USB-Controlled Optical Power Monitor

HIGHLIGHTS

- Low cost

- Wavelength ranges   190-1100 nm
  800-1550 nm
  800-1650 nm
  400-1600 nm

- Bandwidth   10 kHz

APPLICATIONS

- Service

- Laboratory

- R&D

- OEM

PRINCIPLE OF OPERATION

The OPM150 employs high quality, large area photodiodes with a precise analogue transimpedance amplifier and digital signal processing.

FIELDS OF APPLICATION

These power monitors are particularly suitable for field use such as laser servicing or in OEM applications. The unit is USB powered: no external power supply is required. The analogue bandwidth is 10kHz and is sampled at up to 30 Hz using the graphical software supplied.

The photodiode head has a diameter of 25mm for mounting in standard optomechanical systems. The signal processing unit is very compact for simple integration in OEM systems.

The large detector surface ensures easy use.

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ABSOLUTE MAXIMUM VALUES

Average power	15mW
Temperature range	0 – 60 °C

ORDERING INFORMATION

Base module (amplifier and USB interface): OPM150

Order detector heads separately with the order codes as indicated in the table on page 3.

CASE

For direct measurements on fibre optics:

OPM150VIGAFC

For customized solutions, please contact us.

SPECIFICATIONS OF DETECTOR HEADS

Detector Head Order Codes:		OPM150UVS			OPM150G5 AND OPM150G10			OPM150IGA, OPM150VIGA AND OPM150VIGAFC			
Parameter	**Conditions**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**Units**
INPUT											
Wavelength range		190		1100	800		1550	800 [IGA] 400 [VIGA]		1650 [IGA] 1600 [VIGA]	nm
Maximum measurable powers	OD1, OD2 and OD3 refer to use with the respective attenuating filter										
Minimum measurable powers											
OUTPUT											
Connectors		DB9 (detector head) and USB									
Bandwidth		10[1]									kHz
Sampling rate	GUI-Control Direct polling	30[2] 1000									S/s
Gain stages		1, 10, 100, 1000, 10000									
Accuracy		± 6									%
Reproducibility		± 3									%
Linearity		± 0.2 ± 0.4									dB
SUPPLY											
Type		USB									
DIMENSIONS											
	Base module Head	60 x 81 x 36 mm (B x L x H) 35 x 30 (φ x L)									mm

Accessories: - calibrated filters
- adapters for standard optomechanic systems
- reducing apertures
- fibre receptacles

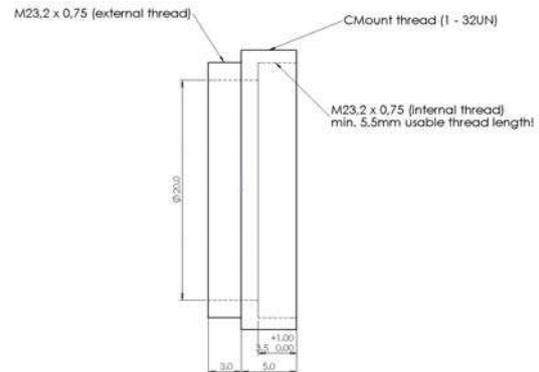[1] Also available: 100kHz base module (article number 30.070.00021) with analogue output (BNC): 0-12.3V.

[2] 20S/s with 2-channel software.

ACCESSORIES

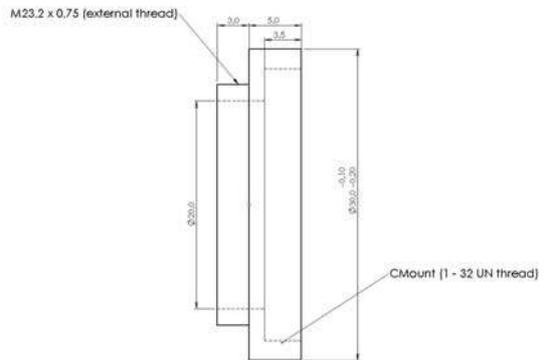We stock a wide range of accessories for this product to ensure absolute ease of use.

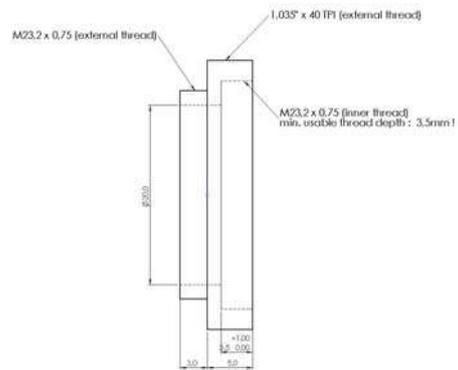Adapter C-Mount male thread

Order code: 20.430.00005

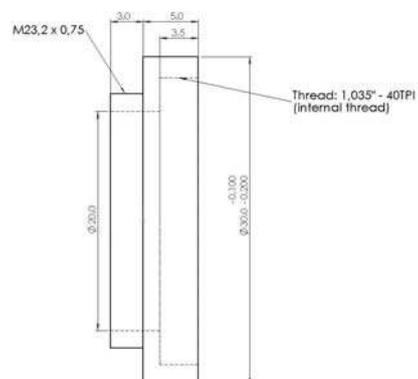Adapter C-Mount female thread

Order code: 20.430.00006

Adapter lens tube system (1.035''x40TPI) male thread
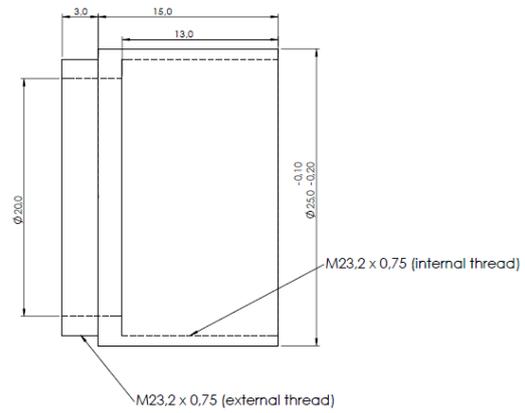
Order code: 20.430.00004

Adapter lens tube system (1.035''x40TPI) female thread

Order code: 20.430.00007

Filter holder for mounting loose filters. The thread length allows cascading several filter holders.

Order code: 30.070.00017

CALIBRATED FILTERS

Our filters are mounted in the filter holder depicted above and can be screwed onto the front end of the OPM150 detector head. Each filter is delivered with a calibration file which can be read into the OPM150 graphical software. In this manner, the calibration of the full system is guaranteed.

