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U S E R   M A N U A L

# LightHUB<sup>®</sup> ULTRA



The logo consists of a stylized blue wave-like graphic above the word "LightHUB" in a bold, sans-serif font. A small registered trademark symbol (®) is located at the top right of the "B".

## Imprint

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## Safety Rules



### WARNING!

**Read the safety precautions in this section before installing, powering, operating or servicing this product.**

## Symbols used in this manual

The following symbols are used to identify important safety information



**WARNING! Laser emission is possible. Assure laser safety precautions.**



**CAUTION: Special attention to this point is necessary to meet health regulations and to avoid damage.**



An important note to ensure an unproblematic operation.

## Important safety information

Before operating the LightHUB® ULTRA laser system, read the manual carefully to prevent damages to human persons or animals, integrated devices and connected devices.

Always follow the local or IEC-safety rules (IEC60825-1) during the operation of the system.



**WARNING: The laser system emits visible or invisible continuous laser radiation. The system is variably equipped with different laser diodes and different output power.**

**The laser product classifications are:**

- CLASS 3B laser product, for up to 100/500mW output-power
- CLASS 4 laser product, for up to 1W output-power

**The classifications are evaluated and tested under worst case conditions. Laser diode based lasers are able to output 10x higher output-power under worst case conditions, comparing to the normal operating condition. Avoid exposure of the laser beam or stray laser light to the eyes and the skin!**

Be aware of the laser safety rules and pay attention to the following points:

- Do not look at any laser light directly or through optical lenses.
- Installation of a special working area for the laser is recommended, which only gives access to special trained and as far as laser safety goes, instructed persons.
- Warning labels have to be perceptibly placed at all entries of the area the laser is installed and running.
- Wherever it is possible, the beam should be sheathed by a tube, to prevent direct access to the laser beam.
- The working area of the laser should be shielded to prevent uncontrolled escape of the laser beam. After passing the experimental / working area the beam must be blocked by an appropriate target, which absorbs the laser light.
- The laser beam should not run at eye level.
- Wear appropriate safety glasses to prevent light from entering the eye, even reflections from any surfaces.

Notes for the LightHUB® ULTRA laser system about different laser diodes and wavelengths:

- The LightHUB® ULTRA laser system is available in different wavelengths and power levels. The laser class has to be re-classified after any modification and changes to the system. Do not make any other modification to the LightHUB® ULTRA laser system than specified in here.
- Beware of the different safety rules regarding the different safety classes.

Notes about the electrical safety:

- The LightHUB® ULTRA laser system comes with the build in power supply. The electrical units should not be operated in hazardous environment.
- Always check for loosen connectors or wires.
- Do not touch any not isolated (due to damage) electrical parts, beware of electrical shock.
- Always check fixed cable connections.

**CAUTION for OEM-usage:**

The LightHUB® ULTRA laser system is also available as an OEM-product. Then it is only for usage in systems such as customer designs. Then the customer has to include the laser system in the safety-interlock chain and main key-control and laser-emission indication. The OEM-customer is responsible for a safe operation of the LightHUB® ULTRA laser CLASS 3B or CLASS 4 product. In any kind of OEM usage, the Interlock and safety shutter circuits must be evaluated and tested in the end-use application. We will be glad to give detailed assistance to our customer, if there are any questions in safe system integration.

## Laser warning and explanatory labels

The LightHUB® ULTRA laser system is designed as a laser class 3B or class 4 product. It complies with the rules of the IEC 60825-1 and with FDA performance standards for laser products except for deviations pursuant to Laser Notice No 50, dated June 24, 2007.



**ATTENTION: Do not look into the beam or into reflections of the beam from surfaces!**

When operating the laser under open environment installation, it may emit stray-light, which is a health hazard for the eyes and skin. Always wear protective eye-goggles according to the used laser wavelength. Avoid exposure of laser light to the skin and eye.



**CAUTION: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure!**

The following picture shows an example for a LightHUB® ULTRA system.



Figure 1: LightHUB® ULTRA laser system rear view

The following labels are fixed at the laser system next to the fibre output:

**1. Laser-warning sign (common):**



Size:	15 x 15mm
Colour:	yellow / black
Location:	front side, left side aperture

**2. Laser-warning and laser ray explanatory label:**

**Class 3B:**

For the **invisible-range (UV)**: Wavelength / output power:

	Size: 52 x 26mm	
	Colour: yellow / black	
	Location: top cover, front side	
375[nm] / 20[mW]	375[nm] / 70[mW]	395[nm] / 120[mW]

For the **visible-range (VIS)**: Wavelength / output power:

	Size: 52 x 26mm	
	Colour: yellow / black	
	Location: top cover, front side	
405[nm] / 20[mW]	405[nm] / 60[mW]	405[nm] / 120[mW]
405[nm] / 300[mW]	415[nm] / 120[mW]	425[nm] / 120[mW]
445[nm] / 50[mW]	445[nm] / 100[mW]	457[nm] / 100[mW]
460[nm] / 100[mW]	473[nm] / 20[mW]	473[nm] / 80[mW]
473[nm] / 100[mW]	488[nm] / 25[mW]	488[nm] / 60[mW]

488[nm] / 80[mW]	488[nm] / 100[mW]	488[nm] / 150[mW]
488[nm] / 200[mW]	505[nm] / 80[mW]	515[nm] / 20[mW]
515[nm] / 25[mW]	515[nm] / 80[mW]	515[nm] / 100[mW]
515[nm] / 150[mW]	532[nm] / 20[mW]	532[nm] / 50[mW]
532[nm] / 80[mW]	532[nm] / 100[mW]	532[nm] / 150[mW]
552[nm] / 20[mW]	552[nm] / 60[mW]	552[nm] / 80[mW]
552[nm] / 100[mW]	552[nm] / 150[mW]	561[nm] / 20[mW]
561[nm] / 50[mW]	561[nm] / 80[mW]	561[nm] / 100[mW]
561[nm] / 150[mW]	594[nm] / 20[mW]	594[nm] / 60[mW]
594[nm] / 100[mW]	633[nm] / 100[mW]	638[nm] / 40[mW]
638[nm] / 100[mW]	638[nm] / 150[mW]	638[nm] / 200[mW]
642[nm] / 140[mW]	647[nm] / 140[mW]	660[nm] / 130[mW]
685[nm] / 50[mW]		

For the **invisible-range (IR)**: Wavelength / output power:

	Size: 52 x 26mm				
	Colour: yellow / black				
	Location: top cover, front side				
705[nm] / 40[mW]	730[nm] / 40[mW]	785[nm] / 120[mW]			
785[nm] / 200[mW]	808[nm] / 140[mW]	830[nm] / 140[mW]			

#### Class 4:

For the **visible-range (VIS)**: Wavelength / output power: higher than 500mW

	Size: 52 x 26mm
	Colour: yellow / black
	Location: top cover, front side

For the **invisible-range (IR)**: Wavelength / output power: higher than 500mW



Size:	52 x 26mm
Colour:	yellow / black
Location:	top cover, front side

### 3. Identification of manufacturer explanatory label:



Size:	46 x 26mm
Colour:	silver / black
Location:	backside

### 4. FDA certification label:

Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No 50, dated June 24, 2007.

Size:	46 x 26mm
Colour:	silver / black
Location:	on the top cover at the front

## Table of contents

<b>IMPRINT .....</b>	<b>2</b>
<b>SAFETY RULES .....</b>	<b>3</b>
<b>SYMBOLS USED IN THIS MANUAL .....</b>	<b>3</b>
<b>IMPORTANT SAFETY INFORMATION.....</b>	<b>3</b>
<b>LASER WARNING AND EXPLANATORY LABELS.....</b>	<b>5</b>
<b>1. <u>INTRODUCTION .....</u></b>	<b>11</b>
<b>1.1 LIGHTHUB® ULTRA GENERAL DESCRIPTION AND KEY FACTS .....</b>	<b>11</b>
<b>2. <u>TECHNICAL DATA.....</u></b>	<b>12</b>
<b>2.1 WAVELENGTHS AND OUTPUT POWER CONFIGURATIONS .....</b>	<b>12</b>
<b>2.2 OPTICAL AND ELECTRO-OPTICAL SPECIFICATIONS .....</b>	<b>13</b>
<b>2.3 OPERATING MODES AND SIGNAL SPECIFICATIONS .....</b>	<b>14</b>
<b>2.4 DIMENSIONS AND WEIGHT .....</b>	<b>15</b>
<b>2.5 ELECTRICAL SUPPLY AND INTERFACE SPECIFICATIONS .....</b>	<b>15</b>
<b>2.6 OPTIONS AND ACCESSORIES.....</b>	<b>16</b>
<b>2.7 THERMAL MANAGEMENT AND ENVIRONMENTAL CONDITIONS.....</b>	<b>17</b>
<b>3. <u>SYSTEM OVERVIEW .....</u></b>	<b>18</b>
<b>3.1 STATUS LEDs .....</b>	<b>19</b>
<b>3.2 INSIDE THE SYSTEM.....</b>	<b>20</b>
<b>3.3 PIN ALLOCATION AND ADDITIONAL EXPLANATION.....</b>	<b>22</b>
<b>3.4 DESCRIPTION OF CDRH-MODE .....</b>	<b>28</b>
<b>4. <u>SYSTEM COMPONENTS.....</u></b>	<b>29</b>
<b>4.1 STANDARD SET OF DELIVERY .....</b>	<b>29</b>
<b>4.2 OPTIONAL PARTS .....</b>	<b>29</b>
<b>5. <u>INSTALLATION AND STARTING INTO OPERATION.....</u></b>	<b>30</b>
<b>5.1 UNPACKING.....</b>	<b>30</b>
<b>5.2 INSTALLATION .....</b>	<b>31</b>
<b>5.3 HEAT SINK INSTALLATION.....</b>	<b>32</b>
<b>5.4 STARTING OPERATION.....</b>	<b>33</b>

<b><u>6.</u></b>	<b><u>OPTO MECHANICAL ADJUSTMENT.....</u></b>	<b><u>34</u></b>
<b><u>6.1</u></b>	<b><u>ADJUSTMENT OF THE LIGHTHUB® BEAM-PATH .....</u></b>	<b><u>34</u></b>
6.1.1	ADJUSTING THE BEAM SHIFTER INSIDE THE LIGHTHUB® .....	36
6.1.2	ADJUSTING THE BEAM COMBINER INSIDE THE LIGHTHUB® .....	37
6.1.3	RECOMMENDED ADJUSTMENT PROCEDURE FOR LIGHTHUBS® .....	38
<b><u>7.</u></b>	<b><u>ADDING LASER MODULES.....</u></b>	<b><u>41</u></b>
<b><u>8.</u></b>	<b><u>TROUBLESHOOTING .....</u></b>	<b><u>44</u></b>
<b><u>9.</u></b>	<b><u>MAINTENANCE .....</u></b>	<b><u>44</u></b>
<b><u>10.</u></b>	<b><u>WARRANTY .....</u></b>	<b><u>45</u></b>
<b><u>11.</u></b>	<b><u>WASTE DISPOSAL.....</u></b>	<b><u>45</u></b>
<b><u>12.</u></b>	<b><u>SPARE PARTS AND SERVICE (MANUFACTURER IDENTIFICATION) .....</u></b>	<b><u>46</u></b>

## 1. Introduction

### 1.1 LightHUB® ULTRA general description and key facts

The LightHUB® ULTRA Compact Laser Combiner can be equipped with up to seven DPSS or diode lasers of different wavelengths in a compact and rugged design. Wavelengths between 375nm and 830nm and optical output powers up to 300mW per laser line are possible. The Compact Laser Combiners can be equipped with several types of fibres or used in free-space emission. Polarization maintaining fibre coupling units and non-polarization maintaining fibres to supply the light to applications in biotechnology like confocal microscopy or flow-cytometry and many more are possible.



