PLH3D-CNC Adapter PRO

User Manual

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General Description

PLH3D-CNC Adapter PRO is a versatile tool suitable for use with Opt Lasers PLH3D-series laser heads: XT8, 30W, 15W, XT-50, XT-10, XF+, or XF. Moreover, it can be seamlessly adapted to other diode laser heads with up to 50 Watts of optical (laser) power.

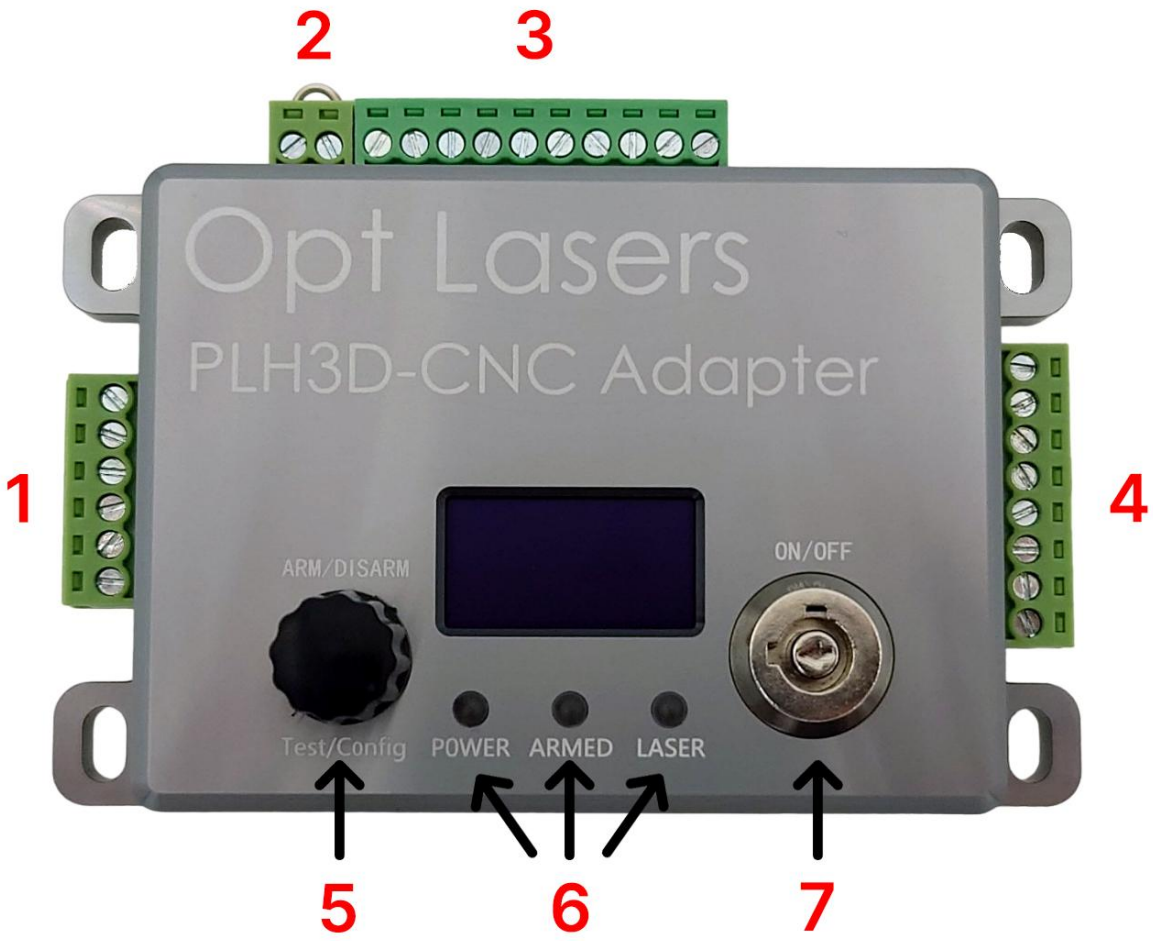
The primary purpose of PLH3D-CNC Adapter PRO is to convert various control signals generated by CNC machine controllers into a PWM/TTL or Analog control signal format compatible with laser heads. Additionally, it functions as an extra layer of safety for both the user and the laser head.

When installed according to the User Manual, the Adapter poses no risk of damaging the controller.

Key Features

- Convenient alphanumeric OLED display for easy navigation.
- Safe start ensures secure operation.
- Key lock function prevents unauthorized use.
- Status LEDs provide real-time operational feedback.
- Option to enhance safety with an external key lock, stop button, or sensors.
- Remote arming option for convenience.
- High-quality durable aluminium enclosure ensures longevity.
- Easy configuration with a majority of CNC machines.
- Compatibility with all Opt Lasers laser heads.

Device Overview



1. **Laser head connector**
    a. Attach the laser head cable here.
2. **External switch connector**
    a. An external switch (e.g., a limit switch, a key switch, or an emergency stop) that arms/disarms the laser head can be connected to the PLH3D-CNC Adapter. When not in use, replace it with a jumper wire.
    b. Opening the external switch disarms the laser head immediately.
3. **Extensions connector**
    a. Contains power supply connectors, arming inputs, PWM control, and optional opto-isolated inputs for PWM control and Enable signal.
4. **Control connector**
    a. Connections for managing inputs and outputs.

5. **Knob (Button)**
    a. Press or turn the Knob (Button) to select various options (see Standard Working Modes for more information).
6. **LED status indicators**
    a. POWER: Indicates the presence of the power supply and signals supply errors.
    b. ARMED: Indicates the arming state and signals both disarming by an external switch and laser head disconnection.
    c. LASER: Indicates the presence of the laser head control signal.
7. **Key switch**
    a. Prevents use by unauthorized personnel.
    b. Turn the key switch clockwise to the upper position to turn on the Adapter.
    c. Turn the key switch counterclockwise to the left position to turn off the Adapter.

Pinout

1. **Laser head connector**
    a. **VCC:** Power supply positive for the laser head
    b. **GND:** Power supply negative for the laser head
    c. **SGND:** Signal ground
    d. **PWM:** Normalized to PWM in the range of 0 - 5V (TTL output)
    e. **ANG:** Analog modulation input, normalized to a range of 0-5V
    f. **ST:** Status input from the laser head for optional laser head detection (expecting a high state >4V during normal head operation). Not supported by Opt Lasers models with 5-pin connectors.
2. **External switch connector**
    a. **-** : External switch input (negative)
    b. **+** : External switch input (positive)

3. **Extensions connector**
    a. **PSU:** Power supply positive equivalent to the DC connector
    b. **GND:** Power supply negative equivalent to the DC connector
    c. **ARMING:** Activation input - shorting to ground triggers arming or disarming of the CNC Adapter (similar to pressing the encoder)
    d. **RESERVED:** Reserved for internal functions
    e. **RESERVED:** Reserved for internal functions
    f. **RESERVED:** Reserved for internal functions
    g. **ARMED:** 0-5V output (parallel to the output on the control panel)
    h. **OPTO-TTL:** Optically isolated PWM control input active at a high level (optional)
    i. **OPTO-EN:** Optically isolated enabling input, combined with ENABLE 1 (optional)
    j. **OPTO-COM:** Return connection for optically isolated inputs (optional)

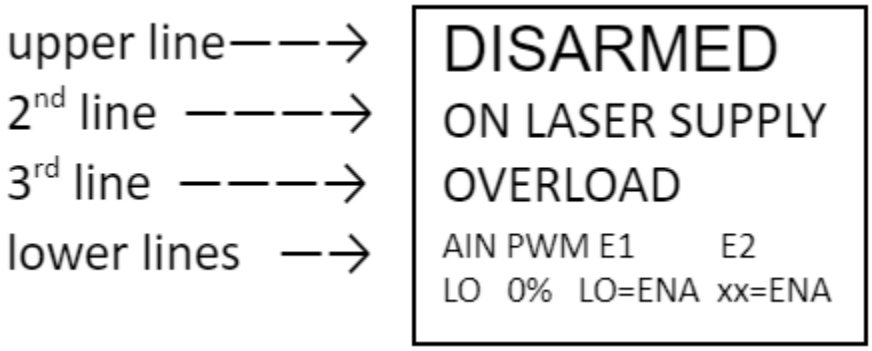
Note: For the opto-isolated inputs there is an internal current limiting circuit. Minimum required current is 2mA. Voltage range is 3 - 24V.

