

# CAVILUX<sup>®</sup> OEM

## Sapotech system

### Operating Manual



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CAVILUX OEM Sapotech system v3.0, Operating Manual, Revision 1.0.1

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# 1 Introduction

Thank you for choosing CAVILUX OEM Sapotech system v3.0 (later in this manual: CAVILUX OEM)!

CAVILUX OEM is a Finnish quality product developed and manufactured by Cavitar Ltd. We hope that you will be satisfied with your product.

CAVILUX OEM is a robust, reliable and easy-to-use pulsed high power diode laser light source designed especially for the visualization of challenging processes in industrial production lines.

Please read this operating manual carefully before using CAVILUX OEM.

Chapter 2 contains important safety information for the safe operation of CAVILUX OEM.

Chapter 3 describes the properties of CAVILUX OEM and Chapter 4 deals with the installation of the system.

Chapter 5 describes the operation of CAVILUX OEM. In addition, useful information related to the use of CAVILUX OEM is provided in Section 5.4. As an example, troubleshooting is covered in Section 5.4.3.

Chapters 6 to 7 cover issues related to maintenance, service, support, accessories and warranty.

The detailed appearance of some components may vary.

The symbols below will be utilized throughout this operating manual:

**NOTE!** indicates useful tips for easier operation

**CAUTION!** indicates potential risk of serious damage to the device

**WARNING!** indicates potential risk of serious injury to the user



## 2 Safety information

PLEASE CAREFULLY READ AND UNDERSTAND THE FOLLOWING SAFETY INSTRUCTIONS BEFORE USING CAVILUX OEM. IT IS OF UTMOST IMPORTANCE TO STRICTLY OBEY THESE INSTRUCTIONS. OTHERWISE SERIOUS DAMAGE TO THE USER OR TO THE DEVICE MAY OCCUR.

THIS PRODUCT IS CLASS 3B LASER PRODUCT IN ACCORDANCE WITH BS/EN 60825-1:2014, PROVIDED THAT ALL INSTRUCTIONS IN THIS MANUAL ARE PROPERLY FOLLOWED. THE PURCHASER ACKNOWLEDGES THAT THEIR COMPLETE SYSTEM (INCORPORATING CAVILUX OEM) MUST COMPLY WITH ALL APPLICABLE REGULATIONS BEFORE IT CAN BE SOLD.

ONLY A PERSON, WHO HAS CAREFULLY READ AND UNDERSTOOD ALL SAFETY INSTRUCTIONS BELOW AND THE REST OF THIS OPERATING MANUAL, IS QUALIFIED FOR USING CAVILUX OEM. CAVITAR LTD. IS NOT LIABLE FOR ANY DAMAGE CAUSED BY THE IMPROPER USE OF CAVILUX OEM.

CAUTION--USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE.

CAUTION--USE OF OPTICAL INSTRUMENTS WITH THIS PRODUCT WILL INCREASE EYE HAZARD.

**WARNING!**  
**CAUTION!**

LASER APERTURE



- CAVILUX OEM is a Class 3B laser product
  - warning and laser class are indicated by the warning label and explanatory label on top of the laser unit (see above)
  - laser aperture on the laser unit is indicated by yellow aperture label (see above)
- Do not look into the direct, reflected or scattered laser beam!
  - 645 nm laser unit emits visible red laser light at  $645 \pm 10$  nm wavelength band
  - if eye exposure to a Class 3B laser radiation is possible, it is mandatory to wear appropriate laser safety goggles
    - optical density of the laser safety goggles must be OD7+ at  $645 \pm 10$  nm
    - always ensure that the laser safety goggles protect especially for the emission wavelength band of the laser!