The LightHUB® ULTRA is very simple to operate, insensitive to transportation and environmental influences, to approach “hands-free operation”. Necessary control possibilities during operation are output power levels, on/off switching and modulation of the light, with all wavelengths being individually addressable via USB communication and the SMA modulation inputs at the back of the device.

#### Key facts:

- Plug & Play laser light source for industry and science
- Up to 7 wavelengths beam-combined to co-linear beam and efficiently fibre coupled into single- or multimode fibres in one compact housing
- Over 25 different wavelengths available
- Single-mode, polarization maintaining fibre coupling with customizable fibre outputs or free-space emission
- Field-upgradable
- Conductively cooled or optional forced air cooling unit available
- Optional single component failsafe laser safety shutter
- Windows™ based laser control software included

## 2. Technical Data

### 2.1 Wavelengths and output power configurations

Available wavelengths and powers:  
(internal laser power)

375nm / 20mW, 70mW  
395nm / 120mW  
405nm / 20mW, 60mW, 120mW, 300mW  
415nm / 120mW  
425nm / 120mW  
445nm / 50mW, 100mW  
457nm / 100mW  
460nm / 100mW  
473nm / 20mW, 80mW, 100mW  
488nm / 20mW, 60mW, 80mW, 100mW, 150mW, 200mW  
515nm / 25mW, 80mW, 100mW, 150mW \*  
532nm / 20mW, 50mW, 80mW, 100mW, 150mW \*  
552nm / 20mW, 60mW, 80mW, 100mW, 150mW \*  
561nm / 20mW, 50mW, 80mW, 100mW, 150mW \*  
594nm / 20mW, 60mW, 100mW \*  
633nm / 100mW  
638nm / 40mW, 100mW, 150mW, 200mW  
642nm / 140mW  
647nm / 140mW  
660nm / 130mW  
685nm / 50mW  
705nm / 40mW  
730nm / 40mW  
785nm / 120mW, 200mW  
808nm / 140mW  
830nm / 140mW

\* DPSS Lasers

**Table 1: wavelengths and output power**

Please see actual wavelengths and powers on the website: [www.omicron-laser.de](http://www.omicron-laser.de).

## 2.2 Optical and electro-optical specifications

The LightHUB® ULTRA is consisting of up to 7 different wavelengths supported by DPSS lasers, LuxX® diode lasers, or mixed combinations. The following table shows a typical combination of two LuxX® diode lasers and one DPSS laser.

Parameter	Laser 1	Laser 2	Laser 3
Wavelength	488nm (+/- 1nm)	561nm (+/- 0.3nm)	638nm (-1/+4nm)
Optical output power (internal)	60mW	20mW	35mW
Modulation principle	direct / diode	direct	direct / diode
Digital modulation / Laser Enable (full on / off) speed	>150kHz	>50kHz	>150kHz
Analogue modulation speed	>1.5MHz	>100kHz	>1.5MHz
Output beam diameter at fibre port	~0.7mm (1/e2)	~0.7mm (1/e2)	~0.7mm (1/e2)
One possible example for the output beam diameter after the fibre (depending on the fibre collimator)	~3mm (1/e2)		
Example for fibre type	Single mode polarisation maintaining broadband fibre		
Typical available output power at the fibre output	36mW	12mW	21mW

Table 2: typical optical and electro-optical specifications

## 2.3 Operating modes and signal specifications

The number of available operating modes is depending on the type of the lasers built in in the LightHUB® ULTRA.

The operating modes are the same as provided from the LuxX® or DPSS lasers. Please refer to the LuxX® or DPSS laser manual for detailed explanation of its operating modes.

LuxX®-Laser operating modes available in the LightHUB® ULTRA:

Operating modes	Mode 1 - CW operation (ACC – Automatic Constant Current) Mode 2 - CW operation (APC – Automatic Power Control) Mode 3 - Analogue modulation	
Analogue modulation input signal type	> 1,5MHz 0...5V (1.2kOhm)	
Laser enable (electronic shutter) input signal type	> 150kHz (full ON/OFF) 5V TTL (5kOhm) <b>(available in ACC and analogue operation mode only !)</b>	
Rise- and falltime	Analogue	< 200ns
	Laser enable	< 2μs
Extinction ratio	Analogue	> 1000 : 1
	Laser enable	infinite

Table 3: Operating modes and signal specifications for LuxX® lasers built in in the LightHUB® ULTRA

DPSS-Laser operating modes available in the LightHUB® ULTRA:

Operating modes	Mode 1 - CW operation Mode 2 - Analogue modulation Mode 3 - Digital modulation Mode 4 - Mixed modulation	
Analogue modulation input signal type	>100kHz 0...5V (1.2kOhm)	
Digital modulation input signal type	>50kHz 5V TTL (5kOhm)	
Rise- and falltime	Analogue	~ 3μs (rise and fall time)
	Digital	~ 18μs (rise and fall time)
Extinction ratio	Analogue	>50:1
	Digital	infinite

Table 4: Operating modes and signal specifications for DPSS lasers built in the LightHUB® ULTRA

## 2.4 Dimensions and weight

LightHUB® ULTRA:



Figure 2: Dimensions of LightHUB ULTRA®

Dimensions (l x w x h)	622 x 402 x 97mm <sup>3</sup> (without fibre coupler) 622 x 402 x 182mm <sup>3</sup> (with optional cooling unit)
Weight	Approx. 22kg (depending on installed lasers) Approx. 40kg (with optional cooling unit)

Table 5: Dimensions and weight of LightHUB+ ULTRA®

## 2.5 Electrical supply and interface specifications

Supply voltage	24VDC (external power supply )
Supply current	10.41A max.
Control interface	USB 2.0

Table 6: Electrical supply and interface specifications

## 2.6 Options and accessories

Options & accessories	Single mode polarization maintaining fibre FC/PC, FC/APC, FCP 8
	Multi mode fibre FC/PC, FC/APC, SMA
	Various collimated light outputs (also on customer demand)
	Single fault condition laser safety shutter
	CDRH Kit (only needed for external key-switch and interlock control)
	Various optical filters for narrowing the diode laser spectrum
	Forced air heat sink

Table 7: Options and accessories

## 2.7 Thermal management and environmental conditions

<b>Storage temperature:</b>	<b>-20° - 85°C</b>
<b>Maximum relative humidity (non condensing):</b>	<b>&lt;80%; up to 30°C</b>
<b>Operating altitude (above sea level):</b>	<b>under 3000m</b>
<b>Storage altitude (above sea level):</b>	<b>up to 13000m</b>



The specified and recommended operating temperature range is 15...35°C. For the LightHUB® ULTRA laser system the heat will be dissipated through its base plate.

Therefore, it is essential to provide enough heatsink at the mounting area.

The total heat dissipation under worst case condition is depending on the number and type of laser heads inside the LightHUB® ULTRA.

For a DPSS laser 10...15W and for a Diode laser 5...10W of heat dissipation must be calculated. Additionally, the temperature stabilization of the system needs up to 150W depending on the environmental condition.

For LightHUB® ULTRA systems, the maximum number of DPSS lasers is 4. Combined with three diode lasers, totally 7 lasers are installed for calculating the worst-case heat dissipation.

**The worst-case heat dissipation will be:  $4 \times 15W + 30W + 150W = 240W$**

We recommend using a heatsink with a thermal resistance of 0.05...0.06 K/W or a heatsink with a thermal resistance of 0.25...0.3 K/W with forced air cooling.

When using the Omicron heatsink option, no further calculation for the required thermal resistance is needed.

