OPM500

Flexible Optical Power Monitor

**HIGHLIGHTS**
- Maximum optical power: +15dBm (30mW)
- Noise equivalent power (NEP$_{RMS}$): -75 dBm (30 pW)
- Rise / Fall time (10% - 90%): 45 µs
- Output: linear analogue USB
- Gain and bandwidth control: 6 gain ranges, 4 bandwidths

**APPLICATIONS**
- Production automation (e.g.: connectorization, pigtailing)
- Component testing, burn-in, lifetime
- Quality control
- OEM

**VERSION**
Applicable for software version FW2.0, serial Number 008 and higher.

**MEASUREMENT PRINCIPLE**
The OPM500 series of optical power monitors employs photodiodes to measure optical power. Precision dual transimpedance input stages provide for high common mode rejection and linearity throughout the full dynamic range of the system.

**FIELDS OF APPLICATION**
These optical power monitors are particularly useful for the measurement and monitoring of optical power in the standard telecommunications bands. The output is a voltage linearly proportional to power. The fast response time at high signal-noise-ratio makes the OPM500 series particularly useful in systems control feedback loops, such as in fibre alignment systems. The high sensitivity and wide dynamic range allow measurement of fibre coupled lasers and LEDs alike.

Several options of photodiode material and optical input, including free beam input, make these units useful in a wide range of applications including non-telecom metrology.

The proprietary auto-nulling function allows up to 7V of offset nulling. This is particularly useful for eliminating a DC signal component to concentrate on signal changes, such as during component burn-in and life-time testing. Bandwidth selection and output polarity are also selectable via the TTL-compatible interface.

![Diagram](image-url)
**ABSOLUTE MAXIMUM RATINGS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Optical Power</td>
<td>+17 dBm (50 mW)</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>0 – 60 °C</td>
</tr>
</tbody>
</table>

**ORDERING INFORMATION**

Full order code: OPM 500 c d r

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>OEM style¹</td>
</tr>
<tr>
<td>L</td>
<td>Lab style</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diode material (d):</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UVS</td>
<td>250-1100nm</td>
</tr>
<tr>
<td>G</td>
<td>800-1550nm</td>
</tr>
<tr>
<td>VIGA</td>
<td>400-1600nm</td>
</tr>
<tr>
<td>X2.0IGA</td>
<td>800-2000nm</td>
</tr>
<tr>
<td>X2.2IGA</td>
<td>1000-2200nm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input receptacle (r):</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>FC fibre coupled</td>
</tr>
<tr>
<td>S</td>
<td>SMA fibre coupled</td>
</tr>
<tr>
<td>B</td>
<td>free beam</td>
</tr>
</tbody>
</table>

For example, an optical power monitor in a small OEM-style case for monitoring a 650nm SM-fibre coupled diode laser would be ordered as:

OPM500GUVSF

For mixed systems (mixed diodes or receptacles), please contact us.

