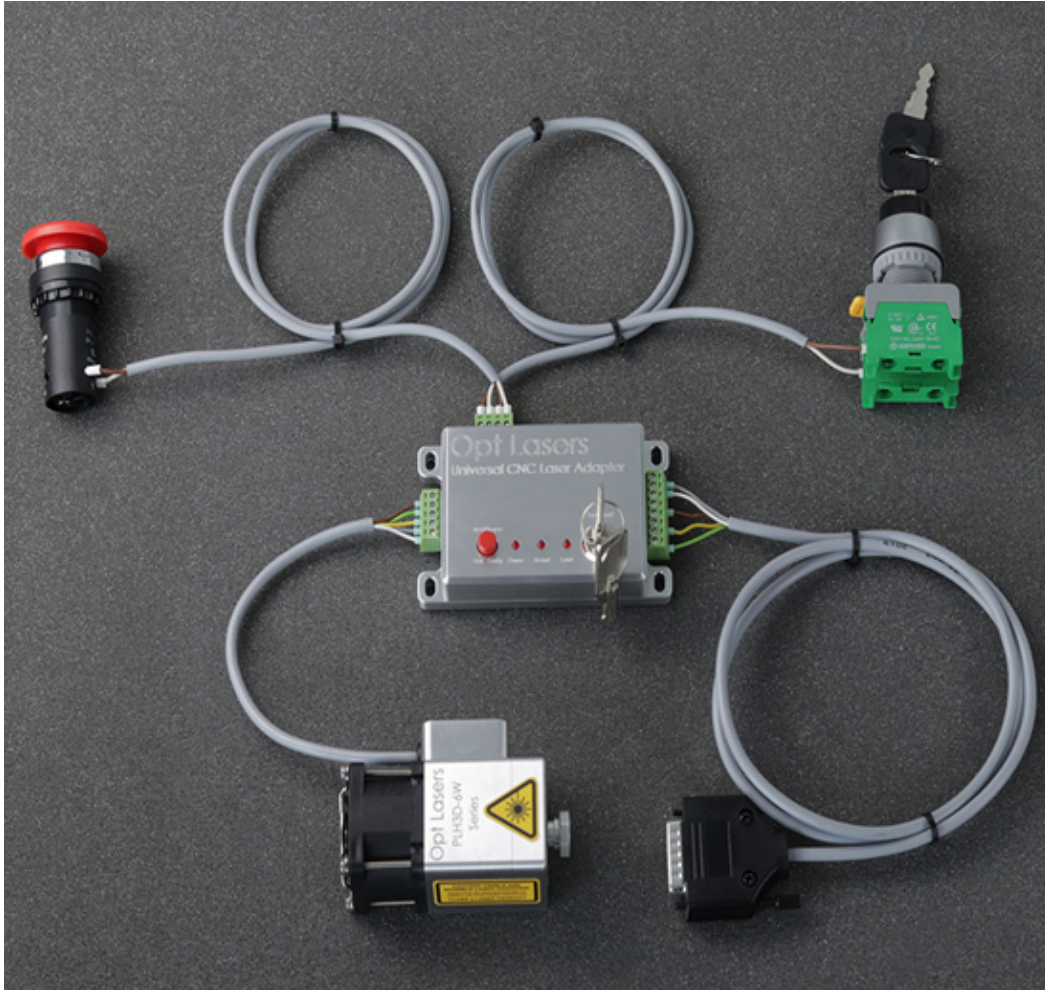


Opt Lasers GRAV



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PLH3D-CNC Adapter (center), PLH3D-6W-XF (bottom left), optional cables with CNC machine connector (bottom right), external keylock (top right) and stop button (top left).

The PLH3D-CNC Adapter serves as a versatile interface and safety unit connected between a CNC machine and a high-performance PLH3D laser head.

Many types of CNC machines and 3D printers available on market, with different control voltage standards and levels available, may be used to control the PLH3D head. The PLH3D-CNC Adapter converts all these signals to the standard compatible with the PLH3D cutting laser.

Key features of the PLH3D-CNC Adapter:

- Key-lock for preventing use by unauthorized personnel;
- Safe start;
- Mode button - can be used for arming/disarming, generating laser pulse for a test, and configuration enable settings;
- Status LEDs - power on, armed, laser working, and setting of Enable Modes;
- Connectors: PLH3D laser head, control, extensions, and external switches;
- Power connector;
- External desktop low-noise power supply;
- Machined aluminum quality enclosure;
- Optional PLH3D laser cables and signal cables dedicated to a CNC machine or controller type;
- Optional external key-lock, stop button, and sensors;
- Compatible with PLH3D laser heads;
- Can be configured for matching with the majority of CNC machines and 3D printers.

The laser head can be made operational by selecting to “arm” and “disarm” the laser head. Arming means turning the head power supply on; the armed head is then able to generate a laser beam. Disarming (turning the head power supply off) brings the laser head to a safe state where generating a laser beam is altogether impossible.

Built-in safety mechanisms prevent misuse and unexpected behavior in case of an emergency. The key switch protects the laser head from being armed by children and other unauthorized people. Arming the laser head is always done manually by the user, by pressing a button. Special circuitry prevents arming during an internal electrical malfunction. The laser head is automatically disarmed in case of an emergency such as a loss of the mains supply (grid power), PSU failure, breakage, or disconnection of the laser head cable. After disarming, the system remains in a safe state, and rearming always requires the user to press the button.

Additional safety mechanisms can be incorporated into the system by adding up to two external switches (e.g., a limit switch, a key switch, or an e-stop). There is also an additional extension connector for future purposes

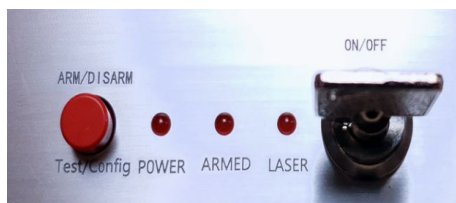
Additional features are industry-standard screw connectors. A dedicated, low-noise desktop power supply unit assures compatibility and reliability as well as eliminates problems caused by using third-party power supplies. The general status (power on, arming, laser working) may be inspected at a glance by looking at the three LEDs.

Controls and Indicators of PLH3D-CNC Adapter

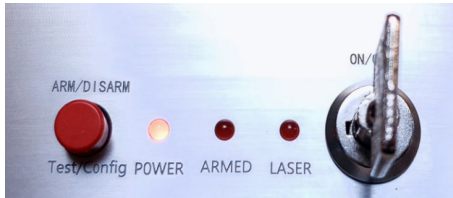


1. Laser Head Connector (with pluggable terminal block)
2. External Switch Connector (with pluggable terminal block)
3. Extensions Connector
4. Power Supply Connector
5. Control Connector
6. Mode Button
7. LED Status Indicators
8. Key Switch

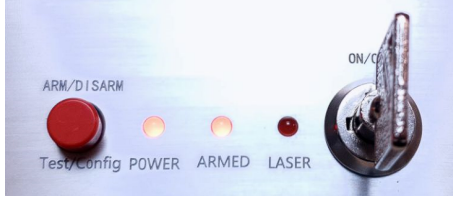
Main States of the PLH3D-CNC Adapter:



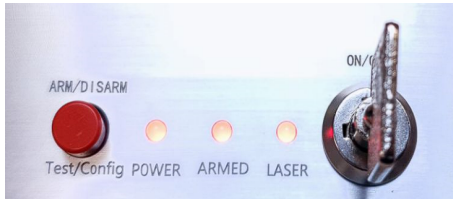
Power Supply - **Off**; Laser Head - **Off**;



Power Supply - **On**; Laser Head - **Off**;



Laser Head - **Armed**; Controlling Signal - **Absent**; Lasing - **No**;



Laser Head - **Armed**; Controlling Signal - **Present**; Lasing - **Yes**;

The detailed description of the distinct parts of the Adapter:

1. LASER HEAD CONNECTOR
 - 1.1. Attach the laser head cable here.
2. EXTERNAL SWITCH CONNECTOR
 - 2.1. Up to two external switches (e.g., a limit switch, a key switch, or an e-stop) that arm/disarm the laser head can be connected to the PLH3D-CNC Adapter. When not using a switch, replace it with a jumper wire.
 - 2.2. Opening any external switch disarms the laser head immediately.
 - 2.3. Then, even if the switch has been closed again, the system will stay disarmed. The mode button must be pressed to rearm the laser head.
3. EXTENSIONS CONNECTOR
 - 3.1. Intended for future applications.
4. POWER SUPPLY CONNECTOR
 - 4.1. Plug in an external 15-24V DC power supply here. We strongly recommend using a dedicated power supply unit exclusively for the PLH3D-CNC Adapter.
5. CONTROL CONNECTOR
 - 5.1. Controlling inputs and outputs are attached here.
6. MODE BUTTON
 - 6.1. Pressing the mode button once will arm the laser head. Doing so will cause the ARMED LED indicator to light up, implying the laser head is in the armed state; the fan in the laser head starts to work as well. To disarm the laser head, press and release the button again.
 - 6.2. A test laser pulse can be generated in the armed state by pressing and holding the mode button for at least 1.5 seconds. An approximately one-second-long pulse at 100% power is then issued on the laser head control line. The LASER LED lights up, confirming the appearance of the pulse. A single pulse will be generated even if the button is held for

longer. Please refer to "Getting Started" section.

6.3. Holding the mode button while turning the power on activates the configuration mode.

For further details, please visit the *For Advanced Users* section.

7. LED STATUS INDICATORS

7.1. The POWER LED shows the presence of power and also signals supply errors.

7.2. The ARMED LED shows the arming state. Furthermore, it also signals both disarming by an external switch and disconnecting the laser head.

7.3. The LASER LED shows the presence of the laser head controlling signal (a steady one or a pulse-like). Note that controlling the laser head is disabled in the disarmed state.

7.4. In configuration mode, the LEDs show the current option(s). Refer to the *For Advanced Users* section. For adapters sold after 20-July-2020, the currently set Enable Option will be displayed for 1 second after turning the switch key on.

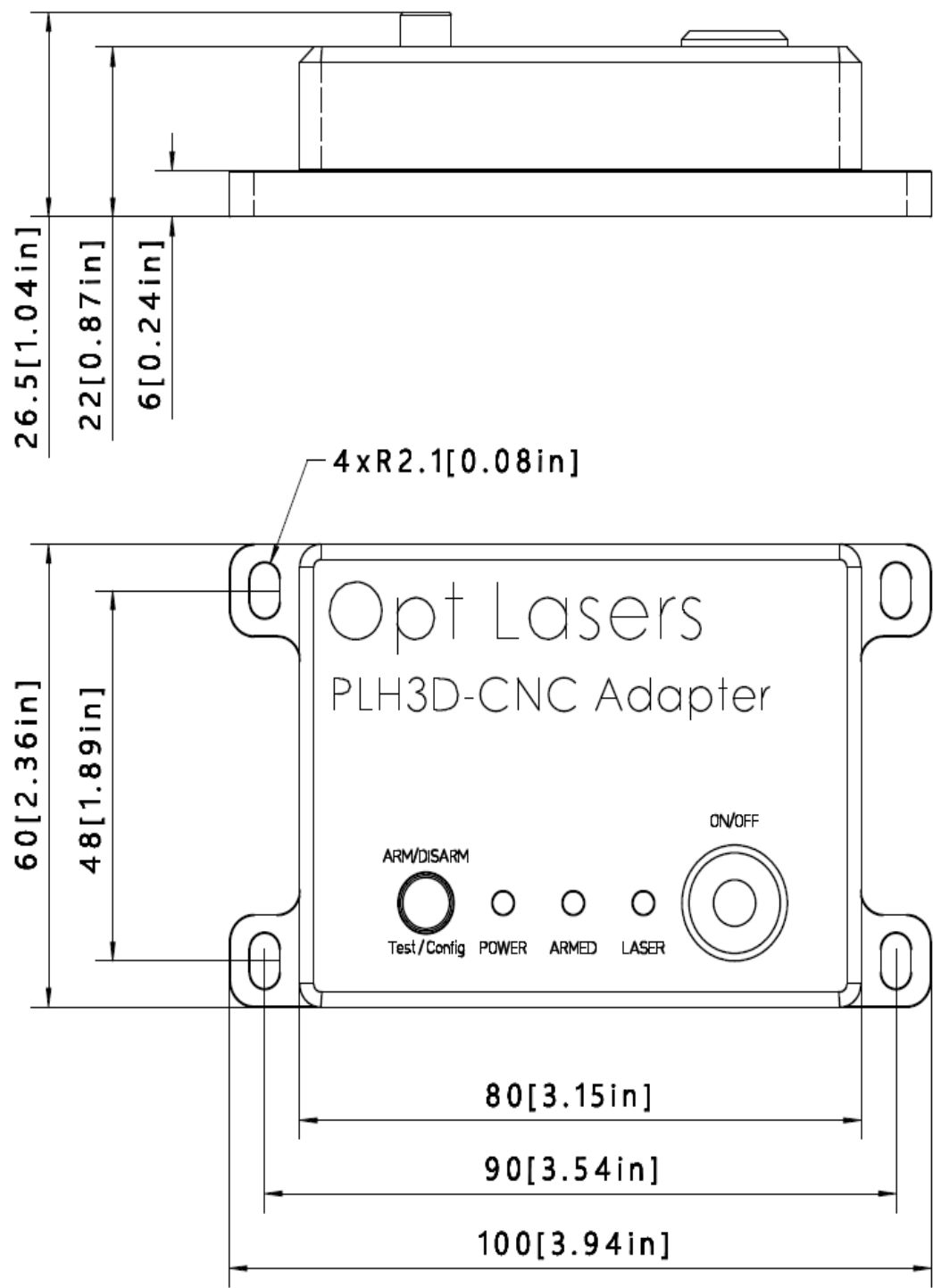
7.5. For adapters sold after 20-July-2020, the currently set Enable Option will be displayed for 1 second after turning the switch key on.

8. KEY SWITCH

8.1. Turn the key switch clockwise to the upper position to switch the PLH3D-CNC Adapter on.

Turn the key switch counterclockwise to the left position to switch the PLH3D-CNC Adapter off.