### 3. System overview

Orientation of the INPUT and OUTPUT connectors at the LightHUB® ULTRA:

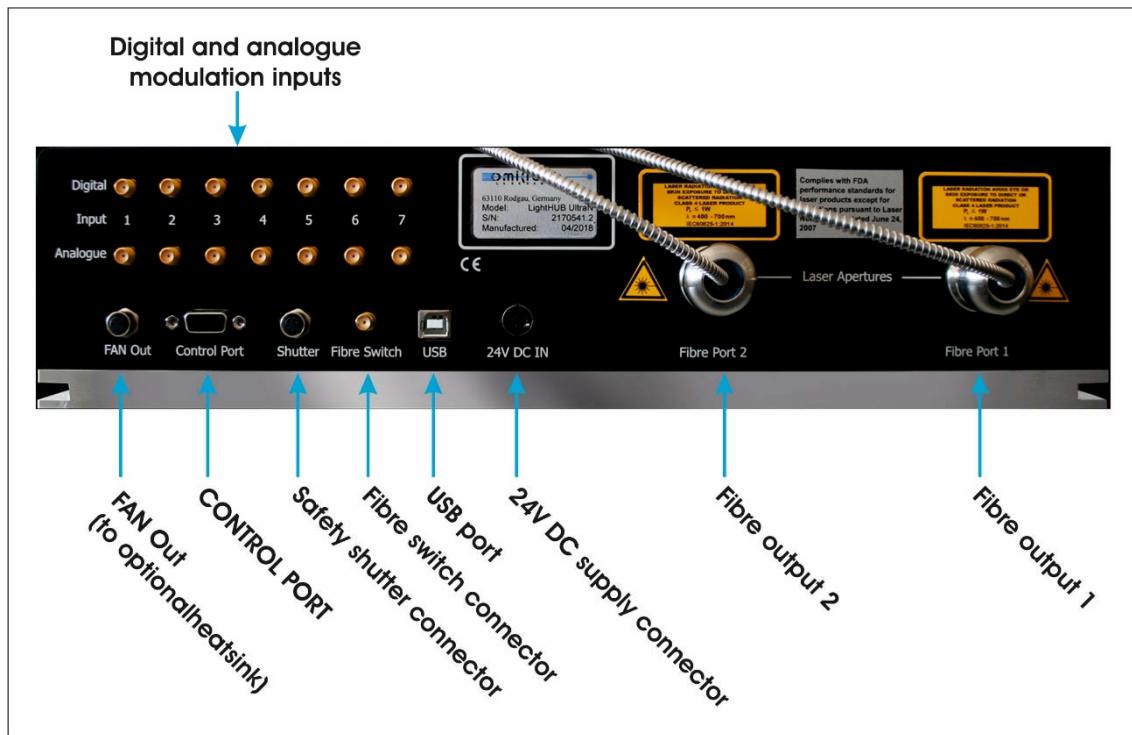


Figure 3: LightHUB® ULTRA laser system rear view

Orientation of the controls and indicators at the LightHUB® ULTRA:



Figure 4: LightHUB® ULTRA laser system front view

### 3.1 Status LEDs

State	Error LED	Interlock LED	Emission LED	Fibre Out 1	Fibre Out 1	Shutter Status
Colour	Red	Yellow	White	White	White	White
DEVICEOFF	OFF	OFF	OFF	OFF	OFF	OFF
DEVICEON	ON <sup>1</sup> /OFF	OFF	OFF <sup>2</sup>	OFF	OFF	OFF
DEVICELASERON	ON <sup>1</sup>	OFF	ON	ON/OFF	ON/OFF	ON/OFF
DEVICEERROR	ON <sup>1</sup>	OFF	OFF	OFF	OFF	OFF
DEVICEINTERLOCK	ON	ON	OFF	OFF	OFF	OFF

Table 8: LED signals

<sup>1</sup> Error LED is blinking, if at least one of the lasers inside the box has a problem. Error LED is on, if a system error occurs.

<sup>2</sup> Emission LED is blinking if a key switch toggle is needed. This is only possible if device is in CDRH mode. See chapter 3.4.

In addition to the status LEDs in the table above, the power switch is backlit with a blue LED. This LED indicates several states for the device. Please find details in the following table:

Power LED (blue) state/duty-cycle	Power State	Keyswitch State	Temperature Regulation State
LED OFF	Device not powered, push button to power up or plug in mains	--	--
LED blinking with 10% duty-cycle	Device powered	Keyswitch OFF	Device temperature <b>not</b> stable
LED blinking with 50% duty-cycle	Device powered	Keyswitch OFF	Device temperature stable
LED blinking with 90% duty-cycle	Device powered	Keyswitch ON	Device temperature <b>not</b> stable
LED ON	Device powered	Keyswitch ON	Device temperature stable

Table 9: Power LED States

If the temperature regulation state indicates a stable temperature, the device is within  $\pm 4^\circ\text{C}$  of the setpoint. Wavelength and power output is only stable, if temperature is within this range.

### 3.2 Inside the system

To get access to the frame unit, open the ten cover screws and remove the top cover. After all the screws are removed, lift the top cover and disconnect the PE-connector. Make sure to reconnect it when closing the housing. It is recommended to unplug the power supply before opening the housing cover.



Figure 5: Opening the top cover of the LightHUB® ULTRA

Once the housing is open see Figure 6: LightHUB® ULTRA inside view for details of the internal parts. Each laser, which is built-in the LightHUB® frame unit, has a laser specific sub board installed on the Main PCB and a laser specific connector board on the laser side. Both boards are connected via ribbon cable. This overview may be necessary to change or upgrade configuration of the system.

The LightHUB® frame unit contains the lasers, combiners, mirrors, the optional safety shutter, the optional fibre switch and one or two fibre couplers. Open the four screws and remove the cover to get access to these parts for optical adjustment or upgrade reasons.

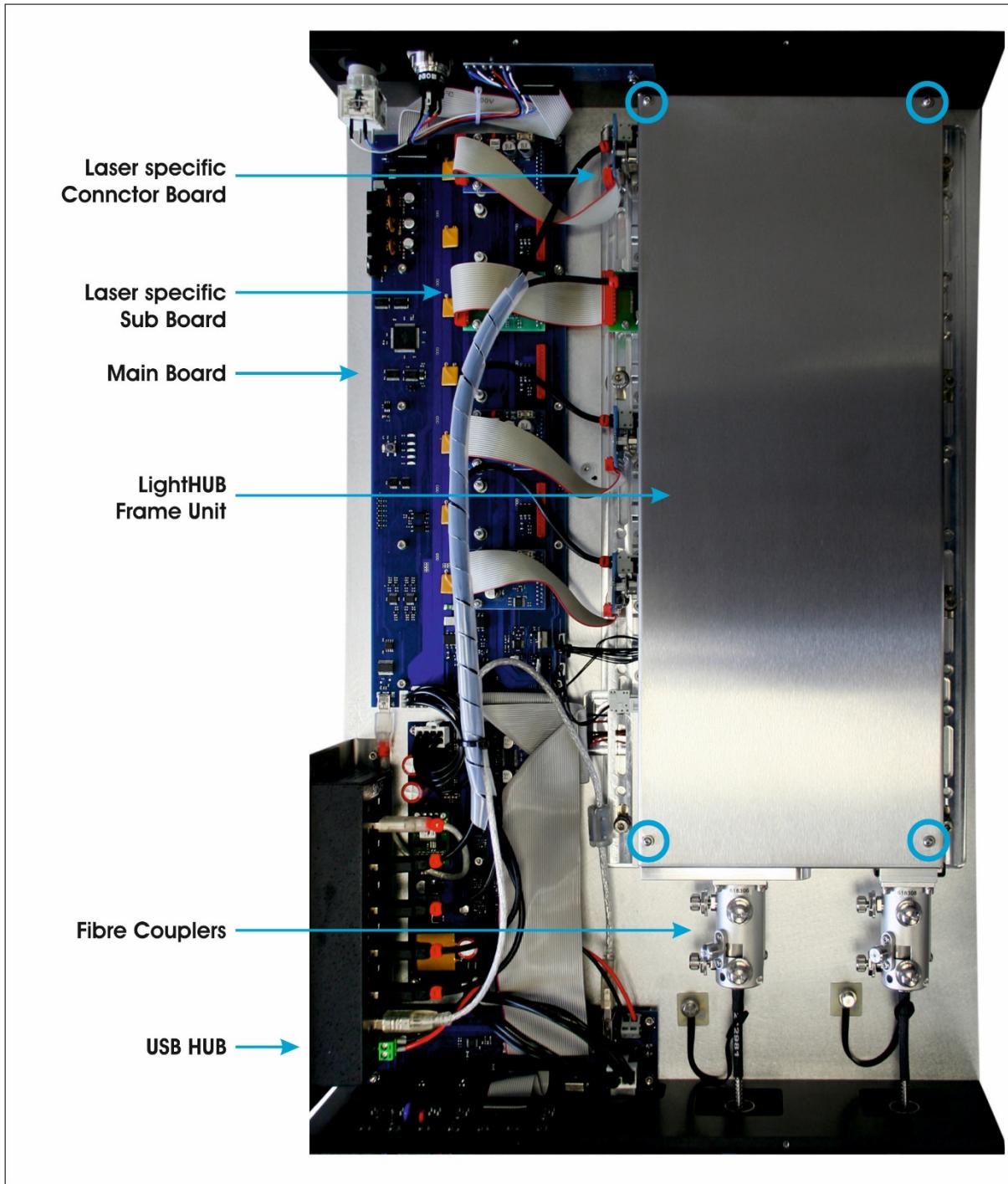


Figure 6: LightHUB® ULTRA inside view

### 3.3 Pin allocation and additional explanation

#### Power supply

It is recommended to use the optional external power supply to operate the LightHUB® ULTRA system. In case of using an own power supply make sure to meet the specifications.

24V DC Supply Connector	
4pin KYCON DC jack - Cable side (KPPX-4P)	Function
1, 2	V+ in (23VDC to 25VDC), max. 13A
3, 4	GND in
Ring	PE

Table 10: Pin allocation of 24V DC Supply Connector

#### Communication interfaces

The LightHUB® ULTRA has a built-in USB Hub to have access to all built-in laser modules. Use the Omicron Control Software to control and monitor all built-in Omicron laser modules and the main controller. Use the OBIS control software to control and monitor the built-in DPSS laser modules.

Please refer to the user manuals of the lasers for further information on controlling the lasers via software or implementing communication into own software projects.

## Control Port

The Control Port gives access to the following control features over a sub-d 15pin HD female connector.

Control Port	
SUB-D HD 15pol female	Function
1	+5V out interlock loop (fused with polyswitch 0,2A fuse)
2	Interlock loop return
3	Key switch (Laser ON/OFF)
4	+5V out (fused with polyswitch 0,2A fuse)
5	NC
6	NC
7	NC
8	NC
9	NC
10	NC
11	Emission LED out (20mA)
12	
13	Interlock LED out (20mA)
14	NC
15	GND
Shield	PE / Screen

Table 11: Pin allocation of the Control Port

## Interlock Loop

The LightHUB® ULTRA has an interlock loop system to cease emission in safety critical situations. The interlock loop is supplied via the control port. Close the interlock loop to allow standard operation. Note that the system needs a software reset or key switch toggle to clear an open interlock loop condition.



Please ensure that the interlock loop is galvanic shielded. Please wire the interlock loop by using an external safety relay or circuit. Please ensure according IEC 60825-1, during the interlock loop is open, the laser system is safely shut down and cannot output laser light. This is ensured by a failsafe relay open contact circuit.



The supplied interlock loop connector may be used to close the interlock loop and key switch on the control port.