4. **Control connector**
    a. **ANGIN 5V:** Analog modulation input, normalized to a range of 0 - 5V. The input withstands voltages up to 24 V DC. The input impedance is 3.9 kΩ.
    b. **TTL:** PWM control function. This input accepts PWM signal with "HIGH" active level. Input works according to TTL standard. Maximum voltage is 24V.
    c. **ENABLE 1:** 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 kΩ. The functionality of this pin is set in firmware and described below.
    d. **GND:** Ground signal
    e. **ENABLE 2:** 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 kΩ. The functionality of this pin is set in firmware and described below.
    f. **ANGIN 10V:** Analog modulation input, normalized to a range of 0 - 10V. The input withstands voltages up to 24 V DC. The input impedance is 7.8 kΩ.
    g. **INV TTL:** PWM control function. This input accepts PWM signal with "LOW" active level. Input works according to TTL standard. Maximum voltage is 0.8V.
    h. **ARMED:** 0 - 5V output, set to 5V when CNC Adapter is in the ARMED mode.

Adapter Display

The CNC Adapter is equipped with an alphanumeric OLED display that shows information about the current working mode and device status.

The display comprises five lines of text:



The upper line displays the name of the current working mode.

The 2nd and 3rd line contain information related to the working mode or present various options.

The two lower lines show current states of the CNC Adapter inputs or contain help on the operation.

Getting Started

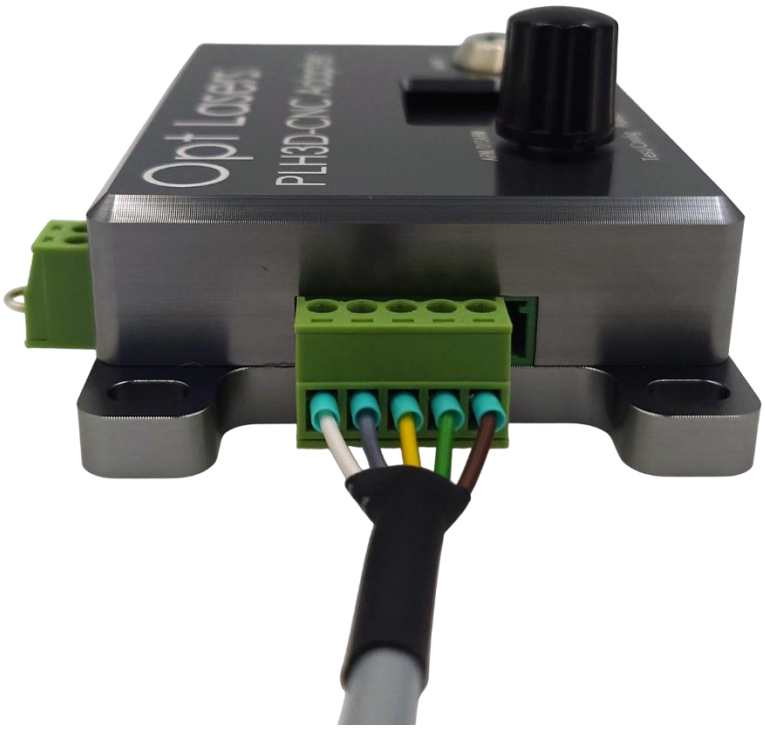
1. Connect the laser head to the Adapter.
    a. Ensure the laser head is securely mounted, for example, on a CNC machine.
    b. If using a Magnetic Docking Station or LaserDock PRO, connect the Adapter to the docking station.
2. Connect the control cable from the Adapter to your device (CNC machine).
3. If an external switch is used, connect its cable to the Adapter.
4. If an extension cable is used, connect it to the Adapter.
5. Connect the power supply to the Adapter.
6. Turn on the Key switch.
7. When using the Adapter with lasers equipped with 5-pin connectors, make sure the “status input” is set to “ignored” (see Advanced Settings).

Laser Cable Connection

Opt Lasers PLH3D-Series laser heads utilize either a 5-pin or a 6-pin connector. The section below outlines the proper connection of each type.

5-pin Connector

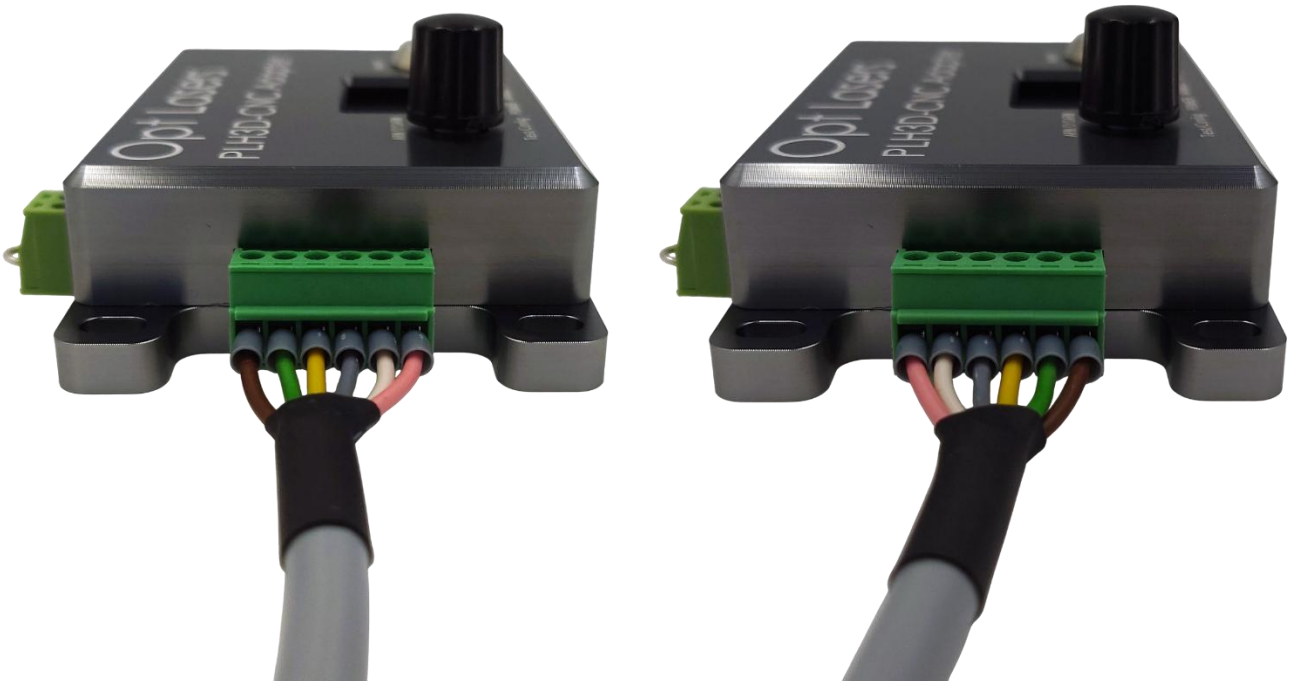
When using the Adapter with an laser that is equipped with a 5-pin connector, the connector must be connected in such a way that the ST pin is left unused.



