Quick Setup Guide for using a PLH3D-6W Laser Head with a Stepcraft CNC Machine

Table of Contents

1. General Laser Safety Warnings and Precautions

Only person with specialized training and appropriate laser safety knowledge can use and maintain the laser head. The laser head operator must be aware of laser radiation hazard.
While laser head is operating protection Laser Glasses designed for 190 – 540 nm (OD 7+) should be used. Make sure that all personnel in the same room worn protection glasses.
Eye exposure to the direct or diffusely reflected laser beam is a hazard. The laser head beam may cause permanent eye damage.
Skin exposure to the laser beam is a hazard. The laser beam may cause serious skin burns. Laser beam may easily burn cloth.
It is possible to get serious injury while using this product or being in the vicinity of an individual using it. Improper use of the laser head can result in injury or death.
Flammable substances exposure to the laser beam may pose fire hazard. The laser head operation in an explosive atmosphere may be dangerous. The working area must be well ventilated. During the operation laser beam may ignite gases or flammable liquids.
Before making any adjustments, changing accessories or performing maintenance, the laser should be powered off and disconnected from the power supply and CNC main board.
The laser head must be properly mounted to a rigid body such that it cannot be moved unintentionally. Unintentional move of the laser head is dangerous.
The unauthorized personnel must have no access to the system into which the laser head is integrated. The laser head must be stored out of the reach of children. Untrained persons are not allowed to operate, maintain and observe operation of the laser head.
Specular reflection materials should not be placed in front of operating lasers head. Remember, diffused reflection of the laser beam is uncontrolled and may pose hazard to eye.
Appropriate shielding should be used around the system into which the laser head is integrated. The system in which laser head is used must be equipped with key switch and safety interlock.

Responsibility of use or misuse belongs to the end user. Tomorrow's System and its affiliates accept no responsibility for use or misuse by the user. If you may not be able to use this product properly, we recommend that you do not begin use or cease use immediately.

2. Necessary and Recommended Parts

a) The following parts are required or recommended for this setup:

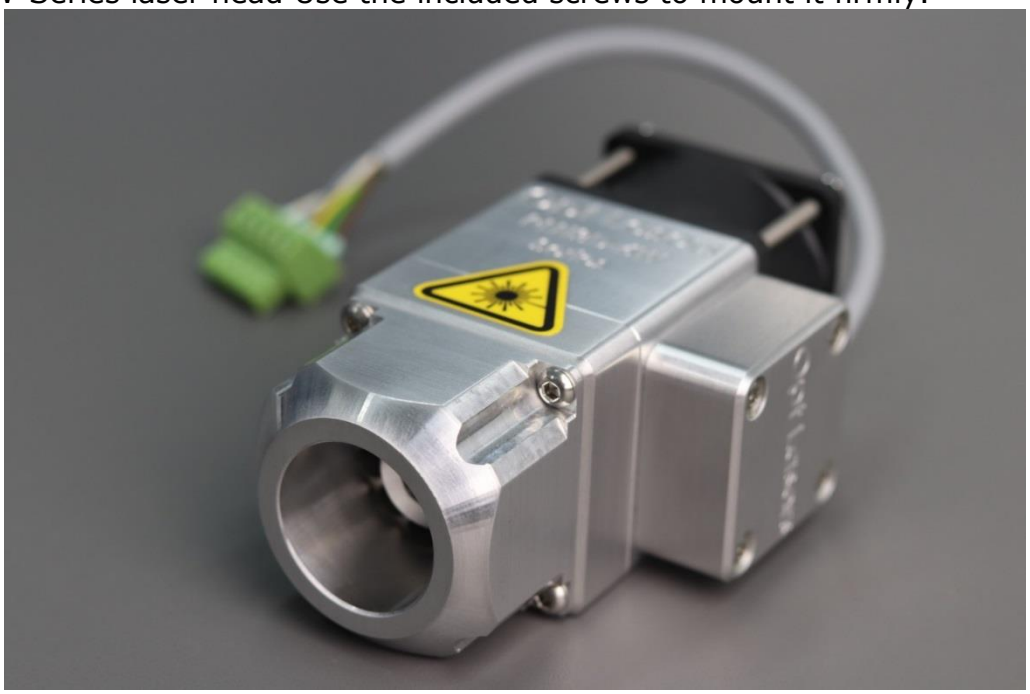
- **Stepcraft D-Series or Q-Series CNC** (from Stepcraft)
- **Stepcraft Full Kit with PLH3D-6W-XF** (from Opt Lasers)

Or:

- **Stepcraft D-Series or Q-Series CNC** (from Stepcraft)
- **PLH3D-6W-XF or PLH3D-6W engraving laser head** (from Opt Lasers)
- **Stepcraft CNC Machine PLH3D-6W Series Adapter** (from Opt Lasers)
- **PLH3D-6W-Series Nozzle & 43mm Spindle Adapter** (from Opt Lasers)
- **CNC Laser Glasses for 450 nm Light** (from Opt Lasers)

3. Connecting the Laser Head to a Stepcraft CNC Machine

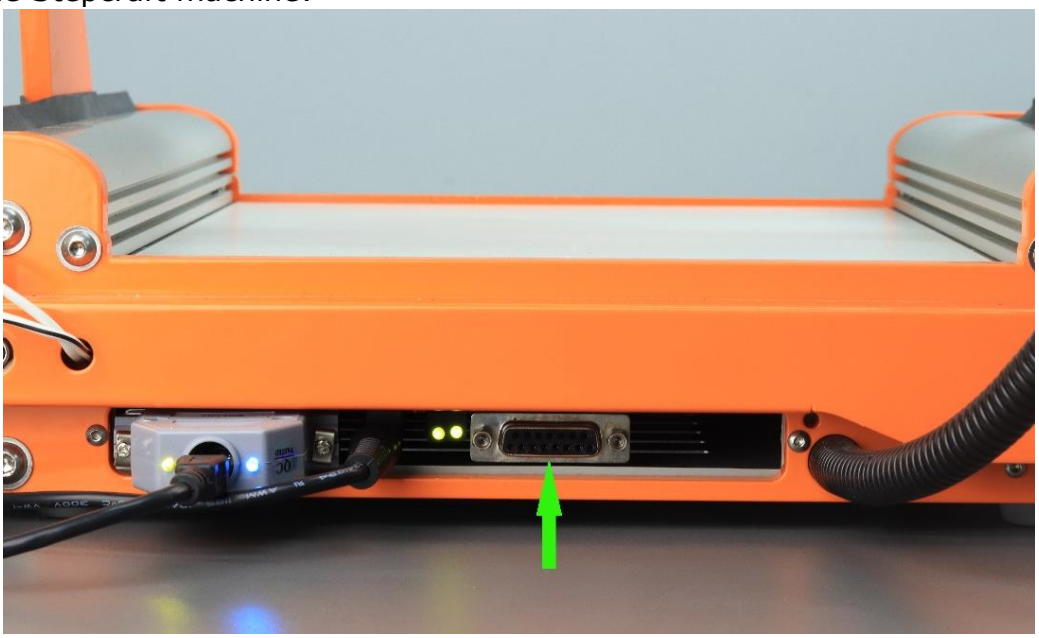
a) Mount the PLH3D-6W-Series Nozzle & 43mm Spindle Adapter to the PLH3D-6W-Series laser head Use the included screws to mount it firmly.