### Key switch

The LightHUB® ULTRA has one built-in hardware key switch on the front panel and an input for an external key switch via the control port on the back panel. The signal from the front panel key switch and the signal from the control port are connected internally with a logic AND. Make sure to close the key switch loop on the control port and set the key switch on the front panel to ON-position (I) to allow emission.



The supplied interlock loop connector may be used to close the interlock loop and key switch on the control port.

### LED output pins

The LED output pins allow the customer to add external indicators for emission, interlock and failure display.



Please note that the max. output current for each pin is 20mA. The internal supply voltage for each pin is 5V.

### single component fail-safe laser shutter system

The single component fail-safe laser shutter system is integrated in the LightHUB® housing inside the LightHUB® ULTRA. Safety is achieved by using two independent laser shutters with mutual monitoring. Please see following figure for shutter position inside the LightHUB®.

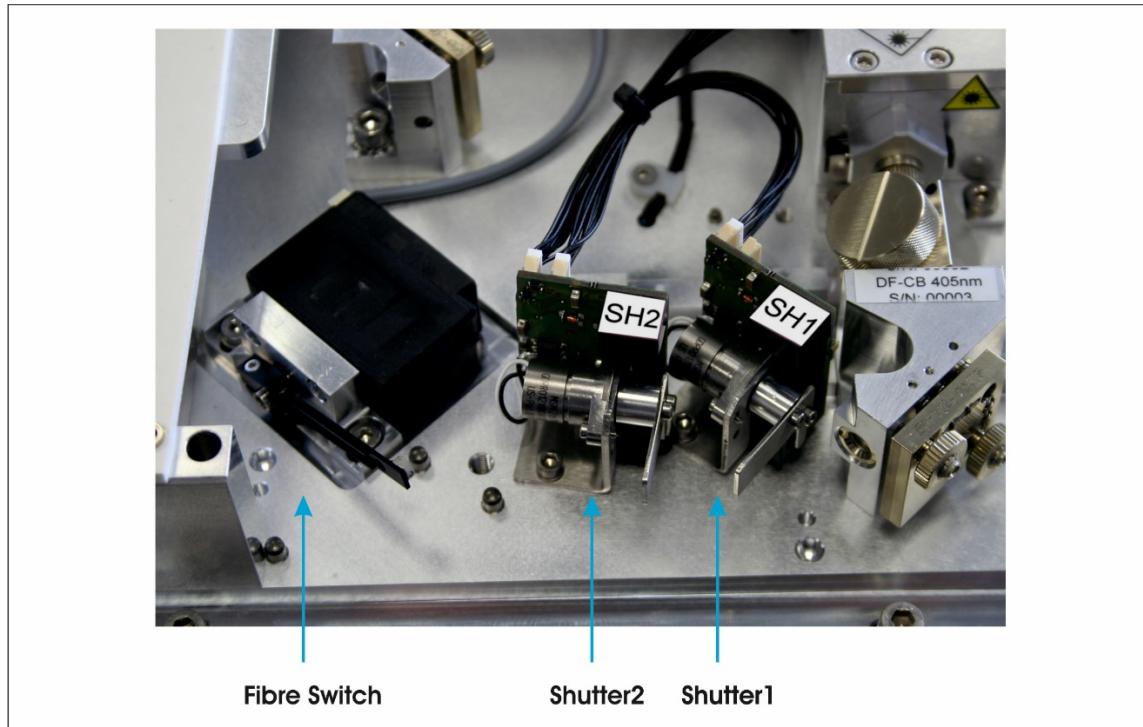


Figure 7: Shutter area inside of LightHUB®

The laser shutters are controlled via the connector on the back of the LightHUB® ULTRA housing. In LightHUB® ULTRA devices, Return 1 and Return 2 are internally connected together. Connect a switch between 'send' and one of the two 'return' pins. Close the switch to open the shutter, open the switch to close the shutter.

Each shutter monitors its own status and the status of the second shutter. If one of the shutters detects an error condition, it blocks the laser beam and closes the second shutter as well.

The following error conditions may occur:

- External control signal for shutter 1 unequal to external control signal for shutter 2
- External control signal for shutter n unequal to feedback signal from shutter n

The error condition is cleared by opening the external switch between 'send' and the two 'return' pins.

Optional Safety Shutter Connector	
Binder M8 4pin female – cable side Binder M8 4pin male	Function
1	+3.3V send (max. 45mA)
2	Return 1
3	Return 2
4	NC

Table 12: Pin allocation of Safety Shutter Connector

### Optional fiber switch

Depending on ordered configuration a fibre switch is installed to switch laser output from fiber1 to fiber2. It is integrated in the LightHUB® housing inside the LightHUB® ULTRA. See Figure 7: Shutter area inside of LightHUB®. The fibre switch is controlled via the connector on the back of the LightHUB® ULTRA housing. Supply a 5V TTL high level to switch to fiber output 2. Leave open or supply a 0V level to switch to fibre output 1.

Fibre Switch Connector	
SMA female	Function
Centre	Fibre switch signal, 5V TTL (10mA max.)
shield	Return

Table 13: Pin allocation of Fibre Switch Connector



It is also possible to control the fibre switch via software. Hardware signals and software signals are connected to a logic AND. That means, if the signal is externally set to fibre output 2 (high level), the software cannot switch to fibre output 1 or vice versa, if the software sets fibre output 2 the system cannot be set to fibre output 1 by supplying low level on the external input.

### Optional heat sink and fan out

An optional heatsink is available for the LightHUB® ULTRA system. There is a 3pin sensor connector on the back plane to power the fans in the external heat sink. Only connect the cable from the external heat sink to the connector.

FAN Out Connector	
Binder M8 3pin female – cable side Binder M8 3pin male	Function
1,2,3	Use with optional heatsink only

Table 14: Pin allocation of FAN out Connector

### Digital and analogue modulation

The LightHUB® ULTRA system is equipped with 7 inputs from digital modulation and 7 inputs for analogue modulation of the built-in laser modules. Modulation capabilities depend on the built-in laser module.

Digital Modulation Connectors 1-7	
SMA female	Function
Centre	Digital Modulation signal, 5V TTL (5kohm impedance)
shield	Return

Table 15: Pin allocation of Digital Modulation Connectors

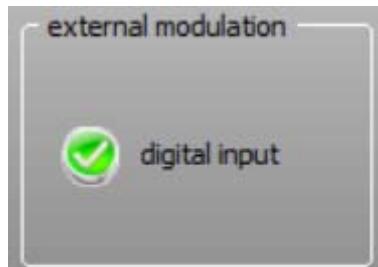
Analogue Modulation Connectors 1-7	
SMA female	Function
Centre	Analogue Modulation signal, 0...5V TTL (1,2kohm impedance)
shield	Return

Table 16: Pin allocation of Analogue Modulation Connectors



Make sure to bring the lasers to correct operating mode via control software to enable external digital or analogue modulation.

If LuxX lasers are built-in the LightHUB® ULTRA system, the digital modulation input is routed to the laser enable input of the LuxX laser. As the digital modulation input is pulled to ground level, the LuxX lasers do not emit laser light, even when switched to CW operation. Therefore, a digital overwrite is available. Use the digital input button on the controller level to deactivate the digital input globally for all lasers.



Alternatively, if the LightHUB® ULTRA housing is open, push the button on the Main PCB to toggle between digital input active and not active.

### 3.4 Description of CDRH-mode

It is possible to operate the LightHUB® ULTRA in a CDRH compliant mode. The main controller manages CDRH functionality. No external CDRH-kit is necessary, as the LightHUB® ULTRA is equipped with a key-switch on the front panel. If CDRH-mode is needed, activation is possible via “?CDRH” command. Refer to command list or programmers guide for further assistance.

#### CDRH features

If the key switch is turned into OFF position, laser emission is not allowed. Thus, the main controller of the LightHUB® ULTRA system sets all lasers into interlock state, so that internal laser diode energy source is turned OFF. Laser ON commands from the PC to the lasers directly are ignored in this case. The laser cannot be turned ON while the key switch is in OFF position. If the key switch is turned ON, the main controller starts all available laser systems step by step. Emission from the first started laser is delayed 3 seconds for CDRH compliance.

At start-up or reset, CDRH requires a key switch toggle to confirm laser operation. The key switch toggle request is indicated by a blinking laser emission LED, if the key switch was in ON position during start-up or reset of the laser system.

## 4. System components

### 4.1 Standard set of delivery

The LightHUB® ULTRA laser system comes with the following parts:

- LightHUB® ULTRA unit with minimum one laser installed and at least one fibre output
- Set of mounting brackets
- Power Supply
- USB cable
- Remote interlock connector
- Laser-control software(s) (content of the installation medium)
- 2 x pinhole for basic adjustment
- User manual (basic manual - printed)

For ordering spare parts, please use the above description of the sub-part or contact your local distributor for assistance in getting the item number.

### 4.2 Optional parts

- single component failsafe laser safety shutter
- Beam compressor or expander optics
- 1 x basic tool set
- Forced air heat sink
- Optional output collimator

For ordering optional parts, please use the above description of the part. Omicron can support the user by selecting the right heat sink, if required.

## 5. Installation and starting into operation

### 5.1 Unpacking

When you receive your LightHUB® ULTRA laser system, please immediately inspect the shipping container. If there is any damage (holes or crushing, etc.) insist that a representative of your local carrier is present while you unpack the contents.

Carefully inspect your LightHUB® ULTRA laser system as you unpack it. If any damage is evident, such as dents or scratches on the covers or broken parts etc., immediately notify your carrier and your local sales distributor.



For a better handling of the laser system in service matter, keep the shipping containers for sending back the laser system. If you find a damage claim, you may need them to demonstrate that the damage occurred as a result of shipping.

Please check the following components which belong to the LightHUB® ULTRA laser system:

1. LightHUB® ULTRA laser system
2. Mounting brackets
3. Power supply
4. Interlock connector
5. USB cable
6. Software installation medium
7. User manual

Optional parts:

1. Collimator optics
2. CDRH remote control box
3. Optical fibre components
4. Heat sink

Please make sure that all components are present.

## 5.2 Installation

The LightHUB® ULTRA laser system is very easy to set up. After unpacking and inspecting, the laser system must be connected as described here:

1. Mount the LightHUB® ULTRA laser system to a suitable heat sink. There are mounting clamps supplied to mount the LightHUB® ULTRA onto an optical breadboard.

Please ensure the surface of the heat sink is flat.