Neutral density (ND) filters

ND Filter, absorbing type	OD1: Transmission = 10%	Order code 30.070.00014
ND Filter, absorbing type	OD2: Transmission = 1%	Order code 30.070.00015
ND Filter, absorbing type	OD3: Transmission = 0.1%	Order code 30.070.00016

Please note that reflecting ND filters cannot be cascaded.

QUICK GUIDE

1. Start the PC (Windows® operating system).

2. Connect the OPM150 to a USB-Port.

3. Connect a OPM150 detector head to the OPM150 base unit.

4. Start the OPM150 software.

5. Select the appropriate wavelength.

6. Switch on the light source to be measured.

7. Start the measurement with one of the three measurement modes.

® „Windows" is a registered trade mark of the Microsoft Corporation.

PRINCIPLES OF OPERATION

The OPM150 measures optical power via a photodiode. Photodiodes are useful for power measurement in the visible and near infra-red due to their inherent sensitivity and speed of measurement.

Photodiodes produce a current which is proportional to the incident light power over a wide dynamic range. The disadvantage when compared to calorimetric devices is the wavelength dependance. However, for use with monochromatic sources, the detector can be calibrated and the measured current corrected accordingly.

The current from the photodiode is converted to a voltage through a precise transimpedance amplifier. This amplifier is very linear over the full measurement range of the device. The OPM150 has 5 gain ranges. The switch is a semiconductor device, free from degradation.

The voltage generated is then converted to a digital value via a 12 bit A/D converter. This process and all calculations and communication with the PC are controlled by a microcontroller in the OPM150 base device. The measurement process is started via a command over the USB interface (software trigger). Alternatively, a continuous measurement stream can be started which samples at 1.5 kS/s.

SOFTWARE

INSTALLING THE DRIVER

The following section describes the installation of the driver under Windows XP step by step. The driver allows direct access to the OPM150 as well as via a virtual COM-Port.

Connect the OPM150 base module to a USB port of the computer. The new hardware is indicated in the task bar.
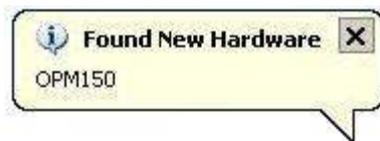
Shortly thereafter, the hardware assistant will start to assist in installing the driver.

Activate the radio button "No, not this time" and then click on the button "Next >".

In the next step you will be advised to insert the installation CD into the CD-ROM drive. In the case that the PC has no CD-ROM drive (for example, a netbook), use the USB thumb drive provided with the system. Having done so, the radio button "Install from a list or specific location (Advanced)" should be activated and then click the button "Next >".

The next window prompts for the location of the driver. Activate the radio button "Search for the best driver in these locations" as well as the chek box "Include this location in the search".

Now click on the "Browse" button and select the appropriate drive (CD-ROM or USB thumb drive). Select the folder "Drivers" and click the button "Next >".

The installation of the driver will begin and the files will be copied into the system.

Hardware Update Wizard

Please wait while the wizard installs the software...

Artifex Engineering OPM150 series

ftdibus.sys
To C:\WINDOWS\system32\drivers

< Back   Next >   Cancel

At the end of the installation, the following window will appear. Click the button "Finish" to complete the installation process.

In the unlikely event that the installation is not successful, please restart the computer and repeat all steps.

Found New Hardware Wizard

Completing the Found New Hardware Wizard

The wizard has finished installing the software for:

Artifex Engineering OPM150 series

Click Finish to close the wizard.

< Back   Finish   Cancel

Immediately after this installation process, the VCP driver will be installed automatically. If this is not desired, the process can be aborted. Otherwise, please follow the installation assistant in an analogous manner as for the driver installation.

ACTIVATING THE VCP – OPTION

The standard access mode for the OPM150 is direct, ie, the driver is nested into the programme. Alternatively, a COM-Port may be configured for access to the OPM150. Since this port is not an actual hardware port, but rather an emulated port for USB access, it is denoted "virtual COM-Port" (VCP).

Activating and deactivating the VCP is performed using the hardware manager in the system properties control card. Click on the Windows "Start" button and then select "Configuration" → "System Properties" and select the icon "System". Click the button "Device Manager" under the tab "Hardware".

Now open the menu item „USB controllers" and double-click on the item "Artifex Engineering OPM150 series".
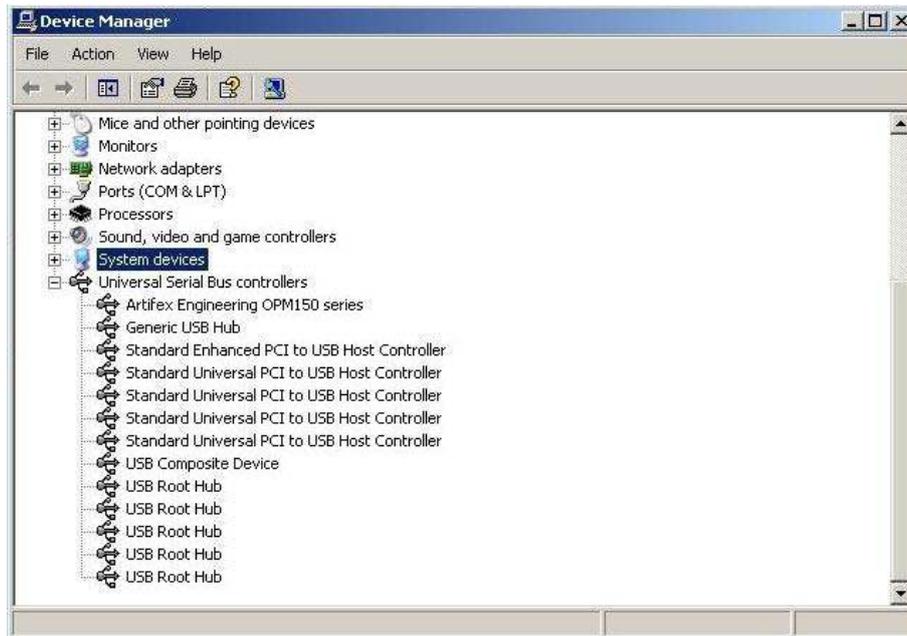
The VCP may now be activated or deactivated via a check box under the tab „Advanced". Note that this tab is not visible if a software is presently accessing the instrument via the driver.

