Prometheus
Product Line

User's Manual

Hannover, 05.08.2003

Version 4.4

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- **When the product is received, the shipping container and its content should be inspected for any damage incurred during shipping. In case of damage, please inform InnoLight GmbH immediately!**

- **If any failure occurs, please contact InnoLight GmbH immediately! Do not open the modules! They do not contain any user serviceable parts!**

- **Read this manual carefully before starting up the laser!**

- **Before connecting or disconnecting any of the cables, switch off the control electronic!**

- **The Prometheus laser system is designed for applications in R&D fields. The laser must only be operated by trained personnel.**

- **Always wear laser goggles to protect your eyes!**

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1 User Safety

1.1 Grounding the Power Supply

To minimize shock hazard, the power supply must be connected to an electrical ground. The power supply must be plugged into an approved electrical outlet using an appropriate AC power cable.

1.2 Line Voltage Selection

Before connecting the power cord, verify that the line voltage setting on the reverse side of the power supply agrees with your local line voltage.

1.3 Removing the Electronics Cover

Warning:
Dangerous voltages exist inside the power supply, even with the power switched off. Only qualified service personnel should remove the cover.

1.4 Laser Safety Warnings

Warning:
Exposure to laser radiation may be harmful. All apertures which can emit laser light in excess of levels which are considered safe are identified with the appropriate labels shown later in this section. Take extreme care when working in areas where these labels are placed.

Warning:
Always provide protective eyewear suitable for the laser's emission wavelengths. The emission wavelengths of your laser model are 1064 nm and 532 nm, accessible by two different apertures.

Warning:
Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure. The use of optical instruments with these products will increase eye hazard.

Caution:
Lasers may be damaged by improper setting of the current controls or by improper use of the modulation inputs. Check line voltage setting before connecting power.

Warning:
This laser product must not be used for any medical applications, whatsoever.

The positions of the laser safety and aperture labels affixed to the laser housing of the **Prometheus** Product Line are illustrated in the following Figure 1.1:

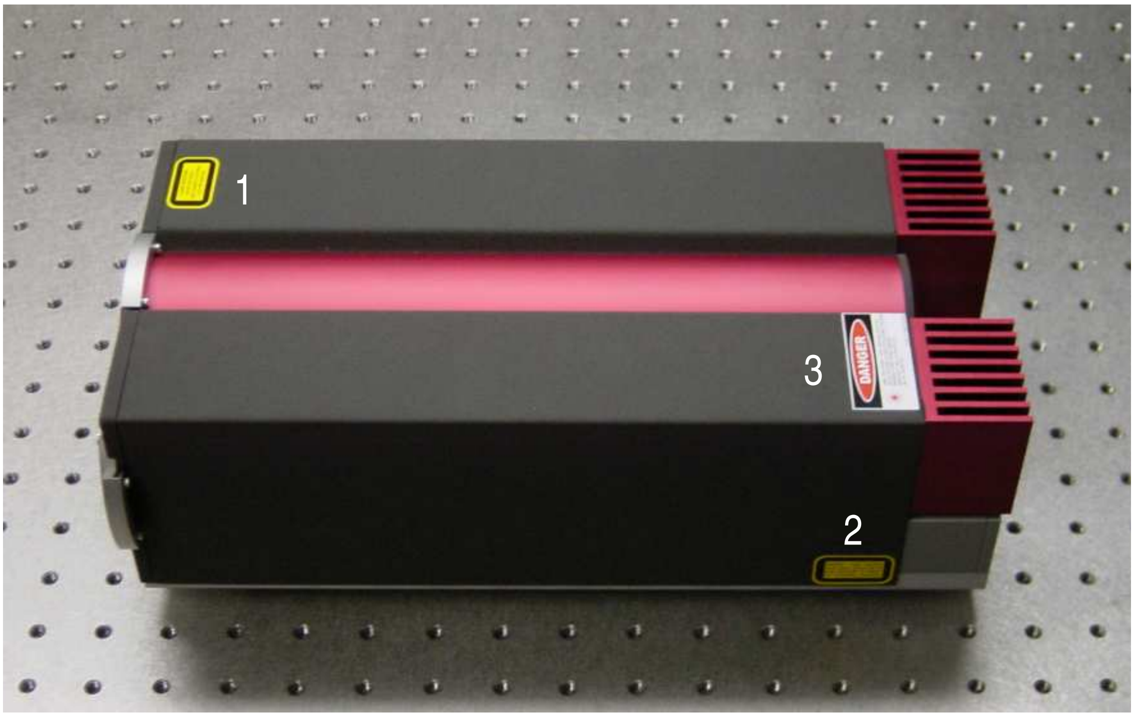
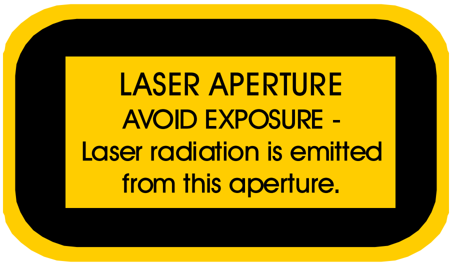
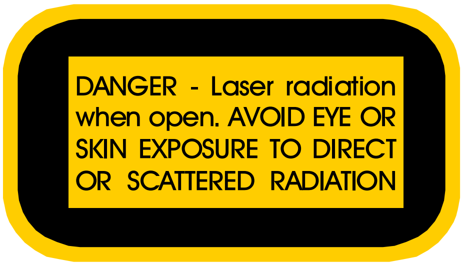


Figure 1.1: Positions of laser safety and aperture labels

Reproductions of the laser safety and aperture labels for lasers of the **Prometheus** Product Line are illustrated in the following Figure 1.2:



Label 1



Label 2

Label 3

Figure 1.2: Reproductions of laser safety and aperture labels

The maximum laser power level emitted from lasers of the **Prometheus** Product Line is 2 Watts at a wavelength of 1064 nm and 100 mW at a wavelength of 532 nm in continuous wave operation. The nominal laser output power levels for your laser model are given in the data sheet.

This laser product complies with the Federal Register 21 CFR 1040.10 Laser Safety Standard as applicable.

1.5 Servicing

There are no user replaceable parts inside the control electronics unit. Refer all servicing to qualified personnel or contact InnoLight GmbH.

1.6 Initial Activation

Read this manual carefully before operating the laser system !

The remote interlock connector must be installed at the rear panel of the control electronics unit (see Figure 2.3). It is installed when shipped. If it is not in place, the yellow *Interlock* LED on the front of the control electronics unit will glow and the unit will be inoperable.

2 The **Prometheus** Laser System

2.1 Introduction

The **Prometheus** laser system consists of two self-contained units, the laser head (see section 2.2) and the control electronics unit (see section 2.3). This manual is intended to provide some more detailed information on how to operate these devices properly.