¹ Small OEM-style case with gull wings for mounting
## Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Si, InGaAs</th>
<th>Ge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input</strong></td>
<td></td>
<td>Min</td>
<td>Typ</td>
</tr>
<tr>
<td>Wavelength range</td>
<td>extended InGaAs</td>
<td>1000</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>InGaAs</td>
<td>400</td>
<td>2000</td>
</tr>
<tr>
<td></td>
<td>UV-Si</td>
<td>250</td>
<td>1100</td>
</tr>
<tr>
<td>Power ranges (full scale)</td>
<td>+5°</td>
<td>800</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>-10</td>
<td>400</td>
<td>-30</td>
</tr>
<tr>
<td></td>
<td>-20</td>
<td>400</td>
<td>-30</td>
</tr>
<tr>
<td></td>
<td>-30</td>
<td>400</td>
<td>-30</td>
</tr>
<tr>
<td></td>
<td>-40</td>
<td>400</td>
<td>-30</td>
</tr>
<tr>
<td>Noise equivalent power (NEP&lt;sub&gt;max&lt;/sub&gt;)</td>
<td>Range 1-5</td>
<td>full scale -45</td>
<td>full scale -32</td>
</tr>
<tr>
<td></td>
<td>Range 6</td>
<td>0.02</td>
<td>0.1</td>
</tr>
<tr>
<td>Polarization Dependant Loss (PDL)</td>
<td>single mode, multi-mode</td>
<td>*</td>
<td>0.1</td>
</tr>
<tr>
<td>Fibre type</td>
<td>single mode, multi-mode (ϕ core ≤ 62.5 μm; NA ≤ 0.275)</td>
<td>*</td>
<td>0.1</td>
</tr>
<tr>
<td>Receptacles</td>
<td>FC, FSMA, free beam</td>
<td>*</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>Linear analogue</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V&lt;sub&gt;out&lt;/sub&gt; = scale x P&lt;sub&gt;i&lt;/sub&gt;</td>
<td>*</td>
<td>1</td>
</tr>
<tr>
<td>Output scale</td>
<td>Range 1</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Range 2</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Range 3</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Range 4</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Range 5</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Range 6</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Output Range (full scale)</td>
<td></td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Connectors</td>
<td>BNC&lt;sup&gt;3&lt;/sup&gt; and DB25</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Rise / Fall time (10% - 90%)</td>
<td>Small signal (-1→+1V)</td>
<td>45</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Large signal (-10→+10V)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reproducibility</td>
<td>± 0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linearity</td>
<td>± 0.1</td>
<td>± 0.2</td>
<td>*</td>
</tr>
<tr>
<td>Output impedance</td>
<td>BNC output</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>DB25 output</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Logic</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current required for switching</td>
<td>-10</td>
<td>0.01</td>
<td>10</td>
</tr>
<tr>
<td>Switching time</td>
<td></td>
<td>150&lt;sup&gt;4&lt;/sup&gt;</td>
<td>*</td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Wall plus (supplied)</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>30 x 50 x 60</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>105&lt;sup&gt;5&lt;/sup&gt; x 45 x 116 mm (w x h x l)</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

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* = Identical data

<sup>1</sup> linearity guaranteed to 0dBm (1 mW)

<sup>2</sup> Adapters for other connector systems available

<sup>3</sup> Logic switching < 1µs. Effective switching time limited by settling time.

<sup>4</sup> 130 mm including case wings
CASE STYLES
OEM-Style (Gullwing)

Lab-Style

TYPICAL PERFORMANCE CURVES

Linearity

<table>
<thead>
<tr>
<th>Laserleistung [µW]</th>
<th>OPM Ausgang [µW]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1E-02</td>
<td>0</td>
</tr>
<tr>
<td>1,1E+00</td>
<td>1</td>
</tr>
<tr>
<td>1,1E+02</td>
<td>10</td>
</tr>
<tr>
<td>1,1E+04</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Laserleistung [µW]</th>
<th>Linearity [dB]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1E-02</td>
<td>-0,20</td>
</tr>
<tr>
<td>1,1E+00</td>
<td>-0,15</td>
</tr>
<tr>
<td>1,1E+02</td>
<td>-0,10</td>
</tr>
<tr>
<td>1,1E+04</td>
<td>-0,05</td>
</tr>
<tr>
<td>1,1E+04</td>
<td>0,00</td>
</tr>
<tr>
<td>1,1E+04</td>
<td>0,05</td>
</tr>
<tr>
<td>1,1E+04</td>
<td>0,10</td>
</tr>
<tr>
<td>1,1E+04</td>
<td>0,15</td>
</tr>
<tr>
<td>1,1E+04</td>
<td>0,20</td>
</tr>
</tbody>
</table>
**APPLICATIONS EXAMPLES**

The range of applications for optical power monitors is very broad. The OPM500 series is especially conceived for applications in the manufacturing environment of telecommunications components. Typical applications may be found in measuring:

Components: lasers, ASEs, fibre coupled LEDs
fibres, connectors, couplers
switches, multiplexers, demultiplexers
isolators, circulators
filters, fibre bragg gratings (FBGs)
amplifiers

Parameters: output power
optical return loss (ORL)
insertion loss
polarization dependant loss (PDL)
bandwidth
crosstalk
transient behaviour
polarization dependant bandwidth (PDBW)

In the following, some of these applications are represented schematically to give an idea of how a typical measurement setup may be configured. If you have any questions, please give us a call and use our expertise in optical metrology.

