PRODUCT MANUAL
RLS/CCS-HPP

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Cool & Control
Series
*CC-S Single-Mode laser diode
driver / SOA driver*

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Contents

Revision Sheet

Release No.	Date	Author	Revision Description
V3.0	27/03/2020	AMU	First version under AERODIODE
V3.1	10/04/2020	AMU	Added safety advice and warning

Disclaimer

Information in this document is subject to change without notice.

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1. General information

Please read this manual carefully, it describes the hazard the user might be exposed to while using the product. It also explains in details how to use the product in the safest and more efficient way possible.

The safety of any system incorporating the product is the responsibility of the assembler of the system.

Any actions taken by the user that is not clearly described in this user manual might present a risk and is the sole responsibility of said user.

This product is to be used in laboratory or industrial tasks, and only by personnel who have followed a training in laser hazard.

1.1   Definitions

Caution : A caution is advised when dealing with hazardous situations, tasks or objects, to prevent harm or death and avoid material damage or failure.

Warning : A warning is given for potentially dangerous situation for people which cause them harm or lead to death

Note : A note is a complementary piece of advice that must be acknowledged by the user.

1.2   General warning

Caution
The compatible laser diodes used with the CC-S can deliver up to several Watts of coherent LASER radiation. Always wear protective goggles and observe the safety instructions provided by the laser diode supplier when using the CC-S driver with your laser diode.

WARNING
Do not try to open or remove the cover of the CC-S module

Note
Only use the genuine power supply, and the supplied USB cable

WARNING

Avoid all chocs and strains when handling the CC-S

WARNING

Handle the fiber-optics cable with care as it is fragile. Do not bend or pinch it.

WARNING

Any software settings or hardware tinkering that is not described in this user manual or in the usage recommendation may put the user or its environment at risk.

WARNING

the maintenance and servicing of the CC-S should not be executed by the end user : only AERODIODE is able to maintain the CC-S.

2. Safety Instructions

2.1. Wiring

Caution

- Please first connect the input pins to the board and then plug the DC Power Supply.
- Use caution when connecting the Power Supply.
- Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from the CC-S module.
- Connect the ground completely. Electric shock may occur if the ground is not connected correctly.

2.2. Operating Environment

Caution

- Do not install near any heat sources such as radiators, heat registers, stoves, or other equipment (including amplifiers) that produce heat.
- To reduce the risk of fire or electric shock, do not expose the CC-S to rain or moisture.

WARNING

Not following the safety recommendations and the caution mentioned above can lead to eye damage.

2.3. Contact

If you have any question about the CC-S module, please contact AERODIODE.

3. Package Content

The CC-S package comes with:

- 1 CC-S board
- 1 DC Power Supply (+12V DC / 4A)
- 1 USB-Jack FTDI cable
- 1 USB Key with "Aerodiode Control Software Suite" & User manual in pdf
- 1 User Manual

4. Product overview

Physical characteristics		
Length	130	mm
Width (edge to edge)	110	mm
Width (Connector to connector)	125	mm
Height (top plate)	18	mm
Height with fins	28	mm
Weight	400	g

4.1. Front view of the product

1. **TTL/LVTTL input pulse command/trigger**
    SMA TTL/LVTTL input voltage connector. The signal must be between 0 and +3.3V max.
2. **Power alarm indicator**
    Red LED indicates that the maximum peak current level is reached. If the red light is on, reduce the current level using the software or with #6 / #7 control.
3. **Temperature alarm indicator**
    Red LED indicates that the laser diode temperature is not reached
4. **Signal peak power adjustment (analog input)**
    BNC input voltage connector (0 to +5V) for peak power adjustment.
5. **Signal peak power adjustment (manual knob)**
    Knob for peak power adjustment.
6. **Power ON indicator**
    Blue LED indicates that the device is powered.