Essentially the laser head consists of four components: One or two (depending on model) diode laser(s) which are electrically driven and provide the pump radiation for the monolithic Nd:YAG laser crystal. Some optics are required to focus the pump light into the Nd:YAG laser's fundamental mode. The infrared radiation of the monolithic Nd:YAG laser at 1064 nm is focused into a nonlinear crystal to generate the second harmonic wavelength at 532 nm. The visible radiation at 532 nm is then separated by suitable optics. Therefore, the **Prometheus** laser series can provide dual frequency output at both the fundamental and the second harmonic wavelength, phase-locked to each other.

Optionally, a fraction of the generated Nd:YAG laser light is focused onto a photo detector to analyze variations of the emitted radiation. This signal, appropriately filtered and amplified by an electronic SMD board mounted inside the laser head, is fed to the diode laser pump source. Activating this feedback loop, the Nd:YAG laser's intensity noise is suppressed by a large amount close to the fundamental limit set by quantum noise (see section 4.6).

In order to operate the **Prometheus** laser system, the control electronics unit needs to be connected to the laser head. The provided electrical power is converted into coherent narrow bandwidth radiation with an efficiency of about 30 %. The remaining power heats the diode laser, which must be cooled to prevent overheating. Furthermore, the wavelength of the diode laser depends on the junction temperature. Therefore, temperature stabilization of the diode laser is essential. The wavelength of the Nd:YAG laser light also depends strongly on the crystal temperature, consequently the Nd:YAG laser crystal must be temperature stabilized as well. The control electronics unit is designed to provide all required subsystems to drive and control the **Prometheus** laser system**,** featuring:

- a *Laser Diode Driver* that provides a very stable, low noise injection current to the diode lasers up to a value of 3 A. This subsystem also contains the protection circuitry that is essential for reliable operation of the laser system (see sections 5.4 and 5.5) and a temperature controller that regulates the diode laser temperature.

- a *Precision Temperature Controller* that stabilizes the Nd:YAG crystal's temperature. Because of an integrated pre-stabilization stage, typical drifts of this controller are only a few 100 μK / min, corresponding to a variation of the laser frequency of less than 1 MHz / min.

- a *Precision Temperature Controller* that stabilizes the nonlinear crystal's temperature, required for efficient second harmonic generation (SHG).

- analog modulation inputs (BNC connectors) for diode laser current, laser crystal, and doubling crystal temperature to externally control output power, laser frequency and doubling efficiency of the **Prometheus** laser system.

- a diagnostics connector (D-Sub connector) to monitor all vital signals and voltages of the **Prometheus** laser system without opening the control electronics unit.

2.2 Prometheus Laser Head

The dimensions of a laser head of the **Prometheus** Product Line are illustrated in the following Figure 2.1. The infrared laser beam is emitted from the laser aperture in the middle of the front side, the visible laser beam is emitted from the second laser aperture. Both apertures can be closed individually with a mechanical shutter.

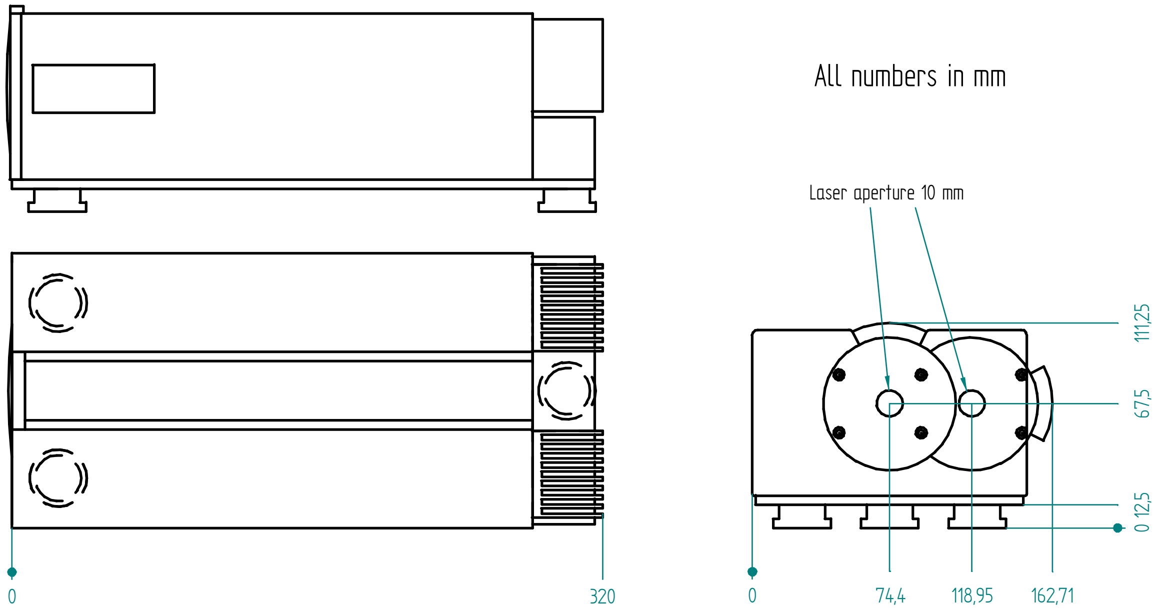


Figure 2.1: Dimensions of the **Prometheus** laser head

At the rear side of the laser head, a 37 pin D-Sub connector and a BNC connector are located. While the D-Sub laser connector (see section 6.1) is used to connect the laser head with the control electronics unit, the BNC connector can be used to apply a high voltage signal in the range –100 V to +100 V to a PZT element on the laser crystal for fast tuning of the laser frequency (see section 4.2).

The following section illustrates the front and rear panels of the control electronics unit. The power ratings illustrated in Figure 2.3 are just one possible configuration to be used e.g. in Western Europe.