**The roughness or evenness of the mounting surface must be better than 1/10mm over the whole ground plate of the LightHUB® ULTRA.**



It is important to mount the LightHUB® ULTRA to an appropriate heat sink. Refer to chapter “thermal management” for further information.

2. Connect the optional CDRH remote control box or the supplied interlock connector to the control-port.



**CAUTION: As standard setting for the laser system “auto-start” and “auto-power” function is ON. The lasers are set to digital + analogue modulation. If CDRH mode is enabled, the lasers need a key switch toggle to start operation.**

3. Connect the power supply unit or an appropriate power supply to the device.



In case of using not the original power supply, make sure to meet the specified power supply demands.

### 5.3 Heat sink installation

To connect the optional heat sink unit, place the heat sink on a table and put the LightHUB® ULTRA on top (see figure 5). Insert the three supplied stable pillar posts from the bottom side into the heat sink unit and screw the posts tight. Make sure the LightHUB® ULTRA system stays properly orientated on top of the heat sink unit. Use the 6 additional M4 screws to fix the heat sink to the LightHUB® Ultra system.

After all posts are tightened, connect the cable from the heat sink unit to the fan out connector of the LightHUB® ULTRA. The supplied mounting clamps can also be used to mount the heat sink unit onto an optical breadboard.



Figure 8: LightHUB® ULTRA with heat sink unit

## 5.4 Starting operation

Use the following steps to setup the system and start operation.

1. Connect the external power supply to the LightHUB® ULTRA.
2. Connect the external power supply to the mains.
3. Connect the loopback connector to the control port or connect a customer specific circuit to close the key switch and the interlock loop. Alternatively connect the optional CDRH kit.
4. If you have an optional heatsink, make sure the cable is plugged into the Fan Out connector.
5. Push the power button on the front panel of the LightHUB® ULTRA. Key switch is off.
6. The fans should turn on and the blue backlight LED of the power button starts blinking.
7. Turn the key switch to ON position. Blue backlight LED of the power button stops blinking if system operating temperature setpoint is reached.
8. Connect a signal to the safety shutter connector or use a bridge connector to open the safety shutter.
9. Connect a logic high level to the digital modulation input and an appropriate voltage level to the analogue modulation input of a channel, which is equipped with a laser.

OR

Connect the system to a personal computer via USB and run Omicron Control Center software to change operating mode of the lasers to CW and deactivate digital input.



**WARNING! Laser emission is possible. Assure laser safety precautions. The system should emit laser light now.**

## 6. Opto mechanical adjustment

The following chapters explain the opto-mechanical adjustment of the LightHUB® system. This should only be necessary in case of an upgrade or change in configuration.

### 6.1 Adjustment of the LightHUB® beam-path

To get access to the beam adjustments the frame cover of the LightHUB® system has to be removed.



**ATTENTION:** Do not look into the beam or into reflections of the beam, when the top cover is removed! When operating the LightHUB® under open cover condition, it may emit stray-light, which is a health hazard for the eyes and skin. Always wear appropriate protective eye-goggles.



**CAUTION:** Please wear gloves during the adjustment procedure to prevent hand contamination of the opto-mechanical parts of the LightHUB®.

Depending on the configuration of the LightHUB®, up to 7 laser modules are installed. The next figure shows a typical combination of LuxX® diode lasers and a DPSS laser with their opto-mechanical adjustment devices.



Figure 9: typical combination of three LuxX® diode lasers and one DPSS laser in the LightHUB® without frame cover

The beam path of each laser can be adjusted by a beam shifter and a beam combiner (see Figure 10). They have adjusting screws with fixing rings. The fixing rings are pre-aligned and factory adjusted for the right strength. If the fixing rings must be opened for any reason, the right strength will be reached at a hand tight torque.

There is no need for final tweaking after using the fixing rings.

Figure 10 shows the beam combiners and beam shifter parts in a LightHUB® as well as the direction for the alignment process as blue and yellow arrows. The following chapters explain the alignment process in detail.

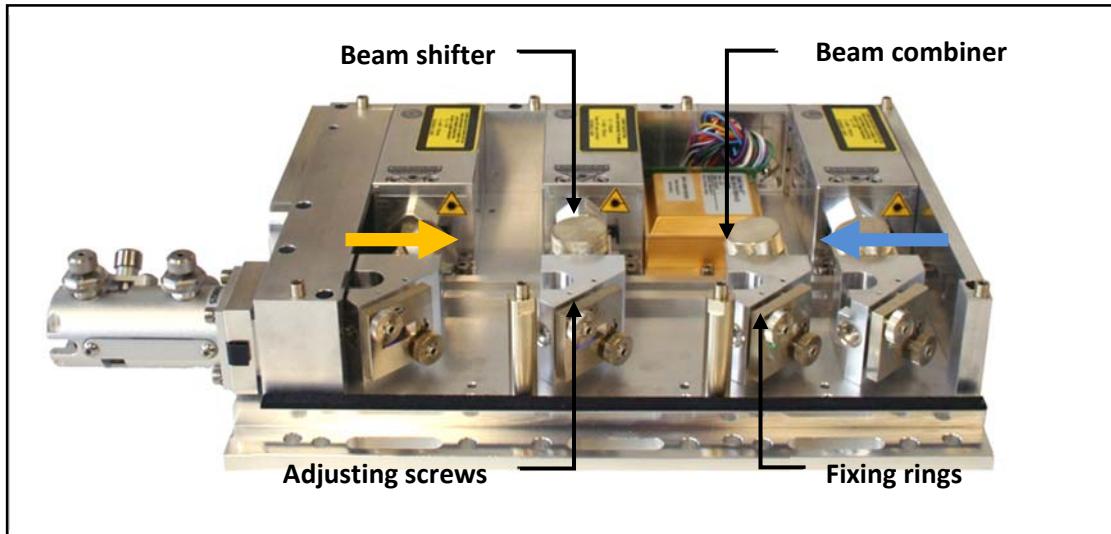
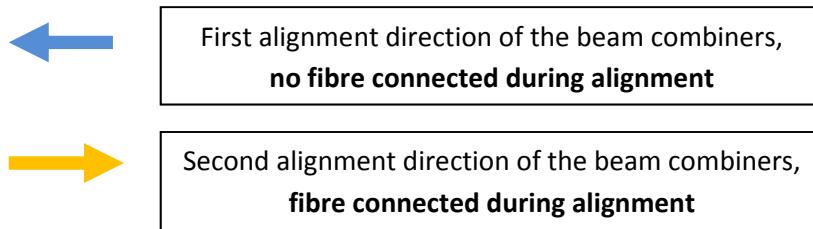


Figure 10: beam shifter and combiner for LightHUB®



### 6.1.1 Adjusting the beam shifter inside the LightHUB®

The beam shifter enables a centring of the laser beam on the beam combiner.

The knurled knob on the beam shifter moves the beam in one axis and the rotation of the beam shifter itself rotates the shift-axis. Therefore, an accurate positioning of the laser beam on the beam combiner is possible.

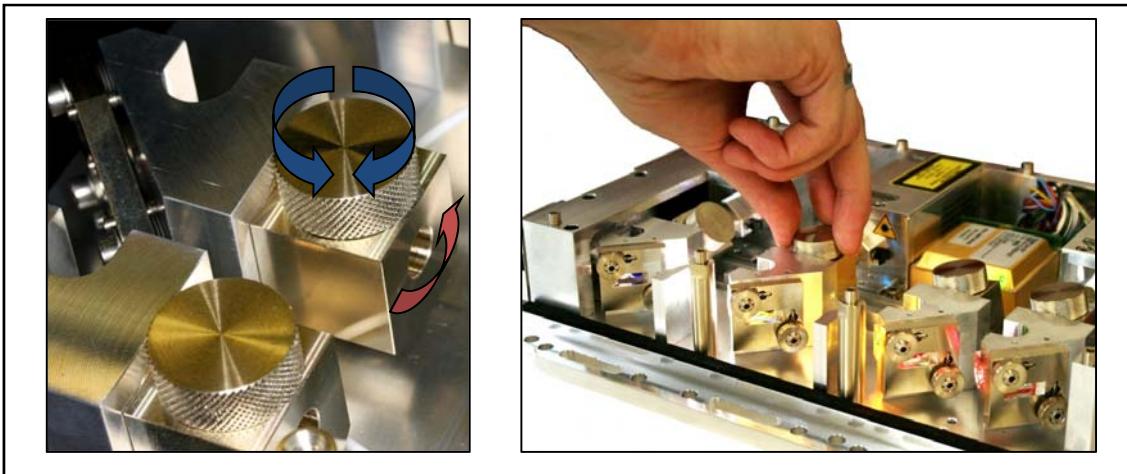


Figure 11: the beam shifter positions the laser beam on the mirror

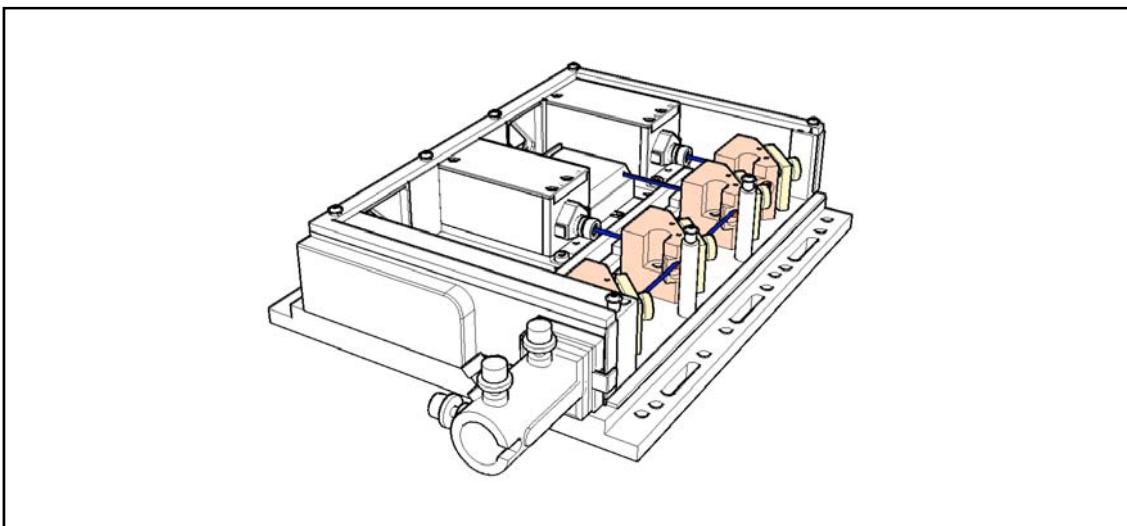


Figure 12: beam path inside the LightHUB®

### 6.1.2 Adjusting the beam combiner inside the LightHUB®

The beam combiner deflects the beam in the direction of the fibre coupler unit.