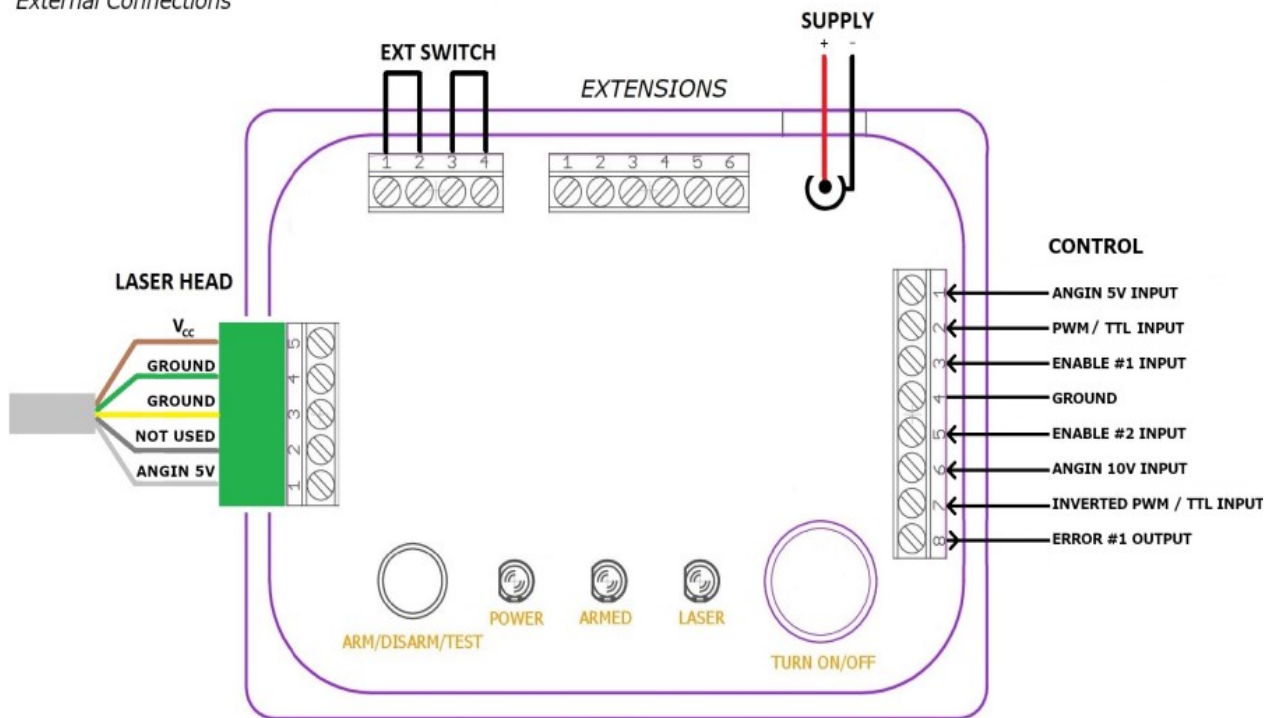
Dimensions:



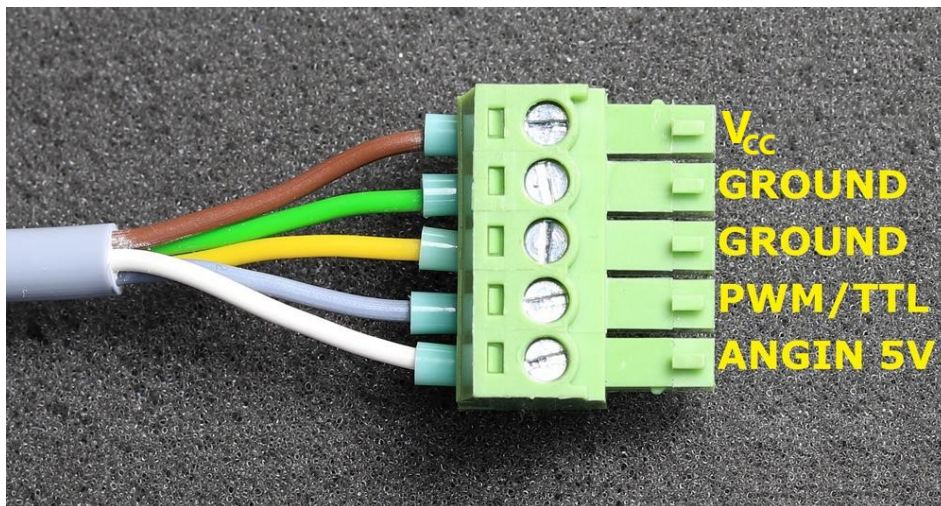
Pinout:

PLH3D-CNC Adapter

External Connections



Pinout of the cable located between the laser head and the PLH3D-CNC Adapter:



Note: If you are using a laser docking station, this cable should be plugged into the laser docking station instead into the laser head.

Getting Started

1. Connect the laser head to the PLH3D-CNC Adapter.
 - a) At this instance, the laser head ought to be mounted on your CNC machine or 3D Printer in a firm manner.
 - b) If you are using the Magnetic Laser Docking Station, connect the laser head to the docking station. Please follow it up by connecting the docking station to the PLH3D-CNC Adapter. This can be done via the 5-wire cable, which is provided in the bundle.



- c) To find out more about how to connect the cables, feel free to have a look at our video guide available at https://youtu.be/MQ5v1CD_rlc
- d) Remember to subscribe to our YouTube channel. You will immensely benefit from Opt Lasers' hands-on tutorials and inspirations.

2. Connect the signal wire to the PLH3D-CNC Adapter, and to the CNC machine controller (a visual representation is depicted in the "Connection to CNC Machines" section).



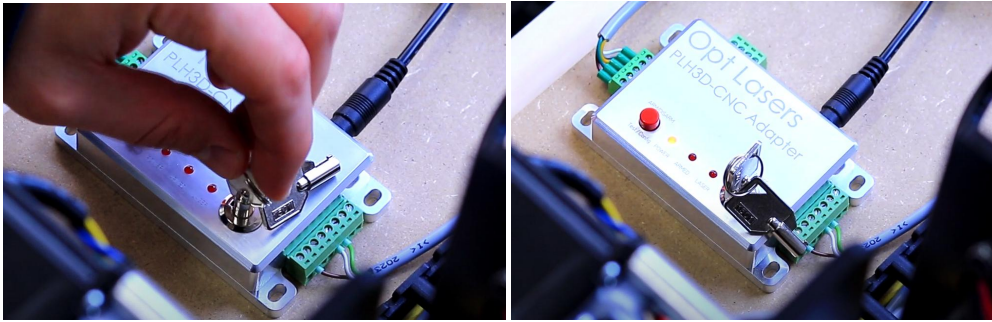
3. Important: Please don't forget to wear a pair of laser safety glasses that can shield you from 400 to 500 nm light radiation.



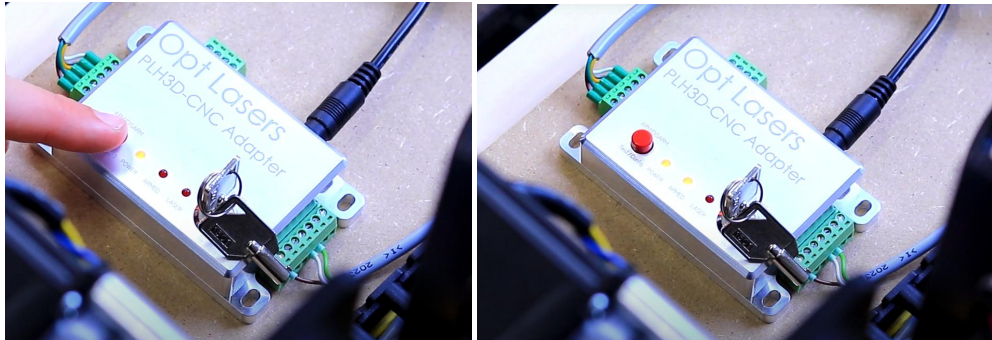
4. Place a piece of non-reflective material under the laser head, such as balsa or plywood. During the next steps, the laser will be turned on.
5. Connect the power supply to the PLH3D-CNC Adapter.
6. Turn the switch key in the PLH3D-CNC Adapter.

Note: After turning the key switch On, the current Enable Option setting will be displayed with indication LEDs for a second. (Applicable for PLH3D-CNC adapter sold after 20-July-2020)

After that Power LED should be lit. If it's not, go to the "Troubleshooting" section.



7. Press the Mode button once. The Armed and Power LEDs ought to be radiant at this point. If this is not the case, go to the "Troubleshooting" section of the user's manual.



8. Now the laser head will be tested. Press the MOD button continuously for approximately 2 seconds. A short laser pulse (at full power), lasting for just about 1 seconds, will be generated. This procedure will verify whether the laser head is connected in a correct fashion. If it doesn't work, go to the "Troubleshooting" section.
9. Once the laser has been connected properly, and the procedure described above has been concluded without any issues, you can start engraving and cutting using your CNC machine with the laser head attached.

Conduct a pulse test and verify if the cutting laser powers on and fires.

1. ***Put your laser safety glasses on. Place a piece of scrap material under your engraving and cutting laser.***
2. ***Turn the key to the on position.***
3. ***Push the red (mode) button to arm the device.***
4. ***Hold the red button down 1.5 seconds. The cutting laser will power on and fire a laser pulse for a brief moment. It should leave a burn mark.***

You've now confirmed your cutting laser is working properly.

Connections to CNC machines

Connection to CNC machines

The sections below depict how to connect a cutting and engraving laser to a choice of popular CNC machines, 3D printers and controllers.

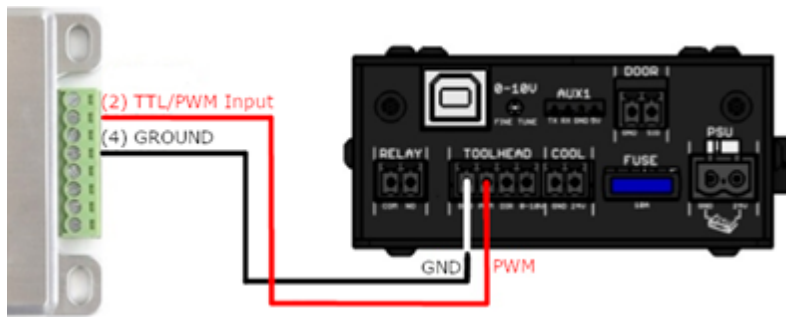
AVID CNC / CNC Router Parts



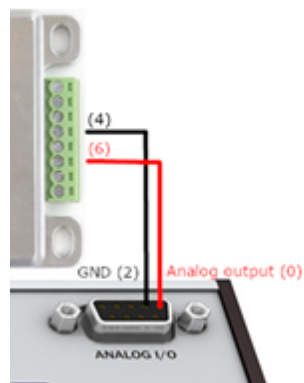
Smooth Stepper



BlackBox Motion Control System

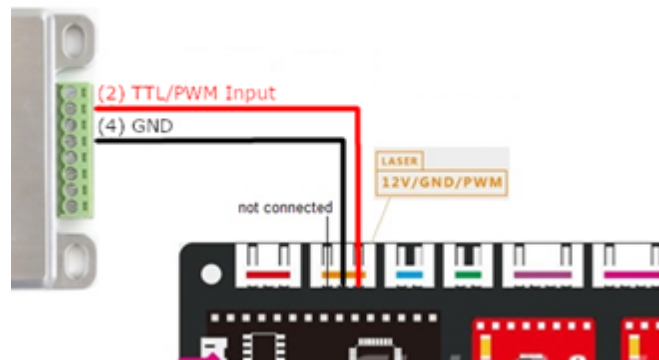


CSMIO Controller

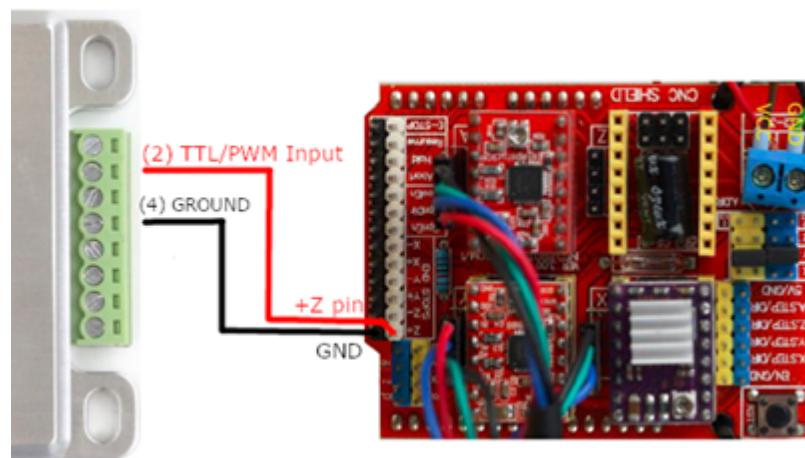


EleksMaker Controller

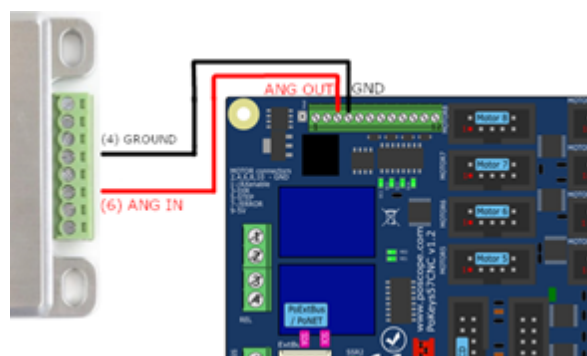




Openbuilds Controller



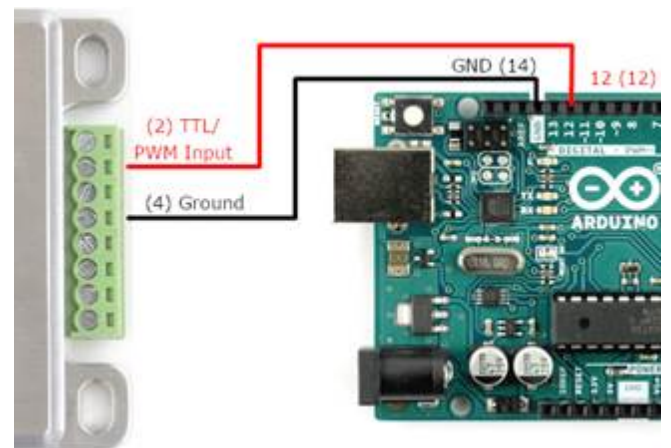
Pokey57 CNC Controller



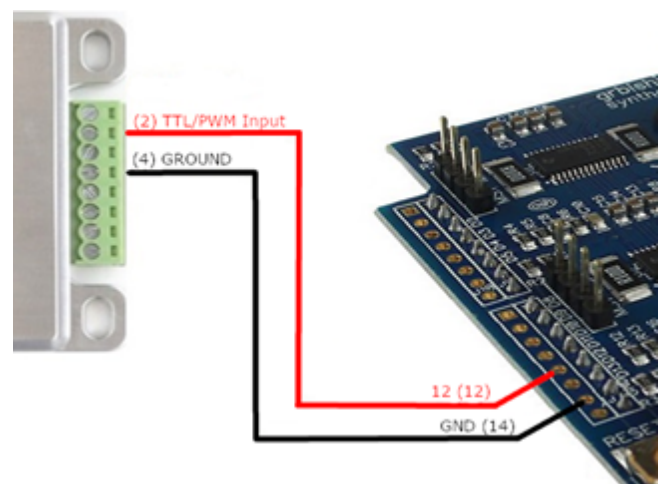
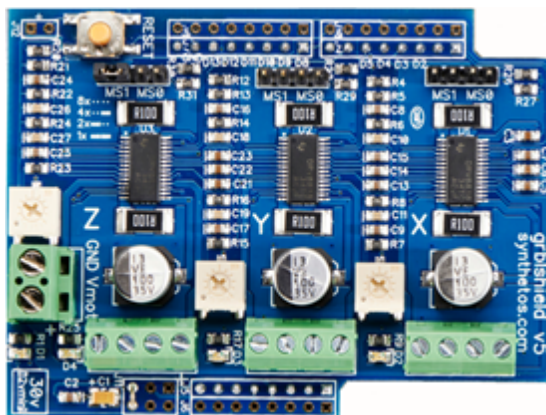
Shapeoko CNC



