measurement, special conditions etc.

The content of the comment field can be printed using the function *File/Print Report.*

Now take the mouse pointer to the graphics area, a vertical bar follows the mouse pointer, under the diagram the corresponding measurement time points and the respective measured values can be read. The colours of the individual measurement channels are visible in the legends below to the left.

On the left side of the diagram, four icons are located:

Hide and/or unhide the comment window.

Reset of the window's zoom function.

For each measurement value, a point on the diagram curves is placed.

For the diagram's curves, four different line widths are selectable.

To have a closer look at a moment in time in the diagram, perform a zoom. Move the mouse pointer to the preferred starting timestamp, press the left shift-key and keep it pressed and move the mouse pointer over the desired time to mark the zoom area.

Now release the left mouse button and the marked area is now zoomed to fit the whole window width. If the Strg-key is pressed instead of the shift-key the area of thee Y-axis can also be zoomed.

If the dataset of a single-spot measurement is opened, the measurement values are shown in a bar chart. The comment window to tag the separate measurement values opens through double-clicking with the left mouse button. The other functions of the graphic window are similar to those of the long-term measurement.
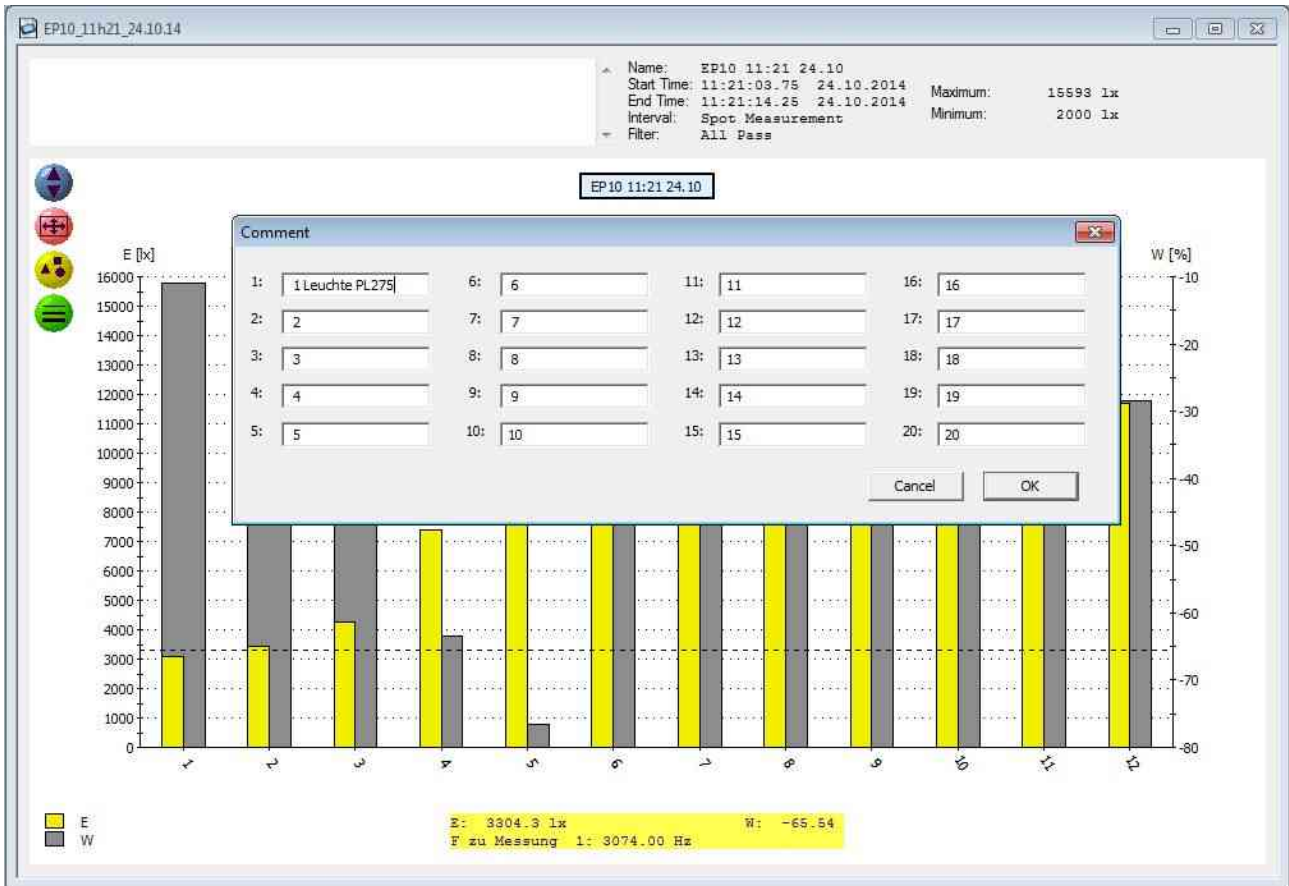
7.9. Cutting down datasets

Using the *Edit/Crop* function a time frame of a data set can be cut and saved.