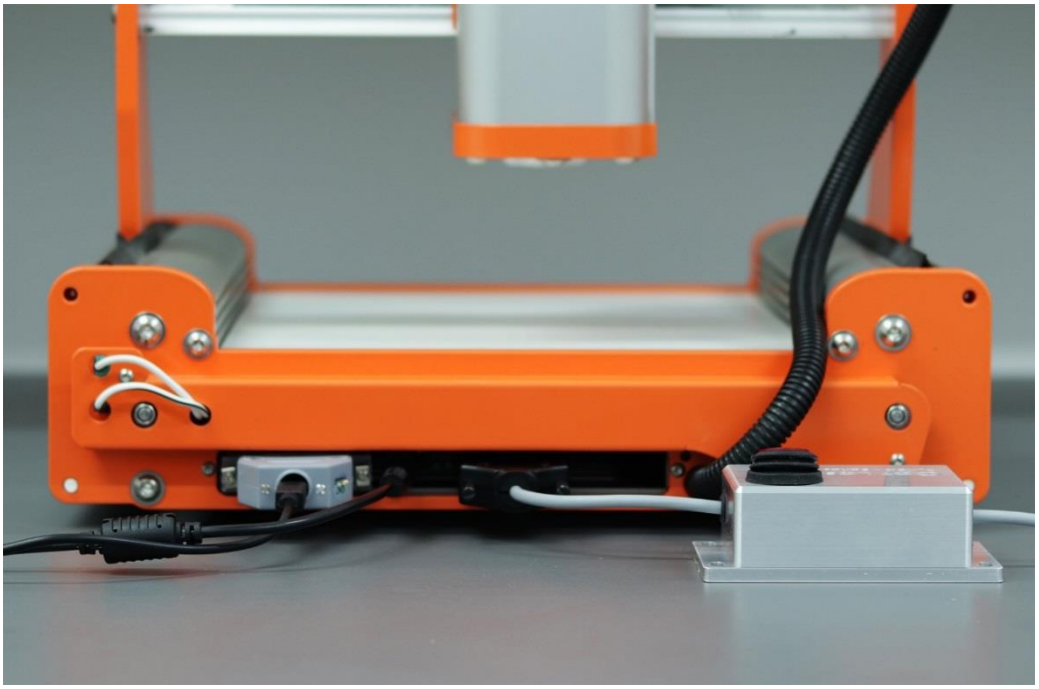


b) Insert the laser head into the 43mm diameter spindle holder.

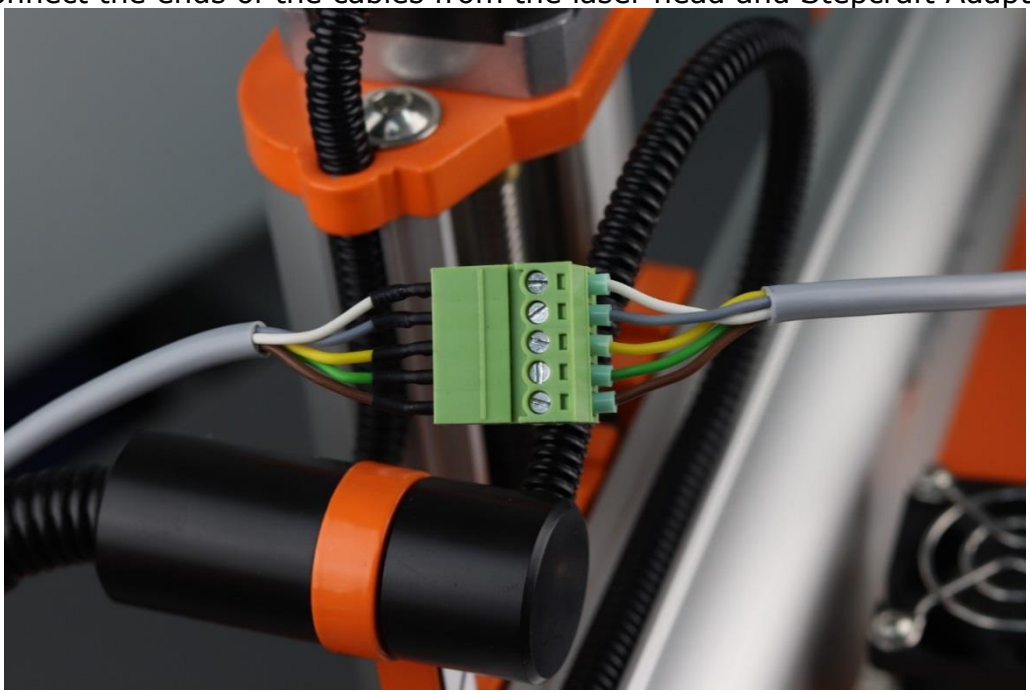
d) Locate the Stepcraft PLH3D-6W Adapter, which will be used to connect the laser head to the Stepcraft machine:

e) Insert the female D-Sub connector on the adapter cable into the male socket on the Stepcraft machine:





f) Connect the ends of the cables from the laser head and Stepcraft Adapter

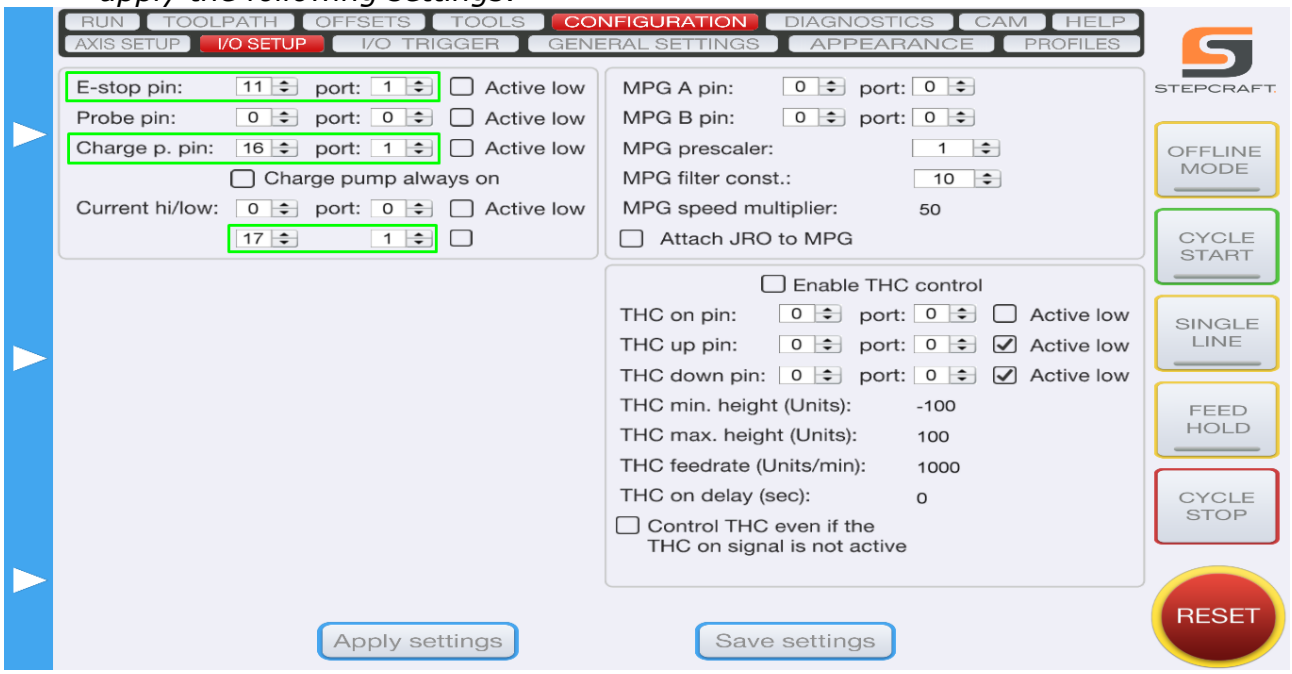


g) Connect the cable to the CNC machine. Make sure that cable will not interfere with the work of the machine.

4. Controlling the Laser Head

To communicate between the laser head and Stepcraft CNC machine, we will use the PWM signal. To make the Stepcraft machine generate this signal, activate pin 17 via the software.
It is also very important to activate pins: 11 and 16. Those pins are responsible for laser's emergency stop.

a) In the UCCNC software program, go to *CONFIGURATION -> I/O SETUP and apply the following settings:*

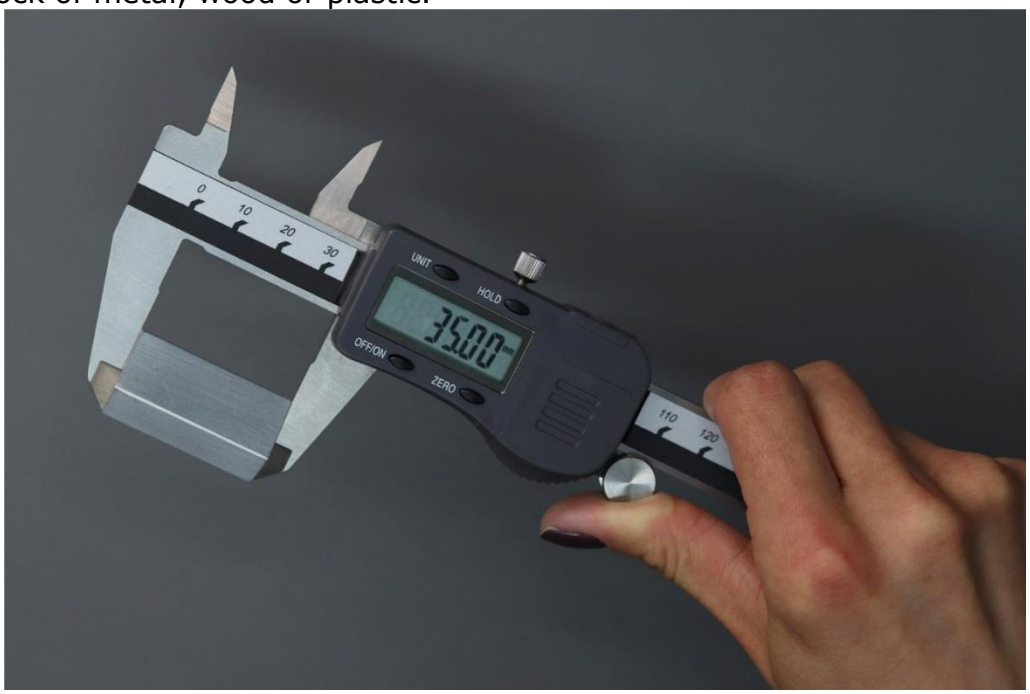


5. Setting the z-axis Distance

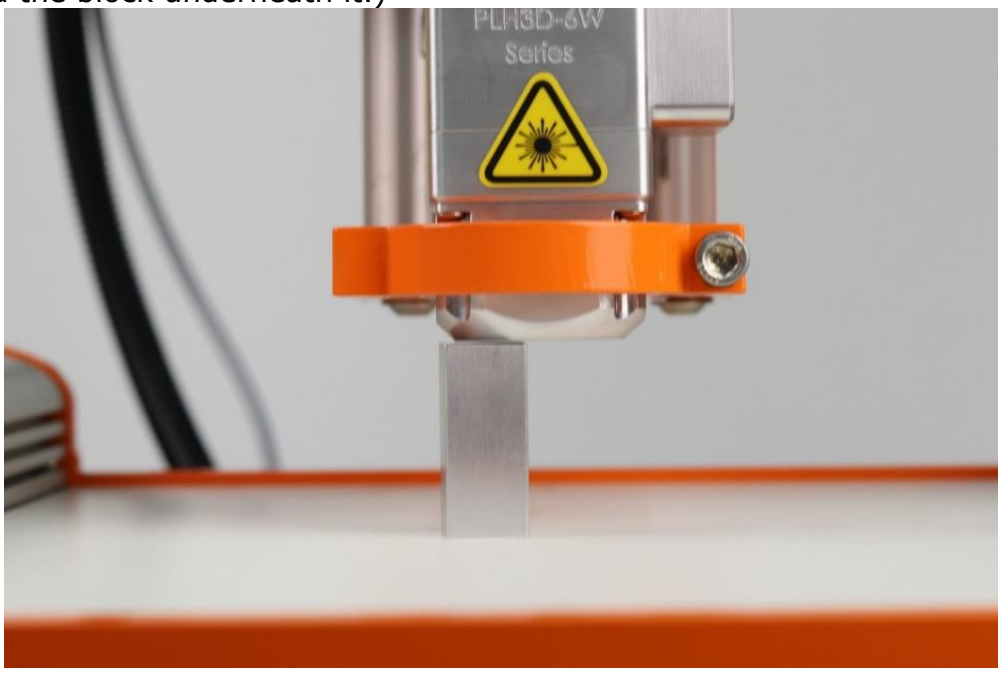
Before cutting or engraving, it is necessary to zero the position of the laser head on the z-axis.