In this case, the “STATUS INPUT” needs to be set to “ignored” (see Advanced Settings).

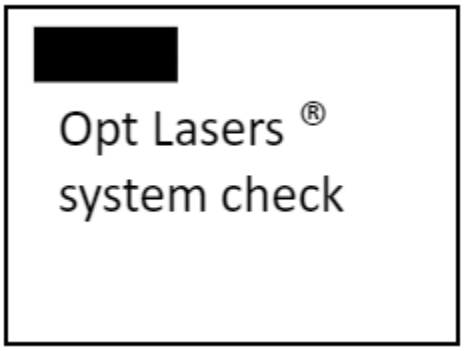
6-pin Connector

When used with a laser cable featuring 6-pin connectors on both ends, either end can be plugged into the Adapter.



Standard Working Modes

After turning on the Power Supply and Key Switch, a device initialization is performed, and a progress bar is displayed.



Following the initialization, the CNC Adapter operates in one of its standard working modes, which are described in the further sections.

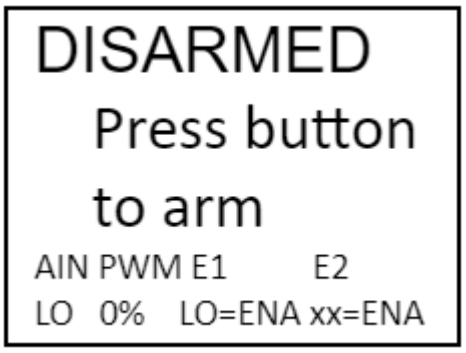
Disarmed

The CNC Adapter enters this mode after turning on the power supply. **In this mode, the CNC Adapter is in the safe state**. The power supply of the laser head is turned off, and consequently, **no laser action is possible.** The POWER LED is illuminated, while the other LEDs are off.

Disarmed By The User

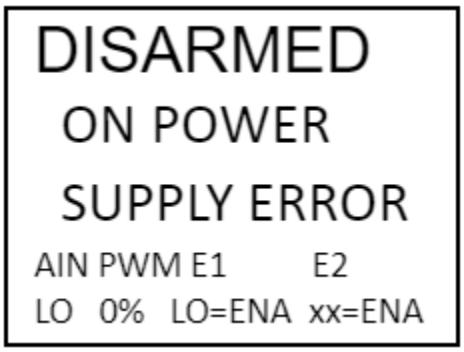
This is the state after turning on the power supply or after manual disarming.

The display appears as follows:



Disarmed On Error

When a critical error is recognized during work, the CNC Adapter goes to the DISARMED mode automatically. The cause of automatic disarming will be displayed on the display in such case:



The following errors cause automatic disarming:

- **POWER SUPPLY ERROR:** improper voltage of the power supply unit (out of the 9V…26V range);
- **LASER SUPPLY OVERLOAD:** overload of the laser head (only if enabled; see SETUP mode);
- **SAFETY SWITCH OPENING**: disconnecting the emergency switch;
- **LASER DISCONNECTING:** disconnecting the laser head cable (only if enabled; see SETUP mode);
- **LASER STATUS ERROR:** low voltage level or open state at the status input (only if enabled; see SETUP mode).

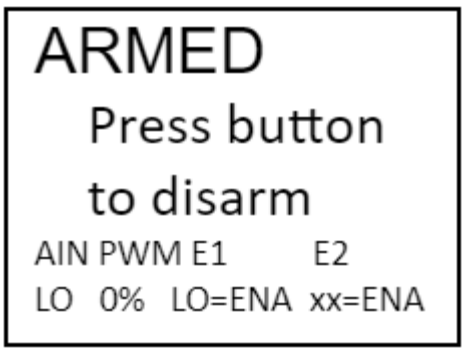
Armed

Laser safety glasses must be worn by all present personnel when the laser is armed.

Press the Button briefly to enter the ARMED mode.

In this mode, the power supply of the laser head is activated, allowing the **laser to operate.** Both the POWER LED and the ARMED LED are illuminated. The LASER LED lights up when a signal is present at the laser head output (either ANL or TTL), indicating that the laser is activated.

The display appears as follows:



Press the Button briefly to terminate the ARMED mode and return to the DISARMED mode.

Press and hold the Button for more than 1 second to enter the TEST MODE.

Test Mode

This mode is intended for testing the laser head. The power supply of the laser head is turned on. In this mode, the laser operates only basing on the signals generated by the Adapter; the signal coming from the CNC controller is not relayed to the laser.

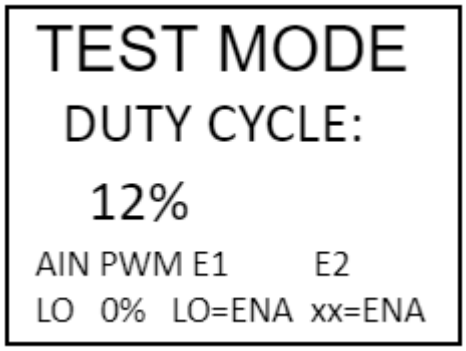
A PWM signal with 10kHz frequency and adjustable duty cycle (0 to 100%) is generated at the TTL output to the laser head. The laser is then activated and its output power (0 to MAX) corresponds directly to the preset duty cycle.

Turning the Knob clockwise/anticlockwise increases/decreases the setting of the duty cycle. Turn the Knob slowly for fine steps. Turn it fast for quicker changes.

To activate the laser, first preset a duty cycle greater than 0%. Then, press and hold the Button. After a second, a PWM signal with the preset duty cycle will be output to the laser. Releasing the Button will immediately turn the output signal off.

If the preset duty cycle equals 0% there is no output signal and the laser does not operate, regardless whether the Button is pressed or not. On entering the TEST MODE, the duty cycle is always 0%.

The POWER LED and the ARMED LED are both lit. The LASER LED is lit when a signal is present at the output.

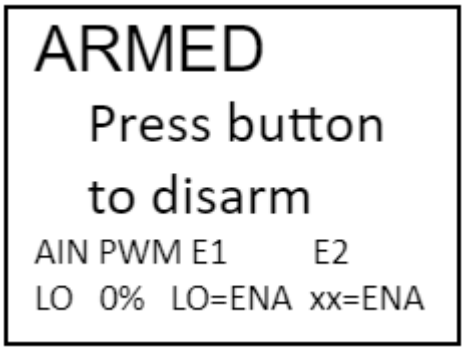


Press the Button briefly to exit the TEST MODE and return to the ARMED mode.

When exiting the TEST MODE, no power setting is saved. When outside of the TEST MODE (normal operation), power is set only through the machine’s controller.

Displaying The States Of The Input Lines

In the DISARMED and ARMED working modes, the states of the input lines are displayed in the two lower lines of the display:



AIN = analog input (either ANGIN 5V or ANGIN 10V):

- **LO:** no signal (input voltage lies continuously below approx. 5% of full range);
- **HI:** signal is present (input voltage exceeds approx. 5% of full range, continuously or pulsing).