- The accidental exposure to direct/reflected/scattered laser beam has to be prevented:
  - utilize suitable casings, curtains, beam blockers/absorbers, closed doors, Remote Interlock (RIL) feature and warning plates/lights/sounds in such a way that no one can enter the region of potential laser exposure by accident
  - pay special attention to possible bystanders or persons passing by
  - ensure that the key is removed from the system control unit after use
- Before turning the device on, make sure that (in addition to the instructions above):
  - everyone inside the region of potential laser exposure wears laser safety goggles that block laser radiation at  $645 \pm 10$  nm
  - the laser output and laser light blockers/absorbers are aligned and positioned in such a way that the direct/reflected/scattered laser beam will not be dangerous to anyone
- the possible risk of fire or explosion in the presence of flammable materials may need to be taken into account
- Ensure that there is no risk of unintentional voltage signal/peak (e.g. static discharge) at the CAM 1...4 connector (sync signal input), since this may enable/disable laser output (see Chapter 3 for more information)
- Other instructions:
  - CAVILUX OEM is not certified for medical use
  - Do not make ANY modifications to the device by yourself
  - Do not try to repair the device by yourself
  - It is strictly forbidden to open the cover of the laser unit or the control unit. Otherwise serious damage or injury to the user or to the device may occur. Laser unit contains gallium arsenide, which is a known human carcinogen
  - Before turning the device on, ensure that all connections are properly made
  - Do not expose the system to moisture, rain or condensing environment
  - Excessive vibration or strong mechanical impact may damage the equipment
  - The operating temperature of CAVILUX OEM is 0...+40 °C. Do not expose CAVILUX OEM to excessively low or high temperatures. Ensure there is no risk of condensation if the system is used in low temperature. The system can only be used in non-condensing environment
  - If you are uncertain about any issue related to safety or proper operating conditions, please contact your vendor or Cavitar



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## SAFETY FEATURES OF CAVILUX OEM:

- Safety information in this manual
  - this safety information as well as the whole Operating Manual need to be fully read and understood before a person is qualified for using CAVILUX OEM
- Key-operated master control for power on/off (to be realized by the integrator)
  - only a person qualified for using CAVILUX OEM has the right to possess the key for the key-operated master control for power on/off
  - the key has to be removed from the system when the device is not in use. This prevents the unauthorized use of CAVILUX OEM
  - key can not be removed while in “ON” position
  - NOTE! It is the responsibility of the system integrator to realize an appropriate key-operated master control for power on/off by utilizing the “Switches” connector of the control unit (see Chapter 3 for more details)
- Remote Interlock (RIL)
  - when used correctly, this safety feature ensures that the laser output will be switched off in case someone enters the region of potential laser exposure
- Mechanical beam stopper
  - for Class 3B laser system, a mechanical beam stopper must be permanently attached to the laser output
  - NOTE! It is the responsibility of the system integrator to ensure an appropriate mechanical beam stopper is in place under all circumstances
- Laser emission indicating devices
  - green “Power” led on the laser control unit front panel indicates that the device is powered and the generation of laser light is possible
  - yellow “Active” led on the control unit front panel indicates that the remote interlock circuit is closed and “Activate” push button has been pressed.
  - red “Pulse” led on the control unit front panel is on when laser light is being generated. Blinking red led indicates that sync signal frequency at CAM input(s) is too high. In this case protective electronics limits the operation of the laser(s)
  - green power indicator led in the laser unit back panel indicates that the generation of laser light is possible
- Laser aperture label
  - laser aperture label indicates the location of the laser output beam
- Laser safety goggles
  - to be applied by the integrator for systems classified as Class 3B
  - appropriate laser safety goggles must have OD7+ at the laser emission wavelength band ( $645 \pm 10$  nm)



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## CERTIFICATIONS AND COMPLIANCE

- Cavitar Ltd. is an ISO 9001:2015 certified company
- CE declaration of conformity
  - CAVILUX OEM, if installed and operated in accordance with the manufacturer's instructions, is in conformity with the following European, harmonized and published directives and standards:
    - 2011/65/EU (RoHS 2)
    - 2014/30/EU (Electromagnetic Compatibility)
    - 2014/35/EU (Low Voltage Directive)
    - BS/EN 60825-1:2014 (Laser Safety)
- Declaration of conformity with 21 CFR 1040.10 and 1040.11
  - Complies with 21 CFR 1040.10 and 1041.11 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.
- Safety
  - CAVILUX OEM meets the requirements of the following electrical equipment safety standards:
    - IEC 61010-1:2010 + Am1:2016
    - EN 61010-1:2010
    - UL 61010-1: 3rd Edition
    - CSA C22.2 No. 61010-1-12
- Electromagnetic compatibility (EMC)
  - CAVILUX OEM meets the requirements of the following EMC standards:
    - IEC 61326-1:2020: Immunity in an industrial electromagnetic environment
    - CISPR 11:2015/AMD2:2019: Group 1, Class A emissions
    - FCC 47 CFR Part 15B: Class A emissions
    - ICES-003 Issue 6: Class A emissions

Group 1 equipment is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy in the frequency range 9 kHz to 400 GHz for the treatment of material or inspection/analysis purposes.