**OPTICAL SOURCE CHARACTERISATION: OUTPUT POWER**

![Schematic diagram of optical source and OPM](image)

**Important parameters:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>+/- 5%</td>
</tr>
<tr>
<td>Reproducibility</td>
<td>+/- 0.5%</td>
</tr>
</tbody>
</table>

* High quality reference cable with documented loss data
INSERTION LOSS

Method 1:

Optical Source → Patchcord* → DUT** → Patchcord* → OPM

Method 2:

Optical Source → 3dB coupler → DUT** → Patchcord* → OPM

Important parameters:

<table>
<thead>
<tr>
<th></th>
<th>OPM Specifications:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>+/- 5%</td>
</tr>
<tr>
<td>Reproducibility</td>
<td>+/- 0.5%</td>
</tr>
</tbody>
</table>

* High quality reference cable with documented loss data
** Device Under Test
LINEAR OR LOGARITHMIC?

The question often arises as to which signal processing technique is better: an output linearly or logarithmically proportional to the input optical power.

The use of logarithmic amplifiers for optical power monitoring results from the large dynamic range of relevant powers. For example, the OPM500 series can measure from 1mW to 30pW: more than 7 decades of optical power. This dynamic range is far beyond the capabilities of a linear amplifier in a single gain range.

However, by breaking the measurement into range subgroups, linear amplifiers can easily cover the same dynamic range as a logarithmic amplifier. This method is slightly more complicated than using a logarithmic amplifier with a single gain, but it brings several advantages:

1. Linear amplifiers are more stable than logarithmic amplifiers
2. Linear amplifiers are faster than logarithmic amplifiers and settle more quickly following sudden input changes
3. Linear amplifiers are more accurate than logarithmic amplifiers at higher outputs

Consider an application example: a fibre optic power monitor is used to measure the power coupled into a device in an automated confectioning system. The device being confectioned may be a laser being pigtailed or fibre being connected to an AWG, for example.

Now the automated positioning system takes the measured value of the coupled power (measured by the power monitor) and uses this value to control the motion stages positioning the fibre. The system searches for the position giving the maximum coupled optical power. Obviously, the accuracy of the positioning will depend on the accuracy of the measurement at the highest powers measured. Since the logarithm function compresses data, the position dependance of a logarithmic amplifier is flatter than for the linear amplifier at higher power. Thus, the linear amplifier will allow the system to achieve better results in this application. This point is depicted in the following diagram:
**PRINCIPLES OF OPERATION**

The OPM500 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 OPM500 has 6 gain ranges. The switch is a semiconductor device, free from degradation.

A unique feature of the OPM500 is the auto-zero function. Further functions include signal inversion and bandwidth reduction. The analogue output signal is available at the BNC connector on the front panel and on the appropriate line on the interface port on the back panel.

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. 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.

The measured photocurrent may also be read out from the USB port. In addition, the calibration value for a given wavelength may be read out. Using these two values, the optical power can then be calculated.
**AUTO-NULL**

The auto-null function sets the momentary output signal to zero. In this manner, a constant overlying signal such as a background illumination or detector dark current may be eliminated. Small signal changes may now be detected more readily.

*Note: the output signal must be positive in order to use this function!*

The auto-null is activated through the “Options” menu or by a HI signal on pin 20 of the DB25 interface or by a command $A on the USB interface. The reset to normal operation is obtained with a HI on pin 19 of the DB25 interface or the command $R on the USB interface.