PWM = digital input (either PWM/TTL or INVERTED PWM/TTL):

- **0%:** no signal, continuously;
- **1% to 99%:** a pulse-like signal is present (the approximate duty cycle is shown);
- **100%:** active signal level, continuously.

Note: for the INVERTED PWM/TTL input, the duty cycle after inversion is shown, i.e. 0% and 100% mean high and low logical levels on the input, respectively.

E1 = ENABLE 1 digital input; E2 = ENABLE 2 digital input:

- **any:** the state of the input does not matter;
- **LO:** LOW voltage level;
- **HI:** HIGH voltage level;
- **xx:** undefined state;
- **dis:** the state is recognized as disabling;
- **ENA:** the state is recognized as enabling.

Note: the undefined state (**xx**) may appear for the ENABLE 2 input only. This is for example the case when the input is left open. The ENABLE 1 input, when left open, shows a logical level that corresponds to the disabled state.

Note that the states of the output lines are not shown on the display. Instead, the LASER LED shows activity (steady level or pulses) of either analog or digital output line.

Displaying states of the input lines recognized in the CNC Adapter, along with the status of enabling/disabling, allows for quick troubleshooting.

For example, it may happen that there is no laser action even though it seems the CNC Adapter receives a proper controlling signal. In such cases, check the display to verify the states of the inputs recognized by the CNC Adapter. The conditions for activating the laser are as follows:

- either the analog input (AIN) should display **HI**, or the digital (PWM) input should display a value **from 1% to 100%**;

- each of the enable inputs (E1 E2) should show either **any** or **ENA**.

Setup Mode

In the SETUP mode, a number of CNC Adapter settings that are kept in the Parameter Memory may be viewed/changed by the user. The same settings will be used on the next Adapter power up.

Entering the SETUP mode is done by pressing and holding the Button, and then turning the Key Switch on. An entry screen appears:

Hold the Button for at least 3 seconds, until the progress bar is filled. Otherwise, the SETUP mode will be skipped and the CNC Adapter will enter the DISARMED mode.

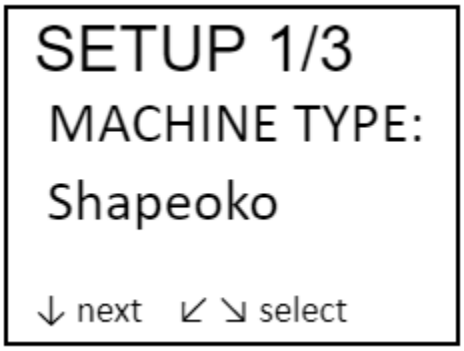
After entering the SETUP mode, “SETUP 1/3” appears in the upper line of the display. The POWER LED is flashing and the other LEDs are off.

There is a set of menu pages in the SETUP mode. On each page, you can choose different settings (options) for a parameter by turning the Knob clockwise/anticlockwise. Pressing the Button will preliminarily confirm the present setting and lead to the next menu page.

Note: At this stage, no changes are being made in the Parameter Memory.

Standard Settings

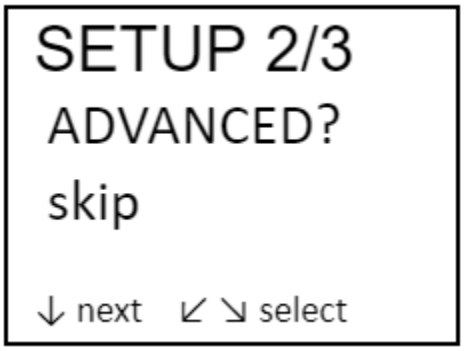
Page SETUP 1/3: MACHINE TYPE:



By turning the Knob, the type of the machine used for controlling may be selected. This setting only determines what states at the enable inputs are required for controlling the laser.

Pressing the Button will navigate to the SETUP 2/3 page.

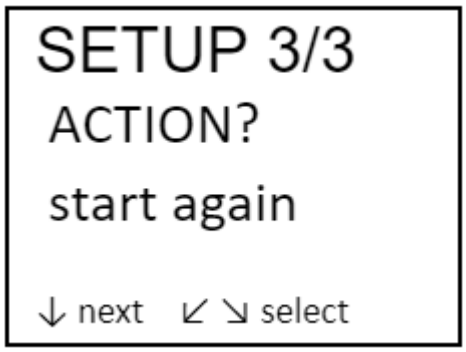
Page SETUP 2/3: ADVANCED?



Here, a special submenu of advanced settings may be entered.

Turning the Knob will select between “skip” and “enter”. Choosing “enter” and pressing the Button will lead to the ADVANCED SETTINGS submenu which will be described later. Choosing “skip” and pressing the Button will lead to the SETUP 3/3 page.

Page SETUP 3/3: ACTION?



Here, further actions can be chosen in the SETUP mode. By turning the Knob, following options are available:

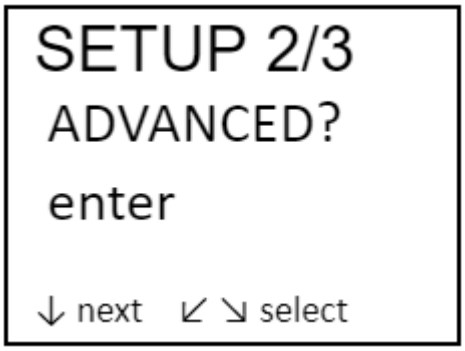
- “start again” will lead back to the SETUP 1/3 page, i.e. to the selection of the machine type;
- “save and exit” will store the settings in the Parameter Memory and the SETUP mode will be terminated;
- “set default” will recall factory settings of the CNC Adapter;
- “quit w/o saving” will discard the changes and the SETUP mode will be terminated.

After termination of the SETUP mode, the CNC Adapter enters the DISARMED mode.

Note that the settings kept in the Parameter Memory will remain unchanged also when the CNC Adapter is turned off.

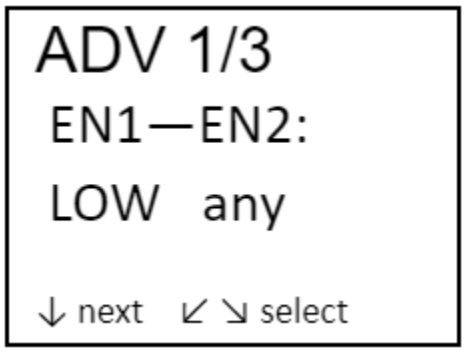
Advanced Settings

Selecting “enter” on the SETUP 2/3 page:



will lead to the advanced submenu (ADV) where additional parameters can be changed:

Page ADV 1/3: EN1—EN2



Here, the option of the enable inputs may be changed manually. This option specifies the necessary states for the ENABLE 1 and ENABLE 2 inputs to allow the input signals to enable the laser.

Usually, this option is set up automatically according to the preset machine type (see SETUP 1/3). However, this option can be adjusted to meet specific requirements. When this option is modified, the machine type will change to 'custom'.