To do this, the time frame to be cut is marked by keeping the left mouse button pressed, the start and end time of the marked frame is displayed using the diagram in red bordered window.

Subsequently, cut the time frame using the *Edit/Crop* function and save the dataset under a changed name.
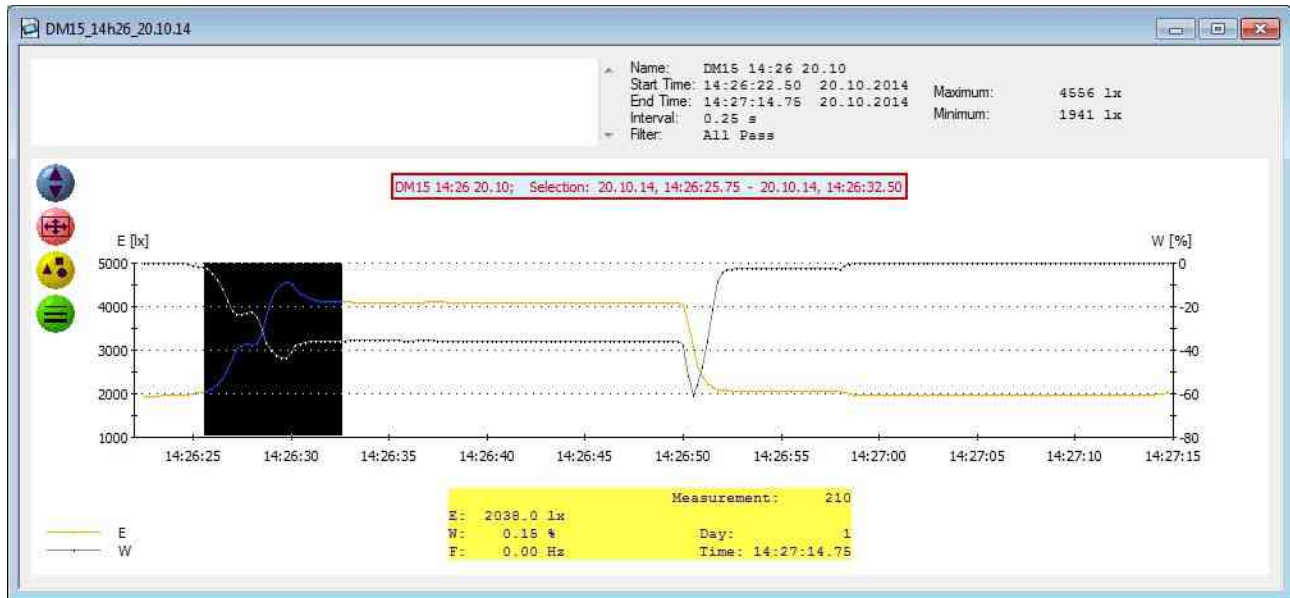
7.10. Print and Export

The graph and the information about the dataset can be printed with comments in order to gene-rate a measurement protocol.

The printing of a measurement diagram is achieved using the menu point *File/Print Graphic* or with a click on the icon 🖨. Here, it is recommended to zoom the graphic window to its maximum size and choose the printer setting lateral before printing.

If the records are very large, some printer drivers may yield incomplete printouts. The graph is printed as screenshot via the File/Print Bitmap menu option or via the icon 🖨. This always creates a correct printout, though the quality depends on the screen resolution.

If the lines in the diagram are very thin on the printed paper, you can vary the line width the icon 🟢.

A protocol showing the most important information about the dataset and the text of the comment are printed using the menu point *File/Print Protocol* or clicking on the icon 🅿.

If you want to edit the measured values with another programme, they can be exported with the function *File/Export Text File*.

The measurement diagram can be displayed as a BMP image file using the function *File/Export Bitmap*. Alternatively, it can be copied to the clipboard with the *File/Copy To Clipboard* function.