When this option is activated, the offset for each gain range is determined and stored internally. Note that depending on the amplitude of the signal immediately prior to the time of auto-zeroing, some gain ranges may be in an overload state. These gain ranges are then invalid following application of the auto-zero function because it is not possible to determine the offset required. The invalid gain ranges are greyed out in the gain menu and will not be activated if autogain is implemented.

The value of the removed portion of the signal is output on pin 25 of the DB25 interface. Activation of the auto-null function does not affect the voltage range of the amplifier. For example, if the auto-null is activated when 3V are output, then the output is reduced to 0V and the remaining dynamic range of the amplifier is 7V.

Pin 23 of the DB25 interface provides a logic control signal for this function. When the function is activated, this pin goes from HI to LO for the duration of the signal acquisition. When the signal is acquired and the auto-null function complete, this pin goes HI again to indicate that the amplifier is now ready for operation.

**OUTPUT POLARITY**

The polarity of the output may be selected via the “Options” menu or via pin 18 of the DB25 interface or using the command $C via the USB interface.

**LO**: Signal is not inverted

**HI**: Signal is inverted

**GAIN**

The amplifier has 6 gain ranges. Using the DB25 interface, the bit pattern is as follows:

<table>
<thead>
<tr>
<th>Range</th>
<th>Si, InGaAs Output scale</th>
<th>Ge Output scale</th>
<th>Pin 12 (MSB)</th>
<th>Pin 11</th>
<th>Pin 10 (LSB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 V / mA</td>
<td>0.1 V / mA</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>10 V / mA</td>
<td>1 V / mA</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>100 V / mA</td>
<td>10 V / mA</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>1 V / µA</td>
<td>0.1 V / µA</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>10 V / µA</td>
<td>1 V / µA</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>100 V / µA</td>
<td>10 V / µA</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Using the USB interface, the gain can be selected with the commands V1, V2, ... V6.
BANDWIDTH REDUCTION
The OPM500 has four selectable analogue bandwidth ranges. Reduction of bandwidth is useful for suppressing high frequency noise from slower signals. The full bandwidth of the amplifier is 10kHz. Using the bandwidth reduction, this may be reduced to 1kHz, 100Hz or 10Hz.

The bit setting on the DB25 interface is as follows:

<table>
<thead>
<tr>
<th>Bandwidth</th>
<th>Pin 17</th>
<th>Pin 16</th>
<th>Pin 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 kHz</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1 kHz</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>10 Hz</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

INDICATORS
The condition of the instrument is indicated through two LEDs:
Power (LED, green): The unit is switched on.
Overload (LED, red): The input current is too high for the gain range chosen.

The overload indicator works only for positive signals and indicates an output greater than 10V. If the overload LED is lit, reduce the input power or reduce the gain setting.

OUTPUTS
The analogue output is provided via standard BNC sockets as well as through the interface. The output is linear with input current, the magnitude of the signal depending on the range selected, as follows:

<table>
<thead>
<tr>
<th>Si, InGaAs</th>
<th>Ge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range:</td>
<td></td>
</tr>
<tr>
<td>+5 dBm</td>
<td>0.1 V / mW</td>
</tr>
<tr>
<td>0 dBm</td>
<td>1 V / mW</td>
</tr>
<tr>
<td>-10 dBm</td>
<td>10 V / mW</td>
</tr>
<tr>
<td>-20 dBm</td>
<td>100 V / mW</td>
</tr>
<tr>
<td>-30 dBm</td>
<td>1 V / µW</td>
</tr>
<tr>
<td>-40 dBm</td>
<td>10 V / µW</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Si, InGaAs</th>
<th>Ge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range:</td>
<td></td>
</tr>
<tr>
<td>+15 dBm</td>
<td>0.1 V / mW</td>
</tr>
<tr>
<td>10 dBm</td>
<td>1 V / mW</td>
</tr>
<tr>
<td>0 dBm</td>
<td>10 V / mW</td>
</tr>
<tr>
<td>-10 dBm</td>
<td>100 V / mW</td>
</tr>
<tr>
<td>-20 dBm</td>
<td>1 V / µW</td>
</tr>
<tr>
<td>-30 dBm</td>
<td>10 V / µW</td>
</tr>
<tr>
<td>-40 dBm</td>
<td>10 V / µW</td>
</tr>
</tbody>
</table>
**INTERFACES**