If the status of the VCP check box is changed, the OPM150 must be briefly disconnected and reconnected to the USB port in order to activate the change.
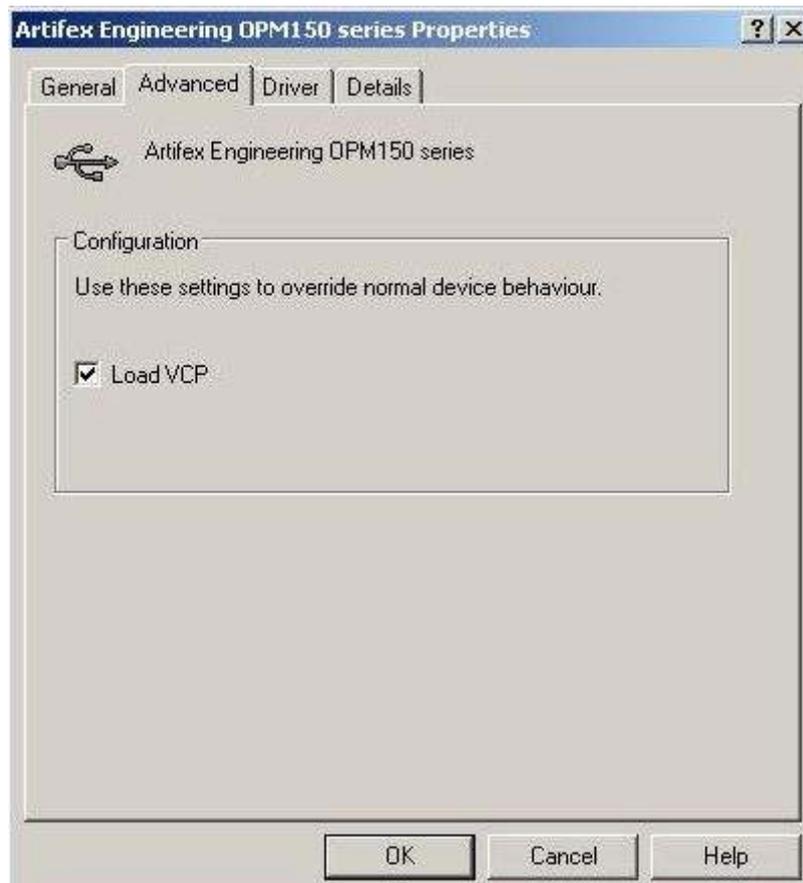
INSTALLING THE APPLICATION SOFTWARE

Insert the CD-ROM or USB thumb drive supplied with the unit and then start the Windows explorer (file manager). Select the appropriate drive and start the programme "Setup.exe".

The installation assistant will begin and will guide you through the installation process.

Click the button „Next >".

Select a folder into which the programme should be stored.
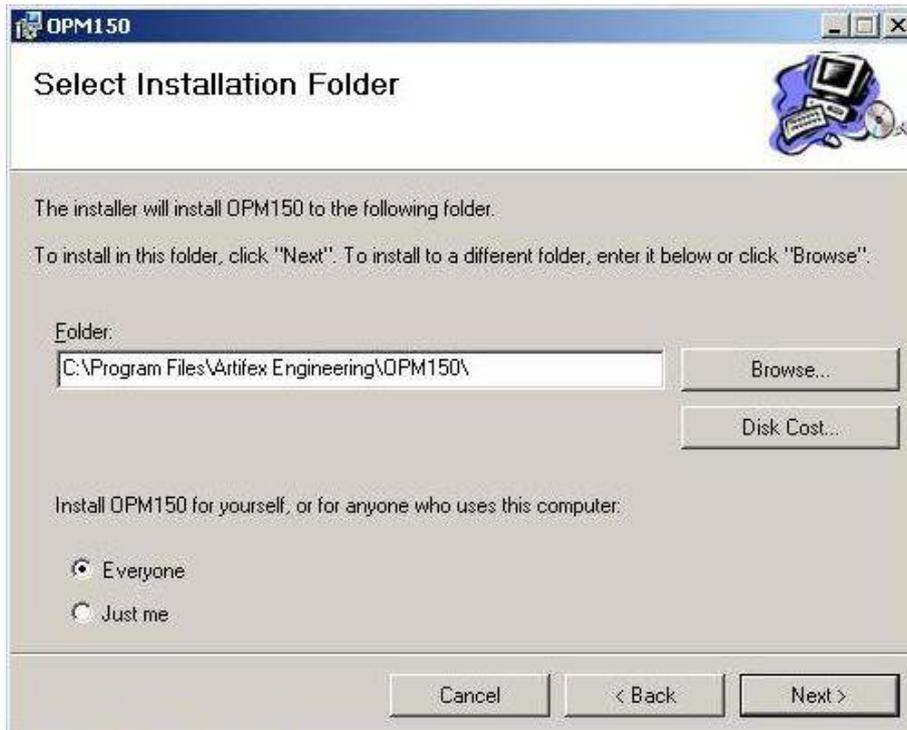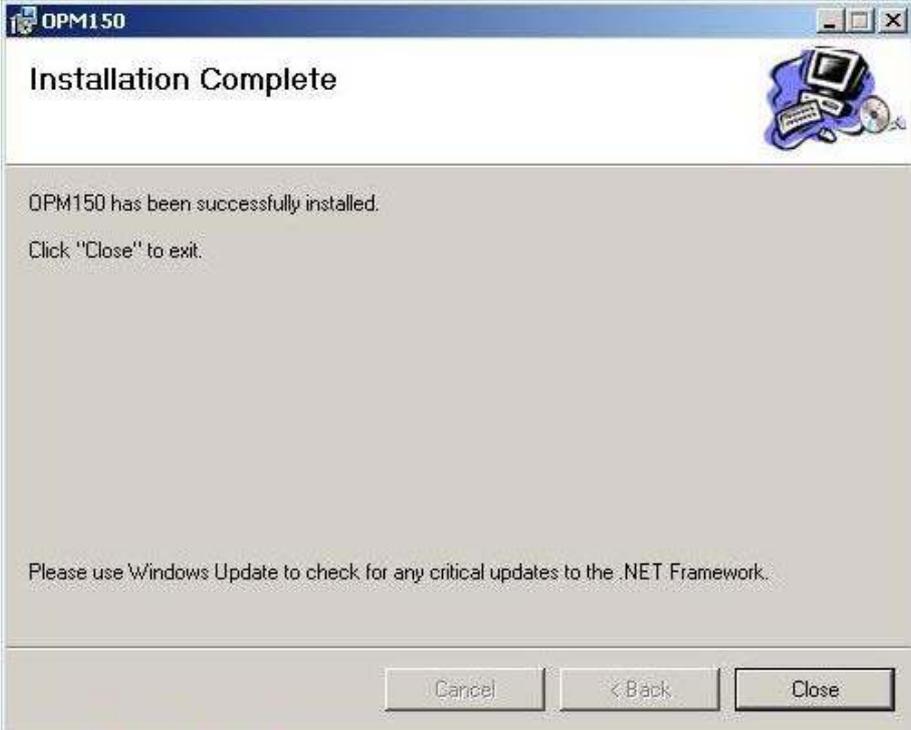

If the computer has more than one user profile, select the installation for "Everyone" or "Just me" as appropriate (radio buttons). Now click on the button "Next >".