The horizontal and vertical position of the deflected laser beam changes by turning the hex head screws. The final position of the beam combiner can be fixed by tightening the fixing rings.

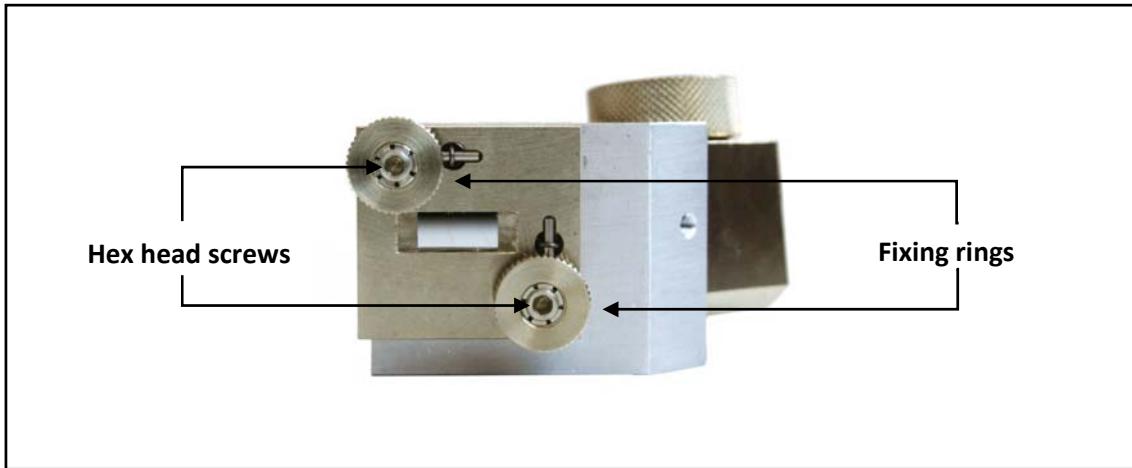


Figure 13: beam combiner for LightHUB® manufactured after Jan. 2011

In order to turn the hex head screws the hex key tool as shown below can be used.

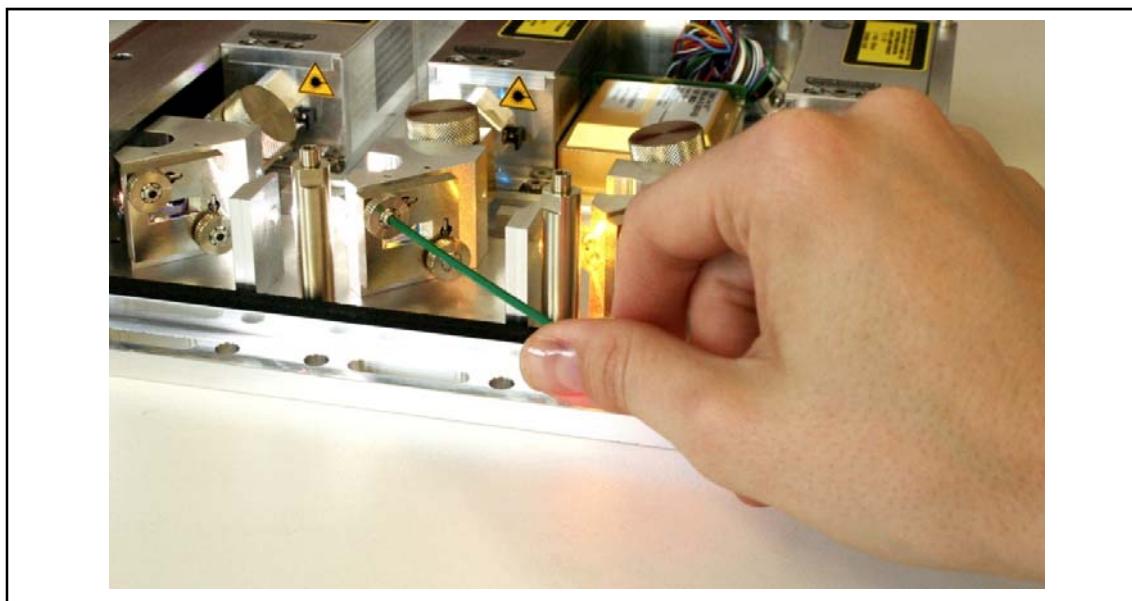


Figure 14: Hex key tool (included in the shipment) for positioning of the beam combiner

The right beam path through the beam combiner has to be tested with additional alignment-plates with pinholes. The pinhole has a diameter of 0.7mm whereas the beam diameter of the lasers is at minimum 0.7mm. So the right beam path through the beam combiner is reached when the laser beam passes the pinhole(s).

### 6.1.3 Recommended adjustment procedure for LightHUBs®

The LightHUB® laser combiner can be equipped by various types and brands of fibre couplers. One example for a fibre coupler is the kineFLEX fibre coupler.

1. Start with the laser which is installed **at the far end, away from the fibre coupler unit**. Activate this laser and turn the others off.

2. For an easier adjustment procedure, it is recommended to put in max. two additional alignment plates with a pinhole after each of the three accessible beam combiners (see Figure 15). The position of the pinholes is fixed by mounting holes (precision position).

Adjust the beam shifter as it is described in chapter 6.1.1. Then adjust the beam combiner as it is described in chapter 6.1.2. The right position of the deflected beam is achieved when the beam passes the pinholes of the alignment plates with maximum power. We recommend using a thermopile power meter for this procedure.

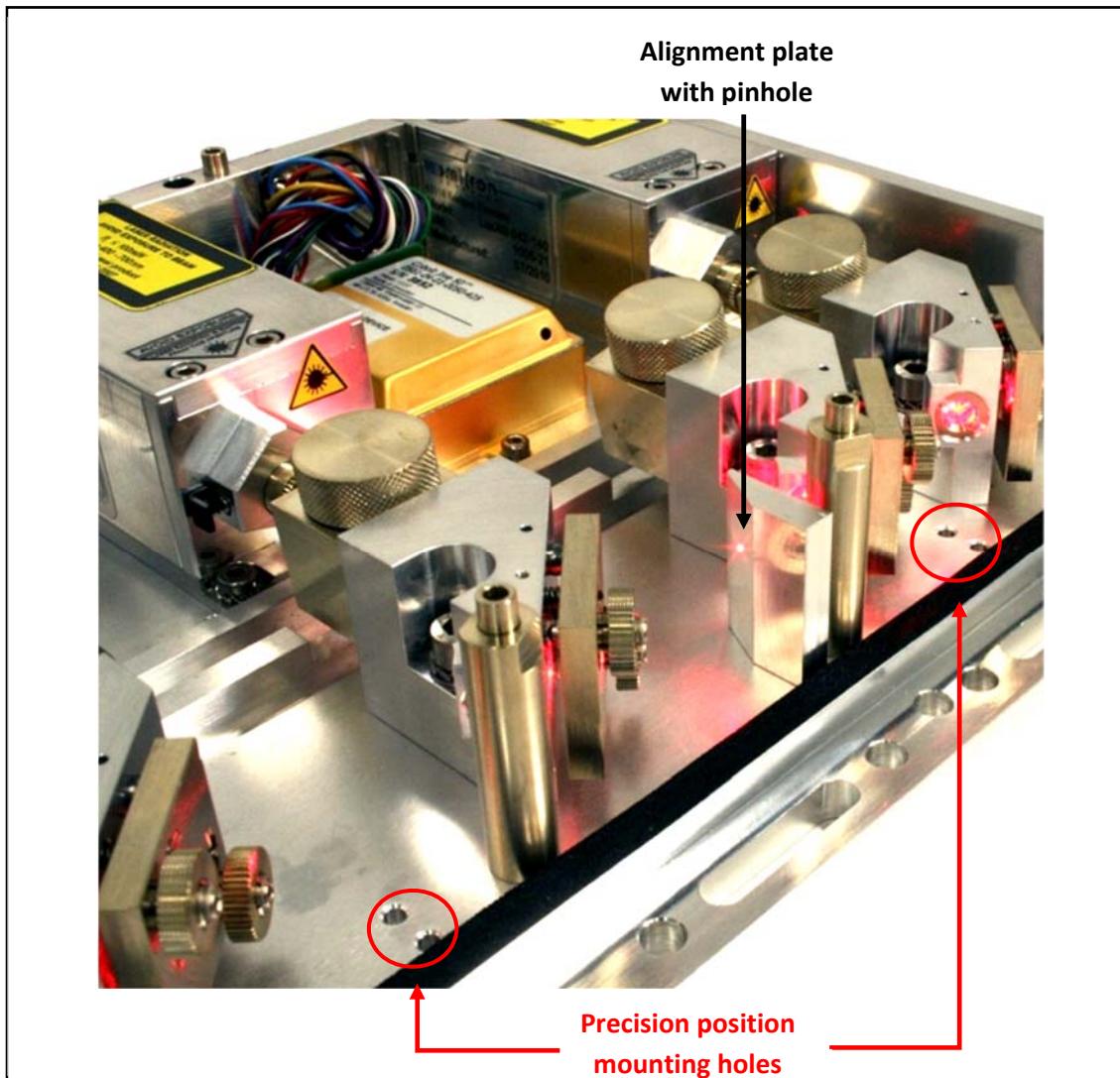


Figure 15: Adjusting the beam shifter for LightHUB® with alignment plates

3. Open the mechanical shutter and place the cylindrical alignment tool into the fibre coupling unit. There is a groove at one end of the cylindrical tool. Please use first the position when the groove is positioned towards the lasers.