Arduino Uno:



gShield (grblShield v5):



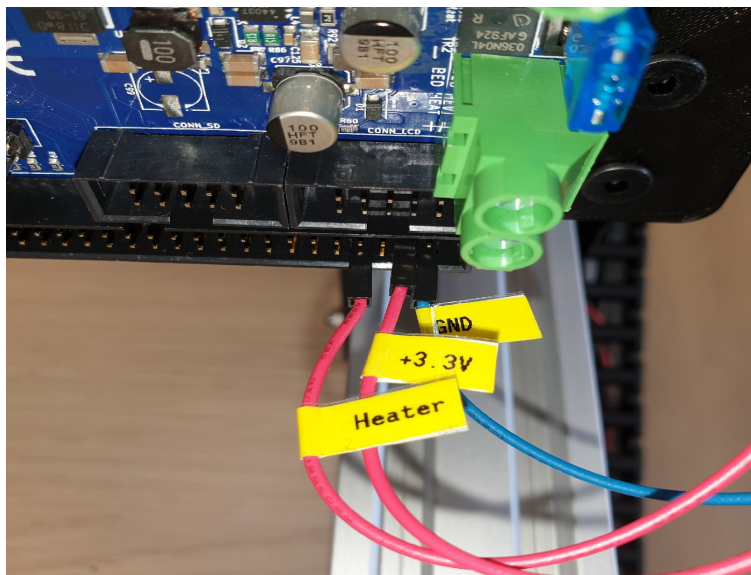
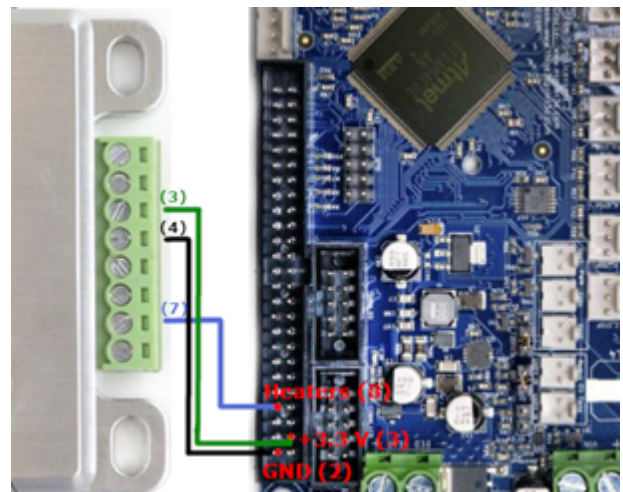
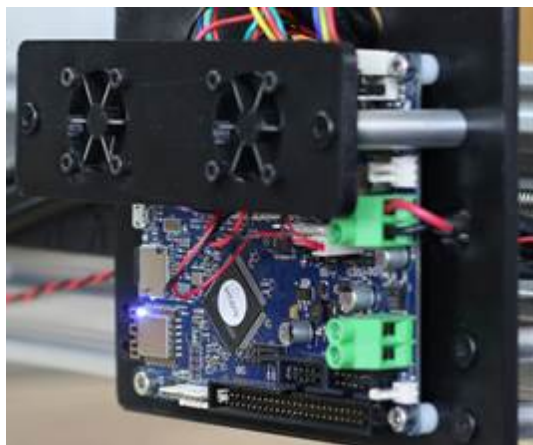
Stepcraft CNC



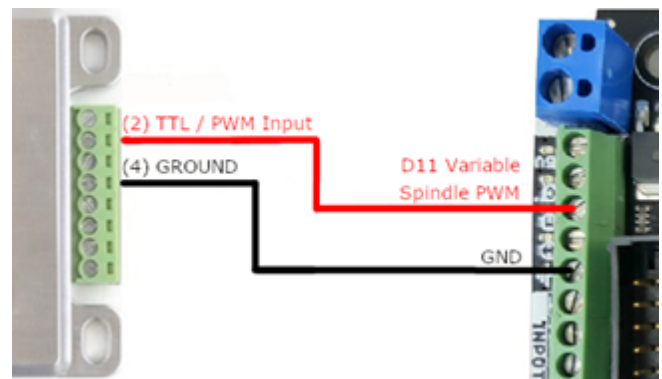
WorkBee CNC



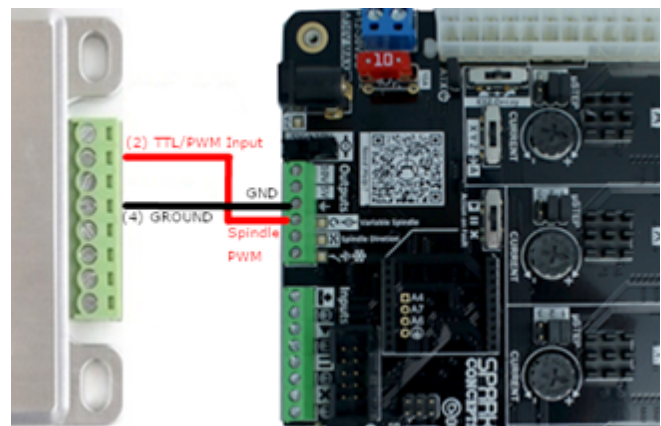
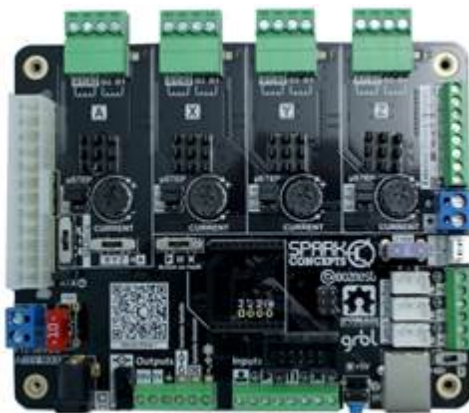
Duet Controller



CNC xPro v3 Controller

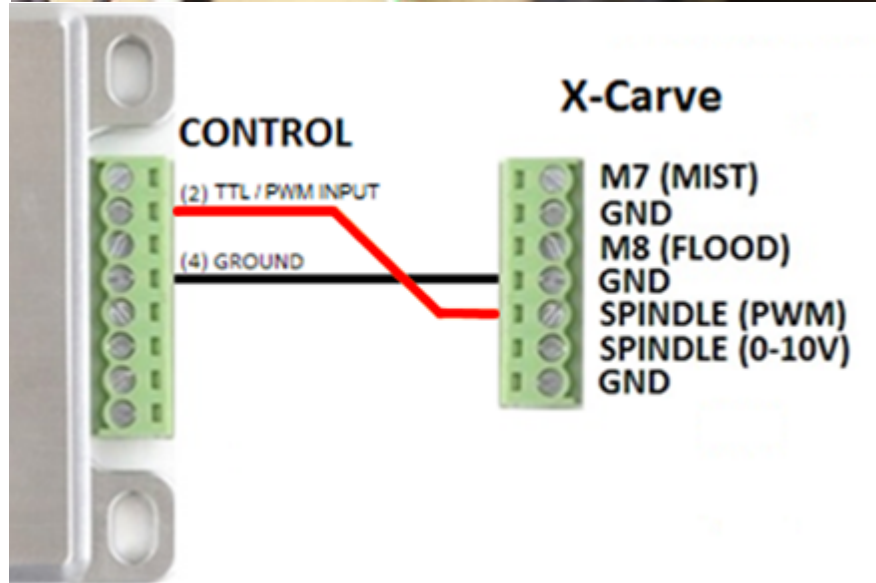


CNC xPro v4 Controller



X-Carve CNC

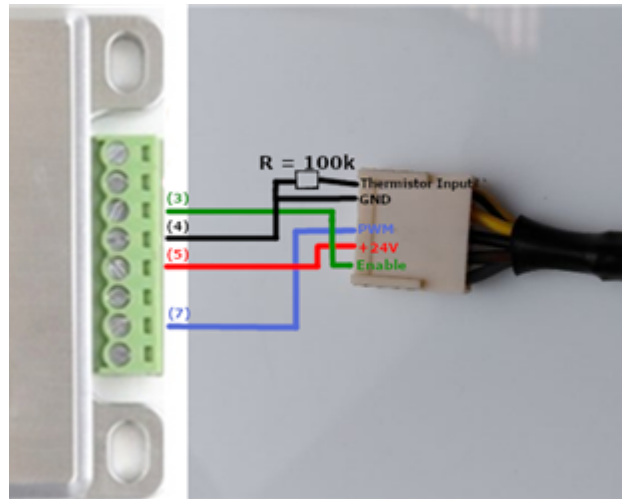




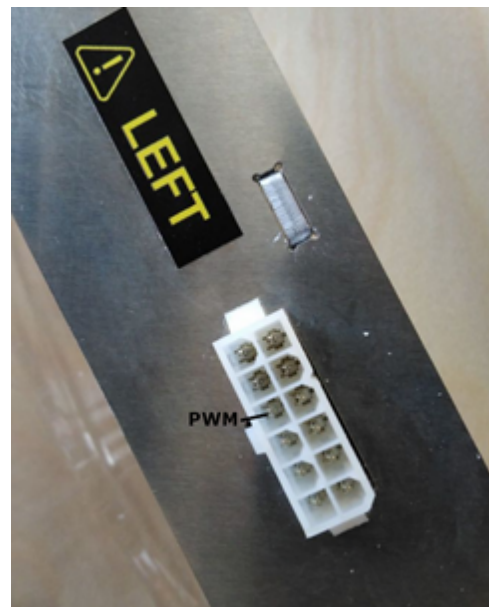
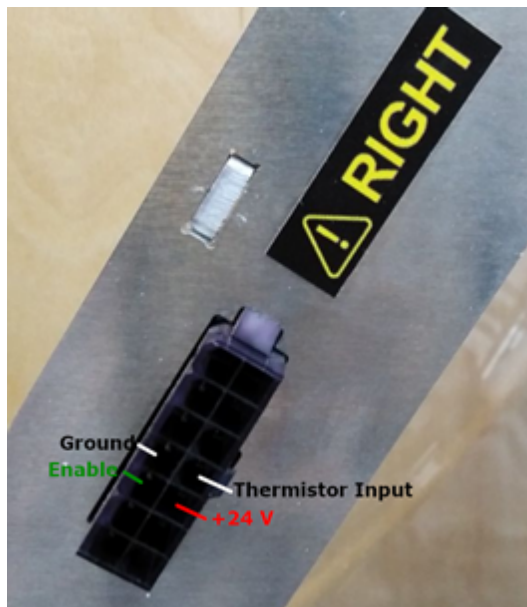
Z-Morph 3D Printer



Opt Lasers Signal Cable for the PLH3D-6W-ZMorph Laser Head:



ZMorph itself (pins at adapter same as above):


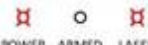









PLH3D-CNC Adapter Enable Options

Specific CNC machines issue special “disable/enable” signals for turning the cutting laser beam off and on. The PLH3D-CNC Adapter can be set in such a way that the engraving and cutting laser beam is enabled only for certain states on two Enable inputs and disabled in other cases. A total of 12 distinct combinations of states (called “Enable Options”) may be selected. This allows the PLH3D-CNC Adapter to connect with virtually any machine. Disabling affects the controlling signal only and does not cause disarming of the cutting laser head.

The table below shows the appropriate settings of the “Enable Options” for a choice of widely used machines.

The PLH3D-CNC Adapter is shipped with the Enable Options already matching the user’s machine. In any case, it is worth double-checking to confirm that the befitting software is loaded before operating the cutting laser head.

Machine	Enable options		
X-Carve	0		ENABLE1=any ENABLE2=any
Stepcraft	11		ENABLE1=TOGGLING ENABLE2=HIGH
Shapeoko	0		ENABLE1=any ENABLE2=any
Z-Morph	7		ENABLE1=LOW ENABLE2=HIGH
WorkBee/i2R CNC with Duet Controller	2		ENABLE1=HIGH ENABLE2=any
WorkBee with CNC xPro Controller	0		ENABLE1=any ENABLE2=any
Avid CNC (Smooth Stepper)	0		ENABLE1=any ENABLE2=any
BlackBox Motion Control System	0		ENABLE1=any ENABLE2=any
Most cases not covered above	0		ENABLE1=any ENABLE2=any

NOTES: 1.  LED is off
 LED is lit
 LED is flashing

2. ANY means:

- lack of connection or any voltage in the 0 - 24 V range.

3. LOW means:

- either a DC voltage from 0 to +0.8 V,

- or a connection to GROUND through a 0 ... 1 kΩ resistance.

4. HIGH means:

- a connection to a DC voltage from +3 V to +24 V directly or through a 0 ... 1 k Ω resistance.

5. TOGGING means:

- LOW-to-HIGH or HIGH-to-LOW transitions, 200 ms or less apart.

How to Check Enable Option in PLH3D-CNC Adapter

Note: After turning the key switch On, the current Enable Option setting will be displayed with indication LEDs for a second. Applicable for PLH3D-CNC adapter sold after 20-July-2020. For older version of PLH3D-CNC Adapter please follow the instruction below.

1. Turn the key switch OFF.
2. Press and hold the mode button.



3. Turn the key switch ON while holding the aforementioned button.



4. Wait approximately one second until any LED is lit and release the button.



5. LEDs will show a combination corresponding to the current setting. Do not press Mode button again.
6. To quit without saving, wait for five seconds until Power LED is lit or turn the switch key off.