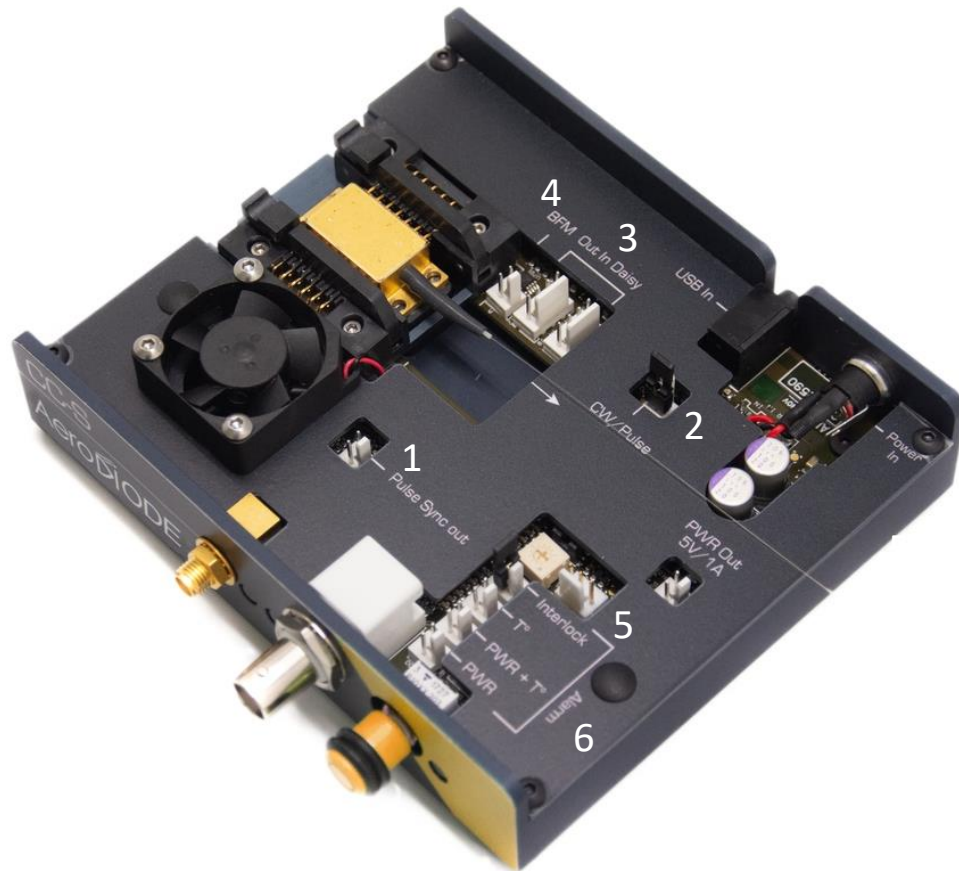## 4.2. Rear view of the device

1. **DC power input (+12 V / +24 V)**
    Input connector for DC power. Use only the provided DC power supply.
2. **USB input**

3.5mm input jack used to connect the CC-S driver with the PC. Use the USB-specific cable which is supplied with your device.

4.3. Top view of the device

1. **Pulse Sync out**
   Synchronization output signal. This Molex output is a LVTTL copy of the CC-S logical driving signal.
2. **Pulse/CW selector**
   2-configurations controls the operating mode. CW mode with jumper and Pulse mode without jumper. It can be switched at any time (no need to power off the module).
3. **Out In Daisy**
   Molex connectors used to chain multiple CC-S drivers or any other ALPhANOV product from the same family (CC-M, PDM, Central etc.). Daisy IN on the left and Out on the right.
4. **Back facet monitor connector**

Molex connector for the laser diode back facet monitor output.

5. **Interlock**

Input connector for interlock control. It must have the jumper in order to have a laser emission.

6. **Alarm monitor**

Molex connector for alarm status (Temperature - Power and Temperature - Power) monitor. The signal is an inverse TTL, so a +5 V output voltage level corresponds to alarm OFF.

5. Installation

5.1. Butterfly Laser diode installation

The CC-S driver is made to drive butterfly laser diodes (14 pins) with internal monitoring photodiode and thermoelectric cooler. The laser diode output fiber must go through the CC-S package.

Note

Use a torque screwdriver for the diode and please refer to the maximum allowed torque given in the diode specification (usually around 15 to 18cNm).

CCS must be adapted to the type of butterfly laser diode : Standard CCS are adapted for type-pinning laser diode (see §11). For Type-2 pinning laser diode, a special version is available, please read the §11 for mounting Type-2 (a TYPE-2 sticker is placed on the cover of the product when it is designed for type-2).