Adjusting the z-axis in a newly purchased laser head

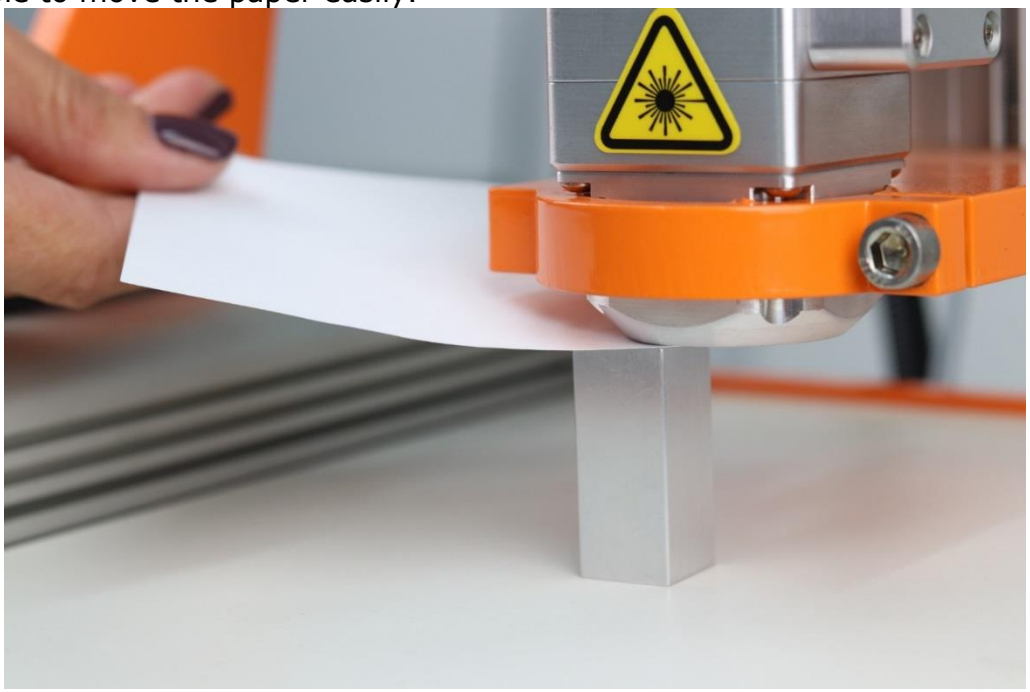
a) Since our laser heads are factory-set to have a focus at 60mm distance, adjustment of the z-axis distance can be made easily using a 35mm height block of metal, wood or plastic.



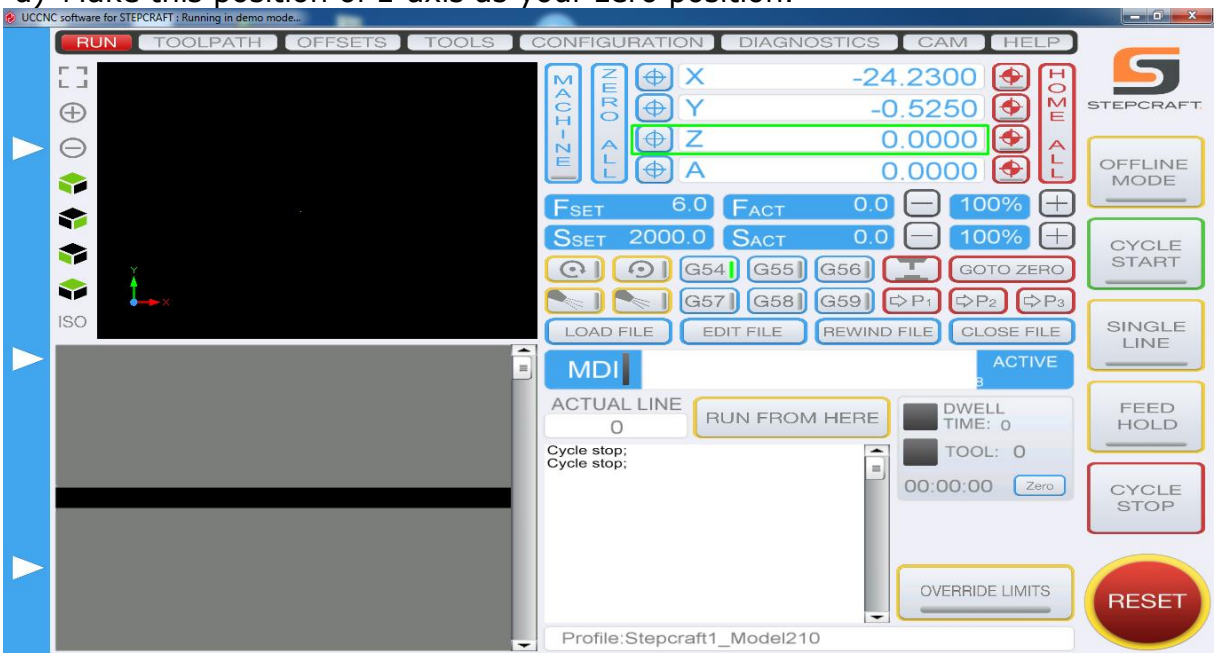
b) Place the block under the mounted laser head and carefully reduce the distance between them. (Note: if you would like to cut material, put the block directly on the Stepcraft's CNC machine table. For engraving, put a material on table first and the block underneath it.)



c) Place a piece of paper between the nozzle of the laser head and the block. Using the slowest possible speed move down the laser head until you will not be able to move the paper easily.



d) Make this position of z-axis as your zero position.



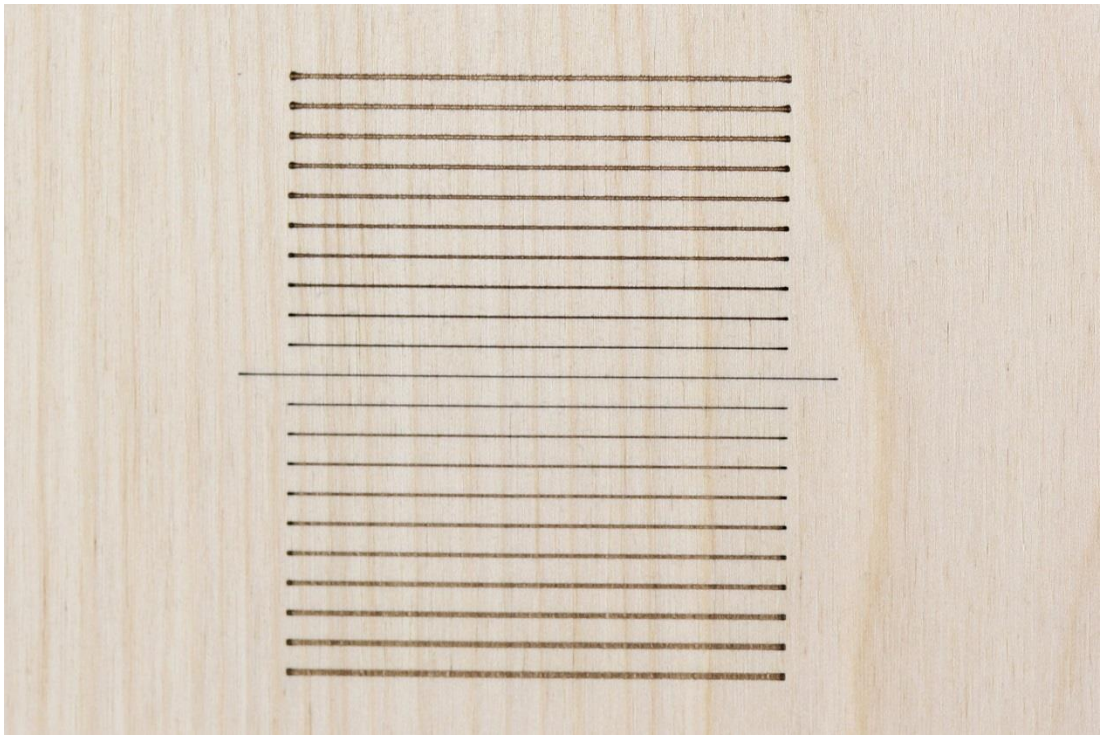
Setting a Different Working Distance (For Advanced Users)

If you would like to set different working distance than 60mm, you will have to find proper z-axis height value.

a) Using the methods described above calibrate the laser head position.