How to Set Enable Option in PLH3D-CNC Adapter

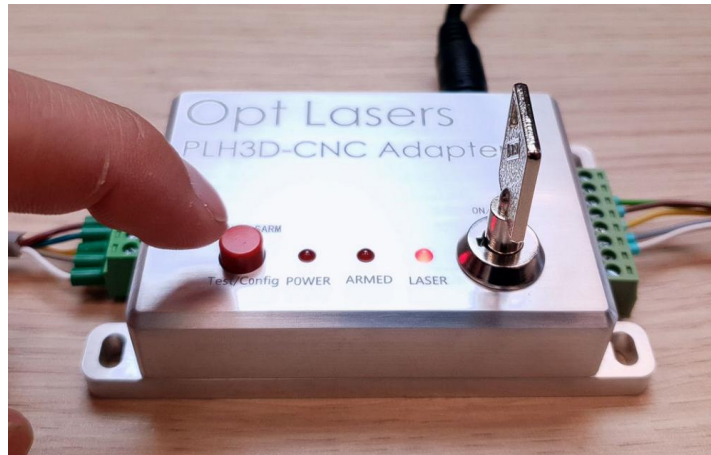
1. Turn the key switch OFF.
2. Press and hold the mode button.



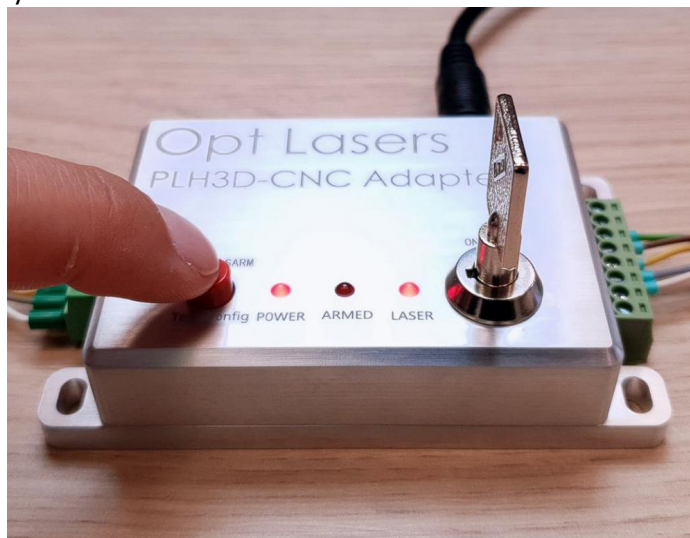
3. Turn the key switch ON while holding the aforementioned button.



4. Wait approximately one second until any LED is lit and release the button.

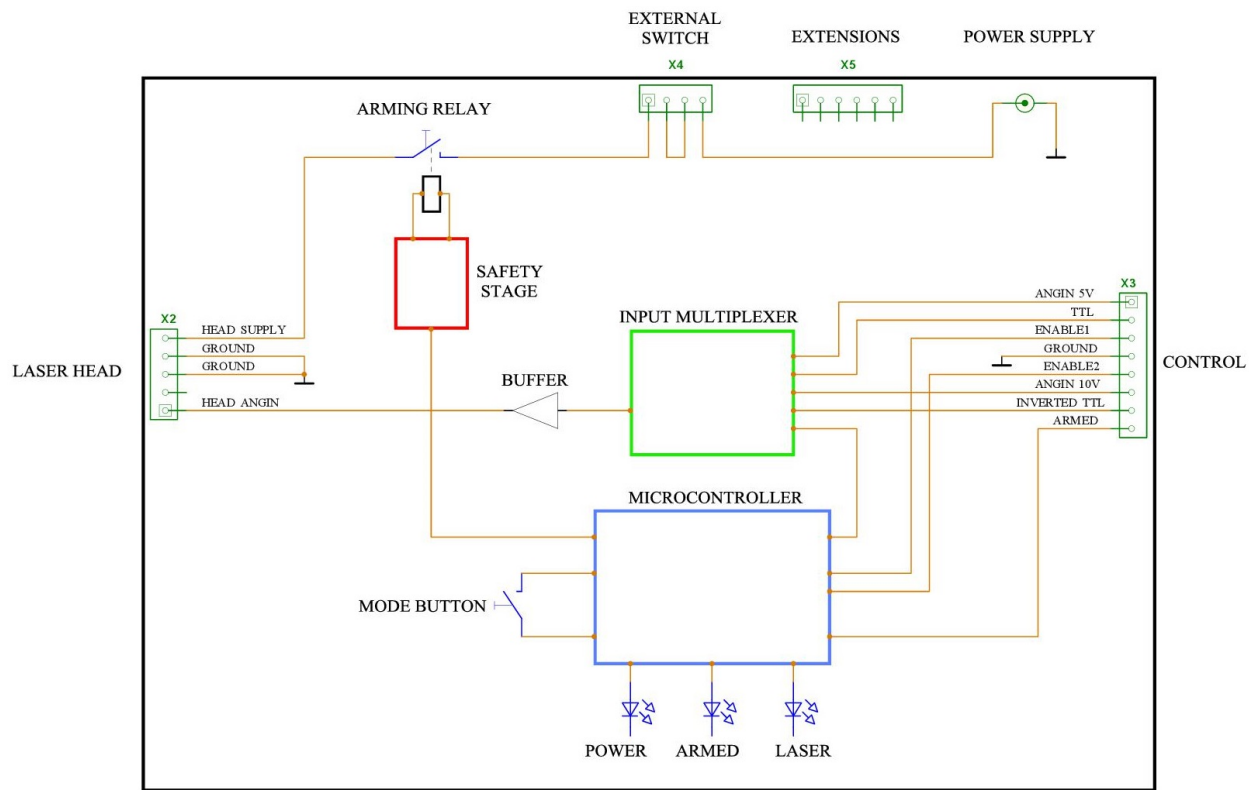


5. LEDs will show a combination corresponding to the current setting.
6. To step to the next setting, press the mode button once. Keep pressing the mode button till you find the settings that you wish to be set.



7. To save the current setting, wait five seconds with the button released. To quit without saving, turn the key switch off before five seconds elapse.

The chosen setting is kept in non-volatile memory and remains unchanged during power-off.

For Advanced Users**Block Diagram**

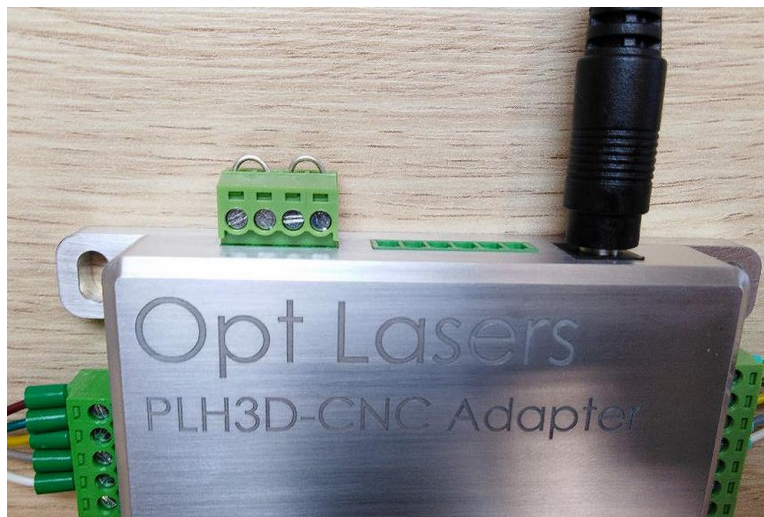
EXTERNAL SWITCH Connector Pinout with Description

Pin no.	Name	External switch
1	A.1	Switch A
2	A.2	
3	B.1	Switch B
4	B.2	

The switches are connected in series with the power supply feeding the power to the laser head through the arming relay. Opening any of the switches disconnects the supply of the laser head and thus disarms it.



Connect the first switch to A.1 and A.2, and the second switch to B.1 and B.2. A lacking switch must be replaced by a jumper wire.



The switches and jumpers can withstand the laser head supply current up to 4 A, and a 30 V DC voltage.

CONTROL Connector Pinout with Description

Pin no.	Name	Description
1	ANGIN 5V INPUT	A proportional (analogue) modulation input, operating in a 0-5 V range (corresponds to 0% - 100% levels respectively). The input withstands voltages up to 24 V DC. The input impedance is 3.9 k Ω .
2	TTL/PWM INPUT	A digital modulation input that accepts PWM and TTL signals. The voltage range of 0-0.8 V corresponds to "off" while the voltage range of 2-24 V corresponds to "on". Compatible logic control signals are: 0/3.3V, 0/5V, 0/10V and 0/24V. The input impedance is 10 k Ω .
3	ENABLE1 INPUT	A digital input that enables/disables laser controlling. The input accepts digital signals where 0-0.8 V corresponds to LOW while 3-24 V corresponds to HIGH. The input impedance is approx. 35 k Ω .
4	GROUND	Ground signal.
5	ENABLE2 INPUT	A digital input that enables/disables laser controlling. The input accepts digital signals where 0-0.8 V corresponds to LOW and 3-24 V corresponds to HIGH. The input impedance is approx. 35 k Ω .
6	ANGIN 10V INPUT	A proportional (analogue) modulation input, operating in a 0-10 V range (corresponds to 0% - 100% levels respectively). The input withstands voltages up to 24 V DC. The input impedance is 7.8 k Ω .
7	INVERTED TTL/PWM INPUT	It is an inverted digital modulation input that accepts PWM and TTL signals. The voltage range of 0-0.8 V corresponds to "on" and the voltage range of 2-24 V corresponds to "off". Compatible logic control signals are: 0/3.3V, 0/5V, 0/10V and 0/24V. The input impedance is 10 k Ω .
8	ARMED OUTPUT	An open-drain output. It is connected to GROUND when the laser is disarmed, and open (high-impedance) when the laser is armed. May be used as an active-low error signal to the controller. The maximum current is 100 mA and the maximum voltage is 40 V DC.

Enable Options

Specific CNC machines issue special “disable/enable” signals for turning the laser beam off and on. The PLH3D-CNC Adapter can be set in such a way that the laser beam is enabled only for certain states on two Enable inputs and disabled in other cases. A total of 12 distinct combinations of states (called “Enable Options”) may be selected. This allows the PLH3D-CNC Adapter to connect with virtually any machine.

Disabling affects the controlling signal only and does not cause the disarming of the laser head.

All 12 available options are listed below:

option	LED combination	laser head controlling condition	
		ENABLE1 input	ENABLE2 input
0	○ ○ ● POWER ARMED LASER	any state	any state
1	○ ● ○ POWER ARMED LASER	LOW	any state
2	○ ● ● POWER ARMED LASER	HIGH	any state
3	● ○ ○ POWER ARMED LASER	any state	LOW
4	● ○ ● POWER ARMED LASER	LOW	LOW
5	● ● ○ POWER ARMED LASER	HIGH	LOW
6	● ● ● POWER ARMED LASER	any state	HIGH
7	○ ○ ✖ POWER ARMED LASER	LOW	HIGH
8	○ ✖ ○ POWER ARMED LASER	HIGH	HIGH
9	○ ✖ ✖ POWER ARMED LASER	TOGGLING	any state
10	✖ ○ ○ POWER ARMED LASER	TOGGLING	LOW
11	✖ ○ ✖ POWER ARMED LASER	TOGGLING	HIGH

NOTES:

- LED is off
● LED is lit
✖ LED is flashing

2. ANY means:
 - lack of connection or any voltage in the 0 - 24 V range.
3. LOW means:
 - either a DC voltage from 0 to +0.8 V,
 - or a connection to GROUND through a 0 ... 1 kΩ resistance.
4. HIGH means:
 - a connection to a DC voltage from +3 V to +24 V through a 0 ... 1 kΩ resistance.
5. TOGGLING means:
 - LOW-to-HIGH or HIGH-to-LOW transitions, 200 ms or less apart.

Additional Features

Applicable to PLH3D-CNC adapters sold after 20-July-2020:

1. Enable Option Check at Power-on.

After turning the key switch ON, the current Enable Option setting will be displayed with indication LEDs for a second. Please refer to the table with Enable Option LED combinations, which can be found in the preceding subsection, namely Enable Options. After a second, the display of the currently selected Enable Option LED combination will disappear. The LEDs will then show the status of the device and the adapter will be ready for use.

For more details about the "Enable Options", please visit the foregoing subsection.

2. Laser Head Type Selection.

In order to best recognize a variety of laser head critical states (disconnecting by the external switch, disconnecting the cable, short circuit), a general type of the laser head can be set up. The following settings are possible:

PLH3D-CNC ADAPTER

selection of HEAD TYPE options

option	LED combination	Check	Applicable to
0	<div> <div>○</div> <div>○</div> <div>●</div> </div> <div>POWER ARMED LASER</div>	Short circuit (only)	Any Opt Lasers' laser head
1	<div> <div>○</div> <div>●</div> <div>○</div> </div> <div>POWER ARMED LASER</div>	Short circuit and discontinuity*	Only for laser heads with no fan (i.e. PLH3D-6W-LC)
2	<div> <div>○</div> <div>●</div> <div>●</div> </div> <div>POWER ARMED LASER</div>	Short circuit and discontinuity	PLH3D-2W, PLH3D-6W-Hobby, PLH3D-6W, PLH3D-6W-XF, PLH3D-6W-uSpot, PLH3D-6W-Zmorph, PLH-12000

NOTES: ○ LED is off
● LED is lit

* - In this case, discontinuity of the laser head can only be recognized at sufficient laser power, hence it depends on how the PLH3D-CNC Adapter's controlling inputs are driven.

To check or set up the laser head type option:

1. Turn the key switch off.
2. Press and hold the mode button.
3. Turn the key switch on while holding the button.
4. Wait at least **4 seconds**.
5. Release the button.
6. LEDs will show a combination corresponding to the current setting (please refer to the table above).
7. To step to the next setting press the button.
8. To save the current setting wait 5 seconds with the button released. To quit without saving, turn the key switch off before 5 seconds elapse.

The chosen setting is kept in non-volatile memory and remains unchanged during power-off.

Basic Troubleshooting

Before proceeding with the troubleshooting, please make sure you followed all the steps described below.

All our products are carefully checked before shipping for product quality and the correct operation of all internal and external signals. It is also verified that the Adapter has the correct setting applied for each and every distinct CNC machine. However, it sometimes happens that the user inadvertently changes the Adapter Setting. There is also a small chance of human error.

A. Also, verify that all the cables are connected in a correct fashion.

B. Mis-set Adapter Program is one of the most common reasons the laser might not be working the way it was intended to. The reason for that is because the adapter expects a different range of signals compared to what is actually arriving at the signal input.