Fiber output direction For SOA see bellow

In case a standard non butterfly laser diode is used (like TO form factor), It is relevant to order a CCS without the Butterfly mounting sockets. This allows to solder the laser diode directly on the Board soldering pads.
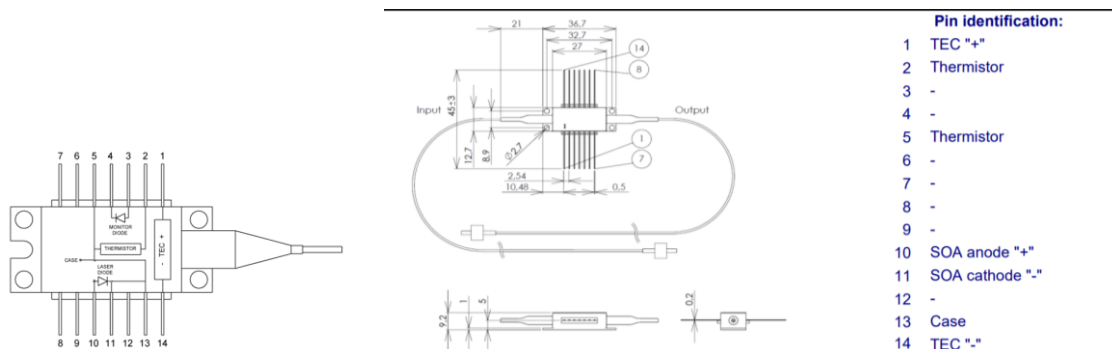
The anode must be soldered on pin 10 and the cathode on pin 11 (see the figure bellow showing pin 10 and 11 by analogy with a butterfly form factor pinning)
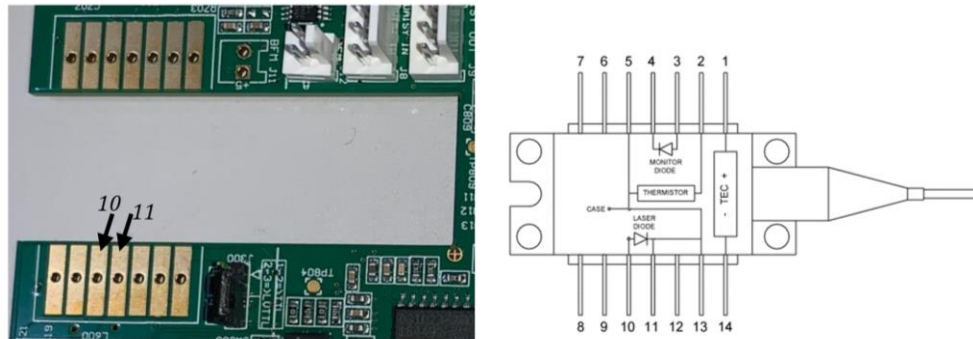
Note that the CCS can be held vertically so that the laser diode emit horizontally.

5.2. SOA installation

In case a SOA is used, make sure the SOA is mounted in the correct direction. Refer to the pin of the SOA (below, right hand side) and compare with a standard Type 1 laser diode (below, left hand side) :

Pin identification:

Pin	Description
1	TEC "+"
2	Thermistor
3	-
4	-
5	Thermistor
6	-
7	-
8	-
9	-
10	SOA anode "+"
11	SOA cathode "-"
12	-
13	Case
14	TEC "-"

In the example above, one can see that the fiber output of the laser diode above (see CCS picture with fiber direction) corresponds to the input of a SOA.

- Software installation
**The CC-S USB specific cable should be unplugged during the installation.**

Double-click on setup.exe to run the installer. The control software will be installed, as well as the driver for the USB cable. A computer restart may be required to complete the installation.

6. Getting started

- When the software is installed, plug the USB cable into a USB port of your computer.
- Next, plug the 3,5 mm jack into the USB input female jack of the CC-S.
- Plug-in the CC-S power supply to turn on the CC-S laser diode driver

