**LuOcean M4**
Diode Laser @ 760nm - 1940nm up to 530W

**Features & Functions:**
- Up to three wavelengths
- 200μm - 1000μm NA 0.22 fiber
- Emitter electrically in series
- Temperature sensor
- Pilot intensity (voltage controlled)
- Water supply for fiber connector

**Options:**
- Exchangeable window
- Red or green pilot
- Fiber sensor
- Power monitor
- OEM diode laser driver
- OEM water chiller
- FSMA or D80 connector
- Water cooling terminal for fiber connector

**Benefits:**
- Single emitter long lifetime
- Tab water cooling
- Sealed housing
- Small footprint

**Applications:**
- Therapeutic
- Dental
- Dermatology
- Veterinary

**Description:**
This LuOcean™ M4 Diode Laser offers an excellent product to manufacture state-of-the-art end user laser systems. The easy integration and safe use of these laser components give the chance to be cost-efficient in development and manufacturing. Equipped with several accessories and features, the LuOcean diode lasers comply with CE & ROHS requirements. Lumics warrants highest reliability single emitter technology through careful design, extensive burn-in, long lifetime & thermal testing.

**Module Drawing (Dimensions in mm)**

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Connector - Laser Diode Supply

Weipu IP68 male connector on laser module (Part No. 5V2113P54A).

Counterpart (?)

Maximum current/voltage per pin is 30 A / 500V
All laser diodes per wavelength group can be operated separately or electrically in series if the current is the same per group.

Caution: Never operate the wavelength group electrically in parallel. This may damage the laser diodes.

Connector - Signals

IP68 male D-Sub connector on laser module

Maximum current/voltage per pin is 3 A / 400V

Counterpart standard 15 pin D-Sub female connector

Water Supply

Push-In connector, Housing material Thermoplastic

Laser diode cooling: thread to module 3/8" and water hose outer diameter 12mm

Optional fiber cable cooling: thread to module 1/8" and water hose with outer diameter 6mm

Electrical and Optical Characteristics / Typical Laser Specifications at 25°C *

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>760</td>
<td>1000</td>
<td>300</td>
<td>20 / 2x28</td>
<td>**D80 flange water cooled, fiber with end cap and AR</td>
</tr>
<tr>
<td>760 &amp; 1064 (dual)</td>
<td>1000</td>
<td>300 &amp; 220</td>
<td>20 / 2x28 &amp; 24 / 1x25</td>
<td>**D80 flange water cooled, fiber with end cap and AR</td>
</tr>
<tr>
<td>760 &amp; 1064 (dual)</td>
<td>1000</td>
<td>170 &amp; 220</td>
<td>17 / 2x28 &amp; 24 / 1x25</td>
<td>**D80 flange water cooled, fiber with end cap and AR</td>
</tr>
<tr>
<td>785 or 808</td>
<td>200 (200)</td>
<td>160 (240)</td>
<td>8 / 2x28 (15 / 2x28)</td>
<td>**D80 flange water cooled, fiber with end cap and AR</td>
</tr>
<tr>
<td>975</td>
<td>200 (Total 280)</td>
<td>15 / 2x25</td>
<td></td>
<td>**FMAS or D80 water cooled, fiber with end cap and AR</td>
</tr>
<tr>
<td>940 &amp; 975 (dual)</td>
<td>200 (Total 330)</td>
<td>15 / 2x25</td>
<td></td>
<td>**D80 water cooled, fiber with end cap and AR</td>
</tr>
<tr>
<td>940 &amp; 975 (dual)</td>
<td>400 (Total 470)</td>
<td>25 / 2x25</td>
<td></td>
<td>**D80 water cooled, fiber with end cap and AR</td>
</tr>
<tr>
<td>940 &amp; 975 (dual)</td>
<td>600 (Total 550)</td>
<td>28 / 2x25</td>
<td></td>
<td>**D80 water cooled, fiber with end cap and AR</td>
</tr>
<tr>
<td>975 &amp; 1470 (dual)</td>
<td>400 (100 &amp; 100)</td>
<td>25 / 25 &amp; 21 / 1x20</td>
<td></td>
<td>**FMAS without cooling</td>
</tr>
<tr>
<td>1064</td>
<td>600</td>
<td>400</td>
<td>26 / 2x25</td>
<td>**D80 water cooled, fiber with end cap or AR</td>
</tr>
<tr>
<td>1470</td>
<td>400</td>
<td>150</td>
<td>21 / 2x25</td>
<td>**FMAS without cooling</td>
</tr>
<tr>
<td>1940</td>
<td>200</td>
<td>33</td>
<td>7.5 / 2x16</td>
<td>**FMAS without cooling</td>
</tr>
<tr>
<td>1470 &amp; 1940 (dual)</td>
<td>400</td>
<td>45</td>
<td>11 / 2x16</td>
<td>**FMAS without cooling</td>
</tr>
<tr>
<td>1940</td>
<td>70 &amp; 23</td>
<td>20 / 20 &amp; 11 / 16</td>
<td></td>
<td>**FMAS without cooling</td>
</tr>
<tr>
<td>1940 &amp; 1940 (dual)</td>
<td>10 &amp; 30</td>
<td>14 / 48, 7.5 / 1x14,1x16</td>
<td></td>
<td>**FMAS without cooling</td>
</tr>
</tbody>
</table>