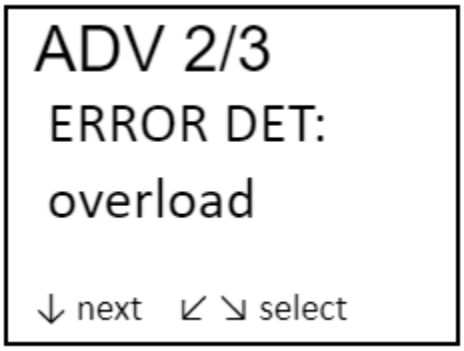
This option selects one of the following 12 combinations:

Description	Level required on ENABLE 1 input	Level required on ENABLE 2 input
any any	unspecified	unspecified
LOW any	LOW	unspecified
HIGH any	HIGH	unspecified
any LOW	unspecified	LOW
LOW LOW	LOW	LOW
HIGH LOW	HIGH	LOW
any HIGH	unspecified	HIGH
LOW HIGH	LOW	HIGH
HIGH HIGH	HIGH	HIGH
tgl any	toggling	unspecified
tgl LOW	toggling	LOW
tgl HIGH	toggling	HIGH

The required levels are as follows:

- **unspecified:** can be left open or attached at any voltage in the 0V…+24V range
- **LOW:** 0V…+0.5V voltage level;
- **HIGH:** +3V…+24V voltage level;
- **toggling:** changing between LOW and HIGH every 0.25s or faster.

Page ADV 2/3: ERROR DET:



Turning the Knob and pressing the Button allows for the selection of which errors in the laser head supply are to be detected.

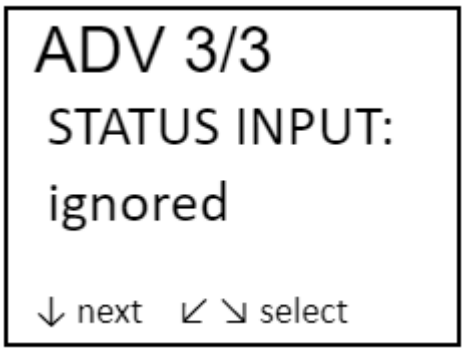
Choosing “**none**” turns off any error detection.

Selecting “**overload**” indicates the detection of an excessively high laser power supply current. A supply current higher than 9A will be recognized as overload and cause automatic disarming of the CNC Adapter.

Choosing “**disconnection**” means that, additionally to the overload, an underload of the laser power supply will be detected. **This setting may be chosen only for certain types of laser heads**, namely ones containing a cooling fan. In such laser heads, some supply current is always flowing to the laser head even if the laser does not operate. In the case of a laser head cable disconnection, the current drops down to zero which will be detected and the CNC Adapter will be automatically disarmed.

Page ADV 3/3: STATUS INPUT:

Note: This option is currently only supported by the PLH3D-XT8 laser head. When using the Adapter with an Opt Lasers model with a 5-pin connector, this option needs to be set to “ignored”.



This option provides instructions on managing the status input terminal, located at the LASER HEAD connector.

Some laser heads issue a digital status signal which is HIGH at normal work and turns LOW on errors.

Choosing “**watched**” allows the use of this status signal. It should be attached to the status input terminal in the CNC Adapter. If the laser head reports an error by turning the status line to LOW, the CNC Adapter will recognize this and disarm automatically.

Note: Disarming will also occur after disconnecting the laser head cable. This is because the status input terminal in the CNC Adapter assumes a LOW state when left open.

Choose “**ignored**” if the status input is not intended to be used.

Remote Arming

This PLH3D-CNC Adapter PRO allows the users to utilize a Remote Arming function.

In this way, the Arming can be performed with an external switch or through the CNC machine controller.

This option responds to an incoming impulse (edge trigger), so there is no need to hold the button.

External Switch

In this option, the external switch needs to be connected to the "ARMING" and "GND" pins in the Extensions connector.

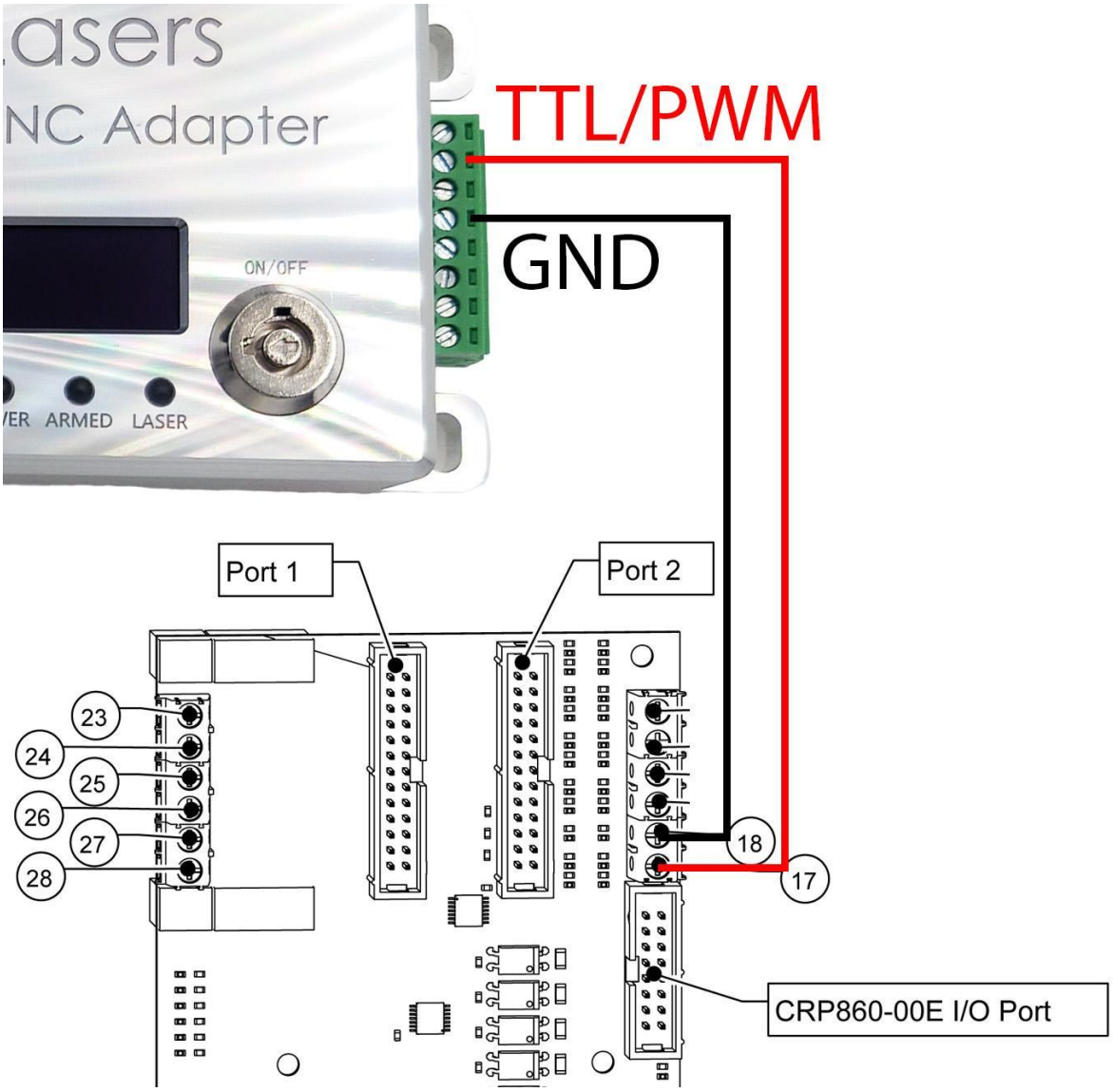
Through CNC machine controller

In this option, the "ARMING" pin in the Extensions connector needs to be connected to the proper pin in the CNC machine controller. Refer to the machine’s manufacturer manual for this information.