Click on the item "ALPhANOV Control Software" located in the Start Menu to run the CC-S control software.
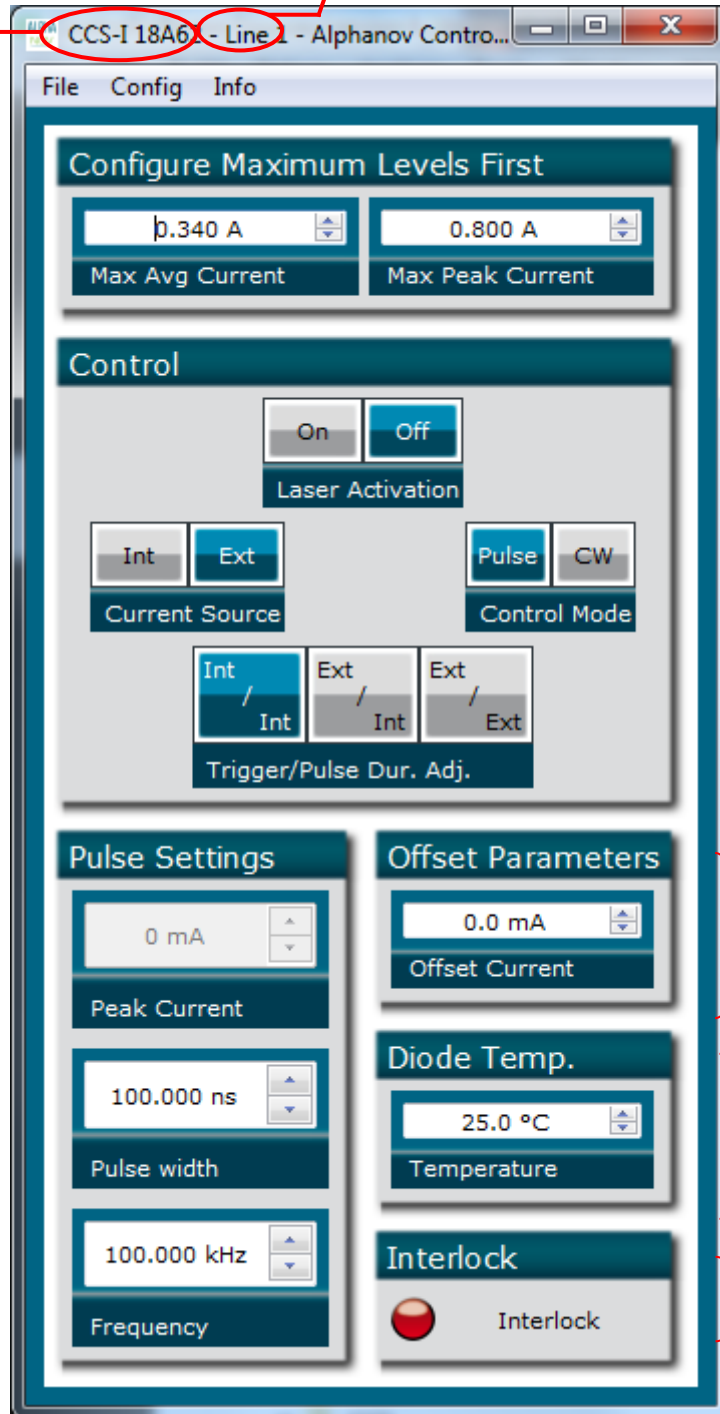
A window will appear:
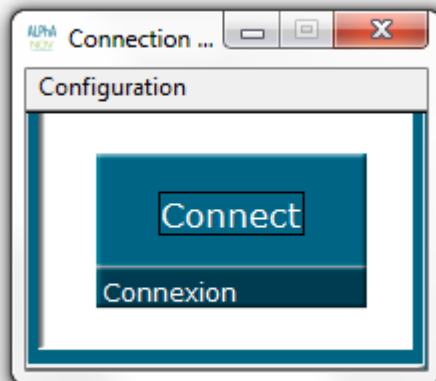
Click on Connect to start the CC-S hardware detection. The software will automatically detect any USB-connected CC-S.

A new window will appear for each CC-S driver.

The window is divided in six parts:
- The average and peak current maximum values are settable in the **Max levels** part. These parameters must be correctly chosen in accordance to the laser diode specifications and maximum ratings. If the Max Peak Current is lower than Max Average Current, the CW operation is not possible
- Triggers in the **Control** part are used to select the operating mode
- Numeric boxes in the **Pulse Parameters** part are used to configure the pulse width, amplitude and repetition rate
- The **Offset parameter** (pulsed mode only) or the **DC parameter** (CW only) are used to configure the DC current (offset in pulse mode)
- The **Temperature** numeric box is used to set the laser diode temperature
- The **Interlock** status is ON (green) when the interlock connector is plugged

The product serial number is written on the top left of the window. The line number (address) is on the top right.

7. Setting the limits

The CC-S laser diode driver includes a hardware overcurrent protection which requires to be set up before driving the laser diode. This protection is active for:
- The average current value
- The peak current value

Before plugging your laser diode into the CC-S socket, please configure these values to the maximum values recommended by the laser diode supplier. **By default, these values are set to zero so the driver will not supply current.** You have to change these values for enabling the driver output.

The average current protection sets the maximum value of the laser diode average current output. This protection is based on an hardware measurement of the average current passing through the laser diode.

The driver output current is temporary halted when the average current level reaches the maximum entered value. In this case, the alarm output level is low (protection is active). Then, as no current is passing though the diode, the average current is measured to be zero and the laser emission will be rearmed automatically.

So, if a parameter (current, pulse-width or frequency) is not changed (smaller), the laser diode emission will be a succession of enable/disable.

The peak current protection limits the laser diode maximum peak current value.

8. Operating modes

8.1. Current source

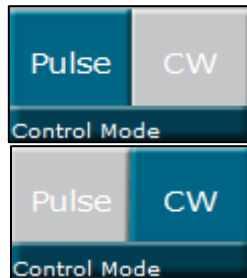This two positions switch controls the current source.