7.11. Modifying of the instrument settings of the LM10L

The logger settings and the basic settings of the Lightmeter LM10L can be regarded in the menu mode of the Lightmeter LM10L and with the software FM-Data.
To view and to edit the settings with FM-Data, the LM10L is connected to the PC, and it is switched to the USB-mode by pressing the **Audio/USB**-button for two seconds.
Using the menu bar *Device/LM10 Settings* or with the icon setup ⚙ the device settings are loaded and shown in the settings window.
Settings like time, logger mode etc. can be made now. With the Button *System Time* the clock of LM10 adopts the current time of the PC.
In *Settings* the buttons for activating the selectable measuring probes on LM10 are available.

For selecting standard settings of LM10L press the *Default* button.
Using the Button *Program* the settings are transferred to LM10L and accepted.
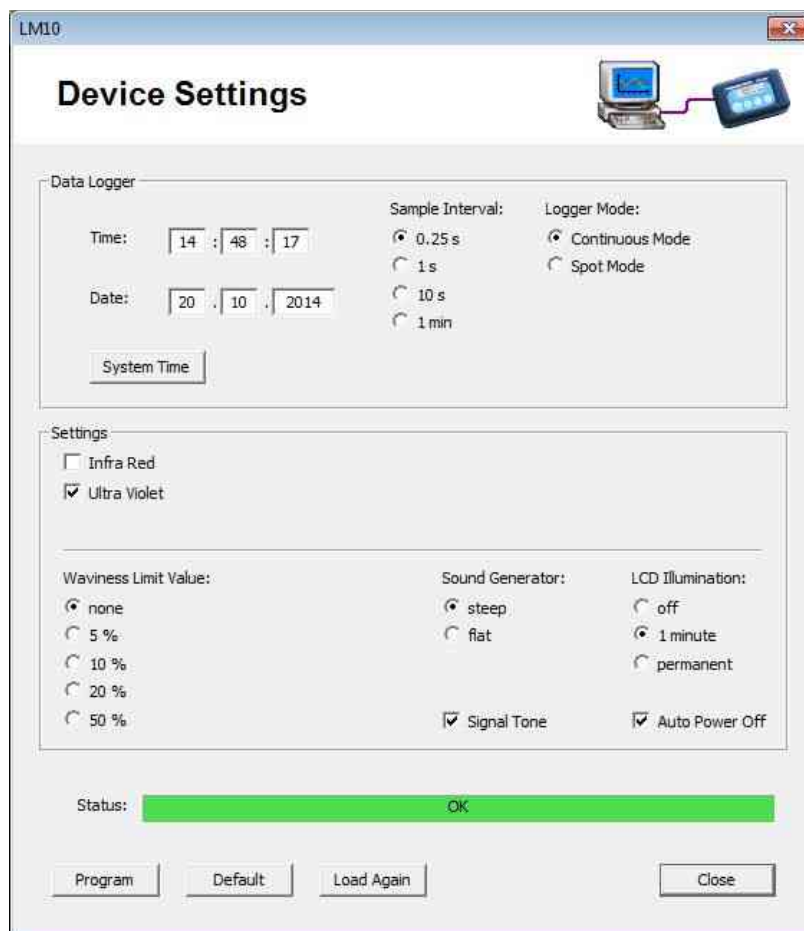
7.12. Help Function

This handbook is available as PDF-file using the F1-key or the menu point *Help.*

8. Appendix

8.1. Power supply

The Lightmeter LM10 is provided with two batteries of type Mignon AA with voltage. The battery compartment is located at the bottom side of LM10.

Batteries of type NiMH are recommended for frequent use of Lightmeter LM10. In accordance with Art.-No. 510, a battery pack with two battery sets and charger is available.

For the measurement operation, the maximum operating time is of approximately 20 hours; in the data logger mode for an interval of one minute, it is approximately seven days.

If the end of battery life is reached or the batteries are almost completely discharged, the battery symbol in the display indicates that the batteries must be exchanged. If the supply voltage necessary for the operation falls short, then the LM10 automatically turns off, wherein a regular data recording independently ends at this point of time, if required. The LM10 gives a warning through a periodic beep shortly before turning off.

The power supply of LM10 can be established via USB-connector with USB-power supply (Art. No. 520). When powered by power supply the batteries may remain in the device without being charged.

If the *Auto-Power-Off* function is active, then LM10 turns off in case no button is pressed for more than five minutes.

8.2. Maintenance

The sensors must be protected against contaminants of all types.