How to Check Enable Option in PLH3D-CNC Adapter

Note: After turning the key switch On, the current Enable Option setting will be displayed with indication LEDs for a second. Applicable for PLH3D-CNC adapter sold after 20-July-2020. For older version of PLH3D-CNC Adapter please follow the instruction below.

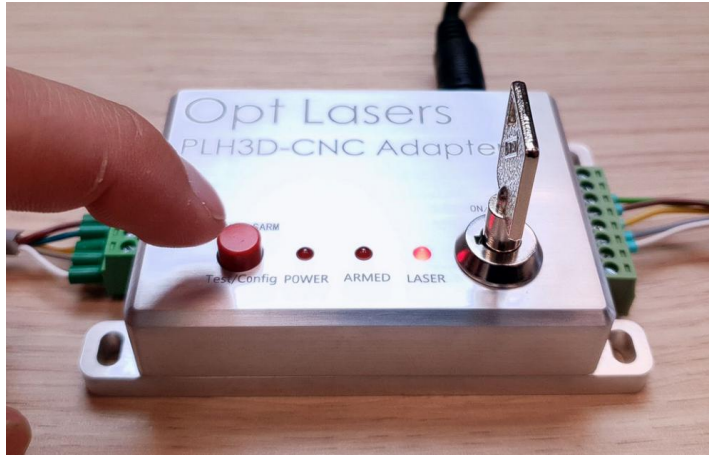
1. Turn the key switch OFF.
2. Press and hold the mode button.



3. Turn the key switch ON while holding the aforementioned button.



4. Wait approximately one second until any LED is lit and release the button.



5. LEDs will show a combination corresponding to the current setting. Do not press Mode button again.
6. To quit without saving, wait for five seconds until Power LED is lit or turn the switch key off.

How to Set Enable Option in PLH3D-CNC Adapter

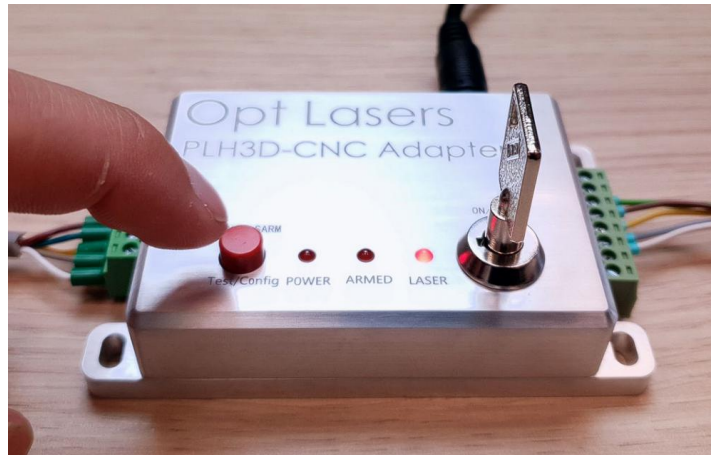
1. Turn the key switch OFF.
2. Press and hold the mode button.



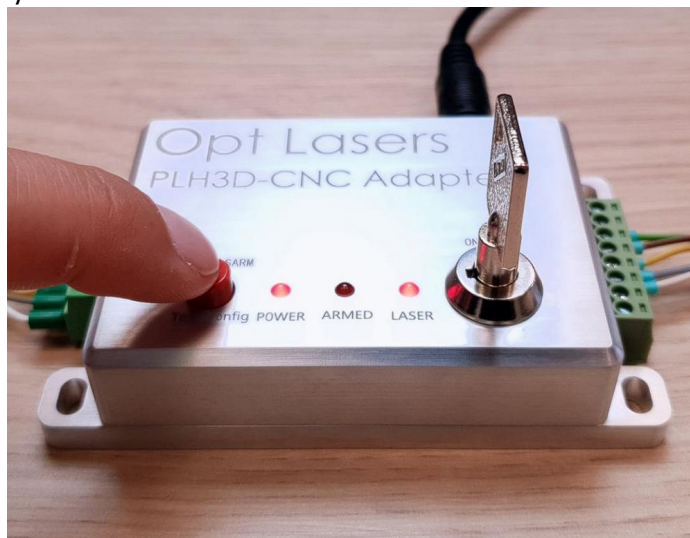
3. Turn the key switch ON while holding the aforementioned button.



4. Wait approximately one second until any LED is lit and release the button.



5. LEDs will show a combination corresponding to the current setting.
6. To step to the next setting, press the mode button once. Keep pressing the mode button till you find the settings that you wish to be set.



7. To save the current setting, wait five seconds with the button released. To quit without saving, turn the key switch off before five seconds elapse.

The chosen setting is kept in non-volatile memory and remains unchanged during power-off.

C. Please perform the 1 second pulse test, described in the Laser Pulse Test section of the Adapter Manual. This will confirm whether the cutting laser is working properly. Place a piece of cardboard at 60 mm from the face of the laser. The cutting laser should leave a burn mark.

D. Another common reason for issues with operation is the improper configuration of the CNC machine software. The CNC software needs to be configured properly in order for it to send relevant signals into the Adapter. For example, Mach 3 assigns an improper port to the PWM spindle signal.

E. First-time laser users may also happen to send an improper G-Code command, which does not release an appropriate signal to control the laser head. For instance, in Mach3, the M03 command switches on the laser cutter, while the S0-255 command sets the power level, and the M05 command switches the cutting laser off. On the other hand, in Stepcraft, the M10 command switches the cutting laser on, the Q0-255 command sets the power level, and the M11 command switches the laser cutter off. Please check whether the G-Code generated by you, which seems not to be working, contains these commands.

Example extract from properly written G-Code for Stepcraft CNC:

;(Header)

M3 -> Activate the spindle

G0 X0 Y0 -> Go to home position

G90 ; -> Use absolute positions

G21 ; -> Use metric system

;(G-Code Body)

G0 X33 Y21 Z26 F10000 M10 Q0 -> Go to the point (x, y, z) = (33, 21, 26) using idle movement (G0) at the speed of 10 000 arbitrary units (F10000) with the laser on (M10), but at 0% power (Q0).

G1 X53 Y41 F1000 M10 Q255 -> go to the point (x, y) = (53, 41) using working movement (G1) at the speed of 10 000 arbitrary units with the laser on (M10), and at 100% power (Q255).

(...)

;(Footer)

M5 -> Deactivate the spindle

M11 ; -> Disable laser

G21 -> Programming in millimeters

G90 -> Positioning defined with respect to part zero

G0 X0 Y0 -> Go to home position

M30 -> Program end code

;(Footer end)

For some machines, there may be a variation of the arbitrary units range in the Q command. The firmware might happen to be configured in the range between 0 and 1000 arbitrary units. Sending the Q255 command in this case might cause the laser to fire at 25% of the real maximum power.

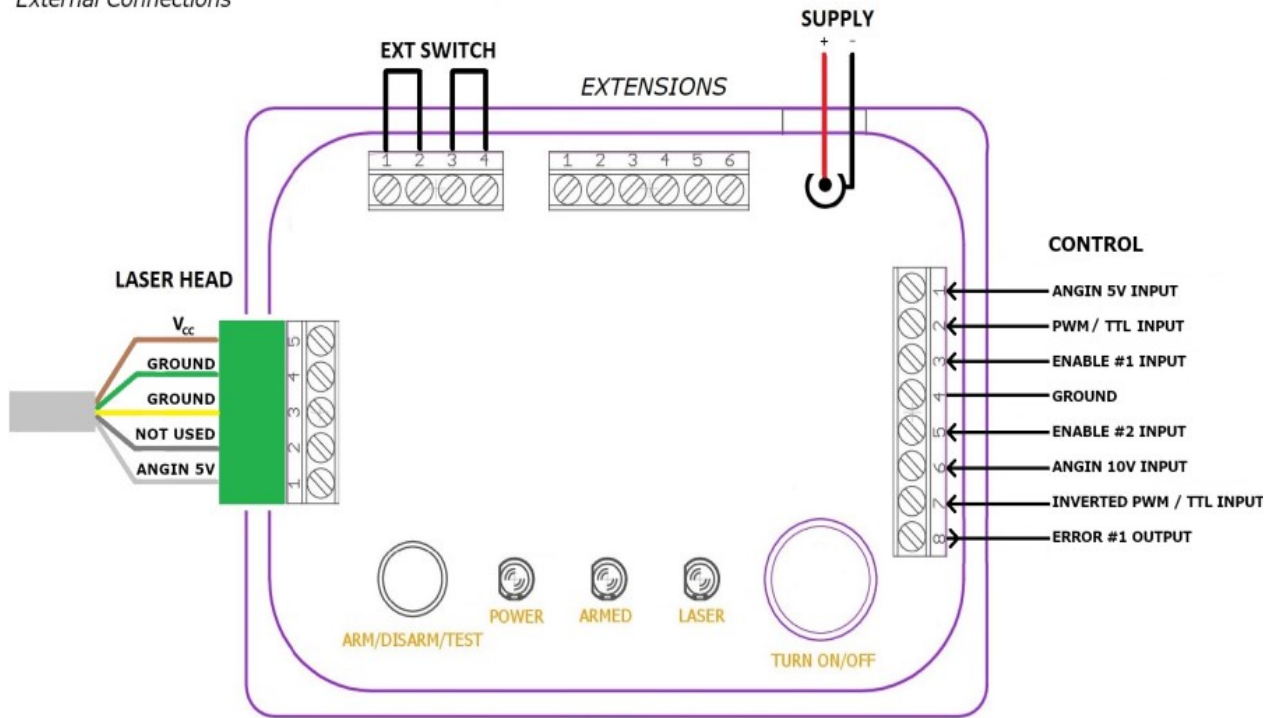
F. There is also a possibility that the output of the controller is disabled in the CNC software. In this case the relevant output needs to be switched on. Alternatively, activating an appropriate Enable Signal can ensure the proper operation of the cutting laser head.

G. Sometimes, the CNC controller might have an otherwise concealed malfunction or wear, which isn't detectable unless a laser head is added to the system and seems not to be working. If all previous points were tested, but the user cannot find the solution, then the proper function of the adapter and the laser head can be verified in the following way:

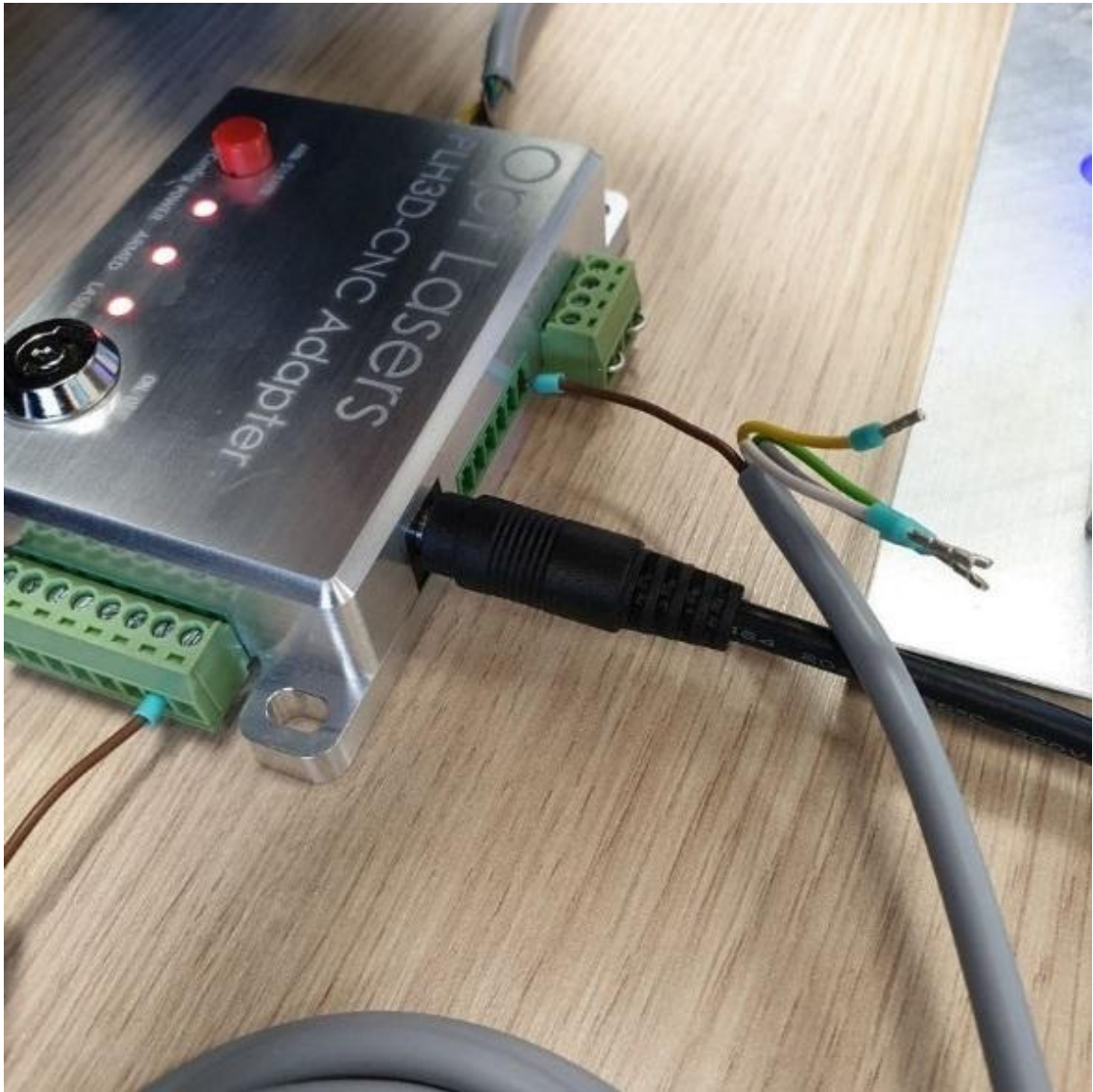
- Prepare a wire with a length of 10 cm or more.
- The control signal plug needs to be disconnected from the signal input of the adapter
- The adapter needs to have the 0 program set.
- You need to ensure that nobody unintended is present in the CNC laser room. The laser should be secured in a stable, vertical position and nothing unintended should be left in the path of the laser beam.
- You need to put your Laser Safety Glasses or Googles on.
- Turn the Adapter on with the key. Then press the Arm button.
- The adapter is now waiting for the signal, which isn't present as a result of the disconnection of the signal cable. We can simulate the signal by using the power supply.

PLH3D-CNC Adapter

External Connections



- Connect one side of the wire to pin 1 of the EXTENSIONS connector (VCC). You may also connect the wire to one of the wire jumpers at the EXT SWITCH connector.