**HARDWIRE INTERFACE**

The hardwire interface (DB25 connector) is active upon starting the OPM500. This interface has two galvanically isolated grounds. The analogue ground (pin 3) is the reference point for the analogue signals (pin 6 and pin 25). The digital ground (pin 9) is the reference for all digital inputs and outputs. It is recommended to not connect these two grounds in order to avoid slight disturbances and glitches which may be present on the digital lines.

The pinning of the DB25 interface is as follows:

<table>
<thead>
<tr>
<th>PIN</th>
<th>Function</th>
<th>PIN</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>n.c.</td>
<td>14</td>
<td>n.c.</td>
</tr>
<tr>
<td>2</td>
<td>n.c.</td>
<td>15*</td>
<td>bandwidth reduction: BW = 1 kHz</td>
</tr>
<tr>
<td>3</td>
<td>AGND (ground for analogue signals)</td>
<td>16*</td>
<td>bandwidth reduction: BW = 100 Hz</td>
</tr>
<tr>
<td>4</td>
<td>digital output: HI = power on</td>
<td>17*</td>
<td>bandwidth reduction: BW = 10 Hz</td>
</tr>
<tr>
<td>5</td>
<td>digital output: HI = overload</td>
<td>18*</td>
<td>polarity</td>
</tr>
<tr>
<td>6</td>
<td>Signal output (buffered equivalent to BNC output)</td>
<td>19*</td>
<td>Auto-null – Reset</td>
</tr>
<tr>
<td>7</td>
<td>n.c.</td>
<td>20*</td>
<td>Auto-null</td>
</tr>
<tr>
<td>8</td>
<td>n.c.</td>
<td>21</td>
<td>n.c.</td>
</tr>
<tr>
<td>9</td>
<td>DGND (ground for digital signals)</td>
<td>22</td>
<td>n.c.</td>
</tr>
<tr>
<td>10*</td>
<td>Gain (LSB)</td>
<td>23</td>
<td>digital output:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LO = load data</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LO→HI = auto-nulling completed</td>
</tr>
<tr>
<td>11*</td>
<td>Gain</td>
<td>24</td>
<td>n.c.</td>
</tr>
<tr>
<td>12*</td>
<td>Gain (MSB)</td>
<td>25</td>
<td>Auto-null offset value</td>
</tr>
<tr>
<td>13</td>
<td>n.c.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Digital input or output
Analogue output
SOFTWARE

INSTALLING THE DRIVER UNDER WINDOWS XP

Connect the OPM150 to one of the USB ports on the PC. A warning will appear that the driver has not been found or installed. Please ignore this. This is in contrast to Windows XP® where it would be possible to install the driver manually.

Open the menu by clicking on the Windows logo at the bottom left of the windows frame. Select the Control Panel.
In the Control Panel, select „Hardware und Sound“.

In the following window, click on Device Manager.
The Device Manager is now open. The OPM150 can be found under „Other devices“. Use a right click to open the context menu of the OPM150. Then left click on „Update Driver Software“.

An installation assistant will open. Choose the option “Browse my computer for driver software”.
You will be asked to enter the location of the driver software. Select the button “Browse” or enter the location directly (not recommended).

The following window will appear to confirm the successful installation. Close this window.
Now the serial port for the OPM150 will appear under „Other devices“ in the Device Manager. The yellow “attention” icon appears here because the port driver has not been installed yet. This may now be performed analogously to the first installation. Open the context menu with a right click on the “attention” icon and then with a left click on the option “Update Driver Software...”. The location of the driver is the same as for the first installation.

After successful installation, the OPM150 should now be visible under „Ports“ and „Universal Serial Bus controllers“ in the Device Manager. The OPM150 is now ready for operation.
INSTALLING THE DRIVER UNDER WINDOWS XP

The following section describes the installation of the driver under Windows XP step by step. The driver allows direct access to the OPM500 as well as via a virtual COM-Port.