2.3 Control Electronics Unit

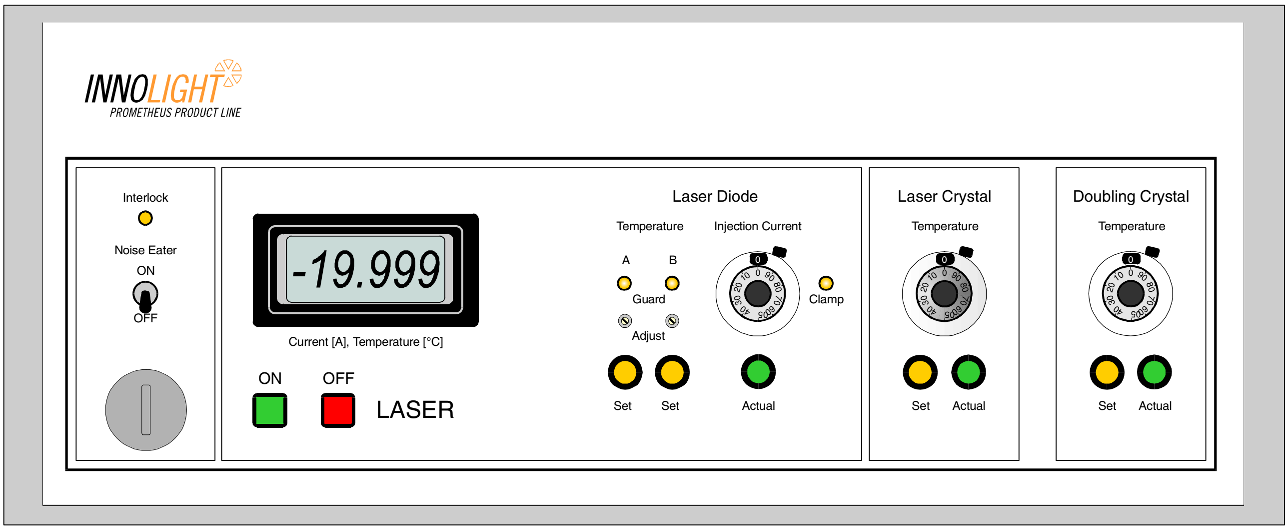


Figure 2.2: Front panel of the **Prometheus** control electronics unit

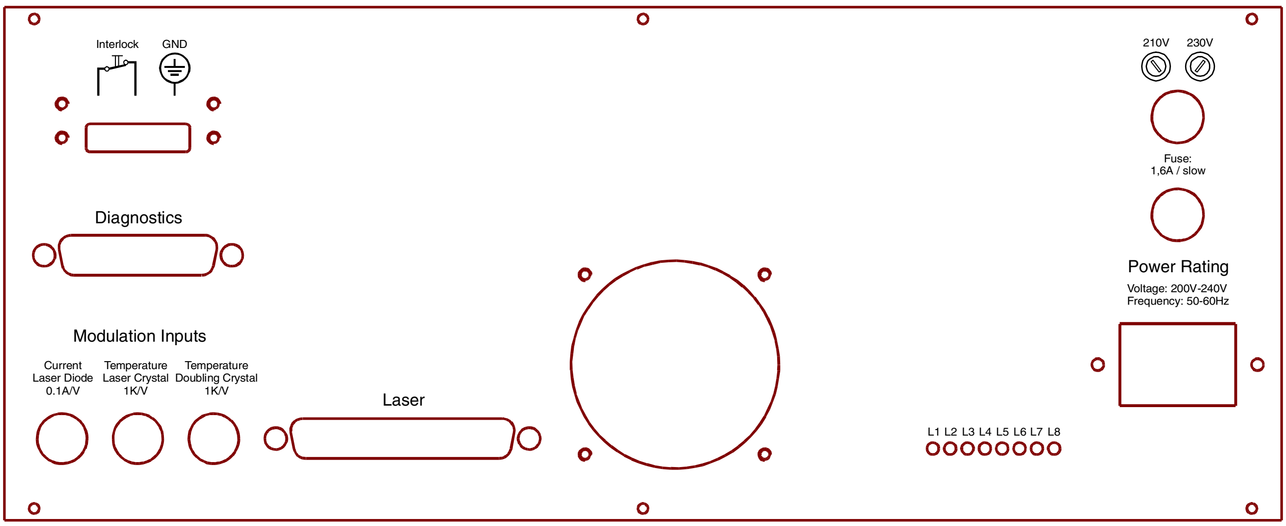


Figure 2.3: Rear panel of the **Prometheus** control electronics unit

The pin configuration of the laser and diagnostics connectors as well as the voltage indicators (L1-L8) are described in section 6.

3 Operating the **Prometheus** Laser System

3.1 Diode Laser Safety Precautions

Diode lasers are very sensitive devices. They consist of semiconductor material, consequently they should not be overheated. For laser operation a resonator is required, in most diode lasers (including these high power lasers) the crystal end faces serve as the resonator mirrors. Therefore, these surfaces need to be perfectly plain and clean. This is normally accomplished by cutting the semiconductor wafer along a crystal plane and by hermetically sealing the case protecting the laser from the environment. The crystal end faces are very sensitive to transient current fluctuations. Even short spikes (shorter than 1 ns) with peak current larger than the normal operation current will build up an excessively intense photon field inside the resonator, destroying the crystal surface. In this event only spontaneous emission remains, the laser behaves like an ordinary LED. As a consequence, the laser has to be protected against current spikes. In the **Prometheus** system, this is accomplished by a sophisticated electronic protection circuitry.

Static charge is also a well known killer of diode lasers. For this reason, the connections of the diode laser should always be shorted, if not in operation. When the laser head is not connected to the electronics unit, a built-in relay shorts the diode pins. After the control electronics unit is connected and switched on, the relay opens the short circuit when the signal power supply reaches its nominal value, ensuring proper operation of the driver circuitry. The driver is still in the inactive mode, and a power MOS-FET shorts the diode laser. Switching the unit into the active mode, the MOS-FET becomes nonconductive and the driver starts working.

If the signal power drops below its nominal value (e.g. caused by mains failure) the driver switches back to the inactive mode. This happens ***before*** the relay shorts the diode laser, so that mechanical ringing of the relay cannot cause any current spikes.

For further protection of the diode laser, a current limiting circuitry is included. The *Injection Current* is restricted to the range from zero to the internally set current limit. It is not possible to exceed this current limit with the dial on the front panel. Theoretically, this could be achieved by applying a positive voltage to the power modulation input at the back panel of the electronics unit. However, in this case, the yellow *Clamp* LED at the front panel of the control electronics unit will glow, and the actual *Injection Current* will ***not*** go beyond the internally set current limit.

To prevent the diode lasers from overheating, the control electronics unit contains a *Temperature Guard* that monitors deviations between the *Set Temperature* and the actual diode laser temperature and switches the driver into inactive mode in case of overheating (see Section 5.4).

3.2 Installing the Prometheus Laser System

Before connecting the power cord, verify that the line voltage setting on the reverse side of the power supply agrees with your local line voltage. If your laboratory environmental features an interlock switch that remains off under unsafe conditions, connect it to the left two pins of the three-pole screw-type connector at the rear of the unit (see Figure 2.3). For activating the diode driver, these pins have to be shorted. You can use the right hand pin to ground the unit, e.g. by connecting it to the metal laboratory breadboard.

For mounting the **Prometheus** laser head on an optical table or a breadboard, use the three holding forks to fix the three pedestals. Further clamping or squeezing of the laser head is not recommended, as it may cause temporary misalignments of the optics inside. The laser head should be mounted with free surroundings.

The two units of the **Prometheus** laser system, the laser head and the control electronics unit, are to be connected only by using the suitable cable shipped with the laser system.

Caution:
Before connecting the two units, make sure the control electronics unit is switched off.

3.3 Turning the Laser on and off

For proper operation of the **Prometheus** laser system, the following activation sequence is recommended. All controls mentioned are located on the front panel of the control electronics unit (see Figure 2.2):

1. Use the main key switch to turn on the unit. The red *OFF* button will glow and the fan will be operating.

2. Make sure, the yellow *Interlock, Guard,* and *Clamp* LEDs are not glowing.

3. Check the *Set Temperature* of the diode laser(s) by pushing the *Set* button(s) in the section *Laser Diode*. Compare the values with those given in the data sheet of the laser.

4. Check the *Set Temperature* of the Nd:YAG laser crystal by pushing the *Set* button in the section *Laser Crystal*. The correct operation temperature depends on your requirements and may be around 25 °C (consider recommendations in section 3.4).