Class A equipment is suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

Warning: Class A equipment is intended for use in an industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances. This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Changes or modifications not expressly approved by Cavitar Ltd could void the user's authority to operate the equipment.



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## 3 Properties

CAVILUX OEM typically consists of the following components:

### LASER UNIT

- laser warning label, explanatory label and aperture label
- pulse rise time <20 ns
- wavelength  $645 \pm 10$  nm (see the device label on the bottom of the laser unit)
- four mounting holes on the bottom (M4 thread)
- green laser emission warning indicator led
- physical dimensions approximately 36 mm x 62 mm x 150 mm (laser connector requires additional space behind the laser unit)

### CONTROL UNIT

- max. laser output duty cycle (DC) 0,03 %
- CAM 1...4 input connectors for synchronization of laser units
- LU 1...4 output connectors for laser units
- RIL (Remote Interlock) connector
- SWITCHES connector for key-operated master control for “Power on/off” and “Activate” push button (for instructions on how to connect to SWITCHES connector, see attachment 3)
- 4 rotary switches for laser pulse duration selection (2  $\mu$ s steps up to 30  $\mu$ s, one switch for each laser unit)
- front panel indicator leds: Power (green), Active (yellow) and Pulse (red)
- WLS connector for external warning light system (same operation as with front panel indicator leds)

### ILLUMINATION OPTICS

- Fixed optics for area illumination
- Mechanical shutter for stopping the beam

### CABLES

- laser cable(s) between laser unit and control unit





**Table 3.1. CAVILUX OEM specifications.**

|   |   |
|---|---|
| <b>Optical</b>                                |   |
| Wavelength                                    | 645 ± 10 nm   |
| CW/Pulsed                                     | Pulsed  |
| Pulse duration                                | ~1 – 30 µs (in 2 µs steps)                                |
| Max duty cycle (DC)                           | 0,03 %  |
| Max average power                             | < 500 mW  |
| Max pulse energy                              | < 30 mJ   |
| Laser class (according to BS/EN 60825-1:2014) | 3B  |
| <b>Electrical</b>                             |   |
| Control unit input voltage                    | DC 24 V ± 10 %  |
| Control unit power requirement                | 66 W  |
| <b>Mechanical</b>                             |   |
| Control unit dimensions                       | ~200 mm x 200 mm x 72 mm (excl. connectors)               |
| Control unit weight                           | ~1,9 kg (depends on configuration)                        |
| Control unit attachment                       | DIN-rail mounting   |
| Laser unit dimensions                         | ~ 36 mm x 62 mm x 150 mm<br>(excl. optics and connectors) |
| Laser unit weight                             | ~0,5 kg   |
| Laser unit attachment                         | 4xM4 mounting holes, depth 4 mm, DIN-rail mounting        |
| <b>Environmental</b>                          |   |
| Storage temperature                           | 0...+50 °C  |
| Operation temperature                         | 0...+40 °C  |
| Indoor/outdoor use                            | Indoor use only   |
| Humidity                                      | max 80 % RH non-condensing                                |
| Altitude                                      | Max 2000 m above sea level                                |
| Pollution degree                              | PD2   |
| Supply voltage fluctuations                   | ±10 %   |
| Overvoltage category                          | II  |





**Fig. 3.1. Bottom panel of CAVILUX OEM control unit.**

Bottom panel connectors:

- |          |  |
|----------|--|
| LU 1...4 | M12 8-pole female connector for laser unit (connection between control unit and laser unit)  |
| RIL      | Connector for remote interlock circuit. The device will not emit laser radiation when the terminals of the RIL connector are open-circuited (BS/EN 60825-1:2014). Mating connector is LEMO FGG.1B.303.CLAD62Z. See circuit diagram in attachment 1 |
| WLS      | M16 10-pole female connector for warning light system. See circuit diagram in attachment 2   |



