

1. Principle and Key Features

The PID irradiation device is based on the use of super-bright light emitting diodes (LEDs) arranged in an array-like configuration ensuring homogenous sample irradiation over a given area.

The PID 1.0 provides

- a high light output as given by irradiance (e.g. up to 7 mW.cm^{-2} for $\lambda=660 \text{ nm}$)
- homogenous sample irradiation
- excellent experiment-to-experiment reproducibility
- infinite regulation of the light output by adjustment of the current
- a high wavelength specificity, i.e. the diodes used are characterized by a full width at half maximum of the emission peak of about $\pm 10 \text{ nm}$
- exchangeable LED inserts with specific irradiation wavelengths can be ordered
- practically maintenance-free operation

Operation of the PID 1.0 does not

- require additional optical parts such as lenses (for homogenous irradiation)
- require extra cooling of the LEDs
- cause sample warming

2. Technical Data

2.1. Construction

The PID 1.0 consists of 432 superbright LEDs in an 18x24 arrangement. For equivalent current supply of each single LED the diodes were soldered into standard printed circuit boards and connected in parallel. As the maximum current permitted for one LED is 25mA, the array may be supplied with up to 10.8A at about 2.5V.

With this configuration a treatment area of up to 160 cm^2 can be irradiated with a homogenous fluence (max. standard deviation of the fluence is about 10%).

The PID is driven by a standard laboratory power supply capable of providing a current of up to 10 A DC.

For construction details of the PID 1.0 please see Figure 1.

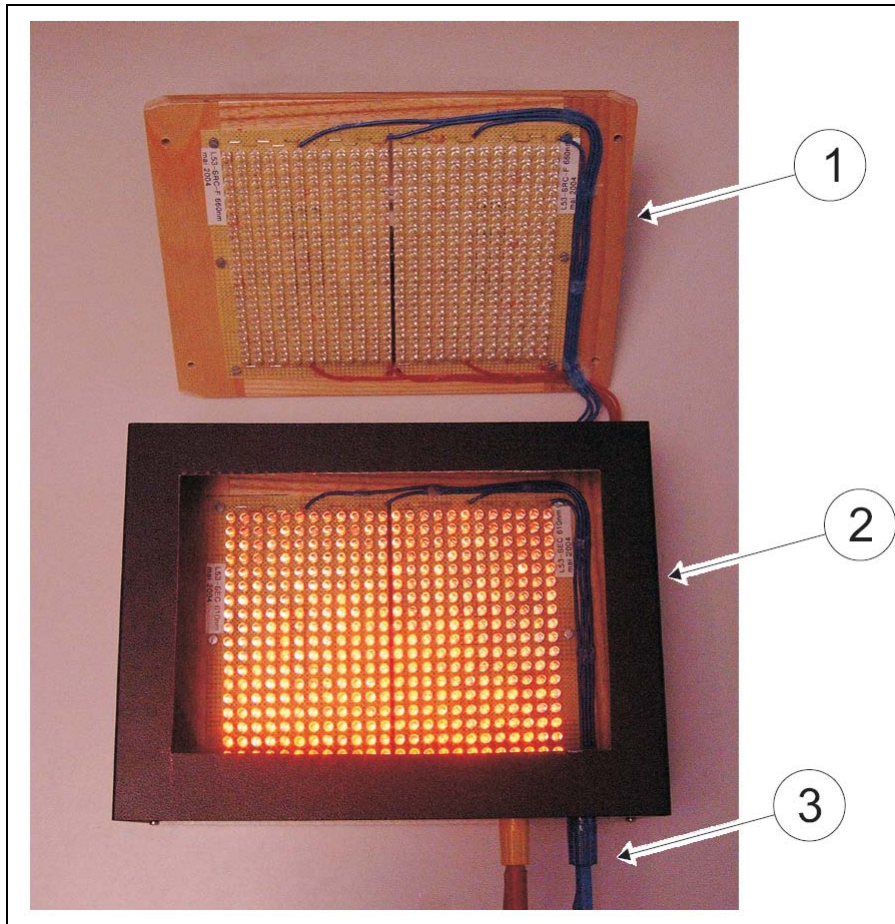


Figure 1 Top-view of the PID 1.0.