- Now run the >10 cm wire to the terminal 2 (PWM/TTL) of the CONTROL connector.
- The Adapter reads it as a high signal that normally turns the spindle on (100% duty cycle). Assuming the laser is armed, the laser should instantly switch on at full power.
- This test verifies that the laser and the adapter are functioning correctly at the Adapter Program 0. It shows the full capability of the laser beam.

There is also a second part of the test, which uses the same Adapter Setting as your CNC machine, but it requires simulating appropriate Enable Signals with relevant G-Code and M-Code.

For instance, to test the Adapter and the cutting laser under the Duet 2 configuration, you need to simulate appropriate signals at both the PWM/TTL signal input and the Enable 1 Input. The Adapter Settings section of the Adapter manuals presents a table that shows what the Adapter expects for each machine configuration. The Duet Controller needs ENABLE 1 signal to be HIGH (a connection to a DC Voltage from +3 to +24 V; while doing so, please be extra careful not to connect the PWM input to the ground).

In case only one of either the PWM/TTL signal cable or the ENABLE 1 signal cable is properly connected to the VCC, the cutting laser will not turn on. You need to connect both PWM/TTL and Enable 1 signal to VCC (high state) to fire the cutting laser.

To additionally decrease the number of factors that may impact the test it is recommended to connect the laser head directly to the adapter without the LaserDock in between. The green terminals are designed in such a manner that the same cable that runs between the adapter and the

LaserDock may be plugged directly into the socket of the cutting laser head.

In case you are not able to test the basic program and you are confident your machine sends correct signals, please go to the Advanced Troubleshooting section of the Adapter Manual.

Additional Troubleshooting

If you find any problems using the PLH3D-CNC Adapter, the following table should be able to address it. In case it doesn't, please feel free to contact our support team at contact@optlasers.com.

Problem	Possible reason	Solution
POWER LED is off	The key switch is not turned on.	Turn the key into the upper position.
	The power supply unit is not attached either to the mains (wall) or to the PLH3D-CNC Adapter.	Plug the power supply in.
	There is no mains supply (grid power).	Check the mains supply (grid power).
	The power supply unit is defective.	Replace the power supply unit.
	The PLH3D-CNC Adapter is defective.	Send the PLH3D-CNC Adapter in for a repair.
POWER LED is flashing	The supply voltage is outside the acceptable range.	Use a dedicated power supply unit.
	The power supply unit is defective.	Replace the power supply unit.
	There is an internal PLH3D-CNC Adapter error.	Send the PLH3D-CNC Adapter in for a repair.
Pressing the mode button does not arm the laser head	The external switches are open or not working.	Close the switches or replace them with jumper wires.
	The laser head is not connected.	Connect the laser head.
	There is an internal PLH3D-CNC Adapter error.	Send the PLH3D-CNC Adapter in for a repair.
ARMED LED is flashing	An external switch has been opened.	Close the switch and rearm the laser head by pressing the mode button.
	The connection with the laser head has been broken.	Reconnect the laser head and rearm it by pressing the mode button.
LASER LED is off	There is no laser controlling signal.	Verify whether your controller is connected in a correct fashion and whether it is sending pulses.
	The laser beam has been disabled by the controller.	Verify whether your controller is connected in a correct fashion and whether it is sending pulses.
	The laser head is not armed.	Arm the laser head by pressing the mode button.
	The enable inputs have the wrong state selection.	Provide the right combination of states at the enable inputs.
		Set up the right enable option.
	The laser control signal is fed to a wrong input.	Attach the controlling signal to the right input.
	There is no control signal connected.	Check the connections.

Advanced Troubleshooting

This section describes common problems encountered by users and how to find out what the malfunction is caused by. In case you have an issue with your adapter, there is a good chance you will quickly find a solution to your problem by going through the list below. Find the case that matches your situation and follow the tips.

NOTE: Some of the tests below require voltage measurements. A cheap multimeter may be used to this end. You need to set the DC voltage range to 30 V or higher.



An oscilloscope may be used as well.

1. **The POWER LED is off**, although the power supply seems to be operational, ie.:

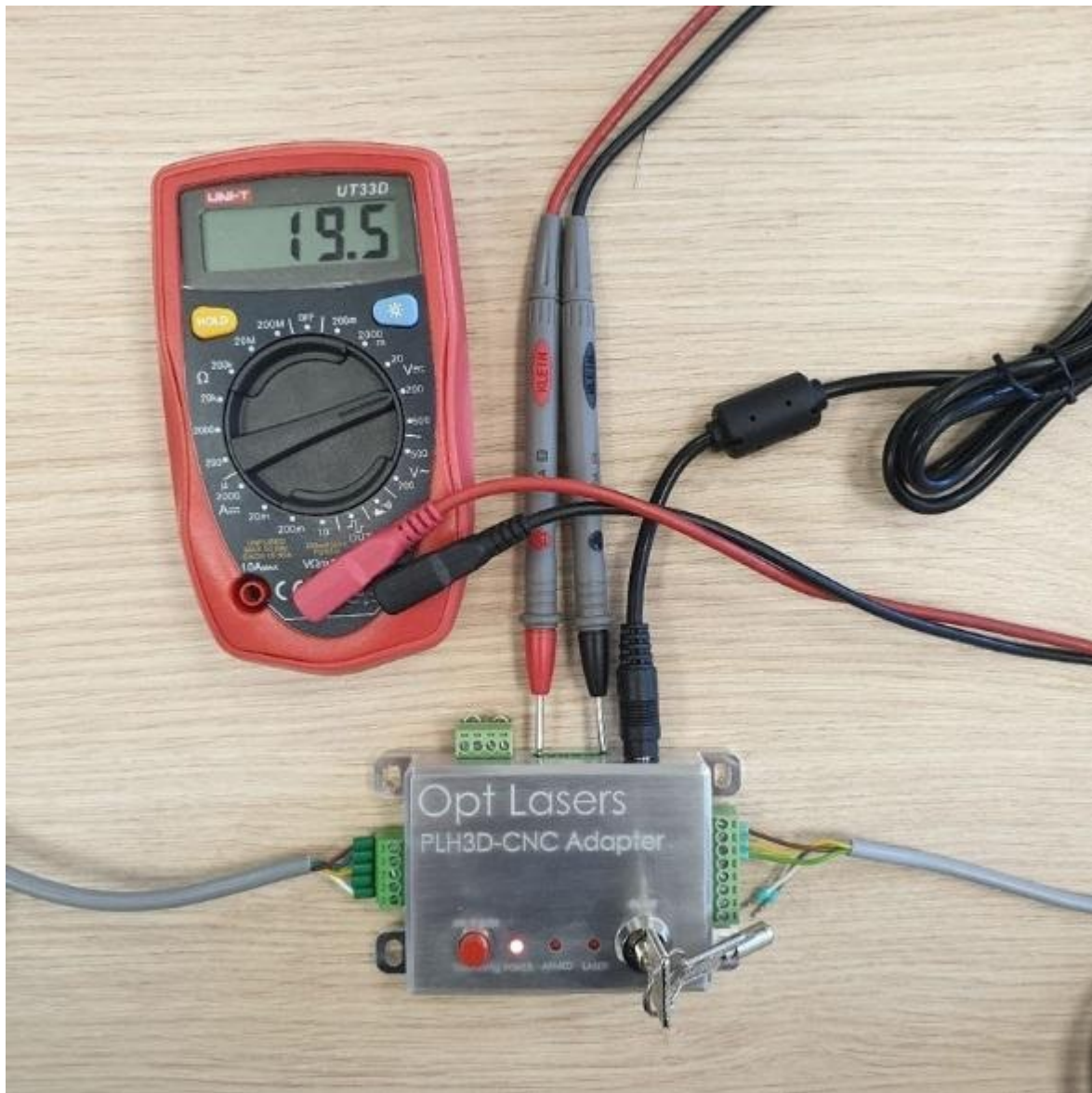
- the power supply unit (PSU) is working;
- the power supply unit is properly attached to the PLH3D-CNC Adapter;
- the key switch is turned on.

ADVICE:

Check the presence of the internal power supply at the EXTENSIONS connector with a multimeter. After turning the PLH3D-CNC Adapter's power supply on, carefully touch the EXTENSIONS connector

pin 1 with the multimeter's (+) probe, and pin 6 with the (-) probe. Refer to the pinout shown in the Dimensions and Pinout section of the Manual.





In case you do not use „external switches” and there are wire jumpers in the EXT SWITCH connector, you can connect the multimeter’s (+) probe to one of the jumpers:





The multimeter should give a reading between 15 V and 24 V. This depends on the type of the PSU used.

- If there is no voltage or the voltage is too low (below 12 V), it means there is something wrong with either the PSU or the PLH3D-CNC Adapter's power supply connector. If you use the PSU from Opt Lasers engraving lasers kits, the multimeter should indicate a voltage above 18 V.
- If there is a correct voltage, then the electronics of the PLH3D-CNC Adapter must be out of order.

2. The POWER LED is lit, but **there is no laser beam, even though it seems there are proper controlling and enabling signals at the inputs of the PLH3D-CNC Adapter. **The LASER LED is not lit.****

ADVICE:

- The laser head may be not armed. Make sure you armed the laser head by pressing the MODE BUTTON in the PLH3D-CNC Adapter. Check whether the ARMED LED is lit continuously (not flashing).

3. The POWER LED is lit, but **no arming takes place when pressing the MODE BUTTON. The ARMED LED is neither lit nor flashing.**

ADVICE:

- the electronics of the PLH3D-CNC Adapter is apparently out of order.

-
4. The POWER LED is lit. After pressing the MODE BUTTON, the **ARMED LED does not light up** and, **after a couple of seconds, it starts to flash**. The built-in fan does not run, which suggests a lack of power supply at the laser head.

ADVICE:

One (or both) of the contact pairs for external switches (EXT SWITCH) may be open. As a result, no power supply gets transferred to the laser head.

You need to check whether the power supply voltage of 15-24 V (depending on the type of the PSU) appears at the LASER HEAD connector. Contact the multimeter's (+) probe to pin 5 of the LASER HEAD connector and the (-) probe to pin 4 of the CONTROL connector. Refer to the pinout shown in the Dimensions and Pinout section of the Manual.



- Make sure a screw terminal plug is plugged into the EXT SWITCH connector.
- If no external switch is used, make sure each pair of the plug contacts (1-2 and 3-4) is shorted by a wire jumper:



- If you use an external switch, verify that it is properly closed.
- If you suspect that the external switch does not close, replace it by a wire jumper at the terminal plug and retry to arm the PLH3D-CNC Adapter.
- If the contacts are properly closed but the issue still persists, then the electronics of the PLH3D-CNC Adapter must be out of order.

ADVICE 2:

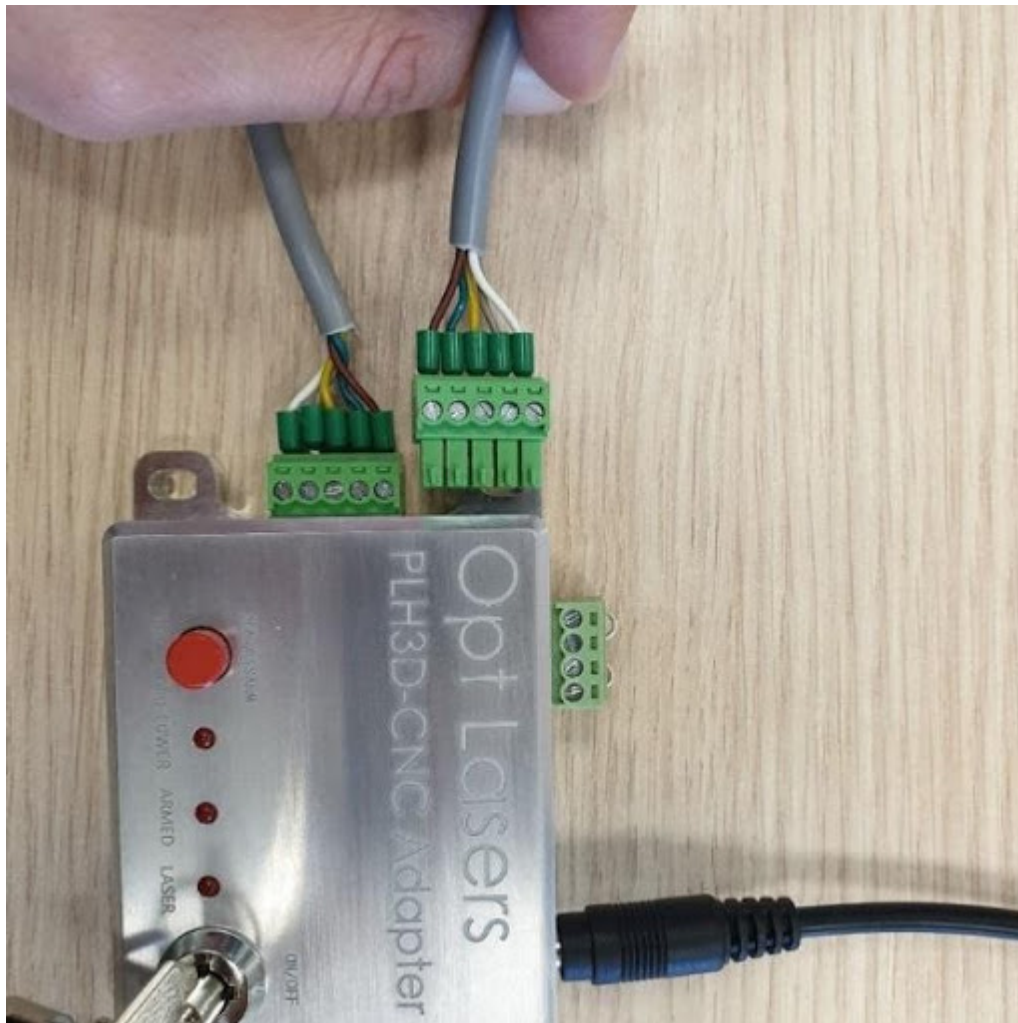
- The same event occurs if the laser head is taken off from the docking station and there is no connection between the laser head and the adapter. Put the laser head on the docking station before arming the laser.
- Another variation of this problem occurs when the connections from the Adapter through the docking station are not stable. Make sure each wire is screwed tight on the connectors. Ensure each wire has a corresponding end on the laser head connector and the Adapter connector.