**Fig. 3.2. Top panel of CAVILUX OEM control unit.**

Top panel connectors:

- |           |  |
|-----------|--|
| 24 VDC    | M12 4-pole male connector for DC 24 V power supply (Polarity: positive pin 1 and ground pin 4) See circuit diagram in attachment 5   |
| SWITCHES  | M16 10-pole female connector for key-operated master control for “Power on/off” and “Activate” push button. See circuit diagram in attachment 3  |
| CAM 1...4 | M12 5-pole female connector for synchronization of respective laser unit (connection between control unit and camera or some other external synchronization source). See circuit diagram in attachment 4 |





Fig. 3.3. Front panel of CAVILUX OEM control unit.

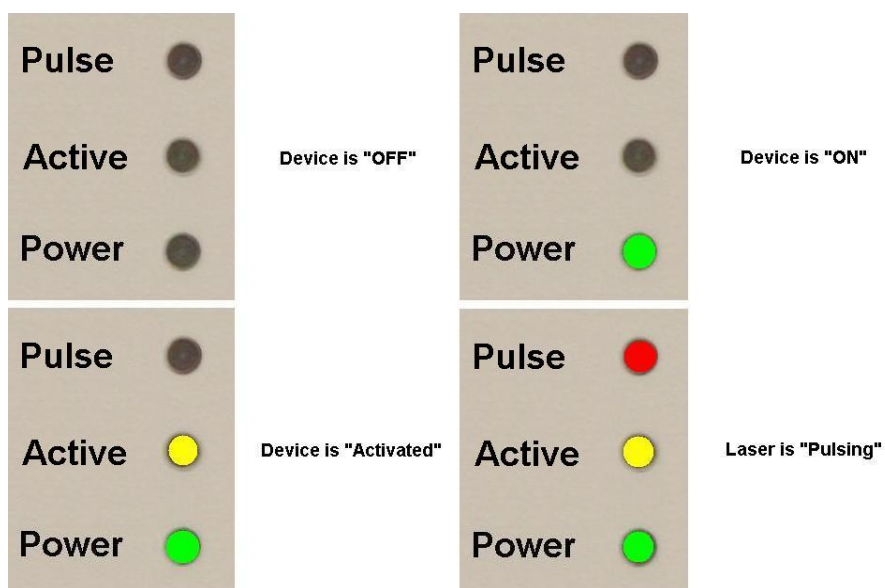


Fig. 3.4. Examples of front panel indicator operation.



Front panel indicator leds:

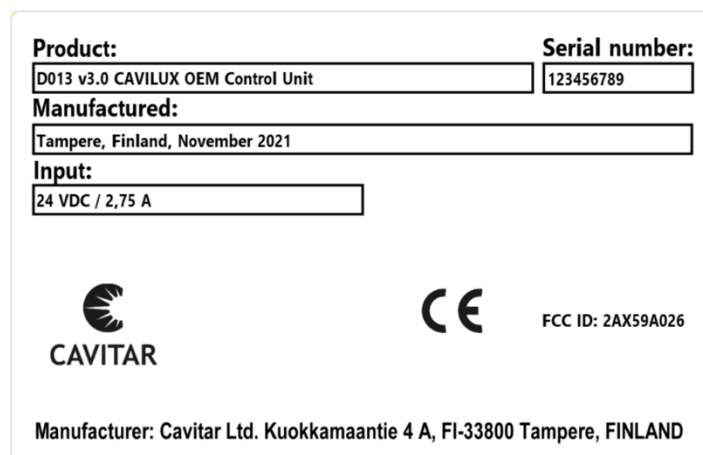
|        |  |
|--------|--|
| Pulse  | red led indicates that the device is generating laser output. Blinking red led indicates that sync signal frequency at CAM input(s) is too high. Protective electronics limits the operation of the laser(s) |
| Active | yellow led indicates that the terminals of the RIL connector are short-circuited and “Activate” push button has been pressed   |
| Power  | green led indicates that the device is powered (key-operated master control for “Power on/off” is in “ON” position) and the emission of laser light is possible  |



**Fig. 3.5. Front panel rotary switches 1...4.**

Front panel switches: 4 rotary switches for laser units 1...4 pulse duration selection (leftmost switch for laser unit 1 and rightmost switch for laser unit 4). More details in Section 5.3.2

Control unit device label is located at the bottom of the control unit (Fig. 3.6).