Coarse Adjustment:

a. Set the current position of the z-axis to the zero position in the UCCNC software.
b. Engrave the "zero position" line on the engraving material. Hint: make this line longer compared to the next engraved line so it will be easier to find "zero line."
c. Engrave 10 lines with a step of 1mm in the positive direction of the z-axis and 3 mm steps on the x-axis.
d. Return to the zero position.
e. Engrave (on the engraving material) 10 lines with a step of 1 mm in the negative direction of z-axis. and 3 mm step in x-axis.
f. Inspect the engraved lines. Locate the thinnest engraved line.
g. Count how many lines away the thinnest line is from "zero line," and in which direction it is. (Let's consider a case when the thinnest line is located 5 lines from the zero line and in the positive direction of the x-axis. In this case, the calibration parameter is +5mm.)
h. In the UCCNC software, move the x-axis "zero position" of the laser head by the calibration parameter.

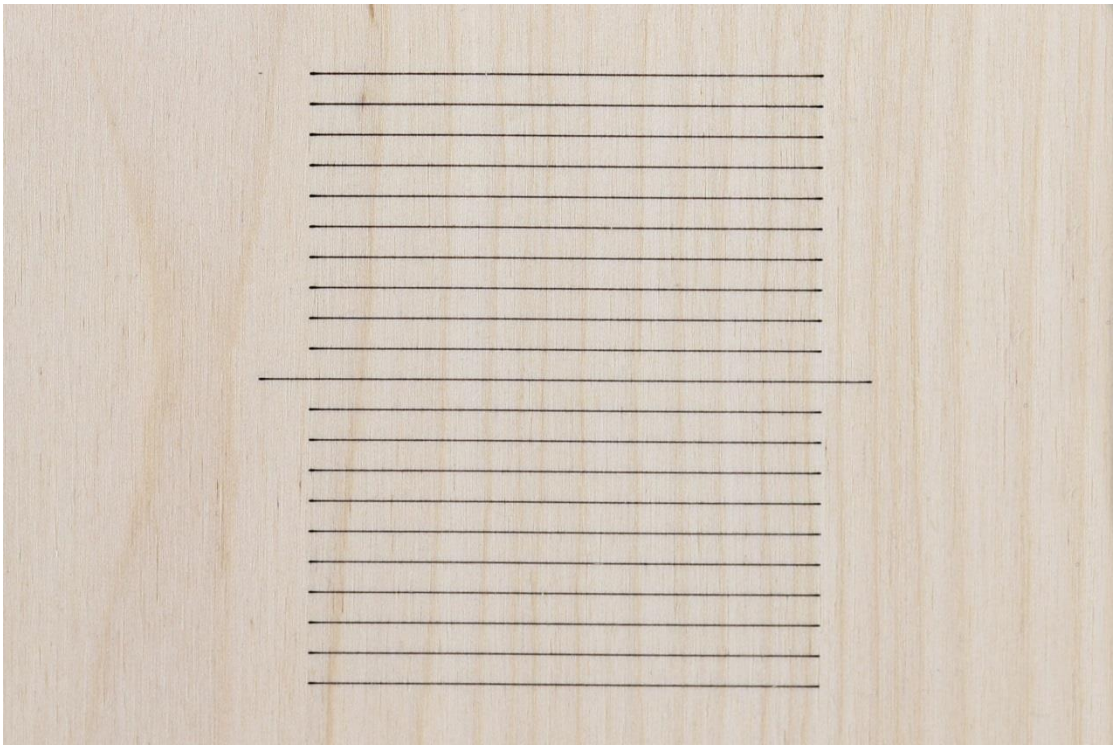


Fine Adjustment:

To obtain the highest power density, which results in the better engraving performance, we recommend making fine adjustments to the distance of the laser head and the engraving material. This adjustment should be done after performing coarse adjustment.

The process is similar to the coarse adjustment process expect steps in Z-axis, they are smaller to make adjustment precise.

i. Set the laser head at the zero position, which was calibrated in the previous step.
j. Engrave the "zero position" line on the engraving material. Hint: make this line longer compared to the next engraved line so it will be easier to find "zero line."
k. Engrave on the material 10 lines with steps of 0.1mm in the positive direction of the z-axis and 3 mm steps on the x-axis. We recommend engraving lines with a length of 50mm so it is easier to compare the thickness of the lines by eye.
l. Retrurn to the zero position.
m. Engrave 10 lines with a step of 0.1mm in the negative direction of the z-axis. and 3 mm steps on the x-axis.
n. Inspect the engraved lines. Locate the thinnest line.
o. Count how many lines away the thinnest line is from "zero line," and in which direction it is. (Let's consider a case when the thinnest line is located 2 lines from zero line and in the negative direction of x-axis. In this case, the calibration parameter is -0.2 mm.
p. In the UCCNC software, move the x-axis "zero position" of the laser head by the calibration parameter.



6. Cutting and Engraving (outline) with Opt Lasers Software

To cut or engrave, it is necessary to generate the appropriate G-code that using the following commands:

M10	Laser ON
M11	Laser OFF
QXXX	PWM duty where XXX is number between 0 and 255 (e.g.: 0 = 0% and 255 = 100%)

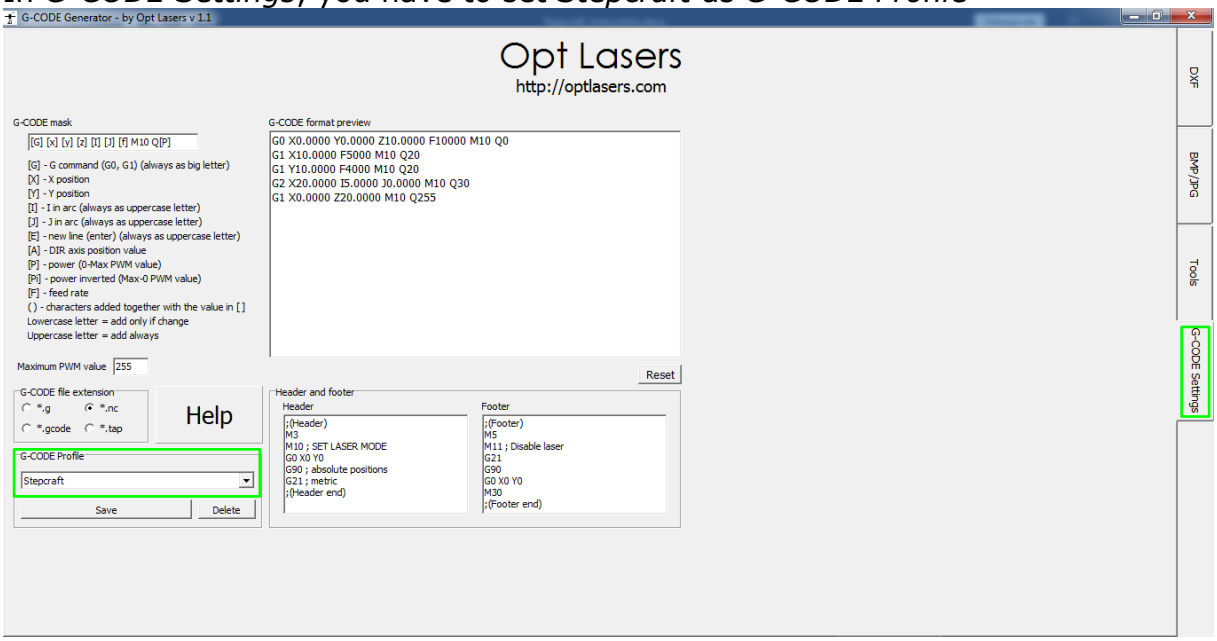
To see an example of G-code, please refer to *Appendix 1*.