5. The POWER LED is lit. After pressing the MODE BUTTON, the **ARMED LED is lit continuously, but there is **no supply at the laser head** (the built-in**

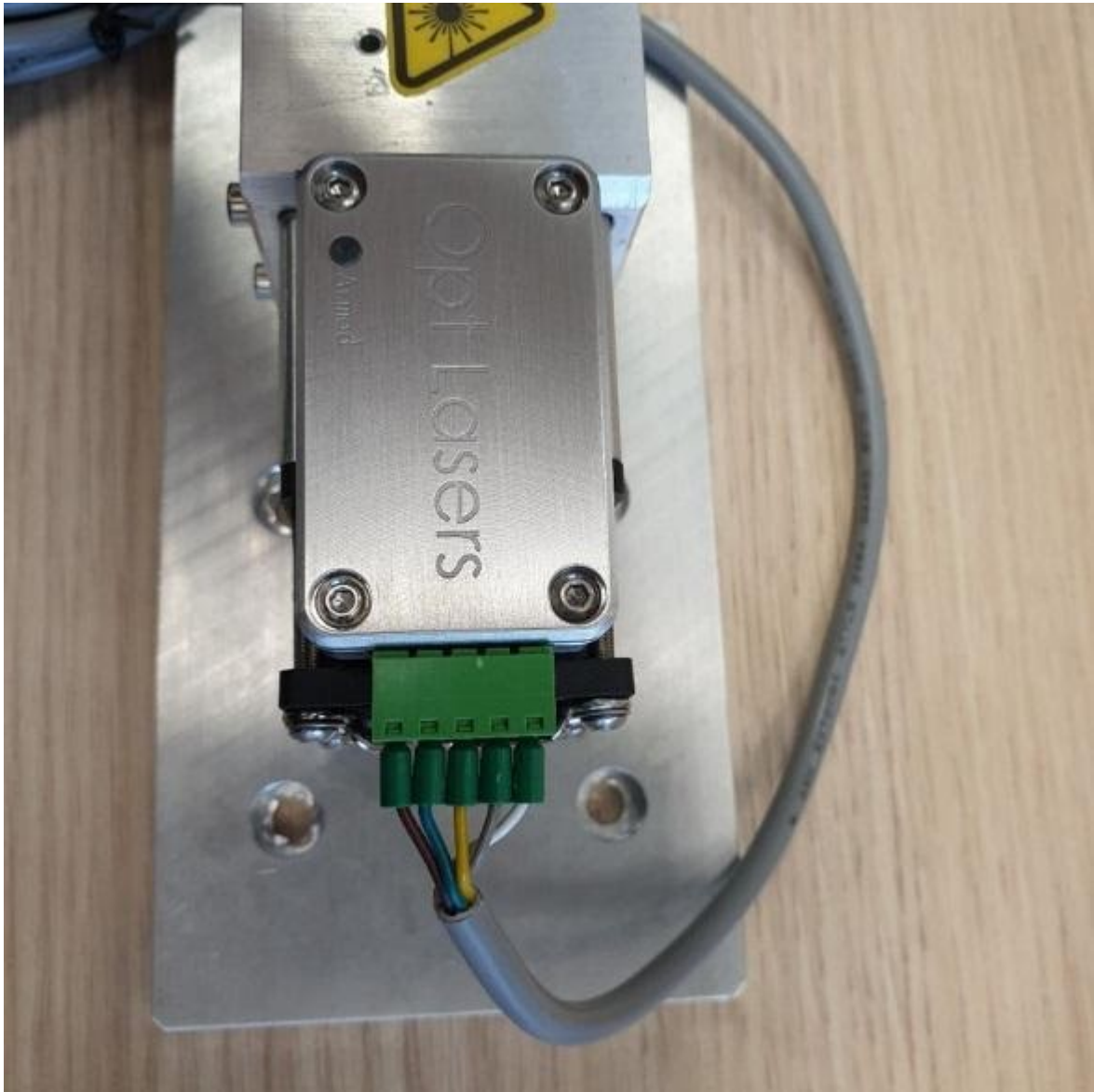
fan does not run).

ADVICE:

Step 1: Check the cable between the PLH3D-CNC Adapter and the laser head. Carefully inspect the cable's pinout. If you are using a Docking Station, please consult relevant documentation as well.







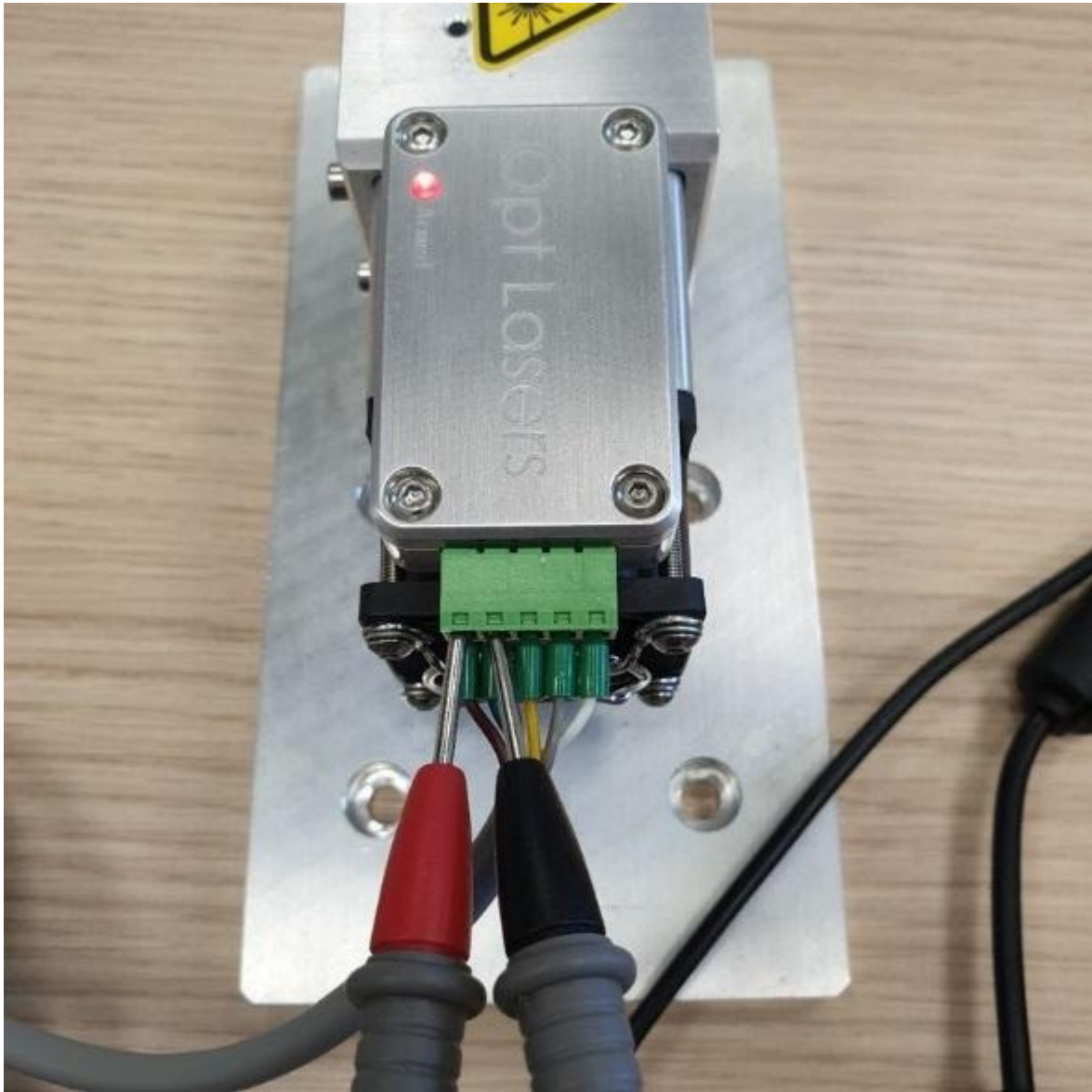
Step 2: Next, check the laser head's power supply at the LASER HEAD connector of the PLH3D-CNC Adapter:





- If there is no voltage or the voltage is too low (below 12 V), then the electronics of the PLH3D-CNC Adapter must be malfunctioning. If you use the PSU from Opt Lasers engraving lasers kits, the multimeter should indicate a voltage above 18 V.

Step 3: If it is possible, check the power supply at the laser head:





- If there is no voltage or the voltage is too low (below 12 V) then the cable must be malfunctioning. The PSU purchased as a part of Opt Lasers engraving lasers kits should show a voltage in excess of 18 V.
- If no malfunction has been found throughout these steps, then it means that the laser head itself must be malfunctioning.

6. The POWER LED is lit. After pressing the MODE BUTTON, the **ARMED LED is lit continuously for a while but **after a couple of seconds the ARMED LED starts to flash**.**

ADVICE:

1. It is possible that no supply current is flowing through the laser diode (even though it might be flowing through the fan). Furthermore, no current is flowing at all in case the contacts at the EXT SWITCH connector are properly closed. Hence the laser head does not get any power. Proceed as described in Case 5.
2. If your PLH3D-CNC Adapter has been manufactured after July 2020, then it contains an option called „HEAD TYPE“. This option might be set incorrectly and might have been changed by the user by mistake.

Please consult the PLH3D-CNC Adapter Settings section of the Manual to check the chosen setting. For cutting and engraving laser with a built-in fan, the option has to be set to 2. For special engraving lasers with no fan (e.g. the liquid-cooled variation), the option has to be set to 1. You may also set the option to 0 for all types of engraving laser heads.

-
7. The POWER LED is lit. After pressing the MODE BUTTON, the ARMED LED lights up. The laser head receives adequate power supply (the built-in fan is running), but **there is no laser beam**, even though it seems there are proper controlling and enabling signals at the PLH3D-CNC Adapter's inputs. **The LASER LED is not lit.**

ADVICE:

Check the laser by generating a test laser pulse.

Please follow appropriate Laser Safety Procedures and put your Laser Safety Glasses on before proceeding with the test laser pulse. The laser beam is likely to be generated at the maximum power during this test.

Make sure the PLH3D-CNC Adapter is in the armed state.

Press and hold the MODE BUTTON for at least 2 seconds. Laser beam should be activated for a second. During the pulse generation, the LASER LED should light up. Refer to the section *Getting Started* (point 8) of the Manual.

1. If the LASER LED does not light up, then the cable connecting the PLH3D-CNC Adapter with the laser head may have a short circuit. Turn the PLH3D-CNC Adapter off. Disconnect the cable and check it. Look for possible short circuits between the wires.
 - If no issues are found, then the electronics of the PLH3D-CNC Adapter must be malfunctioning.
2. If the LASER LED lights up, but there is no laser beam then go to Case 8.
3. If the laser pulse has been generated successfully and the LASER LED lighted up, then there is an issue with the controlling inputs. Following scenarios are possible:
 1. The chosen setting of the Enable Option is incorrect.
 2. No proper controlling signal appears at the CONTROL connector.
 3. No proper enabling voltages appear at the CONTROL connector.
 4. The electronics of the PLH3D-CNC Adapter is malfunctioning.

Perform your tests in the given order, from 7.3.1 to 7.3.4. Always make sure the PLH3D-CNC Adapter is in the armed state.

During the tests, ensure you always keep your Laser Safety Glasses on and follow appropriate Laser Safety Procedures, since the laser may activate at full power at unexpected moments.

7.3.1. Enable Option

Before performing any other test, check the currently chosen setting of the Enable Option. An incorrect setting usually leads to inadvertent disabling of the controlling signal.

Temporarily set the Enable Option to 0. Refer to the Manual section *For Advanced Users* on page 25. At this setting, the controlling inputs of the PLH3D-CNC Adapter are always enabled.

After restarting the PLH3D-CNC Adapter, arm the laser head and provide the controlling signal.

If neither the LASER LED lights up nor the laser activates, please **go to point 7.3.2.** in order to check the controlling inputs.

If the LASER LED lights up and the laser activates, then the previous setting of the Enable Option

was apparently wrong. Check carefully what the intended voltage levels at the ENABLE1 INPUT and ENABLE2 INPUT are that shall enable the laser.

Find the corresponding Enable Option setting in the table shown in the Manual on page 25. Now, select and store the right setting in the PLH3D-CNC Adapter. Refer to the Manual.

After rearming, provide the controlling signal along with the enable voltages from the controller.

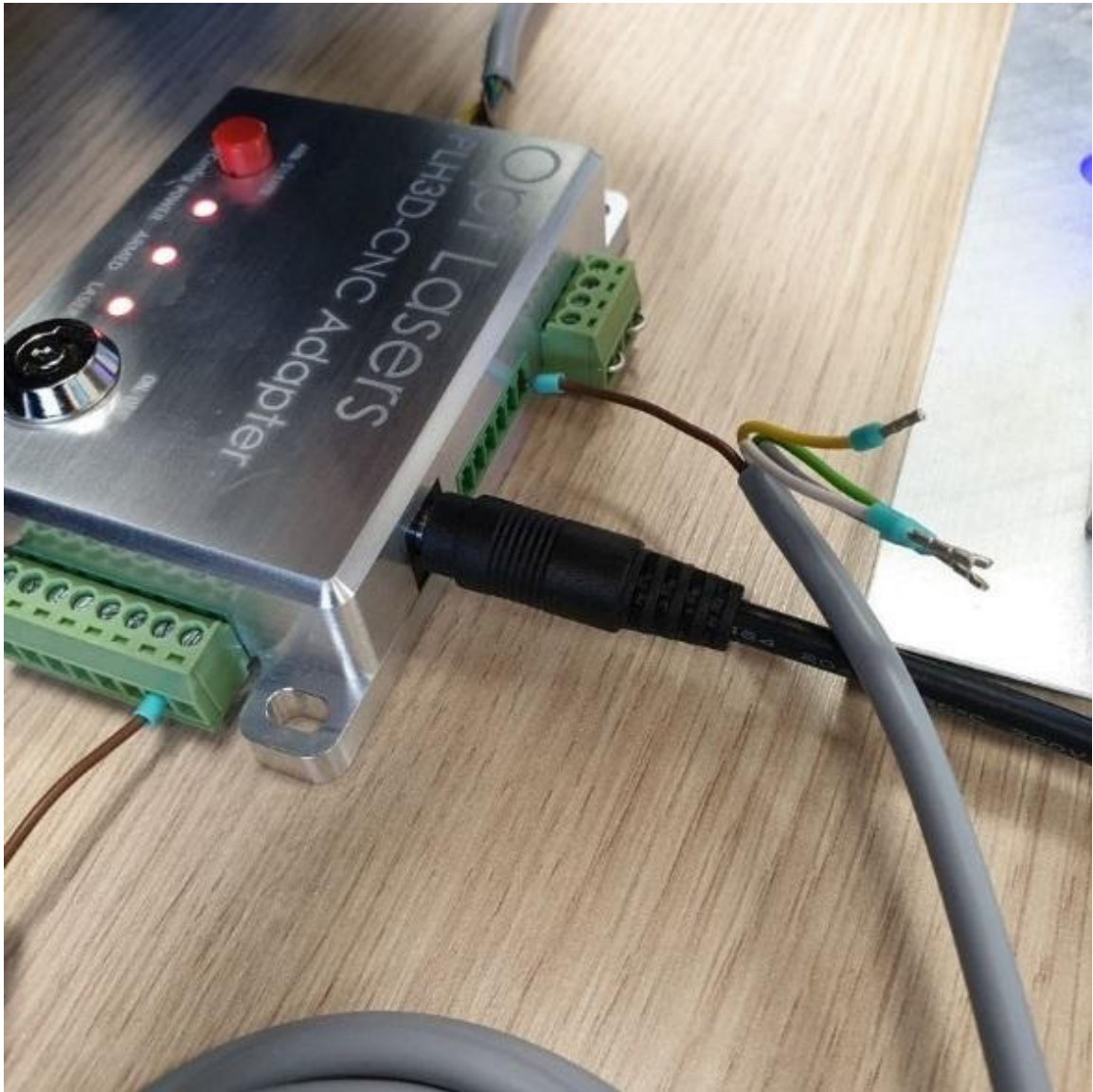
- If neither the LASER LED lights up nor the laser activates, then **go to point 7.3.3** in order to check the enable inputs.
- If the LASER LED lights up and the laser activates properly, then the troubleshooting is over. You have now set the Enable Option correctly.