**Fig. 3.6. Control Unit device label (example).**



Fig 3.7 shows the mechanical dimensions of the CAVILUX OEM laser unit without the fixed illumination optics. An example of device label is magnified on top. The locations of the laser aperture labels and the laser warning label (combining laser hazard symbol, explanatory label and radiation output label) can also be seen.

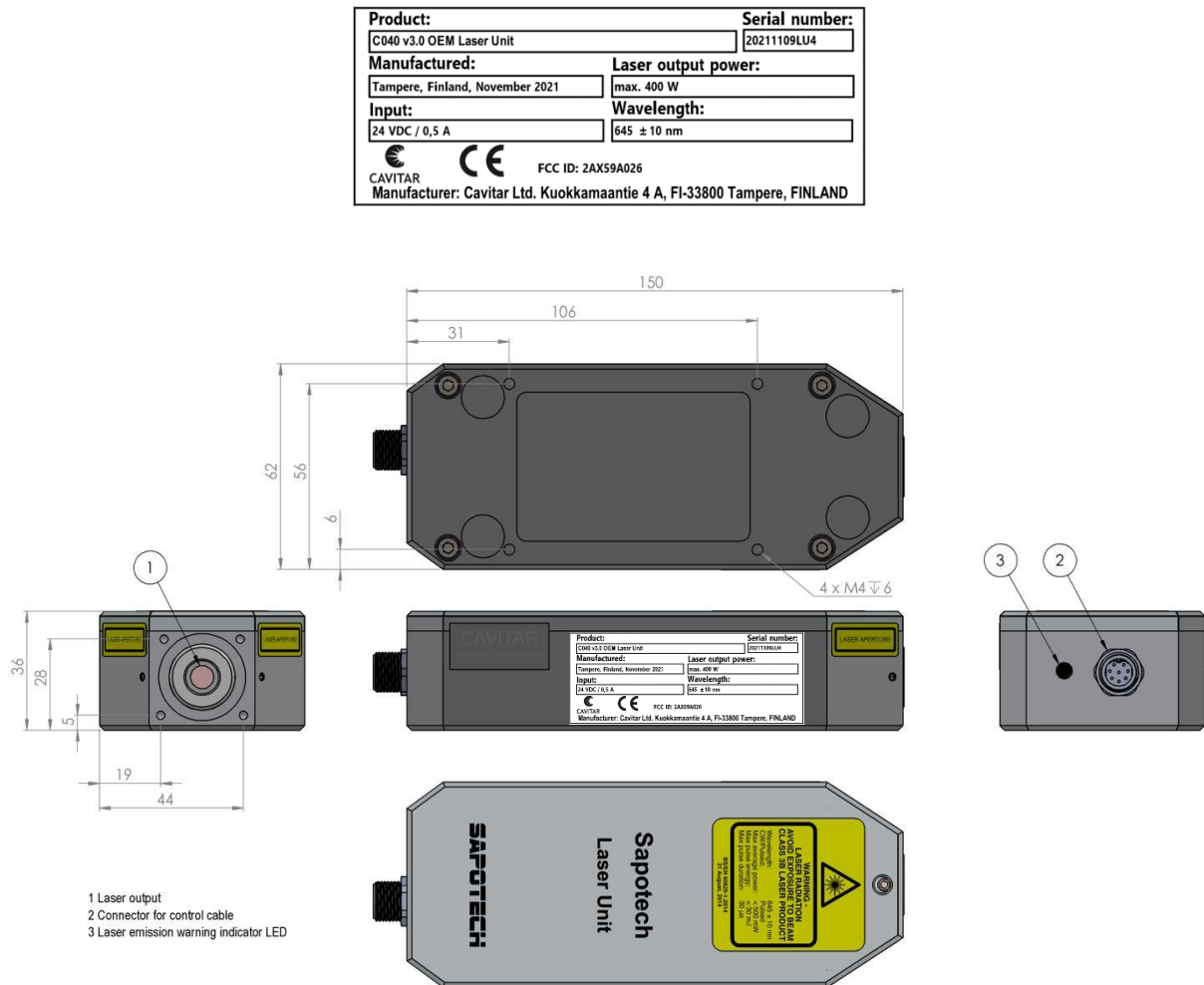


Fig. 3.7. CAVILUX OEM laser unit (without fixed optics).