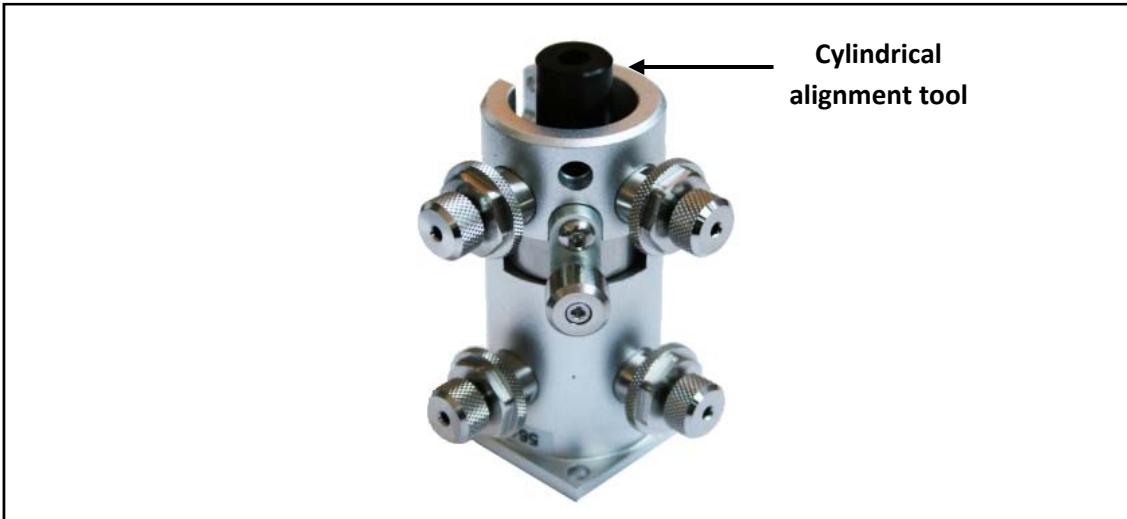


Figure 16: fibre coupling unit with cylindrical alignment tool

4. Try to adjust the laser beam with the beam combiner by turning the hex head screws (see chapter 7.1.2), so that the beam passes the 1mm pinhole of the cylindrical alignment tool with only a small power loss. **Please use always the beam shifter for the first manipulation and the hex head screws at the beam combiner for the second manipulation.**



Please use a power meter to maximize the power through the optical beam path. Please remove the cylindrical tool and place it in the opposite direction inside the fibre coupler. The groove at the end of the tool is now positioned into the direction of the laser beam. Please adjust the fibre coupler screws only at the front position if the groove is located in the front. Adjust the fibre coupler screws at the back, if the groove is located in the back. Please realign the fibre coupler to be sure that the first laser transmits the pinholes and the cylindrical tool in both directions with maximum power.

5. After the first laser beam is adjusted, turn off this laser. The first pinhole must be removed from its first position and placed after the second beam combiner. Then switch on the laser mounted next to it (towards the fibre coupler). Again centre its laser beam with the beam shifter on the beam combiner and adjust the beam combiner as before including the pinholes. The second pinhole is placed in front of the last accessible position of the laser towards the fibre coupler.
6. Adjust the laser beam of the remaining laser like the laser beams before. On the last laser there is no possibility to place the pinhole in front of the combiner. Please use the fibre coupler with the cylindrical tool as the reference.
7. Now switch on all lasers. All beams should hit the flat surface at the same position, so that they overlay each other almost. If not please readjust the beam combiners.

8. If the beam adjustments are completed, switch off all lasers, remove the alignment pinholes and place the fibre into the coupling unit. **Please turn the output power of all lasers to approx. 10mW not to damage the fibre during final adjustment.** Please switch on the laser close to the fibre coupler and adjust the fibre coupling unit as it is described for example in the kineFLEX operating instructions. In order to optimize the coupling, measure the laser power at the fibre output. Please use a broadband power meter for this procedure (thermopile sensors recommended as before). The optimum is achieved at the highest output power. In some cases a slight readjustment of the beam combiners can lead to a higher output power. Fix the fibre coupling unit after these adjustments with its torque tightening lock nut.

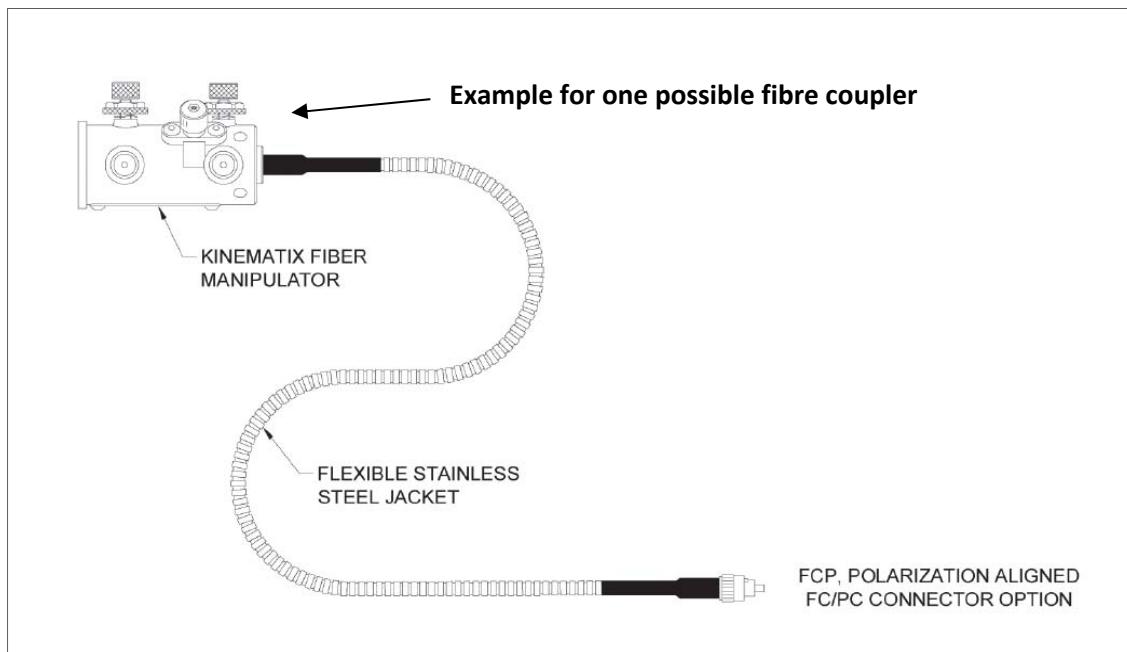


Figure 17: kineFLEX fibre and coupler

9. Please refer now to the next laser, which is placed one position more far away from the fibre coupler. Please align the beam combiner to the maximum output power out of the fibre. Do not touch the fibre coupler manipulator in any case until all lasers are maximized with the beam combiners to max. transmission efficiency and output power of the fibre.
10. Please turn up the output power laser by laser back to 100% and measure the total output power laser by laser. Please compare this with the target specified transmission efficiency printed in the final test sheet.



The maximum power for the used fibre might be different from the model and type. Please check the maximum allowed power for the used fibre before turning on all lasers at the same time.

## 7. Adding laser modules

The LightHUB® ULTRA can easily be upgraded by the experienced user with further laser modules. For example, if the LightHUB® is equipped with three laser modules, up to four more can be installed.

In this case the upgrade kit comes contains the laser module and a beam combiner unit (factory pre-adjusted), the corresponding optics, spacers and mounting screws. Additionally, there is a laser specific “connector board” and “sub board” as well as a ribbon cable provided to connect the laser to the main board. The wavelength setup of the LightHUB® ULTRA needs to be checked by an OMICRON service representative to make sure that it supports the desired new wavelength. The top cover must be removed to add or replace a laser. Please open the 4 top cover screws, while the system is turned OFF.



**ATTENTION: Do not look into the beam or into reflections of the beam, when the top cover is removed! When operating the LightHUB® ULTRA under open cover condition, it may emit stray-light, which is a health hazard for the eyes and skin.**

**Service personnel please always wear appropriate protective eye-goggles.**

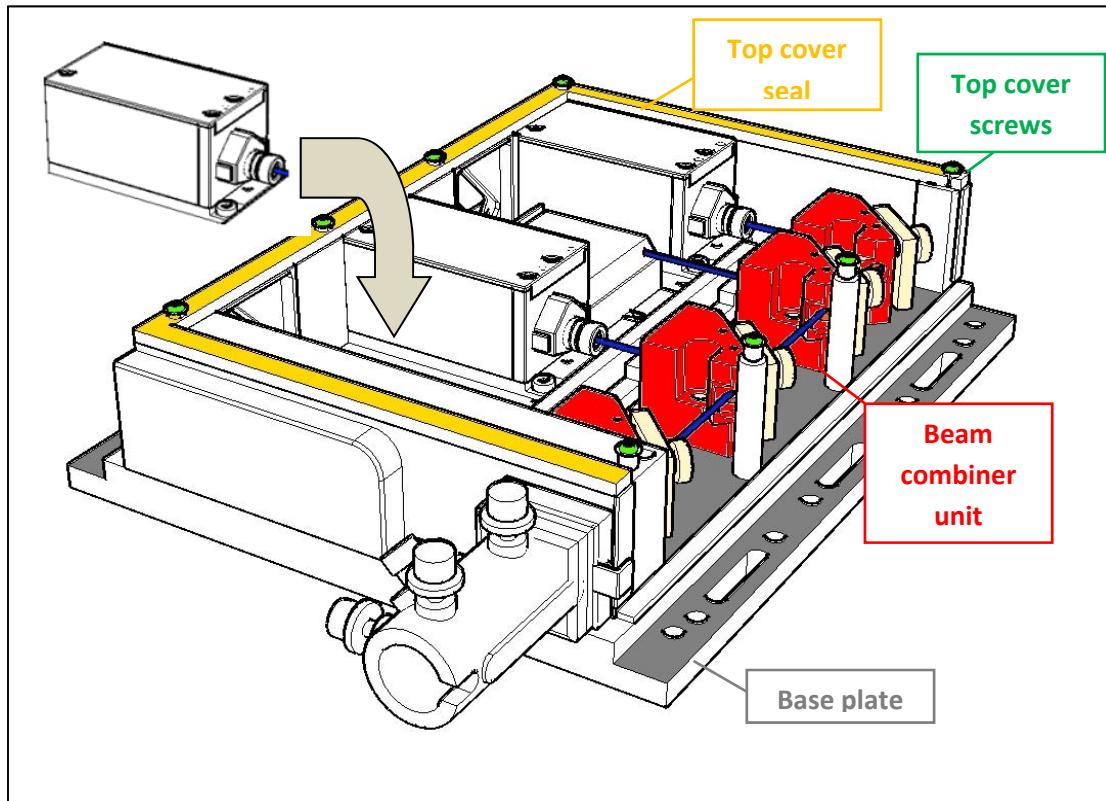


Figure 18: Adding a new laser head and location of the top cover screws

At first, please clear the space for the laser by removing the top cover seal and the (blind-) spacer at the backside of the LightHUB®. Install the laser at the reserved position. There are precision steel positioner bolts to keep the laser in its exact intended position for the beam path. The laser must fit there with no strength during placement. Then use the four laser screws (M4 x 10mm) with star washer and washer for installing the laser head tight to the base plate. Please tighten the screws until the star washers are under strength. The beam combiner unit has also a reserved position. There are precision steel positioner bolts to keep the beam combiner unit in its intended position. There is one screw to hold the beam combiner down to the base frame. Please use the star washer and the washer with the screw for installing the beam combiner. Please tighten the screw until the star washer is under strength.