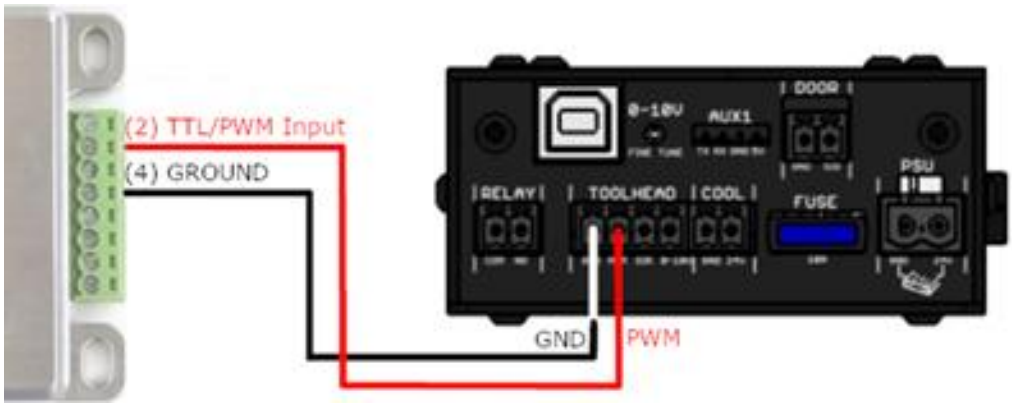
CNC Machines Connections

The following sections demonstrate how to connect the CNC Adapter to various popular CNC machines, 3D printers, and controllers. This list is not exhaustive; additional information can be found on the Opt Lasers Laser Upgrade Instructions website.