Connect the OPM500 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.

![Found New Hardware Wizard](image)

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

---

Found New Hardware Wizard

Welcome to the Found New Hardware Wizard

Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission).

Read our privacy online

Can Windows connect to Windows Update to search for software?

- Yes, this time only
- Yes, now and every time I connect a device
- No, not this time

Click Next to continue.
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 check 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 >”.

![Found New Hardware Wizard](image)

This wizard helps you install software for:

CPM500

If your hardware came with an installation CD or floppy disk, insert it now.

What do you want the wizard to do?

- Install the software automatically (Recommended)
- Install from a list or specific location (Advanced)

Click Next to continue.

![Found New Hardware Wizard](image)

Please choose your search and installation options.

- Search for the best driver in these locations:
  Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.
  - [ ] Search removable media (floppy, CD-ROM...)
  - [x] Include this location in the search
  - [ ] Driver
  - [ ] Browse

- Don’t search. I will choose the driver to install.
  Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.
The installation of the driver will begin and the files will be copied into the system.

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.
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, i.e., 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”.

![System Properties](image)
Now open the menu item „USB controllers“ and double-click on the item „Artifex Engineering OPM500 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 OPM500 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.

Select Installation Folder

The installer will install OPM500 to the following folder.
To install in this folder, click “Next”. To install to a different folder, enter it below or click “Browse”.

Folder:
C:\Program Files\Artex Engineering\OPM500\ [Browse] [Disk Cost]

Install OPM500 for yourself, or for anyone who uses this computer:
- Everyone
- Just me

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 >”. 

Confirm Installation

The installer is ready to install OPM500 on your computer.
Click “Next” to start the installation.
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 / OPM500.”
**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. 32 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.34.

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.

Options: **Auto-Zero** – The auto-zero function sets the momentary output signal to zero. This function is only applicable for positive signals. When this option is activated, the offset for each gain range is determined and stored internally. Note that depending on the amplitude of the signal immediately prior to the time of auto-zeroing, some gain ranges may be in an overload state. These gain ranges are then invalid following application of the auto-zero function because it is not possible to determine the offset required. The invalid gain ranges are greyed out in the gain menu and will not be activated if autogain is implemented.

**Auto-Zero reset**– Resets this function and restores the amplitude. All gain ranges are reset to the valid state and are available for autogain implementation.

**Inverting** – Inverts the input.

**Noninverting** – Sets the input to noninverting.

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 order 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.

Offset Zeroing: The present optical power is measured and averaged over a number of samples as chose in the “Preferences” menu. This optical power is then subtracted from all subsequent measurements. When this button is clicked, the button is framed in red. The red frame pulsates during the process of averaging and storing the offset to be zeroed. After this measurement process, the frame stops pulsating and the output drops to the zeroed level.
Note that this is not the Auto-Zero function. Offset zeroing functions only within the gain range selected and employs a different algorithm for determining the offset value. Offset zeroing may be used to eliminate positive and negative offsets. Implementation of this function may take several seconds depending on the settings of the sampling rate and the number of averaging samples for zeroing (see details under “Preferences”, pg. 34). Offset zeroing has no influence on the analogue output voltages (BNC and DB25).

The Status Bar

The most important status information is displayed here.

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 “OPM500 connected” appears. Disconnection will also be recognized and indicated during a running measurement.

Gain: Indicates the presently selected gain – also in autogain mode.

Bandwidth: Indicates the momentary bandwidth of the amplifier. The bandwidth may be reduced in order to reduce noise from sources of higher frequency than the signal of interest.

Optical power level: For optimal signal to noise ratio, as with any measurement instrument, the OPM500 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>
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 spreadsheet programmes such as Excel. The file header is identical to that of the *.TZA files.