Click „Next >" again to confirm that the installation should proceed.

If the installation is successful, the following window will appear. Click "Close" to finish the installation.

The application software will now appear under the Windows "Start" button under the sub-menu "Programs / Artifex Engineering / OPM150.

USING THE APPLICATION SOFTWARE

The graphical user interface is simple and easy to use. All of the important features can be reached directly in the main window.
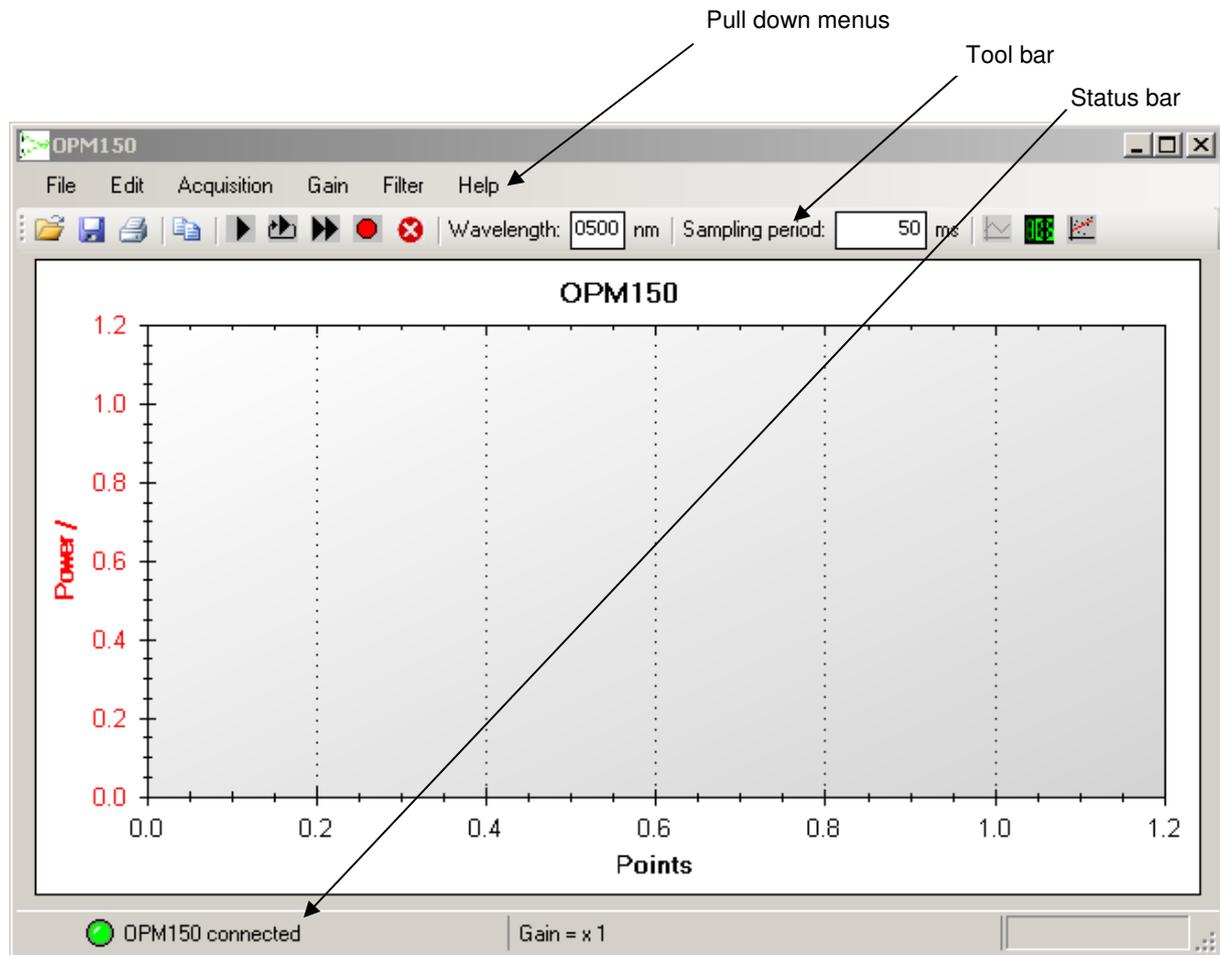
The main window comprises a pull down menu, a tool bar, the diagramme frame and a status bar.

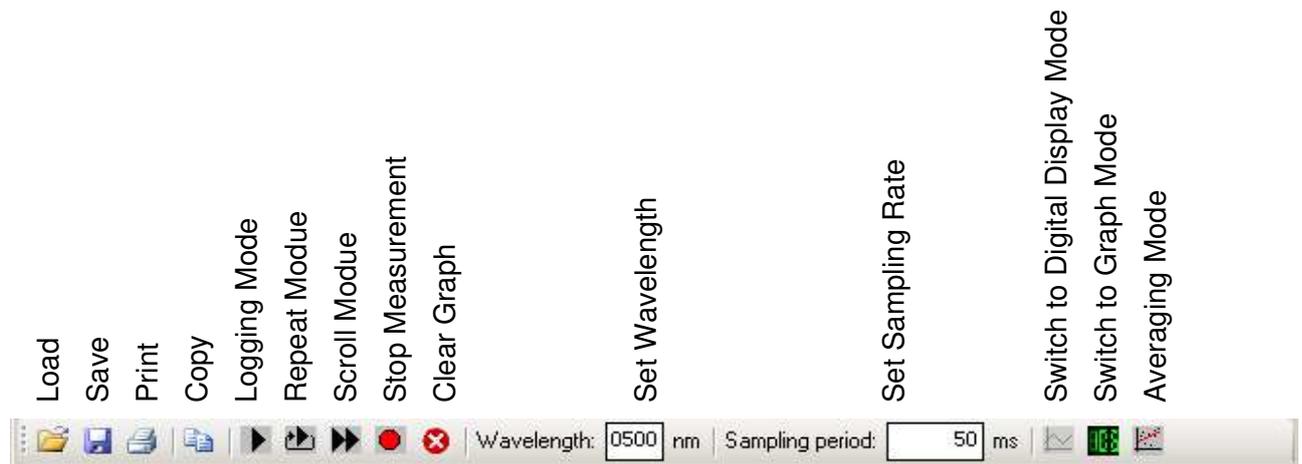**The Functions of the Pull Down Menus:**

File: **Open** – Loads a *.TZA data format file.