Fig 3.8 shows the top view of the laser unit with the fixed illumination optics and mechanical beam stopper in place. The mechanical beam stopper is located at the output end of the illumination optics (rightmost part in Fig. 3.8).

The laser generates an asymmetrical output beam with the direction perpendicular to the plane of paper (in Fig. 3.8) diverging faster than the direction in the plane of paper (in Fig. 3.8). At a working distance of 2 m the dimensions of the illuminated area are approximately 1 m x 0,5 m (direction perpendicular to the plane of paper x direction in the plane of paper).

To close the mechanical beam stopper, move the lever (indicated in Fig. 3.8) 90 degrees counter-clockwise (if viewing from front). Laser radiation exceeding the Class 1 AEL (accessible emission limit) can only be emitted through the illumination optics provided that the mechanical beam stopper is open. Laser aperture label in the illumination optics is also shown in the image.

If the laser unit is placed inside additional protective housing and the distance between the laser control unit and the laser unit exceeds 2 m, duplicated power led must be mounted to the additional protective housing in such a way that it can be easily seen. Cavitar offers dedicated extension cables for this purpose. Also laser aperture label and laser warning label must be attached to the additional protective housing in such a way that they can be easily seen. Furthermore, the mechanical beam stopper must be realized in any additional protective housing.



Fig. 3.8. CAVILUX OEM laser unit with fixed optics.



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## 4 Installation

### Installation of laser unit(s)

The laser unit(s) can be mounted on a firm and stable surface so that the object can be properly illuminated. Also the safety instructions in Chapter 2 need to be taken into account. In the illumination of objects that may cause excessive radiation, heat, vibration or mechanical forces (e.g. explosions, materials processing or hot metal surfaces) the laser unit needs to be properly protected. If you feel uncertain about the correctness of the installation and/or about the suitability of the environment, please contact your vendor or Cavitar. Warranty does not cover damage caused by improper installation.

### Installation of laser control unit

Control unit is designed for DIN rail mounting. Alternatively the control unit can be placed on a firm surface. The safety instructions in Chapter 2 need to be taken into account.

### Making the connections

The connections shall be made in the following order:

- Make connection between key-operated master control, Activate push button and Switches connector.
- Connect RIL-circuitry to the RIL connector
- Connect warning light system to the control unit (WLS connector), if applicable
- Connect the cable(s) between laser unit(s) and control unit.
- Connect synchronization device(s) for synchronization input(s) (CAM 1...4) (e.g. a compatible camera)
- Connect control unit power supply to the power supply connector (24 VDC)

#### **NOTE!**

- To enable laser operation, the terminals of the Remote Interlock (RIL) connector need to be short-circuited together (do not connect to ground!) and “Activate” push button needs to be pressed. To disable operation, disconnect the terminals from each other. The device will not emit laser radiation when the terminals of the RIL connector are open-circuited (BS/EN 60825-1:2014).

#### **CAUTION!**

- **Only a sync signal within the voltage range 0...+24 V can be delivered to CAM 1...4 connectors.** E.g. negative voltage and/or excessively large voltage may damage the control unit.
- **Only attach/detach cables when the system is not powered**



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**WARNING!**

- Ensure that there is no risk of unintentional voltage signal/peak (e.g. static discharge) at the CAM 1..4 connector(s), since this may enable/disable laser output(s) (see e.g. Chapter 3 for more information).
- Ensure that the locations of all operation and adjustment controls as well as other system components are such that neither the operator nor anybody else can be exposed to laser radiation.
- Ensure that all system components are placed in such a way that the applicable mains plugs are always easily removable from the electrical network.