External source
(BNC or manual knob)

Internal source (software)

8.2. Control mode

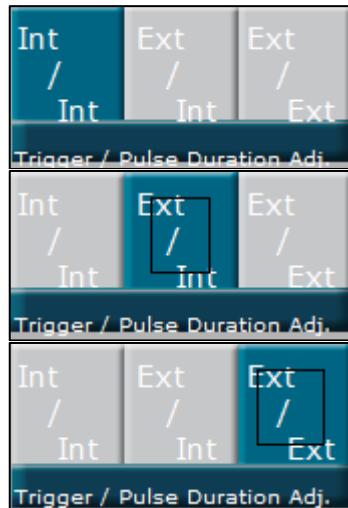This two positions read the operating mode from jump position (see paragraph 4.3)

Pulsed operation

CW operation
(DC current only)

8.3. Trigger and pulse width selection

This three positions switch controls the trigger and the pulse width adjustment. It is only effective in underline pulsed operation.

Internal trigger
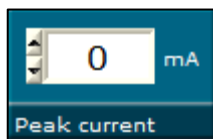Internal pulse width adjustment
(all software)

External trigger (SMA)
Internal pulse width adjustment

External trigger
External pulse width adjustment
(all from SMA)

- If Int/Int is selected, the frequency and pulse width are configured from the software.
- If Ext/Int is selected, the signal is externally triggered by a digital signal on the SMA input. The pulse width is configured from the software.
- If Ext/Ext is selected, the output optical signal is controlled by the digital input signal on the SMA connector.

8.4. Pulse parameters

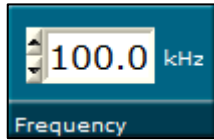The pulse parameters can be modified only when the Pulsed operation is selected (see §4.2).

Peak current in mA
This item can only be modified when the internal current source is selected

Pulse width
Click on the unity (ps, ns or μs) to change it.
This item can only be modified with an internal pulse width adjustment

Frequency (repetition rate)
Click on the unity (Hz, kHz or MHz) to change it.
This item can only be modified when the internal trigger is active

The values which can be entered in these numerical boxes are limited. The limits mainly depend on various parameters such as the wavelength and the maximum allowed optical power.

8.5. Offset/DC current

This item is settable in pulsed and CW operation. It rules the continuous current flowing through the laser diode.
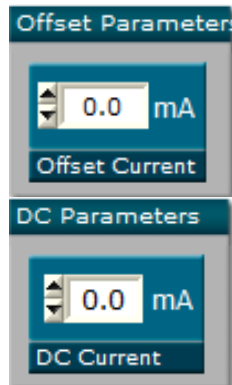
Offset current
This is the offset current which can be superimposed to the pulsed current in pulsed operation

DC current
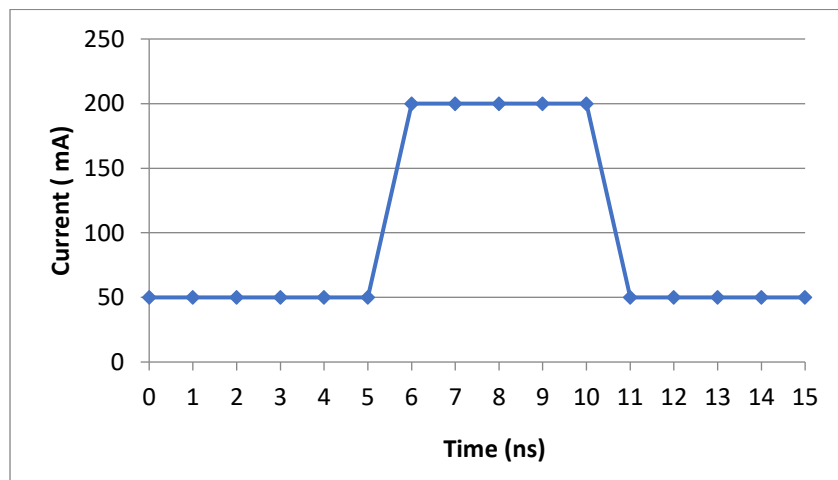In CW operation, this item sets the DC current amplitude

Figure 1 : Diagram of the current passing through the diode (software parameters : Offset current = 50mA, Peak current = 150mA, Pulse width = 5ns
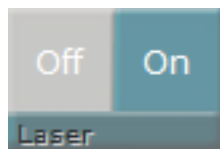
8.6. Temperature

This item configures the internal temperature of the laser diode (on the range 15°C/50°C)