5. Check the *Set Temperature* of the nonlinear crystal by pushing the *Set* button in the section *Doubling Crystal*. Compare the value with the one given in the data sheet of the laser. The correct value depends on the phase-matching condition and may be around 30 – 40 °C

6. Allow about 60 seconds for the temperature controllers to stabilize.

7. Make sure that the 10-turns dial of the *Injection Current* is in its zero position.

8. Choose the *Actual* injection current to be displayed at the monitor by pushing the green button in the section *Laser Diode*.

9. Activate the diode driver by pressing the green *ON* button. The button will glow green.

10. Increase the *Injection Current* until the desired value is displayed at the monitor (see data sheet).

11. The precise value for the nonlinear crystal temperature depends on the Nd:YAG laser crystal temperature and might have to be adjusted when changing the laser frequency by temperature variation of the Nd:YAG crystal. Optimize the setting by monitoring the power of the generated green radiation.

Go through the following steps to switch off the **Prometheus** laser system:

1. Decrease the *Injection Current* to 0 mA.

2. Deactivate the diode driver by pressing the red *OFF* button. The button will glow red.

3. Switch the unit off with the main key switch.

The control electronics unit features a soft-start that smoothly increases / decreases the laser diode's current if the *LASER ON / OFF* buttons are pressed. Because of the limited heat conductivity inside the diode laser's heat sink, a rapid increase of the injection current has to be avoided.

Caution:
Lasers may be damaged by improper setting of the current controls or by improper use of the modulation inputs. Check line voltage setting before connecting power.

3.4 Recommended Operation

The laser head as well as the control electronics unit should not be operated in an environment warmer than 25 °C, which would result in a lot of stress for the electronic and diminished operation efficiency of the laser.

The laser head contains several optical components which are carefully aligned for best performance. Therefore, the laser head should be handled very carefully; any mechanical shock is hazardous ! Misalignment will cause the optical power to decrease and should not be cured by the operator ! Check the output power using a power meter.

In the case of low optical output power or poor beam quality, please contact InnoLight GmbH immediately. Do not attempt to fix the problem on your own!

When mounting the laser head, any mechanical stress inside the case can cause temporary misalignment of the optics. Thus clamping or even squeezing the case is not recommended.

Warning:
Be aware that the laser might disturb equipment that is sensitive to magnetic fields.

Be careful when operating the laser head in humid environment. Condensation of water must be strictly avoided, since the optics cannot be cleaned by the operator.

Caution:
The *Set Temperature* of the Nd:YAG crystal should never be more than 5 °C below room temperature. Under humid conditions, only operation above room temperature is recommended.

Warning:
Keep in mind that an hazardous amount of invisible or visible laser radiation might be diffracted in any direction!

Warning:
Always wear suitable laser goggles to protect your eyes!

3.5 Trouble Shooting

The control electronics unit for the **Prometheus** laser system includes a sophisticated safety circuitry to protect the diode lasers against current spikes or overheating and switches the diode driver into inactive mode in case of problems. This is indicated by the yellow LEDs at the front panel of the control electronics unit. Check for the following possible causes:

- *Interlock*

  Diagnosis: The two pins of the Interlock connector at the rear panel of the control electronics (see Figure 2.3) are not connected.

  Reaction: Short the two pins of the Interlock connector or check the Interlock switch in your laboratory.

- *Guard*

  Diagnosis: The temperature controller is not able to stabilize the diode laser temperature at the given value.

  Reaction: Try to increase the set temperature for the diode laser slightly using the trimmer at the front panel of the control electronics unit, especially if it is set below room temperature. Otherwise contact InnoLight GmbH.

- *Clamp*

  Diagnosis: The injection current of the diode lasers is driven above its internal limit.

  Reaction: Reduce the injection current by about 50 mA using the dial at the front panel of the control electronics unit or reduce the voltage at the power modulation input at the rear panel of the control electronics unit. (see section 2.3)

The presence of all supply voltages required for reliable operation of the **Prometheus** laser system is indicated by a set of LEDs at the rear panel of the electronics unit (see Figure 2.3).

If any of the LEDs L1 to L8 is not glowing, the corresponding supply voltage is not present (see section 6.3) and the laser system will not work properly. In that case contact InnoLight GmbH.

4 Laser Specifications

The general specifications apply to all continuous wave (cw) lasers of the **Prometheus** Product Line and are summarized in the following Table 4.1:

General specifications:	
Beam quality	TEM_{00} (M^2 <1,1)
Beam roundness [%]	1,1
Thermal tuning coefficient [GHz/K]	-6
Thermal tuning range [GHz]	60
Thermal response bandwidth [Hz]	1
PZT tuning coefficient [MHz/V]	>2
PZT tuning range [MHz]	± 200
PZT response bandwidth [kHz]	100
Emission spectrum	single-frequency
Spectral linewidth [kHz/100 ms]	1
Coherence length [km]	>1
Frequency drift [MHz/min]	2
Relative Intensity Noise, RIN [dB/Hz]	<-90
Noise eater option, RIN [dB/Hz]	<-140
Intensity noise, 10 Hz to 2 MHz [% rms]	< 0,1
Waist location (inside laser head) [mm]	125
Laser head size, w · h · d [cm]	14,9 · 11,1 · 32,0
Laser head weight [kg]	3,5
Standard electronics size, w · h · d [cm]	35 · 14 · 34
Standard electronics weight [kg]	10

Table 4.1: General specifications of the **Prometheus** Product Line

The individual specifications of the different laser models of the **Prometheus** Product Line are summarized in the following Table 4.2:

Model specifications:	
Prometheus, power @ 532 nm [mW]	5, 20, 50, 100
Prometheus, power @ 1064 nm [mW]	> 500

Options:

NE (Noise Eater)

Table 4.2: Model specifications of the **Prometheus** Product Line

Some of the laser specifications and the available options of the **Prometheus** Product Line are illustrated in the following sections.

4.1 Beam Quality

The following Figure 4.1 illustrates a typical beam quality measurement of a **Prometheus** laser operating at 532 nm. The laser beam is focused with a lens and the beam radius of the caustic is measured at various distances with a laser beam analyzer.