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## 5 Operation

After successful installation CAVILUX OEM is ready for operation. In the following the operation of the system is described in more detail.

### 5.1 Preliminary issues

Before operation the following preliminary issues need to be performed:

- check that laser unit(s) and laser control unit are installed appropriately and that all optical surfaces are clean
- make sure that the key-operated master control of the control unit is "OFF"
- make sure that the connections are as described in Section 4
- make sure that the mechanical beam stopper is open
- make sure that the safety instructions (Chapter 2) have been properly followed

### 5.2 Operation

- set the pulse durations for each laser output
  - remove the lid from the control unit front panel (see Fig. 3.3)
  - set pulse duration for each laser unit with the front panel rotary switches (see Fig. 3.5 and Table 5.1 for more details)
  - mount the lid back to the control unit front panel
- turn the key-operated master control to "ON"
- activate the system via Switches connector (see Fig 3.2)
- after activation the laser unit(s) will generate pulses with set pulse durations according to sync signals detected at CAM1...CAM4 connectors (CAM1 controls LU1, CAM2 controls LU2 etc.)

### 5.3 After operation

After the operation of CAVILUX OEM the following issues should be carried out:

- make sure that the outputs are disabled (Pulse led is off)
- turn the key-operated master control "OFF" and remove the key
- close mechanical beam stopper to keep optical surfaces clean



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## 5.4 Useful information

### 5.4.1 Maximum repetition rates for different pulse durations

Table 5.1 shows maximum repetition rates for different pulse durations.

**Table 5.1. Maximum repetition rates for different pulse durations.**

| Rotary switch position | Pulse duration ( $\mu\text{s}$ ) | Maximum repetition rate (Hz) |
|------------------------|----------------------------------|------------------------------|
| 0                      | 1                                | 400                          |
| 1                      | 2                                | 150                          |
| 2                      | 4                                | 75                           |
| 3                      | 6                                | 50                           |
| 4                      | 8                                | 35                           |
| 5                      | 10                               | 30                           |
| 6                      | 12                               | 25                           |
| 7                      | 14                               | 20                           |
| 8                      | 16                               | 18                           |
| 9                      | 18                               | 16                           |
| A                      | 20                               | 15                           |
| B                      | 22                               | 13                           |
| C                      | 24                               | 12                           |
| D                      | 26                               | 11                           |
| E                      | 28                               | 10                           |
| F                      | 30                               | 10                           |

### 5.4.2 Calculation of pulse energy

The pulse energy ( $E_{\text{pulse}}$ ) can be estimated by multiplying the pulse power ( $P_{\text{pulse}}$ ) with the pulse duration ( $t_{\text{pulse}}$ ):

$$E_{\text{pulse}} = P_{\text{pulse}} \times t_{\text{pulse}}$$



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### 5.4.3 Troubleshooting

The procedure below provides instructions for solving the situation if the system doesn't appear to generate light as expected. If these instructions don't help, please contact your vendor or Cavitar.

#### **WARNING!**

- At all stages ensure that accidental eye exposure to laser output can't occur. The realization of some of the following steps may result in immediate laser output!

- a) check that all system components seem to be intact
  - pay special attention to cables and connectors
  - check the condition of the protective window of the illumination optics
- b) check that all connections are properly made
  - refer to Chapter 4 of this manual and to the attachments at the end of this manual
  - pay special attention to camera synchronization
  - ensure that the camera is compatible with the control unit
- c) check that the mechanical beam stopper is not blocking the beam
- d) check that the control unit is powered
  - Power led (green) in the control unit front panel (and laser unit back panel) should be on
- e) check that laser pulse duration is properly selected
- f) check that the system is activated
  - ACTIVE led in the control unit front panel should be on
- g) check that system receives synchronization signals
  - Pulse led in the control unit front panel should be on
- h) check camera settings
  - ensure that the camera is set up correctly (refer to camera manual)
  - try increasing the exposure time to 1/frame rate



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## **Maintenance and service information**

CAVILUX OEM is essentially maintenance and service free so normally there is no need for these operations. However, sometimes there may be need to clean optical surfaces or casings or to replace the protective window of illumination optics.