Notes: *
- Taken at internal temperature sensor. Depeding on the laser wavelength an AR = 0.7% (=10m around peak wavelength) coated fiber facet or end cap on fiber module side is required. Avoid direct feedback from materials like mirrors, optics, processed material etc. back into laser module via the fiber cable by more than 10%.

(1) Power is measured ex fiber according to given fiber specifications including measures and tolerances of fiber and ferrules for uncoated fiber facets (exception see *).

Minimum repeatable power with internal temperature and current accuracy of ±0% is ±=±3% of maximum power. Please add tolerance of your temperature and current control.

(2) Do not exceed maximum forward current for rated power as given above by more than 5% otherwise the laser diode may be damaged.

(3) Rule of thumb: Power ex fiber decreases by app. 5% (<1100nm), 7% (<1400nm) and 12% (<1900nm) every 10°C temperature increase at internal temperature sensor. Lifetime decreases by about factor of every 15°C. Required flatness of customer heat sink 0.05mm over entire bottom surface to achieve necessary contact to the heat sink.

(4) Red and green minimum power span is set at factory by customer request. Standard is 3.3 mW.

(5) Adjust trimpot R6 to set maximum intensity with pin 10 control left open or set to 0.3V

(6) Adjust trimpot R4 to set intensity off with pin 10 control set to 0V

(7) Calculation of the thermal load and necessary thermal resistance of a heat sink to maintain internal diode temperature of 25°C:

Thermal load = Output power * (1/(conversion efficiency - 1))

Heat sink thermal resistance = (25°C - ambient temperature) / thermal load

General Parameters / Accessories

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Temperature</td>
<td>T₅</td>
<td>-10</td>
<td>55</td>
<td>⁰C</td>
<td></td>
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<tr>
<td>Internal operating * and ( Ambient temp, c.w.-operation **</td>
<td>T₉₅C.W.</td>
<td>10(5)</td>
<td>35/40</td>
<td>⁰C</td>
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<tr>
<td>Humidity / Non-condensing Atmosphere</td>
<td>90</td>
<td>%</td>
<td></td>
<td></td>
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<tr>
<td>Maximum fiber flange temperature</td>
<td>50</td>
<td>⁰C</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Weight</td>
<td></td>
<td>2.5</td>
<td>kg</td>
<td></td>
<td></td>
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<tr>
<td>Compliance</td>
<td>CE, ROHS</td>
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</tbody>
</table>

Further Options (Please ask for quotation if needed)

- Optical fiber pathcord
- Laser diode drivers for each individual wavelength
- Interface cable
- OEM laser diode driver and temperature controller

* Taken at internal temperature sensor ** We recommend to operate the laser above dew point. Below dew point water condensation on the exit window may damage the window when laser is switched on. If the module was stored below dew point before operation dry the window by pre-heating the module to 25°C
Electrical and Optical Characteristics Typical laser specifications at 25° C *