8.7. Laser enable

Enables/Disables the laser emission

9. Menu bar

- File
    - o Load parameters
      Click on this item to load a .txt file which contains the operating parameters.
    - o Save parameters
      Click on this item to save the current parameters into a .txt file. This file can be loaded using the "Load parameters" menu item.
    - o Exit
      Close the window. A confirmation is asked before shutting down the software: the laser state can be either active or inactive after the software is stopped.
- Config
    - o General Config
      Password protected, ask us for the password.
    - o Starting Mode
      Warning : one starting mode allows to configurate the product with some direct lasing at power on for special OEM integration. This configuration is password protected and this password mustn't be shared with people who are not trained on the laser safety issues associated with Class IV laser emission. Contact us to get this password.

        - Low alarms : the module starts with no laser emission, current level is 0 mA, alarms are set at low levels (100 mA average, 500mA peak current)
        - Zero current : the module starts with no laser emission, current level is 0 mA, Alarms are set at the same current levels as previously saved by user.

- Previous (**default mode**) : the module starts with no laser emission, current level and Alarms levels are the same as previously set and saved by the user.
- Previous OEM : the module starts in exactly the same configuration as it has been previously set and saved by user. If laser was on, the laser is on when the power supply is applied.

  o Save

  Click on this menu item to save the current operating parameters into the CC-S internal memory. These parameters will be saved as default parameters in the flash memory and will be retrieved by the driver at the next power on (even if the CC-S driver is not connected to the PC).
  Please note that if the laser state is active and parameters saved into memory, the lasing will be effective after a shutdown.

- Info

  Displays information about the current version and the internal parameters.

- Help

  Load this help file.

10. Technical Specifications

10.1. General Data

Length	130	mm
Width (edge to edge)	110	mm
Width (Connector to connector)	125	mm
Height (top plate)	18	mm
Height with fins	28	mm
Weight	400	g
Power connector (Jack, positive tip)		mm
Power supply (DC)	12V / 4A	
Safety Features	Interlock	
	Over Temperature Protection	
	Laser Current Limit	

10.2. Detailed data

CCS / SOA	Min	Max	Resolution	Impedance	Bandwidth
Operating temperature	-15°C	+40°C			
Storage temperature	-25°C	+70°C			
Operating Altitude	_	2000m			
Output current for CW mode	0 A	800 mA	12 bits		

Output current for pulse mode	Product dependent		12 bits		
Offset (DC) current	0 A	150 mA	36 µA		
Pulse width (for internal generation)	0,2 ns	510 ns (1275ns on request)	For 0 to 10ns : 10ps For > 10ns : 2 ns		
Frequency	1 Hz	4 MHz / 250 MHz (Product dependent)	1 Hz		
Typical delays between trigger EXT and optical pulse	For Ext/Int Mode : • 0 to 10ns pulse duration : 70ns typ. • > 10ns pulse duration : 85ns typ. For Ext/Ext Mode : 30ns typ.				
Laser Diode Temperature	15°C	50°C	0,1°C		
Trigger In level	LVTTL (2,2 V)	LVTTL (3,3 V)		50 Ohm	250 MHz
Sync Out	LVTTL			50 Ohm	250 MHz
BNC peak power adjustment	0 V	5 V		47 KOhm	15 Hz
Alarms	0 V (active)	5 V (Not active)		1 KOhm	

APENDIX

11.   Supported laser diodes

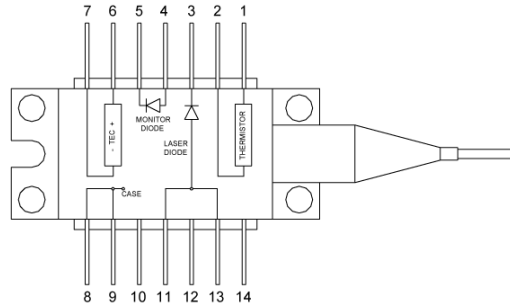### 11.1. Type 1 Butterfly laser : standard CCS

Standard CCS are well adapted for Type 1 Butterfly laser diodes :
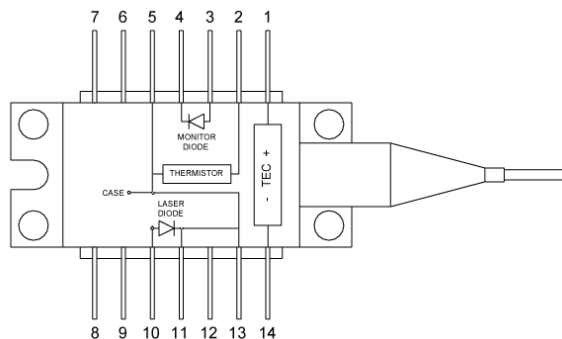
11.2. Type 2 Butterfly laser: CCS-Type2 ("Type 2" sticker on top of the product)

Type-2 and Type-2 Bias-T laser diode are compatible with the CCS – Type 2. Standard two pinouts of type-2 with floating anode are shown below.