AVID CNC

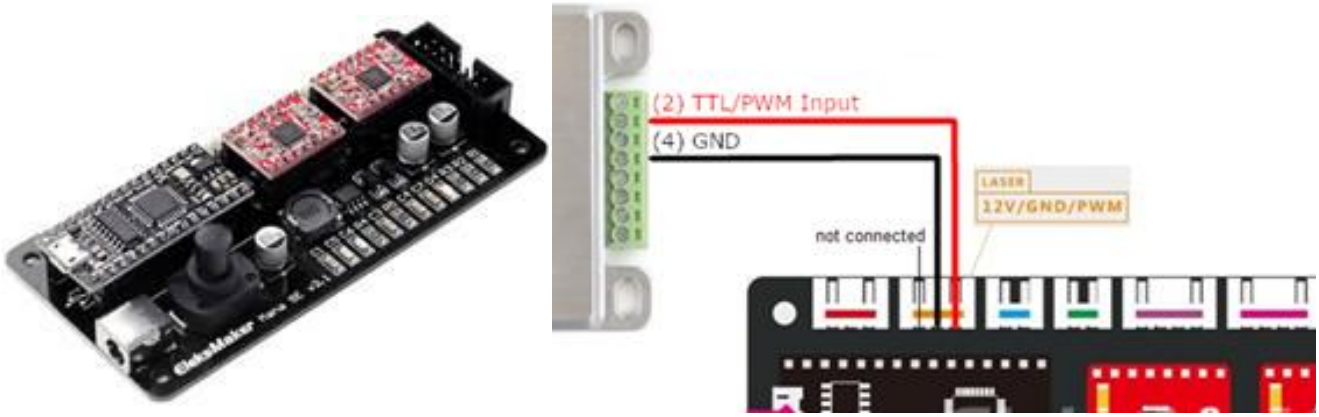


BlackBox Motion Control System

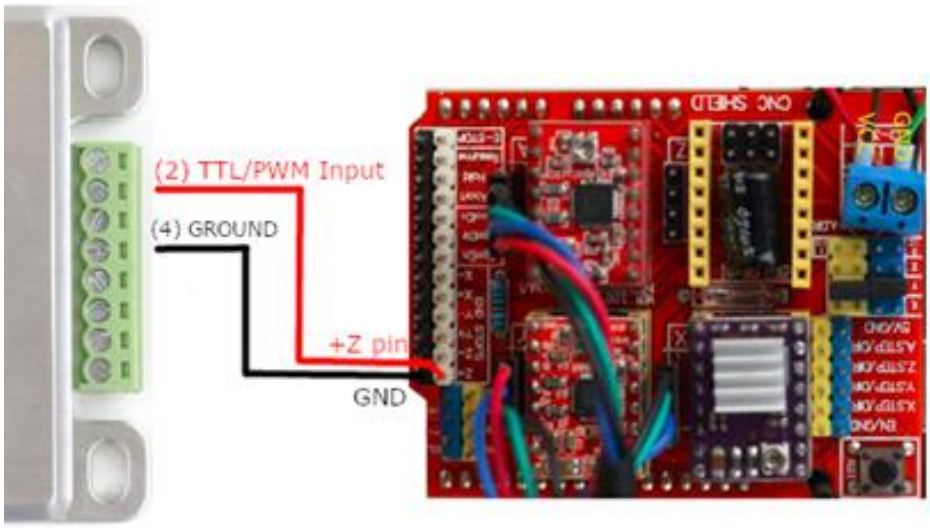


CSMIO Controller

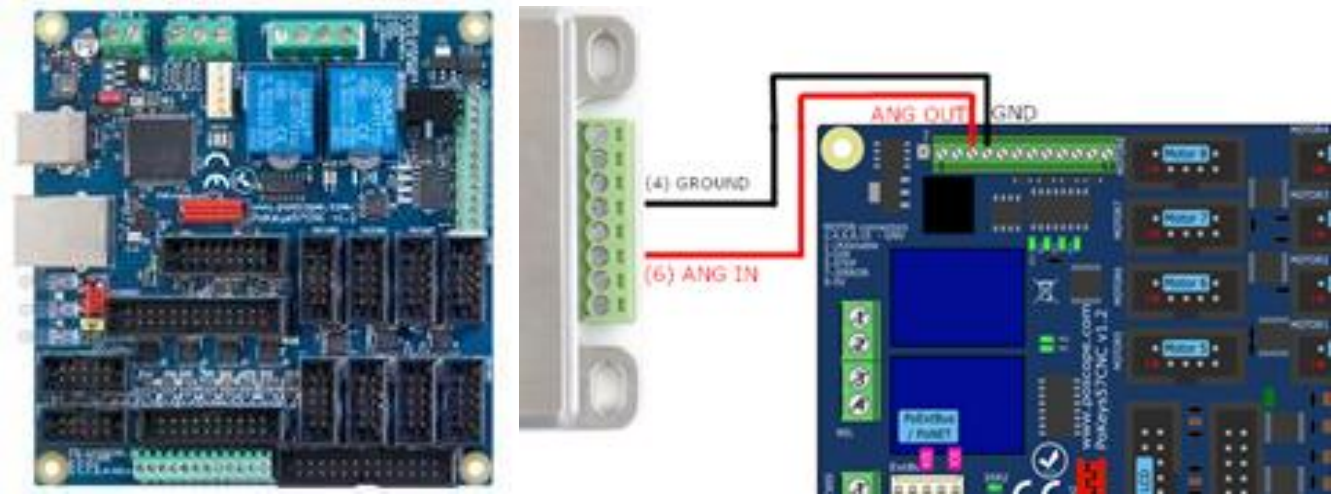
EleksMaker Controller



Openbuilds CNC



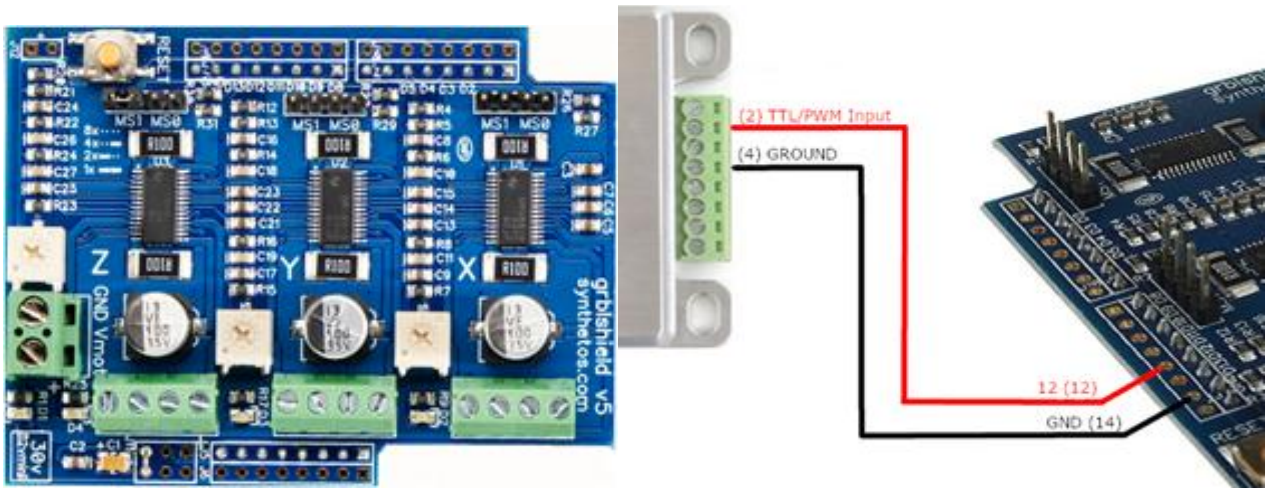
Pokey57 CNC Controller



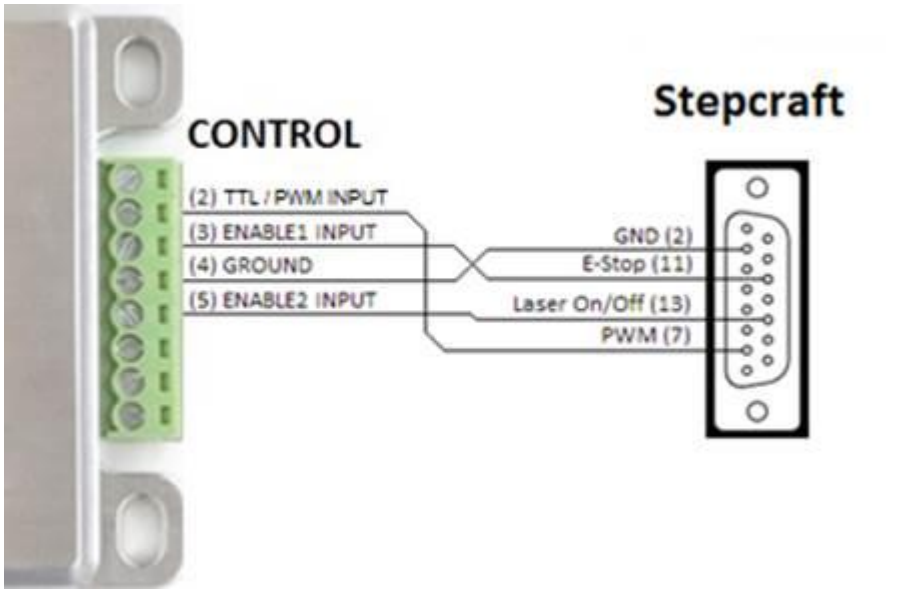
Shapeoko CNC

Arduino Uno

gShield (grblShield v5)