Save – The programme allows saving measurement data in two formats: *.TZA and *.CSV. If a file name and folder have not been previously selected, the user will be prompted accordingly. If a file has previously been saved, this function will overwrite the file.
The *TZA format is specific for this application. The *CSV format is appropriate for exporting data into a format which can be read by Microsoft Excel and various other programmes. See "The *CSV Format", pg. 21 for further information on this data format.

Save as – This function always prompts for the file name and folder. Otherwise identical to "Save".

Export – Exports the present graph frame into a graphic file in one of the following formats: *.emf, *.png, *.gif , *.jpg, *.tif oder *.bmp.

Print – Prints the present graph frame using the printer selected in the following frame.

Page setup – Change the page formatting for the print.

Preview – Printer preview.

End – Ends the programme.

Edit: **Copy** – Copies the present graph frame into the PCs intermediate storage for further use with other programmes. For example, the graph can now be inserted into a text document using the paste function.

Preferences– Opens a new window in which various settings such as the sampling rate and user language can be made. For details, see „Preferences" pg.23.

Acquisition: **Start Logging Mode** – Starts a measurement. All measurement data are displayed at all times throughout the measurement. The latest data are displayed at the right edge of the graph. Each measurement point is numbered sequentially, displayed as the X-axis.

Start Scroll Mode – Starts a measurement. The graph displays a fixed number "n" of measurement data. The frame fills until "n" data points have been registered. Once "n" data points have been measured, the last "n" data are always visible, scrolling from right to left through the frame.

Start Repeat Mode – Starts a measurement. The graph displays a fixed number "n" of measurement data. The frame fills until "n" data points have been registered. Once "n" data points have been measured, the data is deleted and the frame fills again. This is equivalent to the display mode on a standard oscilloscope.

Stop – Stops a measurement.

Clear – Clears the graph. This may also be performed during a measurement.

Gain: **Gain x1 ... Gain x10.000** – Selects the electrical gain of the amplifier. The selected gain is indicated by a check mark.

Auto – Automatically selects the optimum gain setting during the measurement. When active, the selected gain setting is also displayed.

Filter: **Load Filter** – If the head is fitted with a filter, the user may load the calibration curve for the filter to correct all measurement data. That is, the system will then display the actual power entering the front end including the filter. The format for filter data is *.FLT. Up to 5 filter curves can be loaded into the programme. Each filter can then be activated or deactivated by checking in the pull down menu.

Remove Filter– Removes a filterfile from the programme. This does not delete the file from the PC.

No Filter ...Filter 5 – Activate or deactivate one or more of the loaded filters. The active filters are indicated by a check mark.

Help: **Info** – Shows information about this programme.

OPM Info – Shows information on the present instrument connected, including its model and serial numbers.

The Tool Bar

The tool bar allows for quick access to the most important functions.

The file handling functions (Load, Save, Print, Copy,..) are identical to the corresponding sub menus in the pull down menus.

In addition, there are input fields for the wavelength and the sampling rate as well as buttons to select the mode of display (digital and graph modes).

Wavelength:	The sensitivity of the detector head is dependant on wavelength. The individual calibration file is stored in the connector of each detector. Since the head cannot measure the wavelength of the light detected, this must be inputted by the user in oder to allow the software to perform the appropriate correction calculation. The wavelength selection will only be accepted if it is within the range of calibration of the head.
Sampling Rate:	The period of time between two samples can be selected and displayed. This is also accessible in the "Settings" frame of the „Edit" pull down menu.
Graph:	This is the default display mode when the programme starts. The measurement results are displayed graphically: Y-axis = measured value; X-axis = sample number.
Digital Display:	The last measured value is displayed in a large digital display.
Averaging Mode:	This function serves to reduce noise or fluctuations in the Signal. When activated, the software calculates the average of the selected number of measurements before displaying this value. The update rate is unaffected since for the calculation of the next point, the "oldest" measurement datum is replaced by the "newest". The number of measurements for averaging can be set in the Preferences menu.

The Status Bar

The most important status information is displayed here.

Connection status   Selected gain   Amplifier output level
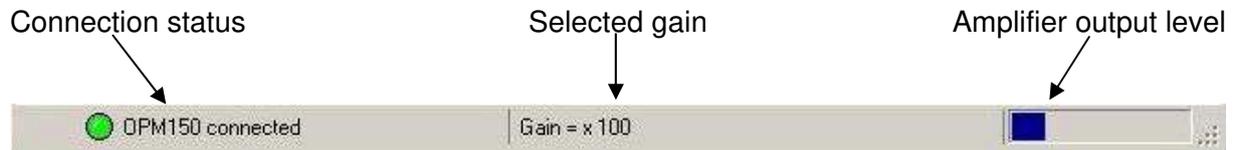
Connection status:	Indicates whether an OPM150 instrument is connected and all relevant connection parameters could be set properly. If a connection error occurs, the fault is indicated here and highlighted with a red virtual indicator lamp.
	The programme will only function if the virtual indicator lamp is green and the status "OPM150 connected" appears. Disconnection will also be recognized and indicated during a running measurement.
Gain:	Indicates the presently selected gain – also in autogain mode.
Optical power level:	For optimal signal to noise ratio, as with any measurement instrument, the OPM150 should not be used in the extreme lower range of its output. If the unit is used in the extreme upper range of output, clipping may occur. A coloured sliding graph bar is used to warn the user of the present amplifier output level (which is not directly visible in the measurement data).
	The optimum operating range is indicated by a blue bar. If the bar is displayed in red, the gain selection should be changed as appropriate. The autogain mode will always drive the unit in the optimum gain setting.