Generating G-code

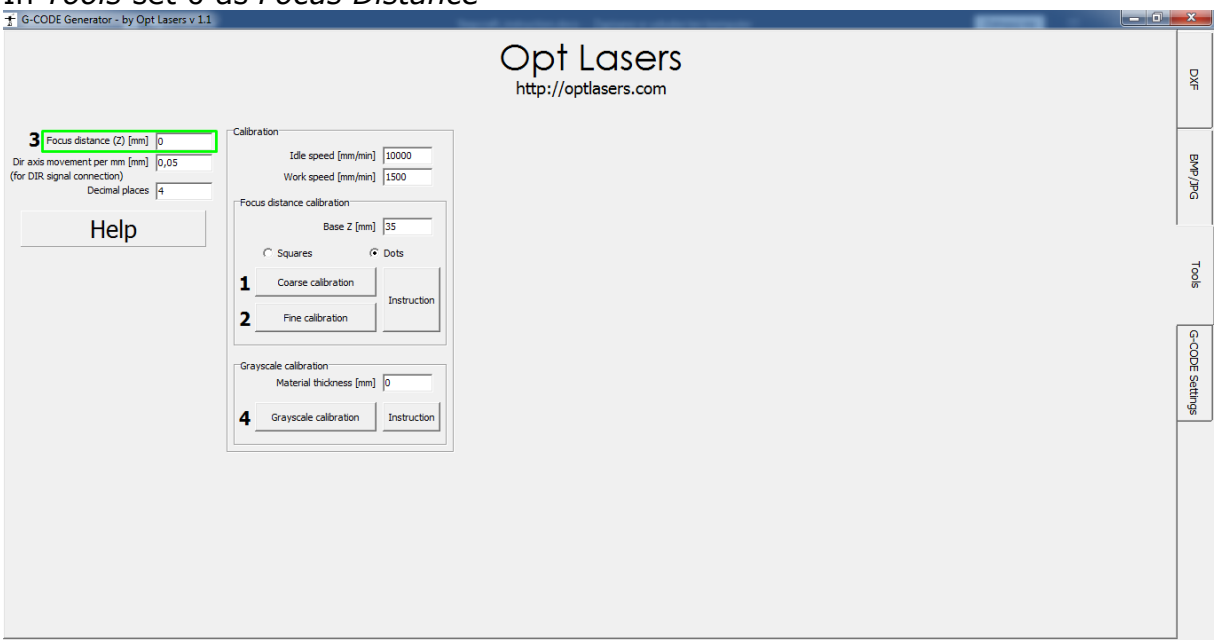
The easiest way to generate proper G-code is to use our software: *Generator*.

a) You will need DXF file from which you will generate G-code.

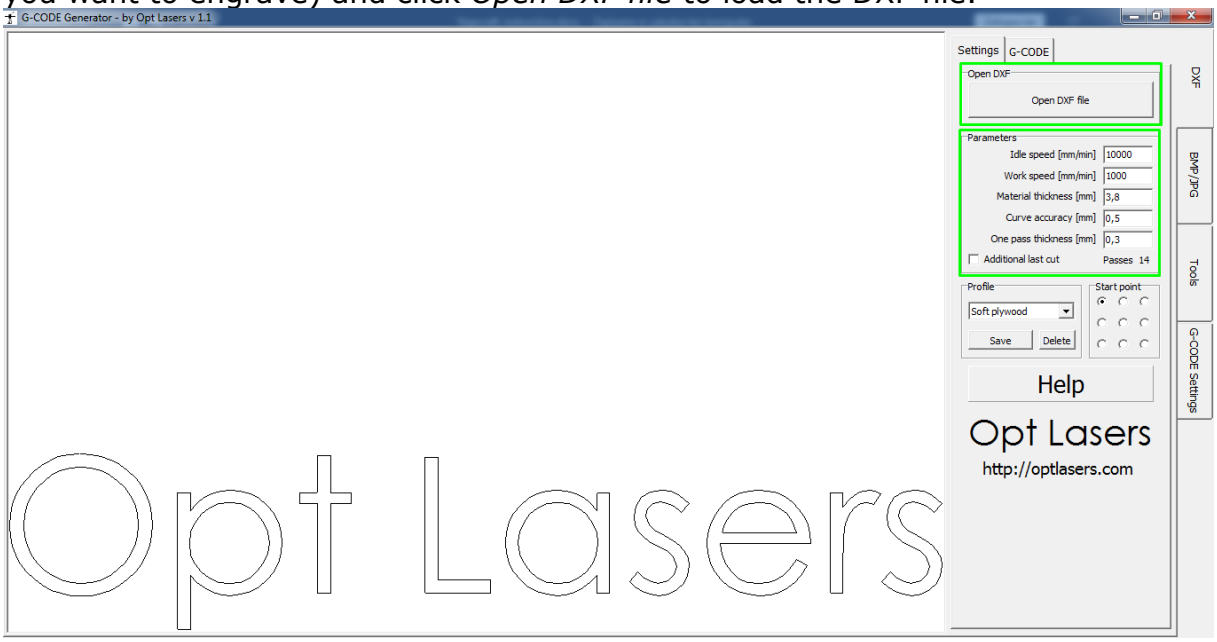
b) In *G-CODE Settings*, you have to set *Stepcraft* as *G-CODE Profile*



c) In *Tools* set 0 as *Focus Distance*



d) Set parameters in *DXF / Settings / Parameters* (set *Material thickness* as 0 if you want to engrave) and click *Open DXF file* to load the DXF file.



e) Click *Generate G-Code* and save it.