Type 2 laser diodes require the CCS "Type-2" version :

Type 2 with Bias-T laser diodes require the CCS "Type-2" version :
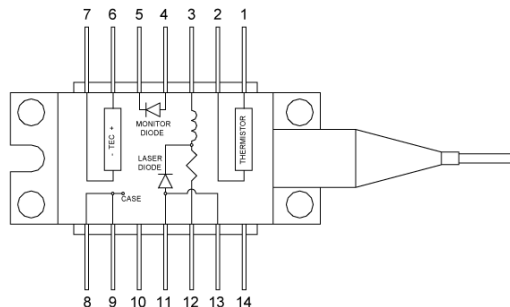
If the anode of type-2 laser (pin 11 or/and 13) is connected to the case (ground) (pin 8 or/and 9) the type-2 diode is called "anode grounded". As the product is intended for use with positive driven current, the current will go directly to the ground without going through the cathode of the laser diode. In this case, the user should mechanically isolated the laser diode by using furnished resin screws (M2,5 screws) and a thermal pad (electrical insulator) between the diode case and the base plate.
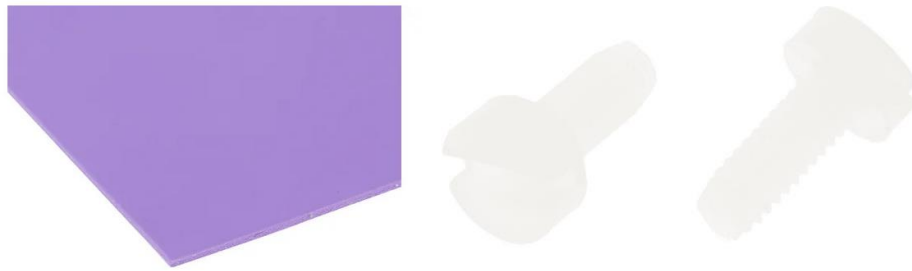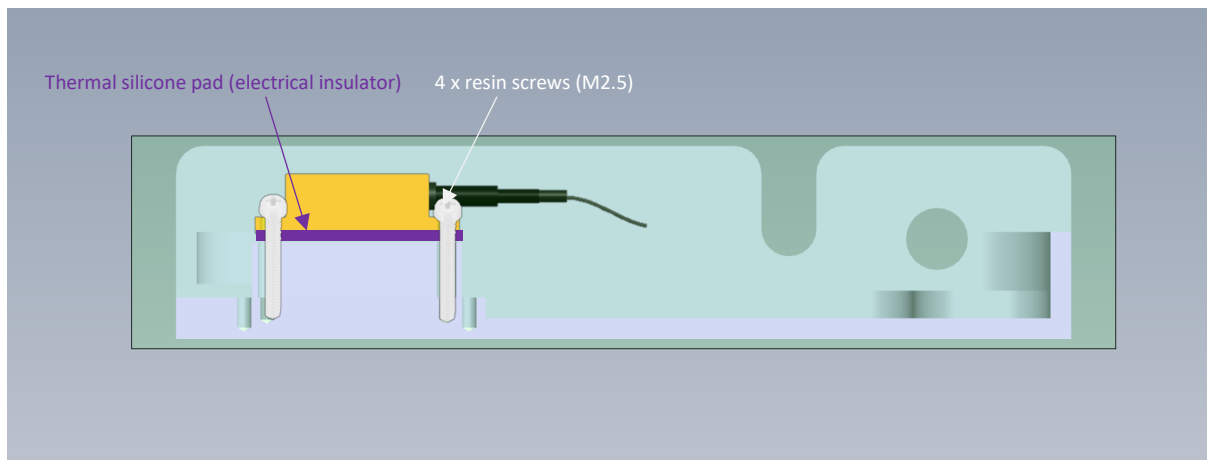
Figure 2 : Silicone thermal pad and resin screws

Thermal silicone pad (electrical insulator)   4 x resin screws (M2.5)

Figure 3 : Cross-section view for mounting type-2 anode grounded laser diodes

12.   How to optimize pulse shapes in case of a high serial laser diode resistor

When using the CCS with a laser diode that has a high internal resistance (>8ohm), the fall time of the pulse could be affected and become slow.