The device and sensors must be checked and re-adjusted by the manufacturer in case of greater pollution and every two years.

Remove the batteries for five minutes in case of an operation error. Switch on the LM10 again. When you keep the **Record** button pressed when switching on, all the settings of LM10 are reset.

If the problem still persists, contact Fauser Elektrotechnik.

8.3. Firmware

The firmware of the field meter LM10 is continuously being updated. Information regarding the current firmware version is available under *www.fauser.biz*.

Send LM10 to Fauser Elektrotechnik for updating the firmware.

8.4. Technical information

Measurement range

Illumination intensity E	20000 lx
Infrared spectrum	200,00 W/m²
Ultraviolet spectrum	20000 mW/m²
Flicker rate	0...100 %
Calculation type	Ripple content according to SBM-2015
	Flicker% according to IESNA
Flicker frequency	50 Hz...400 kHz

Resolution

Illumination intensity E	1 lx
Infrared spectrum	0,01 W/m²
Ultraviolet spectrum	1 mW/m²
Flicker rate	1 %
Flicker frequency	5 Hz

Audio functions

Audible range	20 Hz...20 kHz
Ultrasonic	10 kHz...400 kHz

Display	illuminated double-spaced LCD
Display functions	Illumination intensity, Peak-Hold, infrared, ultraviolet flicker rate, flicker frequency
Ínterface (LM10L/LS)	USB 2.0
Voltage output (LM10S/LS)	quadruple 0...2000 mV
Power supply	2 x Mignon AA
Dimensions	120x79x28 mm
Ambient temperature	0...+40 °C

Measuring probe VL10

Spectral sensitivity	480...660 nm
Spectral approximation	$V(\lambda)$

Measuring probe IR10

Spectral sensitivity ($\lambda_{0,5}$)	790...1050 nm, 940 nm$_{max}$

Measuring probe UV10

Spectral sensitivity ($\lambda_{0,5}$)	220...365 nm, 350 nm$_{max}$

Subject to technical alterations.

8.5. Description of the pin assignment of the output voltage Lightmeter LM10S/LS

Type of connector: Binder Serie 719 Art.-Nr. 09-9789-71-05

❶ Ch 1, total signal (AC und DC)
❷ Ch 2, alternating voltage (AC)
❸ ground of device
❹ Ch 3
❺ Control output (Autorange)
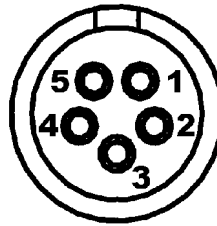

Figure 3: Pin assignment Lightmeter LM10S/LS

8.6. Scope of Delivery

Scope of delivery Lightmeter LM10   Art.-No. 250
Lightmeter LM10, measuring probe VL10 for visible spectrum, extension cable, manual,   batteries, transport case

Scope of delivery Lightmeter LM10S   Art.-No. 251
Lightmeter LM10S, quadruple alternating voltage output, measuring probe VL10 for visible   spectrum, Verlängerungskabel, manual, batteries, transport case

Scope of delivery Lightmeter LM10L   Art.-No. 252
Lightmeter LM10L with data logger, measuring probe VL10 for visible spectrum, extension
cable, USB cable, software-CD FM-Data , manual, batteries, transport case

Scope of delivery Lightmeter LM10LS   Art.-No. 253
Lightmeter LM10LS with data logger, quadruple alternating voltage output, measuring
probe VL10 for visible spectrum, extension cable, USB cable, software-CD FM-Data ,
manual, batteries, transport case

Accessory
Probe IR10 for infrared spectrum   Art.-No. 263
Probe UV10 for ultraviolet spectrum   Art.-No. 265
Probe TF10 for correlated colour temperature CCT   Art.-No. 266
Probe US10 for ultrasound probe   Art.-No. 268
Connecting cable for voltage output LM10 to BNC (2m)   Art.-No. 268
Set with four accumulators and loading device   Art.-No. 510
USB power supply for LM10/FM10   Art.-No. 520

8.7. Disposal

This product bears the recycling symbol according to EU Directive 2002/96/EC. This means that the device has to be returned to the manufacturer in order for recycling. A disposal with the residual waste is not allowed.

The disposal of old batteries in household waste is explicitly prohibited according to Battery Directive. You can submit the old batteries at local collection points or in local stores free of charge. You can return the batteries received from us after use at the address mentioned below free of charge.

Entsorgungsadresse: Fauser Elektrotechnik
Ambacher Straße 4
D-81476 München