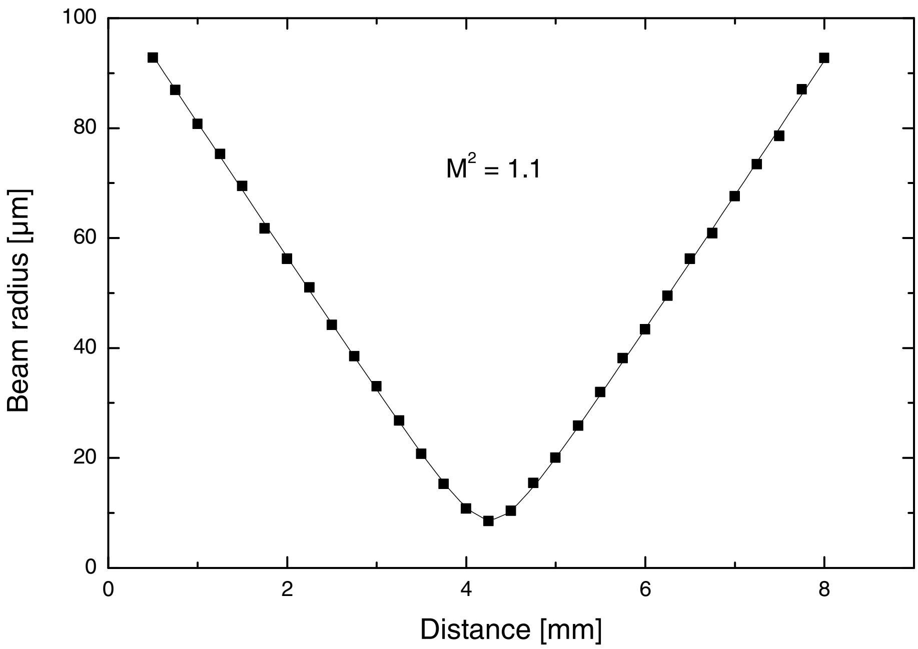


Figure 4.1: Beam quality measurement of a **Prometheus** laser

The filled squares represent the measurement points while the solid line is a theoretical calculation with the beam quality factor "M^2" as fitting parameter. Using the least error squares approach for determining the fitting parameter, an "M^2" factor of 1.1 is obtained. Hence, the output beam of the laser is 1.1 times "diffraction limited".

4.2 Frequency Tuning Capabilities

The frequency of the **Prometheus** laser can be tuned by changing the temperature of the monolithic laser crystal. This can either be done directly at the front panel of the control electronics unit using the appropriate dial (see Figure 2.2) or by applying a voltage to the frequency modulation input at rear panel of the control electronics unit (see Figure 2.3).

The typical tuning characteristic of a **Prometheus** laser operating at 532 nm is shown in the following Figure 4.2. The filled dots represent operation on a single longitudinal frequency, while the open dots indicate the mode-hops, where the laser frequency changes from one longitudinal mode to the next.

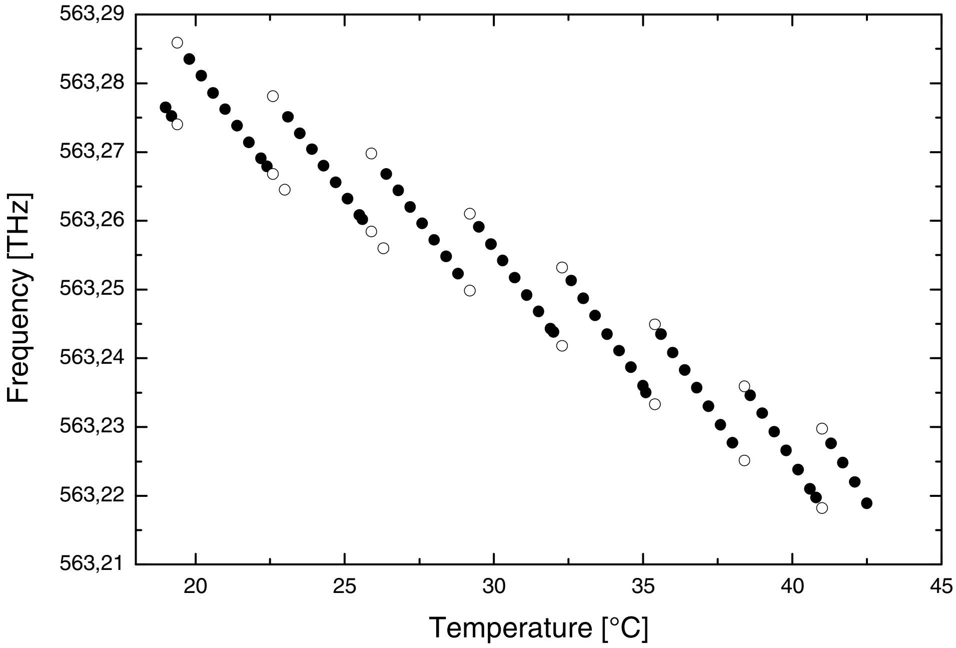


Figure 4.2: Typical frequency tuning by crystal temperature of a **Prometheus** laser at 532 nm

As can be seen, the laser frequency can be tuned continuously by 12 – 16 GHz between the mode-hops, covering an overall frequency tuning range of more than 60 GHz. The thermal tuning coefficient at 532 nm is about –6 GHz / °C. However, due to the large time constants of the thermal tuning, the response bandwidth is limited to fractions of a Hertz.

A number of well characterized absorption lines in iodine is accessible with the **Prometheus** laser system as illustrated in the following Figure 4.3:

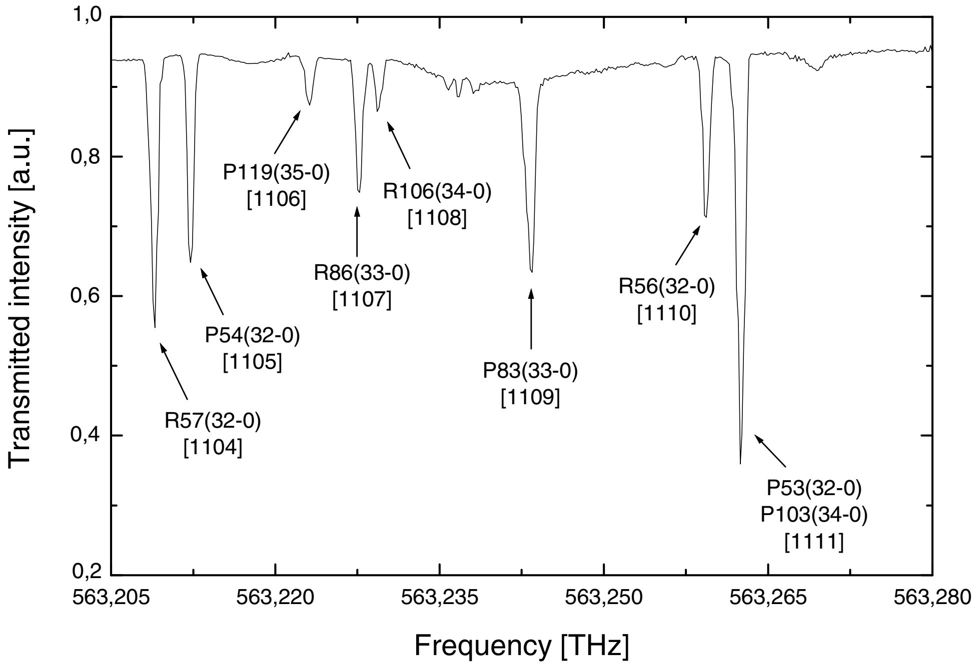


Figure 4.3: Absorption lines in molecular iodine accessible with a **Prometheus** laser system

Fast frequency tuning of a **Prometheus** laser can be achieved by applying a high voltage signal in the range of –100 V to +100 V to a PZT crystal element on the laser crystal, using the BNC connector at the rear side of the laser head (see Figure 2.1). Higher voltages will misalign the laser cavity or even destroy the PZT crystal. Especially RF signals will heat up the PZT and damage it.