1. Interchangeable Diode insert
2. PID 1.0 case with operating diode array
3. Power supply

2.2. Available Wavelengths

Inserts with LEDs covering the following excitation wavelengths are available (Table 1):

Table 1 Available Diode types for the PID 1.0

| Name | Synonyms | Ex-WL | Diodes | Cat. No. | Luminous Intensity (mCd) | Manufacturer / Distributor |
|---|-----------------------------------|-------|--------|-------------------------|--------------------------|----------------------------|
| brominated rhodamine analogue (TH9402) | | 511 | 507 | <u>RL5-A7032</u> | 7000 | superbrightleds |
| rose bengal | | 532 | 525 | <u>RL5-G7532</u> | 7500 | superbrightleds |
| hypericin | | 590 | 595 | <u>RL5-Y5030</u> | 5000 | superbrightleds |
| protoporphyrin IX (and precursors, 5-ALA (Levulan)) | | 630 | 630 | <u>RL5-R8030</u> | 8000 | superbrightleds |
| hematoporphyrin derivatives | Photofrin® / Photosan® / porfimer | 630 | 630 | <u>RL5-R8030</u> | 8000 | superbrightleds |
| ATMPnc | | 630 | 630 | <u>RL5-R8030</u> | 8000 | superbrightleds |
| mTHPC | Foscan(R), Temoporfin | 652 | 660 | <u>RL5-R1330</u> | 1300 | superbrightleds |
| tin ethyl etiopurpurin (SnET2) | | 660 | 660 | <u>RL5-R1330</u> | 1300 | superbrightleds |
| phthalocyanine family | | 660 | 660 | <u>RL5-R1330</u> | 1300 | superbrightleds |
| mono-L-aspartyl chlorin e6 | NPe6 | 664 | 660 | <u>RL5-R1330</u> | 1300 | superbrightleds |
| methylene blue | | 668 | 660 | <u>RL5-R1330</u> | 1300 | superbrightleds |
| phenothiazinium compounds | | 670 | 660 | <u>RL5-R1330</u> | 1300 | superbrightleds |
| benzoporphyrin derivative monoacid ring A (BPD) | Verteporphin | 690 | 690 | L690 | | epitex |
| Lutrin | Lutetium Texaphyrin | 732 | 735 | <u>L200CWIR 731-30D</u> | | ledtronics |

3. Specifications and Characteristics

The following Figures were modified from Pieslinger et al. / Medical Laser Application 21 (2006) 277–283. Please refer to this publication for experimental details.