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Symbol</th>
<th>Min</th>
<th>Typical</th>
<th>Max</th>
<th>Unit</th>
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<tbody>
<tr>
<td>Conversion Efficiency</td>
<td>depending on wavelength</td>
<td></td>
<td></td>
<td></td>
<td>40% (7/8x6mm), 45% (9/10x6mm), 25/15% (14/19x6mm)</td>
<td>%</td>
</tr>
<tr>
<td>Spectral Shift with Temp. &lt;1100nm</td>
<td>( \lambda_{\text{sh}} )</td>
<td>0.3</td>
<td>nm / K</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spectral Shift with Temp. 14xxnm</td>
<td>( \lambda_{\text{sh}} )</td>
<td>0.7</td>
<td>nm / K</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spectral Shift with Temp. 19xxnm</td>
<td>( \lambda_{\text{sh}} )</td>
<td>1</td>
<td>nm / K</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fiber Centricity</td>
<td></td>
<td>&lt;10</td>
<td>( \mu )</td>
<td></td>
<td></td>
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<tr>
<td>Numerical Aperture</td>
<td></td>
<td>NA</td>
<td>0.22</td>
<td></td>
<td></td>
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<tr>
<td>Fiber Connector Type</td>
<td></td>
<td>FSMA or D80</td>
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</tr>
</tbody>
</table>

Pilot Beam (Option)

- **Pilot Beam Output Power**: red/green - adjustable 1-2 3 mW
- **Pilot Beam Wavelength**: red/green 640 / 510 650 / 520 660 / 530 nm
- **Pilot Beam Operating Voltage**: red/green 4/7 5/8 V
- **Pilot Beam Operating Current**: red/green \(<35/200\) mA
- **Pilot Beam Intensity Control Voltage**: red/green 0(max. Intensity) 5(min. Intensity) V

Sensors (Options)

- **Power Monitor Signal Voltage (2)**: 0 4 V
- **Fiber Detection Sensor Signal Voltage**: <0.2 (unplugged) >4 (plugged) V
- **Temperature Sensor**: Standard NTC (10k) or optional (PT100 or LM35)
- **Humidity Sensor (4)**: 0.5 <1.4 1.6 V

Cooling

- **Required water temperature (water quality see (5))**: c.w. TW 15 <=23 °C
- **Required water flow at TW**: c.w. scales with power level \( \text{L/min} \)
- **Thermal resistance x water flux**: c.w. 0.14 \( \text{KW L/min} \)
- **Proportional coefficient between pressure drop and flow rate**: \( Fp \) 0.13 bar / l x min
- **Inlet pressure**: \( p \) 3.5 bar

(4) Sensor signal range from (0.5-4V) and signal voltage depends linearly on humidity. 1.4V means app. 20% rel. Humidity and 4V means 100% rel. humidity. Voltage must be kept below 1.6V for safe operation.

(5) You must use colourless, free of oil and greese DI water of tap water (>20 kOhm) cm, pH between 6-8, hardness <10DH or <200ppm CaCO3, particle diameter <200μm

Calculation example of thermal load and necessary water flow to maintain temperature difference of 10K between water and internal temperature sensor. Required water temperature and flow depends on maximum thermal load and maximum internal temperature. Thermal load is calculated as follows:

**Thermal load = Output power x (1/(Conversion efficiency - 1), Thermal resistance = temperature difference of water to internal sensor / thermal load**

**Example: Output power**: 440 W at 9mm, Conversion efficiency: 0.45, Thermal load = 440 W * (1/0.45 - 1) = 540 W and water flow = 0.12 / (10 K/ 340 W) = 6.5/4

Fiber Connector

(1) Lumics laser diode fiber coupling technology ensures loss into the fiber cladding of <10% (7/8/9/10/14/6mm for fiber core >=10μm), <3% (7/8/9/10/14/6mm for fiber core >=20μm) and <2% (10%/14%mm for fiber core >=200/400μm) of the total power if the fiber centricity (typically <=10μm), ferrule diameter and distance of the fiber end facet to the reference plane complies with shown technical drawing and the Lumics fiber data sheet. Use a fiber microscope to check for dust free fiber end facet and fiber centricity.

(2) Free standing fibers suffer from higher risk of fiber damage to the fiber tip due to mechanical stress by handling and the fiber end facet can not be polished as simple as for not free standing fibers.

(3) For more information see the Lumics fiber data sheet http://www.lumics.de/wp-content/uploads/l_fiber_patchchords.pdf

User Safety

Important Note Read and carefully follow operating manual instructions. Especially, whenever power supply is switched on or off, always disconnect from laser module. See manual for details. Uncontrolled on/off switching may cause spikes and result in fatal device damage. This product is not certified by with IEC 60825-1 or 21CFR1040.10/21CFR1040.11 and and must comply with the applicable regulations by the Purchaser if sold as laser product.