DATA FORMATS

The *TZA Format

The software uses three formats for saving and loading data. The programme specific format *.TZA uses ASCII characters. The file header contains the date, the detector used, the selected wavelength, the active filters and the units of the data values. The measurement samples are separated by semicolons.

The file structure is as follows:

```
Date and time : <Date and time of measurement>
Detector: <Detector type>
Wavelength: <Wavelength used>
Filter: <Filter used>
Unit: <Unit>
<Sample 1>;<Sample 2>;<Sample 3>;...
```

The *CSV Format

The *.CSV format is useful for data export or use with other programmes. These files can be loaded directly into spread sheet programmes such as Excel. The file header is identical to that of the *.TZA files.

```
Date and time : <Date and time of measurement>
Detector: <Detector type>
Wavelength: <Wavelength used>
Filter: <Filter used>
Unit: <Unit>
0;<Sample 1>
1;< Sample 2>
2;< Sample 3>
3;< Sample 4>
...
```

The Filter File

In order for the OPM150 to indicate true input power levels even when a filter is installed, the filter must be calibrated and its file loaded into the programme. The file consists of the end ranges of the wavelengths of calibration as well as the filter transmission values. Furthermore, the name of the filter is included so that the filter can be identified in the pull down menu. This name also appears in the header of measurement data files as discussed above.

<Name of the filter>

<Start wavelength>

<End wavelength>

<Transmission value 1>

<Transmission value 2>

<Transmission value 3>

...

The file must have a transmission value every 10nm and the number of data points must concur with the start and end wavelengths in the header in order for the file to be accepted as valid.

Artifex Engineering provides calibrated mounted filters as accessories (see "Accessories", pg.4).

PREFERENCES

In addition to the settings in the tool bar, there are several which will not be required during normal operation and will usually be set once when first setting up the instrument. These settings are found in the pull down menu "Edit" under "Preferences". The following window then appears:
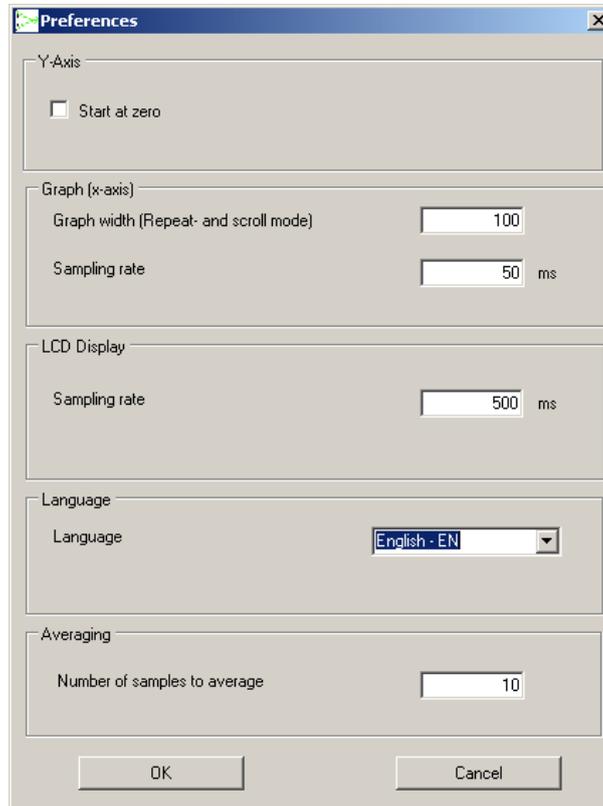
Y-Axis, Start at zero:	When using automatic Y-axis scaling, the lower limit of the Y-axis will lie just under the smalles measurement value. Activating this check box will force the lower limit to be fixed at zero.
Graph width:	A fixed number of samples are displayed in repeat and scroll mode. This number can be set here.
Sampling rate:	Sets the period of time between samples. Different sampling rates can be set for the scope and the digital display modes.
Language:	Selects the language for the graphical software interface. The appropriate Font must be installed under Windows in order to ensure correct representation.
Averaging:	A button in the toolbar allows activation of the averaging mode. The number of measurements to be averaged is selected here.

THE GRAPH

The graph mode is the default mode which will appear when starting the programme. The X-axis represents the sample number of a measurement sequence, the Y-axis the optical power. The units of power automatically adjust to the power level being measured.
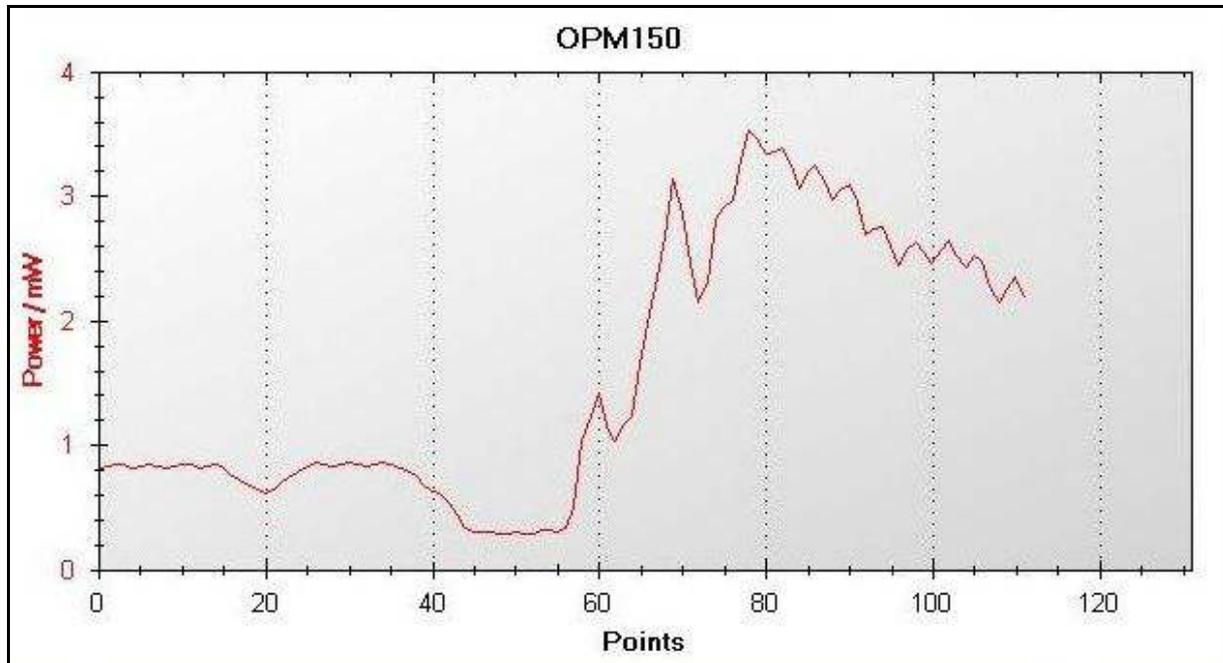
A dynamic zoom can be activated by clicking in the graph window and dragging a box to the size of the desired zoom. If the automatic rescaling is activated, the next measurement will rescale the window to its previous representation. Therefore, if the zoom is to be kept active, the automatic rescaling must be deactivated first (context menu) or the measurement stopped.