Install the laser specific connector board on the back of the laser and the laser specific sub board on the reserved port of the main PCB. Fasten the main sub boards with the supplied M3 HX nuts. The DPPS laser connector board must be fixed with the supplied M2.5 screw. The Luxx laser connector boards are not fixed with screws. Connect the supplied ribbon cable between the two boards. Make sure the direction of the cable is correct. For DPSS lasers, the cable should not be twisted. For Luxx lasers refer to the following picture for explanation:

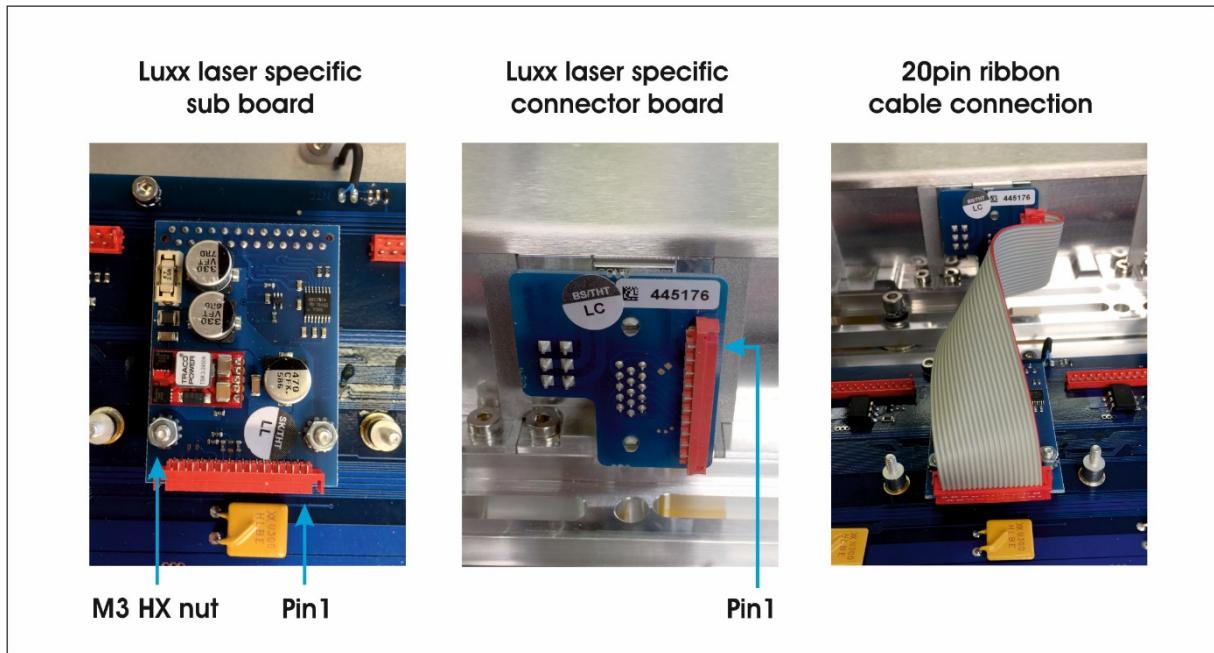


Figure 19: Luxx specific boards and connections

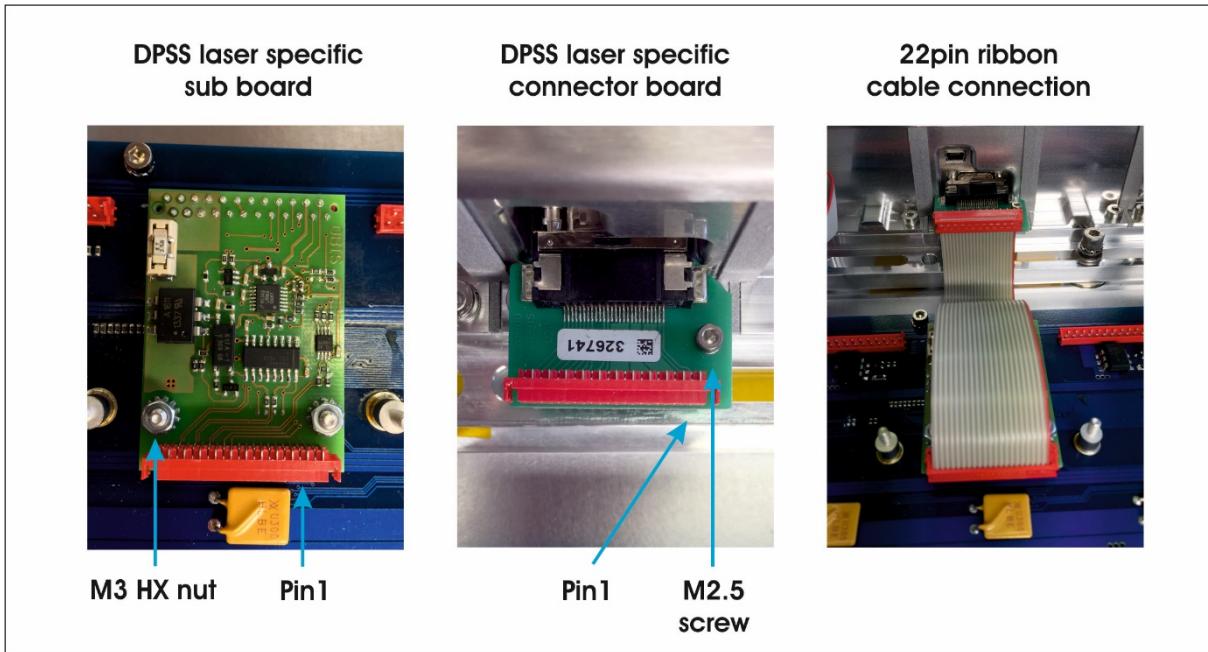


Figure 20: DPSS specific boards and connections

Please turn on laser by laser now and check the output power. The new laser head should emit laser light in the pre-aligned direction. It needs final adjustment to be launched in the fibre coupler, so please refer to the alignment procedure described in chapter 6.

**ATTENTION: Do not look into the beam or into reflections of the beam on surfaces while adjusting the beam to the beam path!**

When finished with the adjustment procedure, please put back the top cover seal in its original position. Please use the top cover screw spacers for finding the right position of the seal. After closing the top cover, please re-check the alignment of the new added laser beam.

Please be careful with the top cover seal. Do not use sharp tools to position the top cover seal. The top cover should not be left open for a long time. After finishing the placement of the additional laser module, it should be closed immediately. Please tighten the top cover screws until the torque will be increased. There are spacers installed to avoid damage to the seal. The screws cannot be screwed in more than the spacer allows.

## 8. Troubleshooting

The errors described below are basic information to trouble shoot the LightHUB® ULTRA laser system. If additional help is required, please contact our service personnel.

Error	Action needed
The system is used with a fibre optic and only one wavelength is low in power	Please refer to chapter 6 and align the beam path. Re-check the transmission efficiency after full adjustment.
The system is used with a fibre optic and the efficiency for all lines is low or the beams are not collinear after fixing the LightHUB® ULTRA to the machine or optical table	Please check the flatness of the mounting area or if there is any contaminant between the base frame ground plate and the mounting area. If so, please remove the contaminant or smooth the mounting area.
Dust is detected inside the LightHUB® ULTRA	Please check the top cover seal for damage and please check each top cover screw if it exists and if it is tight enough.
The laser head temperature exceeds the maximum allowed value or the laser diode temperature exceeds the maximum allowed value	Check ambient temperature and heat sinking.
The system is too cold	Ensure to operate the system within the specified ambient temperature range.
The temperature of the laser diode in one head exceeds the valid temperature range	Check ambient temperature and heat sinking and cabling.
The output power is not stable	Please make sure, the system is completely warmed up before operation. Check ambient temperature and heat sinking

Table 17: Troubleshooting

## 9. Maintenance

The LightHUB® ULTRA laser system is a maintenance free laser product. Please operate the laser system under a clean and dry conditioned environment.

If cleaning is really required, please use only lens cleaning paper with water free methanol (99.99%) and clean acetone (99.99%) for removing the contamination or dust. Please refer to standard optical surface cleaning procedures or please contact our service department for additional cleaning information.

## 10. Warranty

The warranty is limited by the following:

- Unauthorized modification or misuse
- Opening the housing of (one of) the laser head(s)
- Opening the housing of (one of) the laser controller(s)
- Damage of the warranty seals
- Improper or inadequate maintenance by the user
- Operation outside the environmental specifications of the product
- Wrong mounting conditions

## 11. Waste disposal

### **WEEE (Waste of Electrical and Electronic Equipment)**

#### **Recycling of Electronic Products, disposing of this product.**

In 2012 the European Union introduced regulations (WEEE – 2012/19/EG) for the collection and recycling of all waste electrical and electronic equipment. It is no longer allowable to simply throw away electrical and electronic equipment. Instead, these products must enter the recycling process.

This product must not be disposed in normal garbage!

When this OMICRON-Laserage Laserprodukte product is no longer used or out of order and should be disposed please refer to the service address indicated in the scope of delivery to send back the device in its original package to the manufacturer to enter the recycling process.



We thank you for your understanding!

## 12. Spare parts and service (manufacturer identification)

Please contact for service and spare parts:

Omicron-Laserage Laserprodukte GmbH

Raiffeisenstraße 5e

63110 Rodgau, Germany

E-mail: mail@omicron-laser.de

Web: www.omicron-laser.de

Tel.: +49 (0) 6106 – 8224 - 0

Fax: +49 (0) 6106 – 8224 – 10