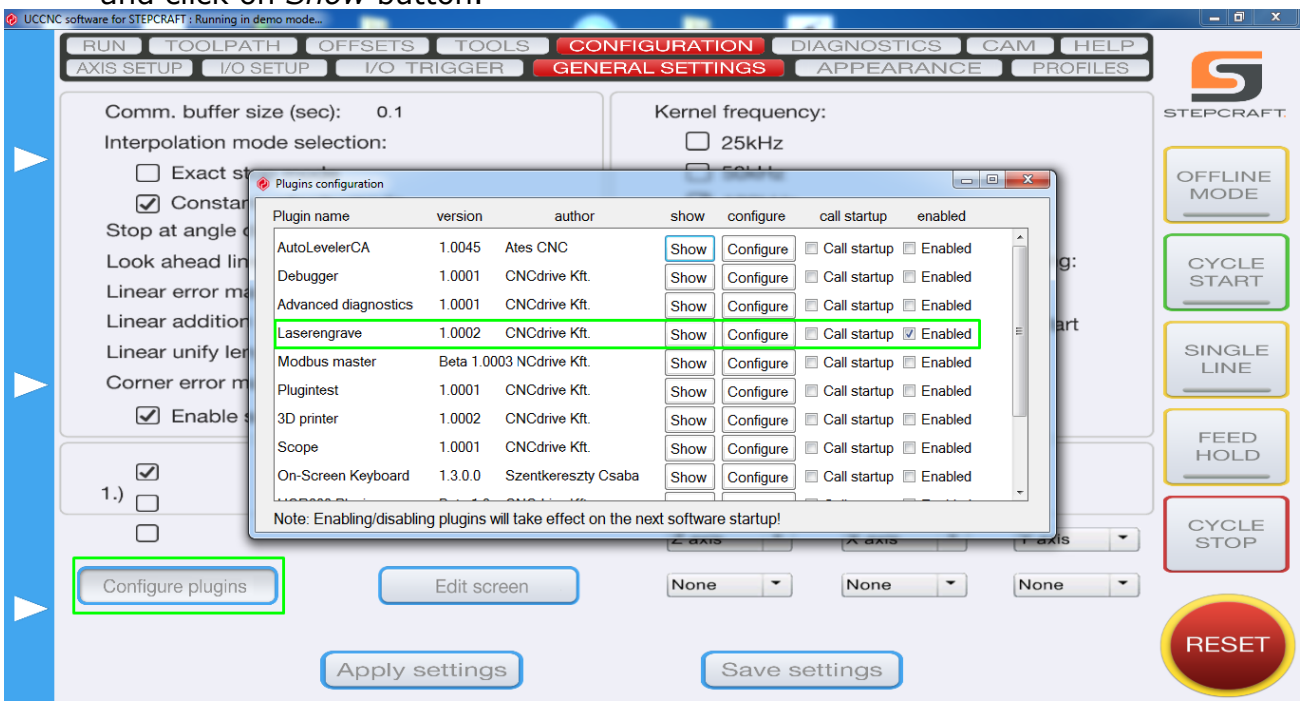
f) Now, you can load the generated G-code in UCCNC software and begin using the laser.

7. Engraving an Image

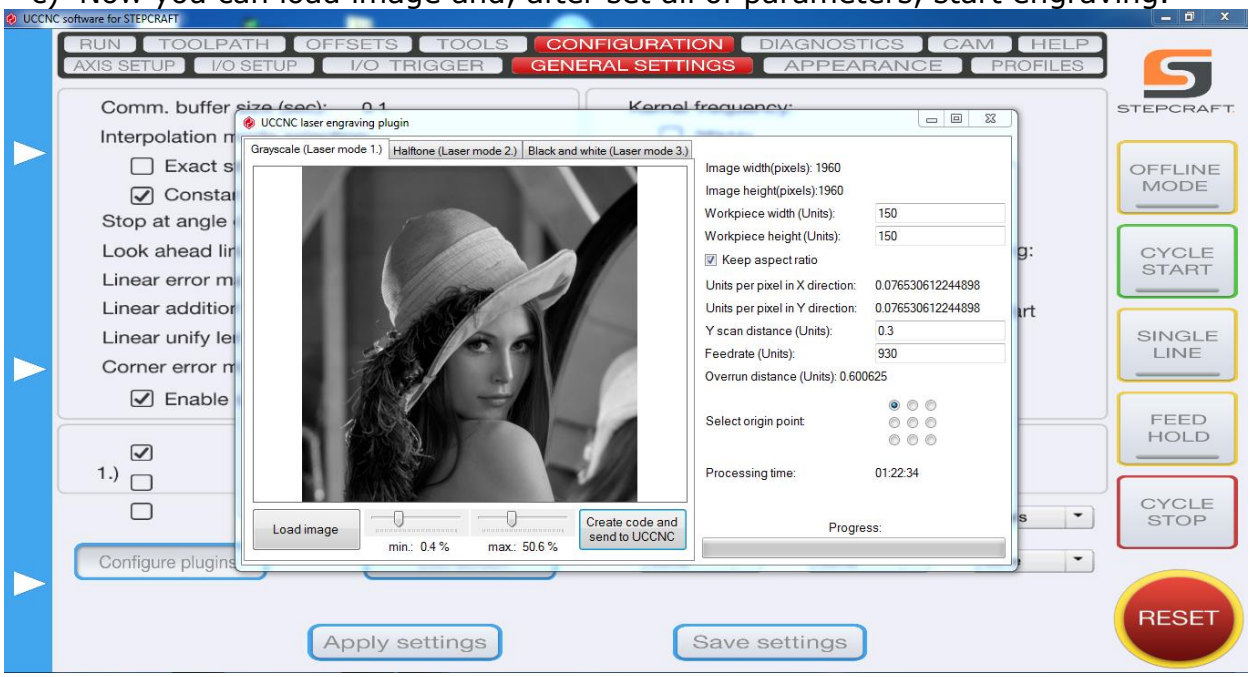
UCCNC software has a plugin that provide possibility of engraving any picture in a scale of gray, halftone or black and white.

a) In the *CONFIGURATION* and *GENERAL SETTINGS* tabs, click on *Configure plugins*

b) Find the plugin *Laserengrave* on the list. If it is your first time using this plugin, check the *Enabled* check and restart the software. Then reopen the program and click on *Show* button.



c) Now you can load image and, after set all of parameters, start engraving.