If the cursor is moved over a given sample in the graph, an information box will appear with the sample values:

Channel 1 is 4,58mW at Point No. 3,0

This option can be activated and deactivated using the context menu.

THE CONTEXT MENÜ
The context menu is opened by a right click within the graph frame.

Copy	
Page Setup	
Print...	
Save Image As...	
Set Scale to Default	
✓ Show Point Values	
Undo all Zoom/Pan	
Un-zoom	
✓ Y-Axis Autoscale	
Y-Axis manuell scale	
Y-Axis starts at zero	

Copy	A picture of the graph is stored to the PC's temporary storage. It may be copied into other programmes for documentation purposes.
Page Setup	Page setup for printing.
Print...	Opens the print control window for output to a printer.
Save Image As...	Saves a picture of the graph to a file.
Set Scale to Default	Resets the graph axes to their default values.
Show Point Values	Activates or deactivates the mouse-over pop-up box with the sample data information.
Undo all Zoom/Pan	Resets all zoom and pan settings.
Un-zoom	Resets the last zoom and pan setting.
Y-Axis Autoscale	Activates automatic rescaling of the Y-axis (unless the „Y-Axis starts at zero" option is activated).
Y-Axis manual scale	Opens an input box in which the upper and lower limits of the Y-axis can be manually fixed. This deactivates the autoscaling.
Y-Axis starts at zero	Fixes the lower limit of the Y-axis to zero. This setting remains active in autoscaling mode, in which case only the upper limit is automatically rescaled.

THE SDK PACKAGE

The OPM150 comes with a software development kit (SDK package) in order to ease integration of the instrument into OEM projects. This package includes the source code of the application programme (written in Microsoft VB.net version 2005) as well as a LabVIEW® VI example.

The SDK package is found on the storage media delivered with the instrument.

SOURCE CODE OF THE APPLICATION PROGRAMME

The project file OPM150.sln is stored on the storage media delivered with the instrument. This file contains all of the necessary window files, modules, graph and icon files as well as the necessary compiling settings. This file may be loaded into the software development environment.

All enclosed files are shown in the project explorer (lower left window). The folder structure is the same as is found on the storage media delivered with the instrument.

The graph in the main window is generated by embedding the file Graph.dll in the output. For more information, see Hinweis.txt.

® „LabVIEW" is a registered trade mark of the National Instruments Corporation.

The programme comprises 6 windows which contain the source code. There are three further modules responsible for the following features:

MOD_Communication: This module governs the communication with the OPM150 via the driver libraries. The data are preprocessed before sending and after receiving. For efficient use of the PC's resources, the send and receive routines are contained in their own thread.

MOD_Language: Governs the language settings. The vocabulary is stored in strings which are called as required.

Mod_Timer: This module is responsible for the software triggering of the instrument. The PC timer is used for accurate sampling rate control.

Further details are contained in the comments in the source code.

DEMO PROGRAMM IN LABVIEW

A LabVIEW demonstration VI is supplied with the instrument to ease integration into LabVIEW environments. The programme is found in the folder \SDK\Labview. All relevant sub-VIs are in the subfolder libraries.

Please note that this is a demonstration programme only and is not intended to replace the fully functional main application software. The VI is capable of measuring, setting gain, wavelength correction and display of error messages. Instrument information can also be read out and displayed.
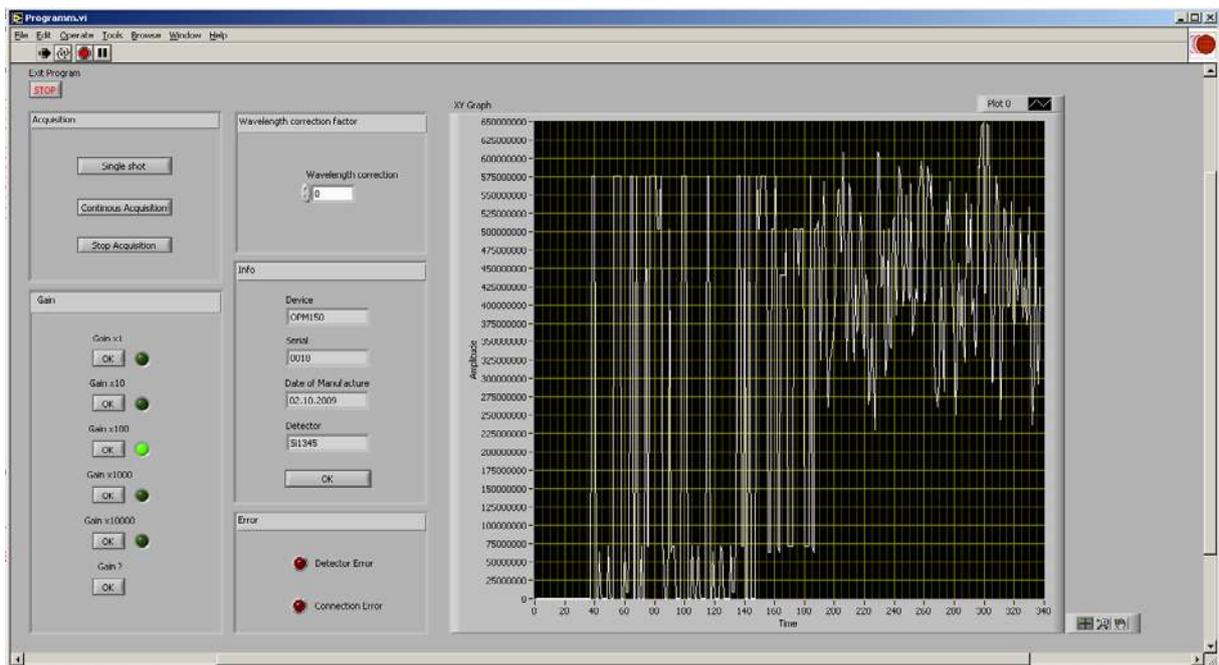
The programme diagramme contains a loop for receiving and calculating data as well as a loop for sending commands.