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

![Preferences Window](image)

- **Y-Axis, Start at zero**: When using automatic Y-axis scaling, the lower limit of the Y-axis will lie just under the smallest measurement value. Activating this check box will force the lower limit to be fixed at zero. This option is inactive when using the dBm scale mode.
- **Units in W**: Radio button to select the units of the Y-axis scale to be in W.
- **Units in dBm**: Radio button to select the units of the Y-axis scale to be in dBm. Note that zero and negative values are undefined in the dBm display mode. This results in undisplayed data points in the graph mode or display of the result “n. def. dBm” (= not defined) in the LCD Display mode.
- **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.

### Offset zero:
A button in the toolbar allows activation of the offset zeroing mode. The number of samples to be averaged for determining the offset level is selected here. Implementation of this function may take several seconds depending on the settings of the sampling rate and the number of averaging samples for zeroing.

---

**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 4.58 mW at Point No. 3.0

This option can be activated and deactivated using the context menu.
**The Context Menu**

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

- **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 OPM500 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 OPM500.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 OPM500

In order to communicate with the OPM500, 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 in 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 OPM500 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 > Communication > Hyper Terminal
Active VCP is necessary for this communication (see “Activating the VCP – Option”, pg.22).
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.

![Communication Parameters Window]

Confirm the changes by clicking „OK“.

If all parameters are correct, an indication will appear at the bottom of the main window that the connection has been successful. This may be checked by typing “$U”. The OPM500 responds with “U-OK”.

NOTE: The active interface when turning on the OPM500 is always the DB25 hardwire interface! No commands over the USB interface will be received! The command “$U” must first be sent in order to switch control over to the USB interface.

Now enter $I (“dollar” and capital “i”, this is the code to request information about the instrument). The OPM500 will respond with a message similar to the following:

OPM500
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 $I 10\mu A$. 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.

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

\[
\text{Optical power: } \frac{10 \mu A}{0.654 A/W} = 15.3 \mu W
\]
The following commands are available:

**Change Interface**

$T  TTL Interface. The DB25 hardwire interface is activated. Control is made using TTL-compatible signals (Default interface on startup).
Response: T OK

$U  USB Interface. Control is made using the USB interface.
Response: U OK

**Data output**

$P :  Polling mode. The measurement takes place continuously at approximately 1.5 kS/s. Sending "$" ends the measurement.

$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.

**Auto-Zero Function**

$A    Auto-Zero activated. The momentary output signal is set to 0V (operative only on positive outputs). When this option is activated, the offset for each gain range is determined and stored internally. Note that depending on the amplitude of the signal immediately prior to the time of auto-zeroing, some gain ranges may be in an overload state. These gain ranges are then invalid following application of the auto-zero function because it is not possible to determine the offset required. The invalid gain ranges are greyed out in the gain menu and will not be activated if autogain is implemented.
Response: Gain: <valid gain ranges>

$R  Auto-Zero reset. Die Auto-null function is deactivated. The output returns to normal operation. All gain ranges are reset to the valid state and are available for autogain implementation.
Response: R OK

**Polarity**

$N  Not inverted. (Default setting).
Response: N OK

$C  Inverted. The signal is inverted in the input stage.
Response: C OK

$F  Request present polarity status
Response: F0 (not inverted)
                 F1 (inverted)
**Bandwidth**

B1    bandwidth 10KHz (default)
B2    bandwidth 1KHz
B3    bandwidth 100Hz
B4    bandwidth 10Hz

Response: B <Bandwidth> OK

B?    Request present bandwidth status

Response: B <Bandwidth>

**Info**

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

Response:

<Instrument> e.g. OPM500
Serial: <serial number.>
Date of Manufacturing: <date of manufacture>
Detector: <wavelength range> e.g. 190nm – 950nm

**Gain**

V1    gain x1
V2    gain x10
V3    gain x 100
V4    gain x 1.000
V5    gain x 10.000
V6    gain x 100.000

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>
**DAMAGE**

The unit may be damaged by exceeding the maximum average input power. Please read „Absolute Maximum Ratings“, pg. 3 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:

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

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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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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