Depending on the actual laser crystal and the modulation frequency, the PZT tuning coefficient is about 2 to 4 MHz / V at 532 nm with a response bandwidth of about 100 kHz. The combination of the slow temperature tuning with a large range and the fast tuning with a high bandwidth is ideally suited for stabilizing the laser frequency to reference cavities or molecular absorption lines.

4.3 Emission Spectrum

A common feature of all models of the **Prometheus** Product Line is the reliable emission on a single longitudinal frequency. This can be investigated using an optical spectrum analyzer like a confocal Fabry Perot interferometer (FPI) as illustrated in the following Figure 4.4. The free spectral range (FSR) of the device was 2 GHz as indicated:

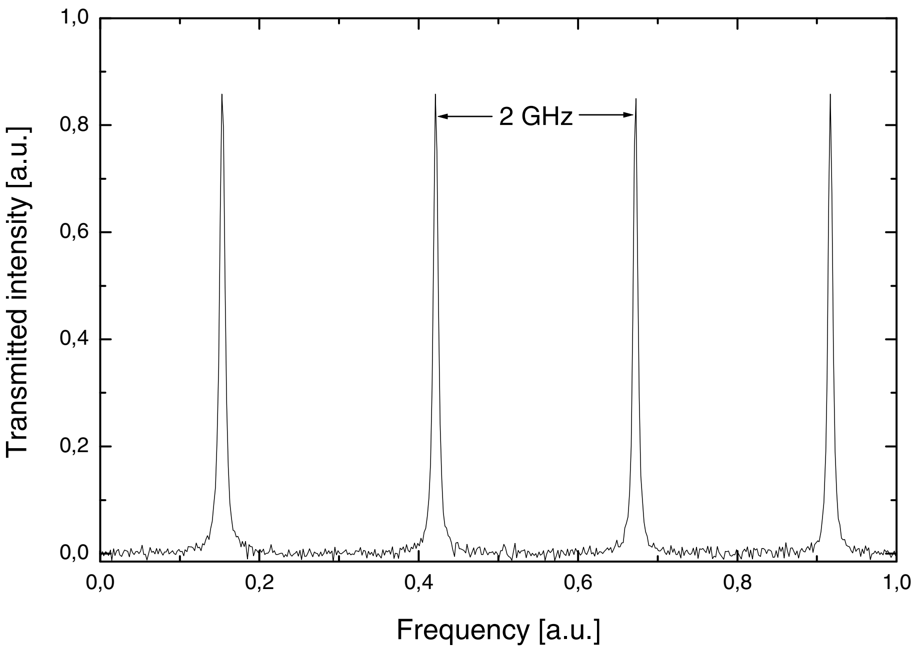


Figure 4.4: Emission spectrum of a **Prometheus** laser using a scanning Fabry Perot interferometer (FPI)

The absence of any peaks between the main resonances of the interferometer clearly indicates the operation on a single longitudinal frequency. Hence, the **Prometheus** laser system resembles the optical equivalent of a quartz oscillator in the frequency range of nearly 600 THz, providing the required precision for applications like interferometry, holography or spectroscopy.

4.4 Spectral Linewidth

Another important feature of the **Prometheus** Product Line is the extremely small spectral linewidth of the laser due to the monolithic cavity. An upper limit for the intrinsic spectral linewidth of such a laser can be obtained by optically heterodyning two identical lasers and analyzing the beat signal with a spectrum analyzer as illustrated in the following Figure 4.5:

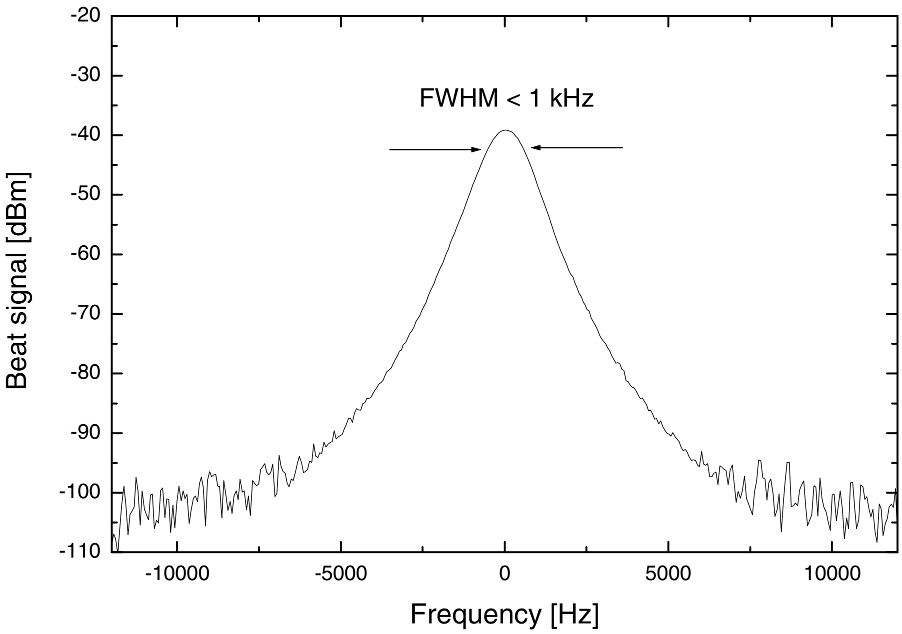


Figure 4.5: Heterodyne beat signal of two identical **Prometheus** lasers,

using the fundamental light at 1064 nm

The typical full width at half maximum (FWHM) or –3 dB linewidth derived from such a measurement is about 1 kHz, giving an upper limit for the intrinsic spectral linewidth of the two individual lasers, limited by the spectral resolution bandwidth of the measurement system.

The combination of reliable single longitudinal frequency operation at nearly 600 THz with an extremely small linewidth of less than 1 kHz is the key feature for using lasers of the **Prometheus** Product Line as optical length and frequency standards.

4.5 Frequency Drift

As the frequency of a **Prometheus** laser at 532 nm can be tuned with a large temperature tuning coefficient of more than 6 GHz per degree (see section 4.2), temperature controllers with micro-kelvin stability are required to obtain a high frequency stability and a low frequency drift of the free running laser. This can be investigated, again by optically heterodyning two identical single-frequency lasers, one actively stabilized to a reference cavity or a molecular absorption line, the other one just passively stabilized.