3.1. Spatial Homogeneity

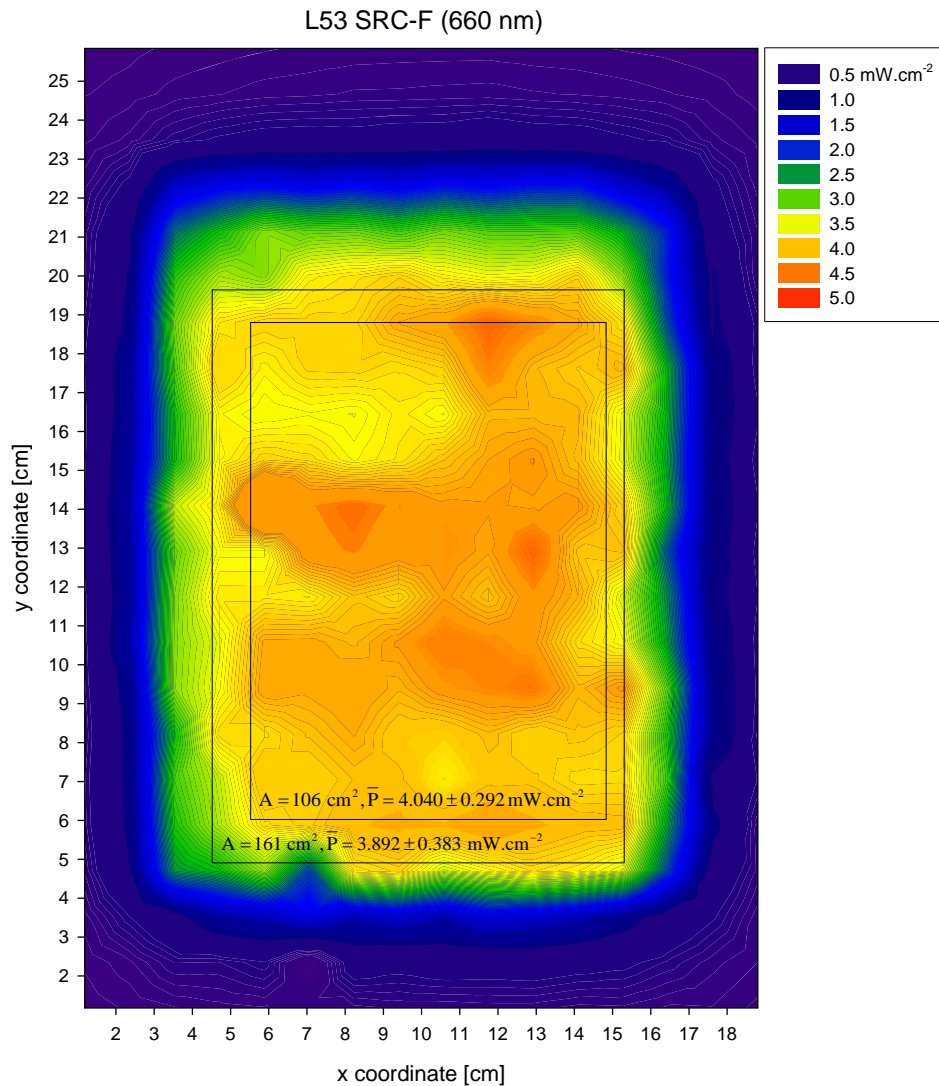


Figure 2 **Spatial Homogeneity of the PID (L53- SRC-F diodes, 660 nm)**

3.2. Irradiance as a function of the current

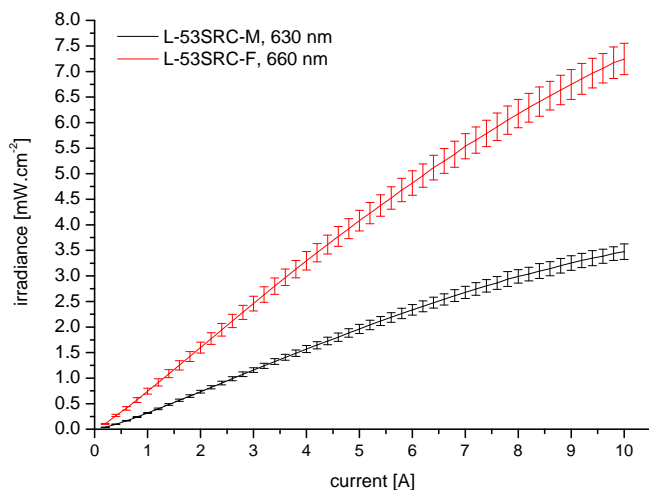


Figure 3 Average Irradiance. By adjustment of the current, the PID allows infinite regulation of the irradiance.

3.3. Cytotoxic Effect

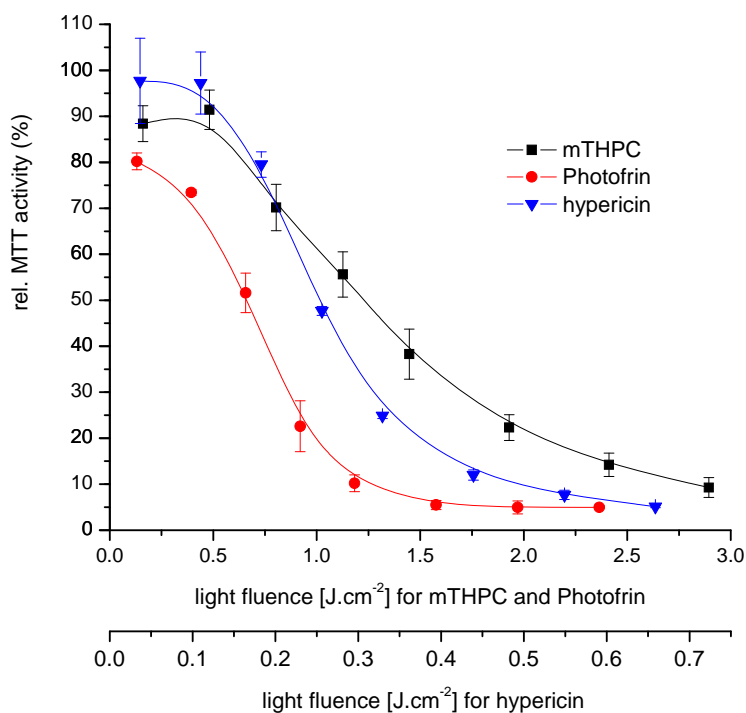


Figure 4 Cytotoxicity of PDT with mTHPC, Photofrin and Hypericin in an A431 human epidermoid carcinoma cell line.