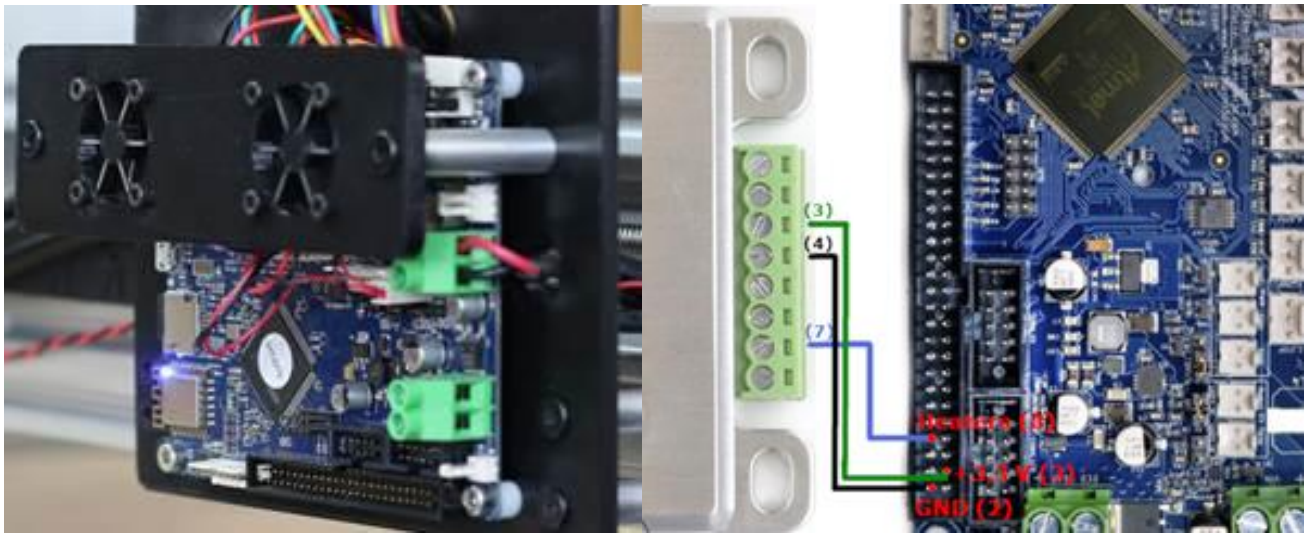


Stepcraft CNC



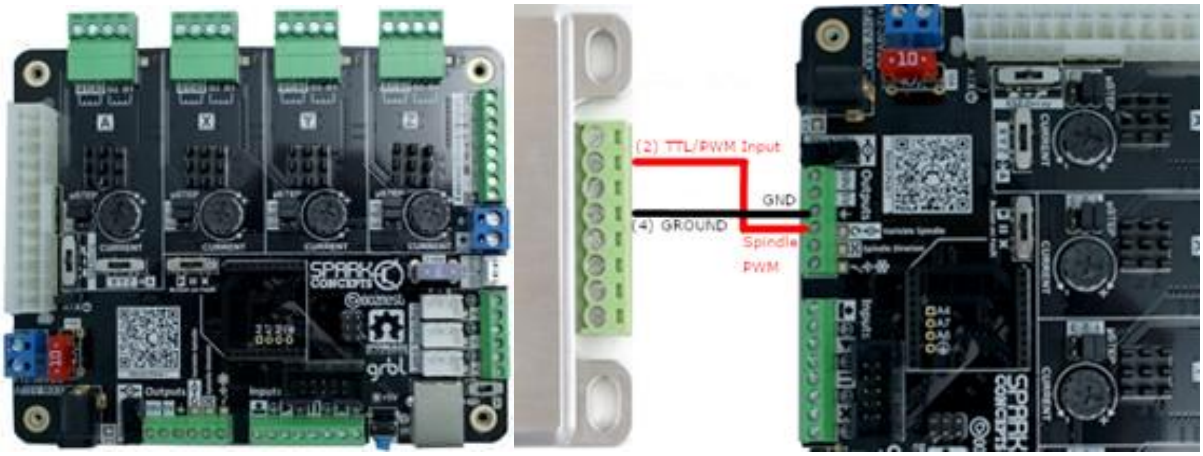
WorkBee CNC

Duet Controller



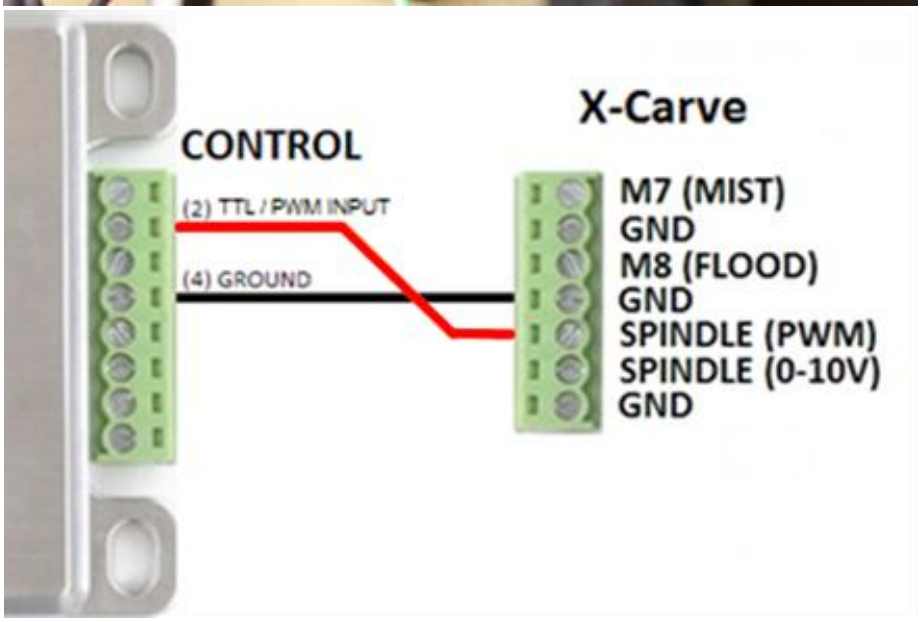
CNC xPRO v3 Controller

CNC xPRO v4 Controller

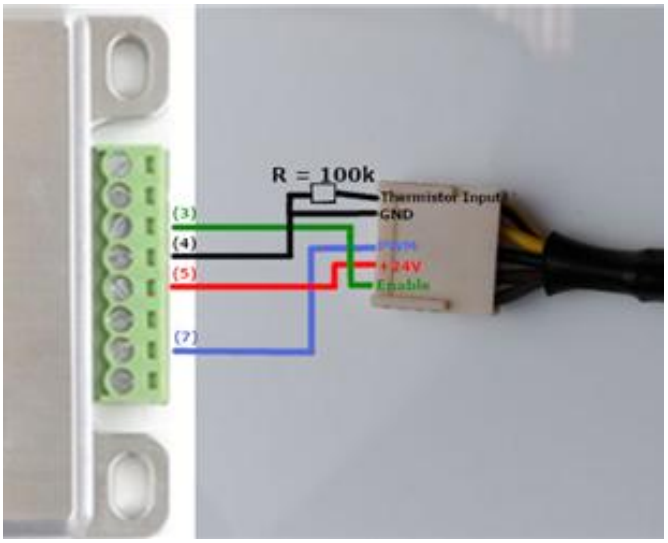


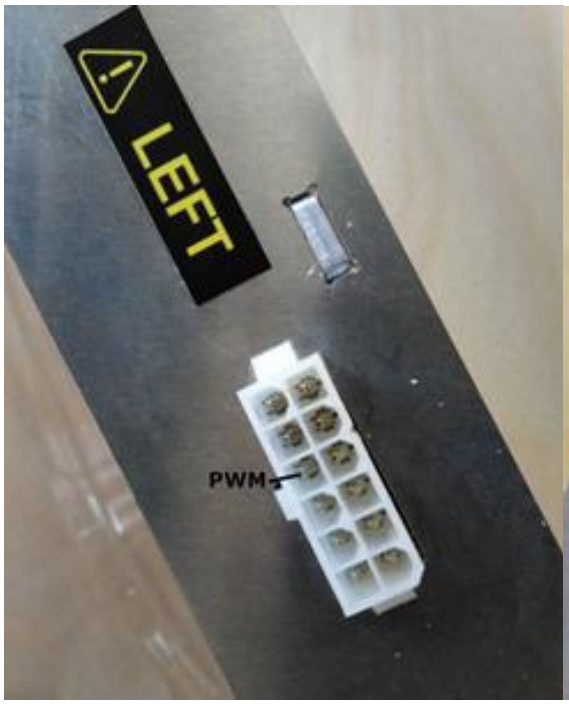
X-Carve CNC


Y1 AXIS
Y2 AXIS
Z AXIS
M7 (MIST)
GND
M8 (FLOOD)
GND
SPINDLE (PWM)
SPINDLE (0-10V)
GND
POWER


CONTROL
(2) TTL / PWM INPUT
(4) GROUND
X-Carve
M7 (MIST)
GND
M8 (FLOOD)
GND
SPINDLE (PWM)
SPINDLE (0-10V)
GND

ZMorph 3D Printer





Basic Troubleshooting

Problem	Possible reason	Solution
POWER LED is off	Key switch is not in the “ON” position.	Turn the Key switch clockwise to the “ON” position.
	Power supply is not connected.	Ensure the power supply is connected to the wall switch and the Adapter.
	There is no main power supply (grid power).	Check the main power supply (grid power).
	The power supply unit is defective.	Replace the power supply unit.
	The Adapter is defective.	Please contact us for repair assistance.
POWER LED is flashing	The supply voltage is outside of the acceptable range.	Use a dedicated power supply unit.
	The power supply unit is defective.	Replace the power supply unit.
	There is an internal Adapter error.	Please contact us for repair assistance.
ARMED LED is flashing	The connection with the laser head has been disrupted or lost.	Reconnect the laser head and rearm it.
	An external switch has been opened.	Close the switch and rearm the laser.
Adapter displays “POWER SUPPLY ERROR”	Voltage of the power supply unit is out of the 9V…26V range.	Replace the power supply with a unit with the correct voltage.
Adapter displays “LASER SUPPLY OVERLOAD”	The power supply for the laser current is excessively high.	Replace the power supply with a unit with the correct current.
Adapter displays “SAFETY SWITCH OPENING”	The emergency switch was disconnected.	Reconnect the emergency switch.
Adapter displays “LASER DISCONNECTING”	Laser head cable was disconnected.	Reconnect the laser head cable.

Adapter displays “LASER STATUS ERROR”	There is a low voltage level or an open state at the status input.	Make sure the status (ST) cable is connected.
	An Opt Lasers model with 5-pin connector is connected and “STATUS INPUT” is not set to “ignored”.	Set the “STATUS INPUT” to “ignored”.
LASER LED is off	Laser controlling signal is not present.	Verify if your controller is connected correctly and sending pulses. Check the display if the signal is present and enable signals are set correctly.
	The laser has been disabled by the controller.	Verify if your controller is connected correctly and sending pulses.
	The laser head is not armed.	Arm the laser.
Pressing the button does not arm the laser	The external switch is open or not working.	Close the switch or replace it with a jumper wire.
	The laser head is not connected.	Connect the laser head.
	There is an internal Adapter error.	Please contact us for repair assistance.

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