The following Figure 4.6 illustrates such a beat frequency measurement using the fundamental laser light at 1064 nm of two identical **Prometheus** lasers with a precision frequency counter over a period of three hours:

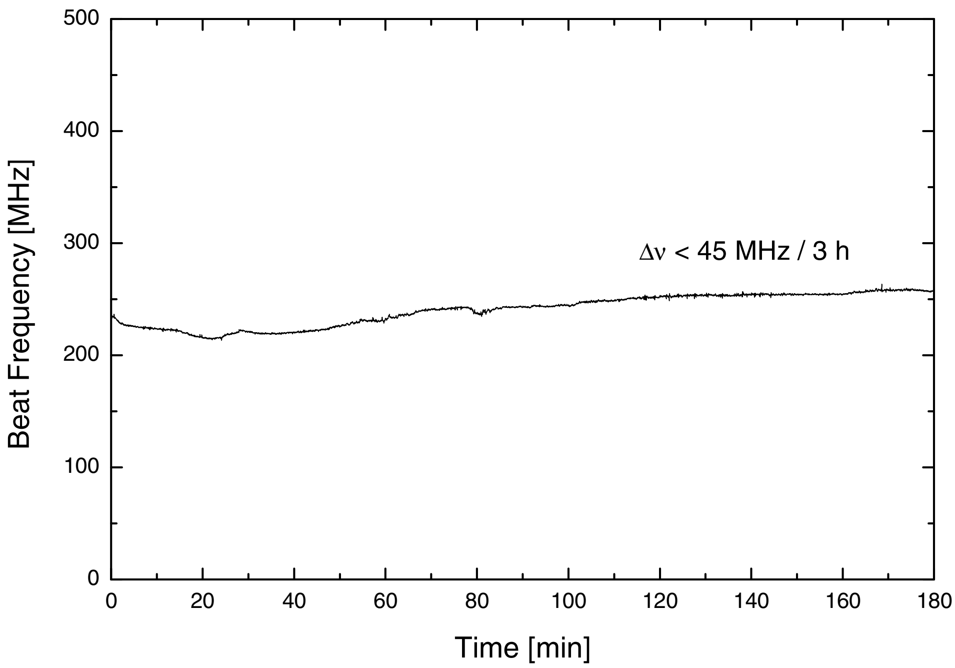


Figure 4.6: Frequency drift of a free running **Prometheus** laser against a stabilized reference system,

using the fundamental laser light at 1064 nm

The resulting frequency variation of the free running laser over the full period is less than 45 MHz for the fundamental wavelength at 1064 nm, corresponding to a relative frequency stability of about $1.6 * 10^{-7}$. If a higher frequency stability is required for a certain application, the **Prometheus** Product Line provides the necessary inputs for active frequency stabilization to reference cavities or molecular absorption lines (see section 4.2).

4.6 Relative Intensity Noise (RIN)

Optionally, all lasers of the **Prometheus** Product Line can be equipped with an integrated intensity noise reduction system. This option reduces intensity fluctuations of the laser beam by several orders of magnitude. These fluctuations are largely due to a phenomenon called relaxation oscillations, owing to the ability of the laser's energy to oscillate between atomic level population and laser cavity field.

The spectrum of these fluctuations resembles the spectral behavior of a white-noise-excited classical oscillator, featuring a large peak and a significant amount of low frequency noise as illustrated in the trace "Free running" of the following Figure 4.7:

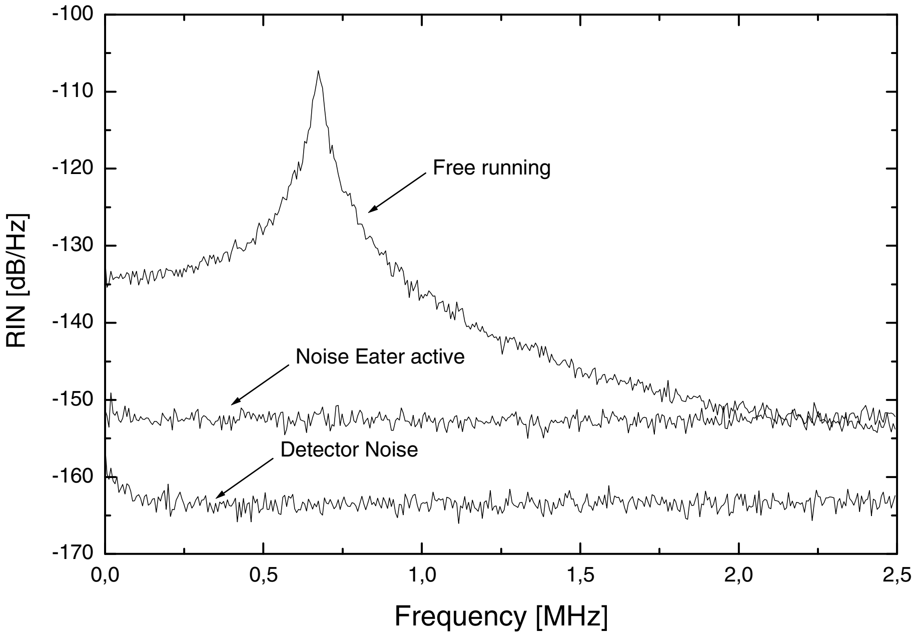


Figure 4.7: Relative Intensity Noise measurements of a **Prometheus** laser with and without

Noise Eater option, using the fundamental laser light at 1064 nm

Both these spectral components can be significantly reduced by using the *Noise Eater* option as illustrated by the trace "Noise Eater active" in Figure 4.7. To achieve this, a fraction of the generated Nd:YAG laser light, transmitted through a mirror, is focused onto a photo detector to analyze the variation of the generated output power. This signal, appropriately filtered and amplified by an electronic SMD board, is fed to the diode laser current to stabilize the output power.

Activating this feedback loop by the switch at the front panel of the control electronics unit (see Figure 2.2), the Nd:YAG laser's intensity noise above a few 100 Hz is suppressed by up to 40 dB. The noise level is moved somewhat into the proximity of the quantum noise limit.

5 Standard Accessories

5.1 Laser Frequency Modulation

By applying an analog voltage signal in the range –10 V to +10 V to the modulation input labeled "Temperature Laser Crystal", using the BNC connector at the rear panel of the control electronics unit (see Figure 2.3), the temperature of the laser crystal can be changed by +1 K / V, corresponding to a frequency change of about –3 GHz / V at 1064 nm and –6 GHz / V at 532 nm, respectively. Due to the large time constants of the thermal tuning, the response bandwidth is limited to fractions of a Hertz.

5.2 Output Power Modulation

By applying an analog voltage signal in the range –10 V to +10 V to the modulation input labeled "Current Laser Diode", using the BNC connector at the rear panel of the control electronics unit (see Figure 2.3), the injection current of the diode lasers used to pump the laser crystal can be modulated by 0.1 A / V. The response bandwidth of this modulation input is limited to about 5 kHz.

5.3 Doubling Crystal Temperature Modulation

By applying an analog voltage signal to the modulation input labeled "Temperature Doubling Crystal", using the BNC connector at the rear panel of the control electronics unit (see Figure 2.3), the temperature of the doubling crystal can be changed by +1 K / V. This can be used e.g. in a feedback loop to actively stabilize the frequency doubled output power.