Both loops are executed until the "Stop" button is pressed. If the programme is stopped via the pull down menu or the tool bar, then the USB port will not be freed for other applications. In this case, the USB cable must be removed from the PC (or the OPM150) and then reconnected.

COMMUNICATION WITH THE OPM150

In order to communicate with the OPM150, the driver can be integrated directly into an existing project. Two examples have been given in the description of the SDK package.

A simpler method is by designating a COM-port. The driver can generate a virtual port n the control panel. One disadvantage of this method is the fact that the PC will designate a port number according to the free ports available. Then the user must use this port number in the programme code, otherwise communication will not be possible.

In any case, the communication parameters must be known. For the OPM150 these are:

Baud rate: 115200 Bits/s

Data bits: 8

Stop bits: 1

Parity: none

Flow control: none

The communication uses ASCII-characters.

As an example, communication via the programme "Hyperterminal" can be realized. This programme is found under:
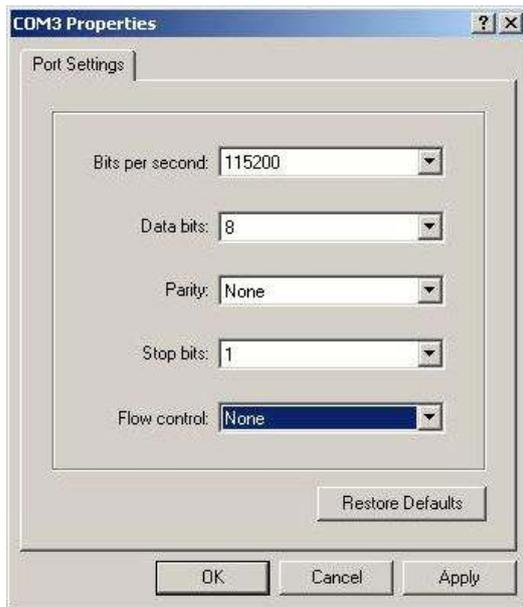
Start > Programs > Accessories > Communikation > Hyper Terminal

Active VCP is necessary for this communication (see "Activating the VCP – Option", pg.11).

When prompted, enter a name for the connection (any name will do) and select the proper port number.

The communication parameters must now be entered in the following window.

Confirm the changes by clicking „OK".

There will now be an indication in the main frame that the communication is active. This can be tested by typing $I ("dollar" and capital "i", this is the code to request information about the instrument). The OPM150 will respond with a message similar to the following:

OPM150
Serial: 0001
Date of Manufacturing: 02.10.2009
Detector: S10001 190nm - 950nm

The commands "$E" (single measurement sample) and "$P" (continuous measurement at 1.5 kS/s) generate measurement data. The output is in the form I10uA . These values represent the current measured by the detector head. In order to convert to optical power, the detector calibration value for a given wavelength can be requested using "Lxxxx" whereby xxxx is the wavelength required. For example, the command L0350 will call the calibration value for 350nm. The instrument response (KFx.xxx) is the calibration value in A/W.

Furthermore, the serial number of the head indicates if the head is an integrating sphere and which multiplier must be used in that case. Integrating spheres are denoted with "U", "V", "W" or "X". The next number indicates the power multiplier as 10^x. For example, a detector with serial number U50001 has a power multiplier of 10^5=100 000.

For example, from the response KF0.654 with a measured value of 10μA and serial number U50001, the optical power can be calculated as follows:

Optical power: $10^{5} \cdot \dfrac{10\ \mu A}{0.654\ \dfrac{A}{W}} = 1.53\ W$

The following commands are available:

Data output

$P : Polling mode. The measurement takes place continuously at approximately 1.5 kS/s. Sending „$" ends the measuremet.
$E : Single measurement mode. One single data sample is measured.

Response:
I<value><units in nA/uA> e.g. I3uA means a current of 3μA.

Info

$I : Information about the system, serial number and date of manufacture.

Response:
<Instrument> e.g. OPM150
Serial: <serial number.>
Date of Manufacturing: <date of manufacture>
Detector: <detector type, serial number. and wavelength range>
      e.g. S10001 190nm – 950nm
      In the case of "U", "V", "W", "X": the detector is an integrating sphere. The next number is the power multiplier in the form 10^x (see page 30).

Gain

V1 : gain x1
V2 : gain x10
V3 : gain x 100
V4 : gain x 1000
V5 : gain x 10000

Response:
V<gain> OK

V? : request present gain status

Response:
V<gain> e.g. V1

Wavelength dependant calibration value

LXXXX = Wavelength in nm

Response:
KF: <calibration value>

Messages

DET ERR   Defective or missing optical head.

DET OK   A valid optical head was detected.

PWR ERR   The USB port cannot provide enough current to supply the OPM150. Please do not use passive or non-powered USB hubs.

PWR OK   The power supply was reinstated.

DAMAGE

The unit may be damaged by exceeding the maximum average input power. Please read „Absolute Maximum Values" for these maximum values before working with the instrument.

TROUBLESHOOTING

In the event that a measurement is not successful, the following possibilities should be analysed:

Symptom	Possible Errors	Correction
No output	• System is not connected to the USB port	• Connect the unit to the USB port
No output	• Input power too low	• Increase input power
	• Input or output connection not correct	• Ensure that the connectors are inserted correctly and locked.
Output at full scale, independant of input current	• Input power too high	• Reduce input power.

In the unlikely event that you are not able to obtain a measurement in spite of these troubleshooting measures, please contact us. We will be pleased to help you solve your problem.

NOTICE

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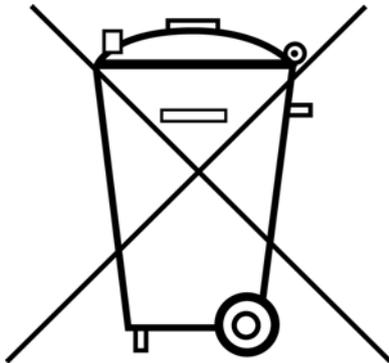
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Attention: The OPM series of power meters is designed for use with lasers. Personnel who use this instrument must, therefore, be instructed in the safe use of lasers and laser beams.

Always wear the proper laser safety glasses designed for the laser in use!

Never allow the direct or reflected laser beam to impinge on the eyeball or to come into contact with the skin!

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