8. Appendix 1: G-Code Example


```
;(Header)
M3
G0 X0 Y0
G90 ; absolute positions
G21 ; metric
;(Header end)
G0 X33.7441 Y21.5261 Z26.6000 F10000 M10 Q0
G1 X53.7441 Y41.5261 F1000 M10 Q255
G0 X33.7441 F10000 M10 Q0
G1 X53.7441 Y21.5261 F1000 M10 Q255
G0 X57.9859 Y31.5261 F10000 M10 Q0
G3 X77.9859 I10.0000 J0.0000 F1000 M10 Q255
G3 X57.9859 I-10.0000 J0.0000 M10 Q255
G0 X6.2419 Y15.5494 F10000 M10 Q0
G1 X6.7274 Y15.5345 F1000 M10 Q255
G1 X7.1987 Y15.4893 M10 Q255
G1 X7.6564 Y15.4144 M10 Q255
G1 X8.0986 Y15.3099 M10 Q255
G1 X8.5274 Y15.1749 M10 Q255
G1 X8.9407 Y15.0105 M10 Q255
G1 X9.3402 Y14.8158 M10 Q255
G1 X9.7250 Y14.5914 M10 Q255
G1 X10.0958 Y14.3366 M10 Q255
G1 X10.4515 Y14.0525 M10 Q255
G1 X10.7936 Y13.7377 M10 Q255
G1 X11.1137 Y13.4003 M10 Q255
G1 X11.4027 Y13.0495 M10 Q255
G1 X11.6622 Y12.6834 M10 Q255
G1 X11.8901 Y12.3043 M10 Q255
G1 X12.0884 Y11.9102 M10 Q255
G1 X12.2558 Y11.5029 M10 Q255
G1 X12.3932 Y11.0803 M10 Q255
G1 X12.4996 Y10.6451 M10 Q255
G1 X12.5760 Y10.1941 M10 Q255
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G1 X12.6214 Y9.7304 M10 Q255
G1 X12.6369 Y9.2524 M10 Q255
G1 X12.6204 Y8.7570 M10 Q255
G1 X12.5706 Y8.2771 M10 Q255
G1 X12.4874 Y7.8106 M10 Q255
G1 X12.3709 Y7.3594 M10 Q255
G1 X12.2216 Y6.9230 M10 Q255
G1 X12.0391 Y6.5011 M10 Q255
G1 X11.8230 Y6.0935 M10 Q255
G1 X11.5736 Y5.6997 M10 Q255
G1 X11.2911 Y5.3213 M10 Q255
G1 X10.9757 Y4.9575 M10 Q255
G1 X10.6289 Y4.6099 M10 Q255
G1 X10.2660 Y4.2938 M10 Q255
G1 X9.8881 Y4.0108 M10 Q255
G1 X9.4948 Y3.7609 M10 Q255
G1 X9.0876 Y3.5442 M10 Q255
G1 X8.6662 Y3.3614 M10 Q255
G1 X8.2301 Y3.2116 M10 Q255
G1 X7.7793 Y3.0949 M10 Q255
G1 X7.3129 Y3.0115 M10 Q255
G1 X6.8330 Y2.9616 M10 Q255
G1 X6.3398 Y2.9451 M10 Q255
G1 X5.8407 Y2.9616 M10 Q255
G1 X5.3574 Y3.0109 M10 Q255
G1 X4.8881 Y3.0935 M10 Q255
G1 X4.4342 Y3.2090 M10 Q255
G1 X3.9954 Y3.3574 M10 Q255
G1 X3.5707 Y3.5390 M10 Q255
G1 X3.1617 Y3.7532 M10 Q255
G1 X2.7659 Y4.0014 M10 Q255
G1 X2.3865 Y4.2813 M10 Q255
G1 X2.0211 Y4.5949 M10 Q255
G1 X1.6729 Y4.9391 M10 Q255
G1 X1.3554 Y5.3004 M10 Q255
G1 X1.0709 Y5.6763 M10 Q255
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G1 X0.2676 Y7.3216 M10 Q255
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G1 X0.0168 Y8.7047 M10 Q255
G1 X0.0000 Y9.1932 M10 Q255
G1 X0.0177 Y9.7252 M10 Q255
G1 X0.0711 Y10.2341 M10 Q255
G1 X0.1600 Y10.7214 M10 Q255
G1 X0.2844 Y11.1858 M10 Q255
G1 X0.4444 Y11.6276 M10 Q255
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G1 X1.1174 Y12.8231 M10 Q255
G1 X1.3867 Y13.1798 M10 Q255
G1 X1.6758 Y13.5158 M10 Q255
G1 X1.9853 Y13.8317 M10 Q255
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G1 X6.2399 Y15.5494 M10 Q255
G0 X6.2972 Y14.3746 F10000 M10 Q0
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G1 X5.2980 Y14.2823 M10 Q255
G1 X4.8334 Y14.1669 M10 Q255
G1 X4.3936 Y14.0053 M10 Q255
G1 X3.9780 Y13.7979 M10 Q255
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G1 X9.0317 Y13.5683 M10 Q255
G1 X8.6360 Y13.8091 M10 Q255
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G1 X14.8722 F1000 M10 Q255
G1 Y0.0000 M10 Q255
G1 X16.0062 M10 Q255
G1 Y4.7725 M10 Q255
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G1 X80.3159 Y3.0557 M10 Q255
G1 X79.8279 Y3.0185 M10 Q255
G1 X79.3967 Y3.0457 M10 Q255
G1 X78.9767 Y3.1272 M10 Q255
G1 X78.5671 Y3.2631 M10 Q255
G1 X78.1719 Y3.4517 M10 Q255
G1 X77.8117 Y3.6841 M10 Q255
G1 X77.4907 Y3.9584 M10 Q255
G1 X77.2089 Y4.2745 M10 Q255
G1 X77.9266 Y5.0907 M10 Q255
G1 X78.2799 Y4.7354 M10 Q255
G1 X78.6420 Y4.4589 M10 Q255
G1 X79.0123 Y4.2614 M10 Q255
G1 X79.3911 Y4.1431 M10 Q255
G1 X79.7783 Y4.1035 M10 Q255
G1 X80.2047 Y4.1514 M10 Q255
G1 X80.5897 Y4.2949 M10 Q255
G1 X80.9378 Y4.5338 M10 Q255
G1 X81.2076 Y4.8442 M10 Q255
G1 X81.3716 Y5.1929 M10 Q255
G1 X81.4264 Y5.5798 M10 Q255
G1 X81.3469 Y6.0431 M10 Q255
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G1 X81.1084 Y6.4529 M10 Q255
G1 X80.8992 Y6.6529 M10 Q255
G1 X80.5903 Y6.8772 M10 Q255
G1 X80.1814 Y7.1261 M10 Q255
G1 X79.6727 Y7.3992 M10 Q255
G1 X79.2234 Y7.6468 M10 Q255
G1 X78.8357 Y7.8928 M10 Q255
G1 X78.5094 Y8.1375 M10 Q255
G1 X78.2445 Y8.3810 M10 Q255
G1 X78.0410 Y8.6230 M10 Q255
G1 X77.8517 Y8.9356 M10 Q255
G1 X77.7165 Y9.2696 M10 Q255
G1 X77.6356 Y9.6250 M10 Q255
G1 X77.6085 Y10.0016 M10 Q255
G1 X77.6519 Y10.4893 M10 Q255
G1 X77.7821 Y10.9324 M10 Q255
G1 X77.9990 Y11.3317 M10 Q255
G1 X78.3027 Y11.6871 M10 Q255
G1 X78.6707 Y11.9776 M10 Q255
G1 X79.0829 Y12.1854 M10 Q255
G1 X79.5392 Y12.3098 M10 Q255
G1 X80.0392 Y12.3514 M10 Q255
G0 X27.8161 Y21.5261 F10000 M10 Q0
G1 X7.8161 F1000 M10 Q255
G1 Y41.5261 M10 Q255
G1 X27.8161 M10 Q255
G1 Y21.5261 M10 Q255
G0 X0.0000 Y0.0000 F10000 M10 Q0
;(Footer)
M5
M11 ; Disable laser
G21
G90
G0 X0 Y0
M30
;(Footer end)
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