The following recommendation helps to get an optimized pulse shape.

In order to have fastest rise and fall time a ~ 8 Ohm global "equivalent" resistor gives the best results.

Equivalent resistor
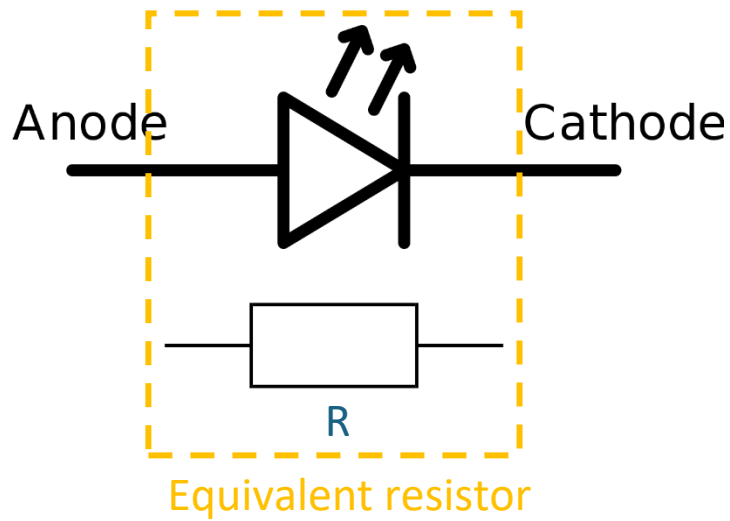
A resistor could be soldered in parallel with the diode directly on the pin of the laser diode. If you don't want to solder the resistor directly on the laser diode, a CMS 0603 resistor could be soldered at the place given below in red (bottom of the board):
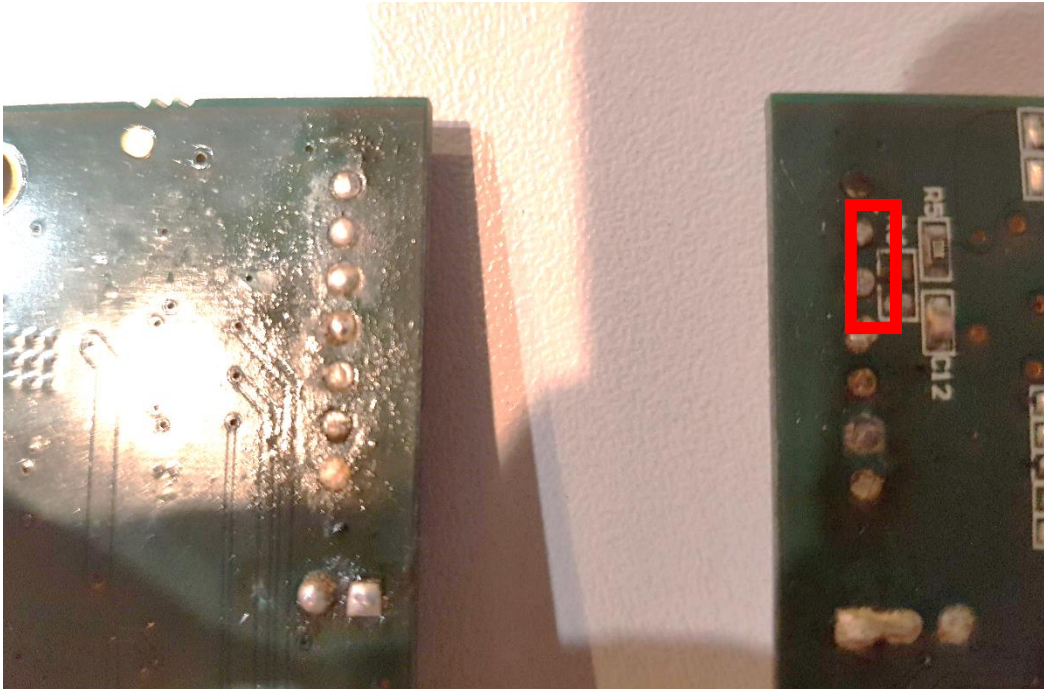
The value of the resistor should be chosen to have best pulse results, but a typical value can be estimated with:

$$R\ (ohm) = \frac{8 \times R_{diode}(ohm)}{R_{diode}(ohm) - 8}$$

If a resistor is soldered, the real current going through the laser diode is not anymore the one that is entered set in GUI. The true value could be estimated by:

$$Current\ (real) = \frac{R}{R_{diode} + R} \times Current\ (set\ in\ GUI)$$

A resistor with enough power dissipation must be chosen (depending on the required current and duty cycle).