### **WARNING!**

Ensure the system is turned off and all power supplies are detached from mains supply before performing any maintenance or service operations!

## **Cleaning optical surfaces**

For optimal performance it is important to keep the laser output window clean. Clean this sensitive optical surface primarily by using clean and dry pressurized air. If this is not sufficient, try dry optical wipes. If needed, the optical wipe can be moistened with ethanol. Be careful not to create any scratches on optical surfaces, as this will deteriorate the performance of the system.

## **Cleaning the system**

Clean casings with slightly moist wipe. Avoid using strong solvents. Ensure the system is fully dry before connecting it to mains supply in order to avoid the risk of electrical shock (pay special attention to connectors).

## **Other maintenance or service needs**

In case any other needs for maintenance or service appear, please contact your vendor or Cavitar (see Chapter 6 for more details).



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## 6 Support and end of life

### Support and contact information

It is of utmost importance to Cavitar that CAVILUX OEM will work reliably and offers the greatest possible benefit to our customers. These objectives have guided the design and manufacturing of the product. However, if problems occur despite of our efforts, it will be our first priority to solve these problems as quickly and efficiently as possible.

In case of problems please contact your vendor or Cavitar by email or by telephone.

Cavitar Ltd.  
Kuokkamaantie 4 A  
FI-33800 Tampere, FINLAND  
tel: +358 3 447 9330  
email: support@cavitar.com

Our current contact information is available at our website: [www.cavitar.com](http://www.cavitar.com).

### End of life

It is not allowed to dispose CAVILUX products as unsorted municipal waste. CAVILUX products must be returned to your vendor or to Cavitar for proper disposal at the end of their life. Alternatively one can consult local, state and federal regulations for proper disposal.

CAVILUX laser units contain Gallium Arsenide. Gallium Arsenide is toxic and must not be released to the environment.



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## 7 Limited warranty

Cavitar warrants to the customer, that the product is free from defects in materials and workmanship and that the product is in good working order. Cavitar does not warrant error free or uninterrupted operation of the product.

The warranty is valid only if the serial number plate is on the product (i.e. not removed or defaced).

The warranty for the product is one year starting from the date of purchase or delivery (unless the applicable law establishes a longer period). Cavitar will provide warranty service and technical support free of charge during the warranty period.

In warranty service Cavitar will first diagnose the fault. Cavitar will repair or change the defective product either by delivering a new or refurbished product. Cavitar may give instructions regarding the return or replacement of defective products. Original packing materials should be retained for possible need during warranty period. All exchanged parts and products replaced under warranty period become the property of Cavitar. In the case that the product will be changed, the defective product has to be returned in its original packing materials to Cavitar without delay. Failure to return the defective product will result in an invoice at current or last published list price. A replacement product will be delivered without other parts, cables or options. Those parts need to be removed from the defective product and they have to be used with the replacement product.

Warranty service does not include repair or replacement caused by the following reasons:

- 1) negligence by the user of the product or overloading of the product or failure to observe the operating instructions or proper care,
- 2) transportation of the product,
- 3) unauthorized modifications or attachments have been made to the product,
- 4) the casing of the product has been opened,
- 5) circumstances outside the control of Cavitar such as freezing, fire or accident or it has been misused,
- 6) repairs or maintenance by maintenance people other than those authorized by Cavitar,
- 7) the use of other than original parts provided by Cavitar, and
- 8) normal wear and tear.

The warranty does not cover defects which are insignificant to the use of the product, such as repair of superficial scratches.

The statement of limited warranty is the exclusive warranty. All other expressed or implied warranties including merchantability and applicability for a certain purpose are excluded (except where the applicable law requires said implied warranties). Any warranty, either expressed or implied, will not apply after warranty period.

### LIMITATION OF LIABILITY

To the extent of the applicable law, the sole remedy of the customer is the warranty service set forth above. Cavitar's liability for actual damages of any kind will be limited to the price paid for the product, its repair or replacement. This limitation of liability does not apply to bodily injury or property damage for which Cavitar is held legally liable. In no event will Cavitar be liable for lost profits nor for incidental, consequential or other damages even if advised of the possibility of said damages.