7.3.2. Controlling Signal

If you have an oscilloscope, check the presence of the controlling signal directly at the appropriate terminal (1,2,6, or 7) of the CONTROL terminal block. You may also use a multimeter if the controlling voltage does not change fast.

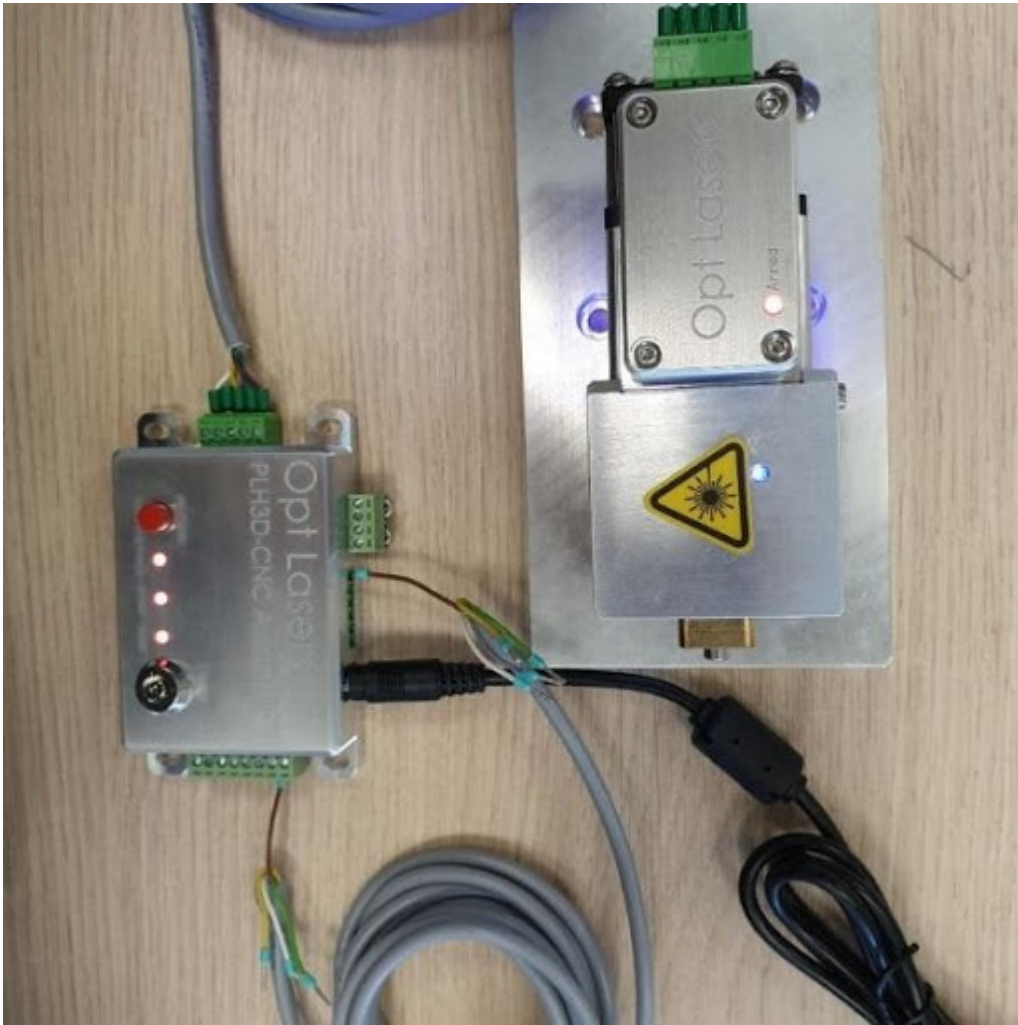
You may check the controlling inputs with a temporary wire connection:

1. Disconnect the wires from the terminal block in the CONTROL connector.
2. Prepare a wire with a length of 10 cm or more. Connect one side of the wire to pin 1 of the EXTENSIONS connector. You may also connect the wire to one of the wire jumpers at the EXT SWITCH connector.
3. Arm the PLH3D-CNC Adapter. Now run the >10 cm wire to the terminal 2 of the CONTROL connector. Refer to the pinout shown in the Dimensions and Pinout section of the Manual.





The wire connection forces a valid voltage level at the controlling input. It happens regardless of whether a proper signal is issued from the controller. If the laser head is armed, then the laser should now activate:



A different input terminal (1 or 6 or 7) can also be checked with a temporary wire connection.

To check terminal 1 (ANGIN 5V INPUT) or terminal 6 (ANGIN 10V INPUT), run the >10 cm wire to the respective pin.

To check terminal 7 (INVERTED TTL/PWM INPUT), connect one side of the >10 cm wire to terminal 4 of the CONTROL connector (GROUND) and then run it to terminal 7 of the CONTROL connector.

If the temporary wire connection activates the laser while the signal from the controller does not, then it seems an improper input signal from the controller appears at the CONTROL connector. Check the cable and the controller in this case.

7.3.3. Enabling Voltages

Using a multimeter or an oscilloscope, check the voltage levels at the enable inputs directly. Do so at the appropriate terminals, namely terminals 3 and 5, of the CONTROL terminal block. Compare measured levels to the levels shown in the table in the Manual on page 25 for the current setting of the „enable option“.

Note:

- proper voltage levels have to be at BOTH enable inputs;

- if “Any State” is specified for an enable input, then the input may be either left open or attached to any permissible voltage (see page 24 of the Adapter Manual), including ground.
 - If the measured voltage levels are fully matching the setting shown in the table and the laser still does not activate, then the electronics of the PLH3D-CNC Adapter must be out of order.

7.3.4. The Electronics

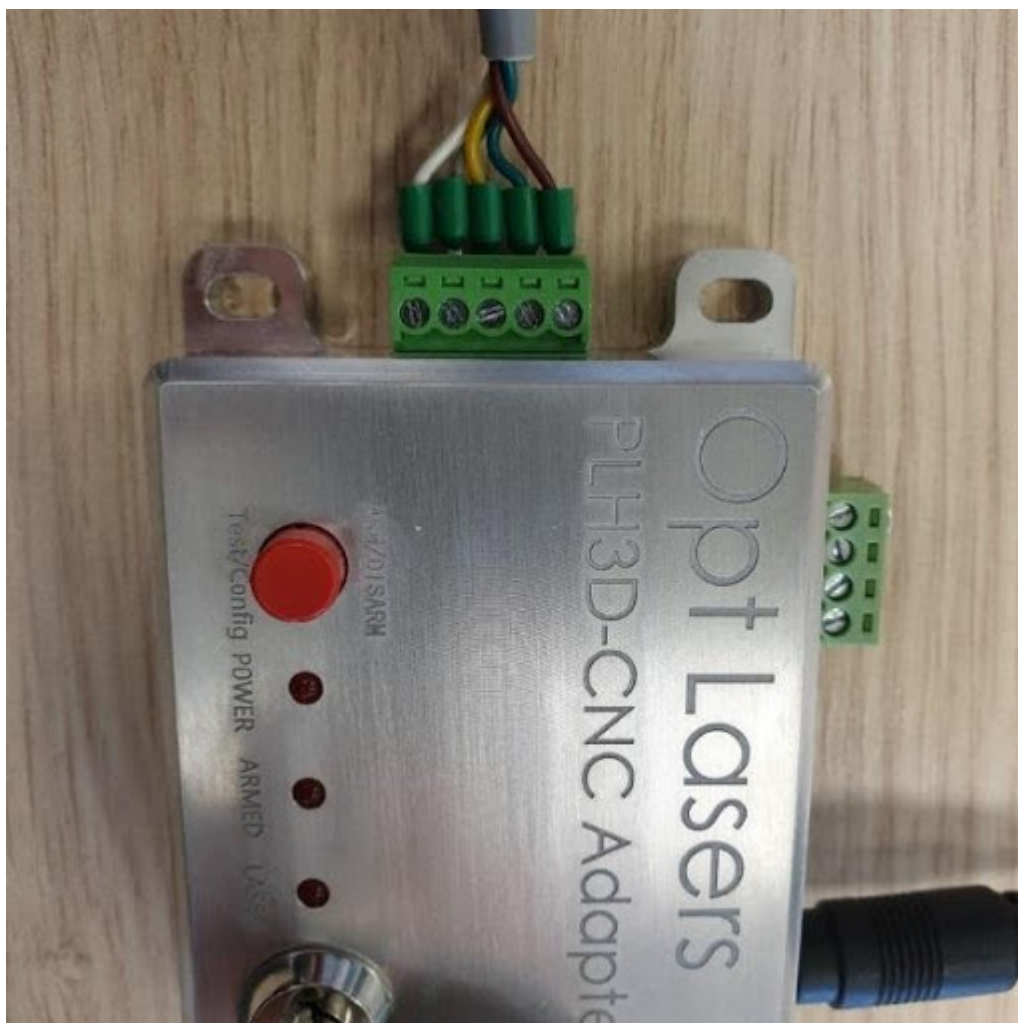
- If none of the tests described above indicated the reason for the encountered issues, then the PLH3D-CNC Adapter must be out of order.

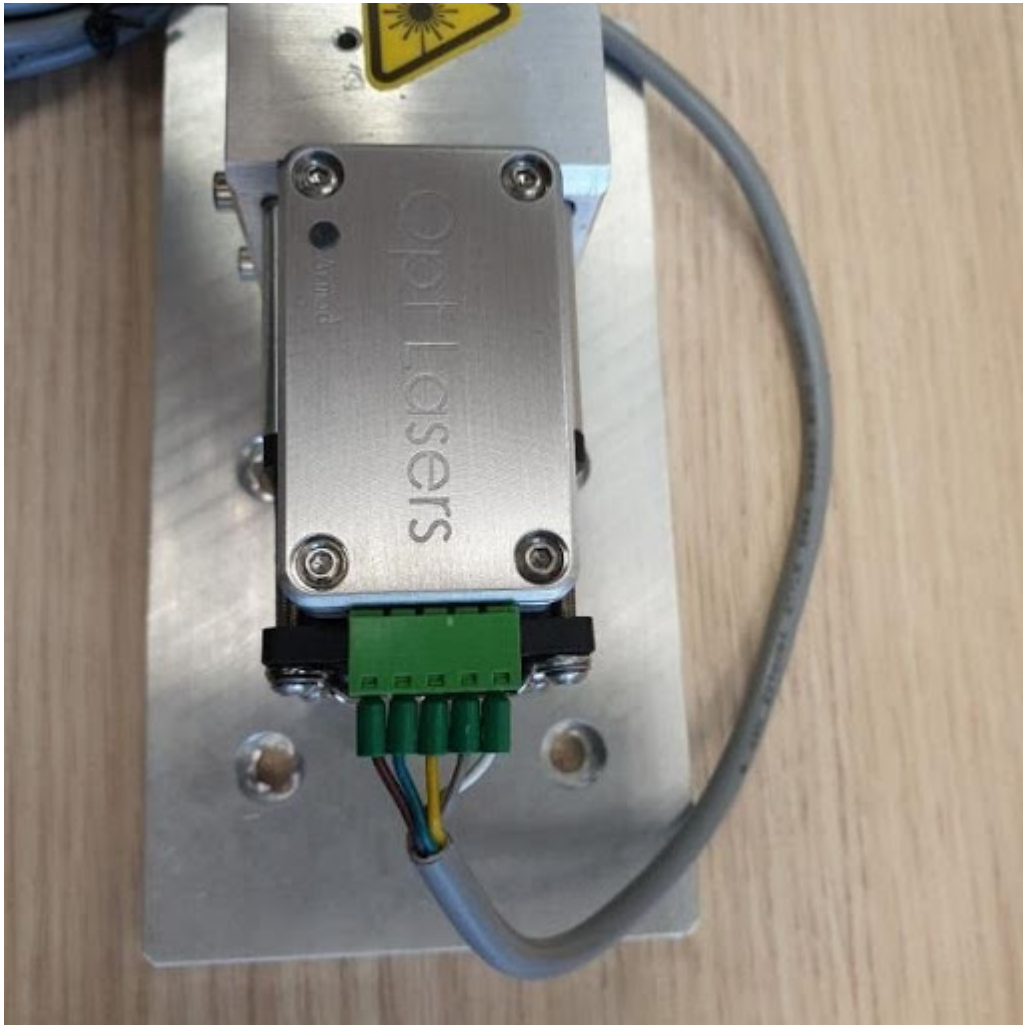
8. The POWER LED is lit. After pressing the MODE BUTTON, the ARMED LED lights up. The laser head receives adequate power supply (the built-in fan is running). There is a controlling signal at the PLH3D-CNC Adapter’s input and the LASER LED is lit, but there is no laser beam.

ADVICE:

The controlling signal apparently passes through the PLH3D-CNC Adapter correctly and also appears at the LASER HEAD connector. The signal either does not reach the laser head or the laser head is out of order.

1. There may be a lacking connection in the cable between the PLH3D-CNC Adapter and the laser head at the ANGIN 5V line. Check the cable, especially the pinout:





2. The laser head may be out of order.
3. Although it is unlikely in such case, the electronics of the PLH3D-CNC Adapter may be out of order.