5.4 Temperature Guard

Failure to regulate the temperature of the diode lasers will result in diminished performance and lifetime. Hence, to ensure long term operation of the diode lasers, the **Prometheus** laser system is equipped with an integrated *Temperature Guard* that monitors deviations between the *Set temperature* and the *Actual temperature* of the *Laser Diode Driver*. It protects the laser diodes against failure by switching the driver into inactive mode in case of any deviation between the two values for more than 1 minute. This is indicated by the *Guard* LED at the front panel of the control electronics unit (see Figure 2.2).

5.5 Safety Interlock

If your laboratory environment features an interlock switch that remains off under unsafe conditions, connect it to the left two pins of the three-pole screw-type connector at the rear of the unit. For activating the diode laser driver, these pins have to be shorted. The **Prometheus** laser system is shipped with a jumper installed. The present status of the *Interlock* is indicated by a yellow LED at the front panel of the control electronics unit (see Figure 2.2). If the *Safety Interlock* is activated, e.g. by disconnecting the two pins, the LED glows and the *Laser Diode Driver* will switch into inactive mode.

6 Pin Configurations

6.1 Laser Connector

The two units of the **Prometheus** laser system, the laser head and the control electronics unit, are to be connected only with a suitable cable, shipped with the laser system. The following Figure 6.1 illustrates the 37 pin D-Sub connector at the rear panel of the control electronics unit:

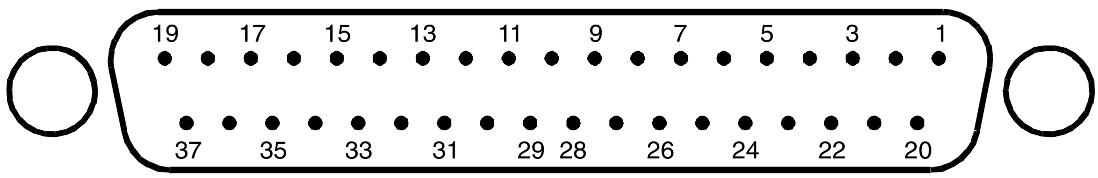


Figure 6.1: Laser connector (37 pin D-Sub) at the rear panel of the control electronics unit

The description of the individual pins of the laser connector is given in the following Table 6.1:

Pin	Description
1	Diode laser cathode
2	Diode laser 1, TEC anode
3	Diode laser 1, TEC cathode
4	Diode laser 2, TEC anode
5	Diode laser 2, TEC cathode
6	Laser crystal, TEC anode
7	Laser crystal, TEC cathode
8	Doubling crystal, TEC anode
9	Doubling crystal, TEC cathode
10	Diode laser 1, monitor diode, cathode
11	Diode laser 1, monitor diode, anode
12	Laser crystal, NTC reference voltage 6,85 V
13	Laser crystal, NTC ground
14	Doubling crystal, NTC ground
15	Diode laser 1, NTC reference voltage 6,85 V
16	Diode laser 1, NTC ground
17	Diode laser 2, NTC ground
18	n/c
19	n/c
20	Diode laser anode
21	Supply voltage +12 V
22	Relay, negative supply voltage
23	GND
24	Relay, positive supply voltage
25	Supply voltage -12 V

Pin	Description
26	Noise Eater, monitor
27	Noise Eater, switch
28	n/c
29	Diode laser 2, monitor diode, cathode
30	Diode laser 2, monitor diode, anode
31	Doubling crystal, NTC reference voltage 6,85 V
32	Interlock
33	GND
34	Diode laser 2, NTC reference voltage 6,85 V
35	n/c
36	n/c
37	n/c

Table 6.1: Pin description of the laser connector

6.2 Diagnostics Connector

All vital information about the status of the **Prometheus** laser system can be monitored without opening the control electronics unit, using the diagnostics connector. The following Figure 6.2 illustrates the 25 pin D-Sub connector at the rear panel of the control electronics unit:

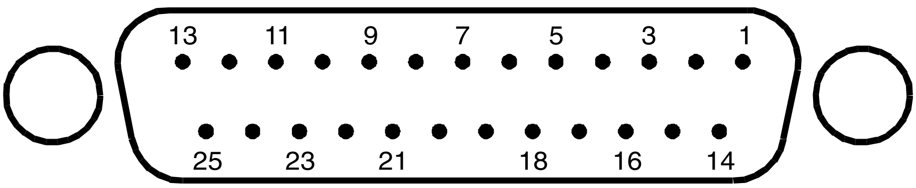


Figure 6.2: Diagnostics connector (25 pin D-Sub) at the rear panel of the control electronics unit

The description of the individual pins of the diagnostics connector of the control electronics unit is given in Table 6.2:

Pin	Description
1	Diode laser 1, power monitor, 1 V / W
2	Diode laser 2, power monitor, 1 V / W
3	Laser crystal, TEC error signal, 10 V / °C
4	Doubling crystal, TEC error signal, 10 V / °C
5	n/c
6	Diode laser 1, TEC error signal, 10 V / °C
7	Diode laser 2, TEC error signal, 10 V / °C
8	Diode laser 1, temperature guard
9	Diode laser 2, temperature guard
10	n/c
11	n/c
12	Noise Eater, monitor
13	Interlock
14-25	GND

Table 6.2: Pin description of the diagnostics connector of the control electronics unit

6.3 Supply Voltage Indicators

In order to quickly check the presence of all supply voltages required for reliable operation of the **Prometheus** laser system without opening the control electronics unit, they are indicated by a set of 8 LEDs at the rear panel of the control electronics unit (see Figure 2.3). The description of the indicators is given in the following Table 6.3:

LED	Description
L1	Negative supply voltage, temperature controllers
L2	Positive supply voltage, laser crystal temperature controller
L3	Positive supply voltage, diode laser 2 temperature controller
L4	Positive supply voltage, diode laser 1 temperature controller
L5	Supply voltage, diode lasers
L6	Supply voltage, noise eater
L7	Negative supply voltage, electronics
L8	Positive supply voltage, electronics

Table 6.3: Description of the supply voltage indicators at the rear panel of the control electronics unit

7 Warranty

InnoLight GmbH gives a 24 months warranty on its products, excluding the diode laser pump sources. The warranty period on the diode laser pump sources is 6 months. The warranty shall not cover any damage incurred during shipping. When the product is received by the customers, the shipping container and its content should be inspected for any damage incurred during shipping. In order to obtain service under this warranty, the customer must notify InnoLight GmbH of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. In all cases the customer will be responsible for properly packaging and shipping the product back to InnoLight GmbH, with shipping charges prepaid. If the product is not properly packed, it will be damaged in shipping and the warranty will be voided.

This warranty shall not apply to any defect, failure, or damage caused by improper use, failure to observe proper operating procedures per the product specifications (see section 3), or improper / inadequate maintenance. InnoLight GmbH shall not be obligated to furnish service under this warranty 1) to repair damage resulting from attempts by personnel (other than InnoLight GmbH's representatives) to repair or service the product; 2) to repair damage resulting from improper use or connection to incompatible equipment; 3) to repair damage resulting from operation outside of the operating environmental specifications of the product; 4) to repair damage resulting from improper packaging of the product in order to return it to InnoLight GmbH.

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