

Guide to the configuration parameters of a GRBL-based laser marker.

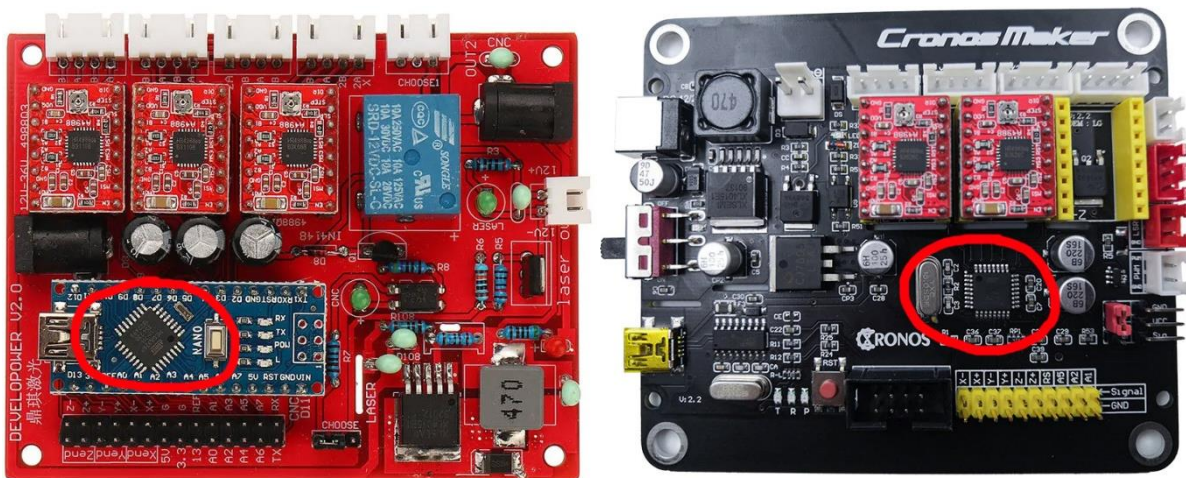
By arkipita, developer of the LaserGRBL software

Hi!

I am the developer of LaserGRBL, a free and open-source program that you may have received together with the laser engraver you have just purchased, or that you have downloaded from the internet looking for something simple to use for your laser job.

Before you get started, there are a few things you should know about your engraver and how to set it up to get the most out of your jobs.

The heart of a laser marker is hidden in its control board, on which there is a small chip on which runs a software capable of transforming the commands it receives from LaserGRBL (which in jargon are called g-code commands) into the right impulses to move the motors and to control the laser.



This software is called **GRBL**, and needs to be configured through special commands or through a convenient configuration window available on LaserGRBL.

#	Parameter	Value	Unit	Description	
0	Step pulse time	10	microseconds	Sets time length per step. Minimum 3usec.	
1	Step idle delay	25	milliseconds	Sets a short hold delay when stopping to...	
2	Step pulse invert	0	mask	Inverts the step signal. Set axis bit to...	
3	Step direction invert	0	mask	Inverts the direction signal. Set axis b...	
4	Invert step enable pin	0	boolean	Inverts the stepper driver enable pin si...	
5	Invert limit pins	0	boolean	Inverts the all of the limit input pins.	
6	Invert probe pin	0	boolean	Inverts the probe input pin signal.	
10	Status report options	1	mask	Alters data included in status reports.	
11	Junction deviation	0,010	millimeters	Sets how fast Grbl travels through conse...	
12	Arc tolerance	0,002	millimeters	Sets the G2 and G3 arc tracing accuracy ...	
13	Report in inches	0	boolean	Enables inch units when returning any po...	
20	Soft limits enable	0	boolean	Enables soft limits checks within machin...	
21	Hard limits enable	0	boolean	Enables hard limits. Immediately halts m...	
22	Homing cycle enable	0	boolean	Enables homing cycle. Requires limit swi...	
23	Homing direction invert	0	mask	Homing searches for a switch in the posi...	
24	Homing locate feed rate	25,000	mm/min	Feed rate to slowly engage limit switch ...	
34	Config readed successfully!	late	500,000	mm/min	Seek rate to quickly find the limit swit...

Let's go!

We connect our marker to the computer with the USB cable. We launch LaserGRBL and choose the serial port (usually we have to use the one with the highest port number) and press the "connect" button.

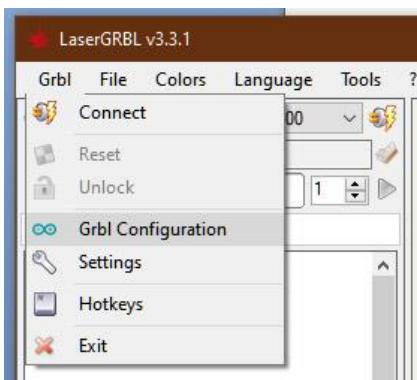
If all goes well, the message "Grbl" with the version number should appear, in this case 1.1h which is currently the most updated version.

If this does not happen, try another port. If it still doesn't work, it may be that you are missing the drivers, and you can install them from the "Tools" menu.

Finally in the worst case it could be that your controller is not a GRBL board (for example it may have another firmware called BenBox or others) and LaserGRBL is unable to communicate because it is designed to work with grbl (with experimental support for Marlin and Smoothie which are two other firmware).

In this case you can try to understand if it is possible to put grbl on your control card, but it is not the object of this document.

The GRBL configuration is accessible by clicking on the "**Grbl - Grbl Configuration**" menu.



Attention, in order to see and modify the configuration, the machine must be connected and in the "Idle" state or inactive.

If not, connect it and press the Unlock button if it is in the "Alarm" state.

Let's finally see these configuration parameters!

In this document I will explain the parameters of the **Grbl v1.1 version**. With previous versions of GRBL, you may be missing some parameters.

Let's forget the first three values which are very technical.

The first interesting parameter is **\$3** which controls the direction of the axes. LaserGRBL uses the convention of the Cartesian plane, therefore increasing X to the right and increasing Y moving away from the observer, the Z finally grows upwards.

If your machine does not respond according to this convention, you can change this parameter according to a bit mask that allows you to reverse the direction of the axes.

So looking at this table, if we set the value 0 no axis will be inverted. If we set 1 we will have the inversion of the X axis, with 2 we will have the inversion of the Y axis with 3 we will have the inversion of both X and Y and so on.

Correctly configuring the direction of the axes is one of the first steps to be able to use your marker correctly.

Setting Value	Mask	Invert X	Invert Y	Invert Z
0	00000000	N	N	N
1	00000001	Y	N	N
2	00000010	N	Y	N
3	00000011	Y	Y	N
4	00000100	N	N	Y
5	00000101	Y	N	Y
6	00000110	N	Y	Y
7	00000111	Y	Y	Y

We also skip parameters **\$3**, **\$4**, and **\$5**. You can learn more about their meaning on the official GRBL page.

<https://github.com/gnea/grbl/wiki/Grbl-v1.1-Configuration>

The **\$10** parameter affects what information GRBL sends to LaserGRBL to let it know its current location and some other diagnostic information. I suggest setting the value 3 which gives the most complete information.

Let's jump **\$11** and **\$12**, which are also very technical. **\$13** causes GRBL to report the position in inches, it should be left at zero because LaserGRBL is designed to work in mm and may behave unexpectedly if it receives the position in inches.

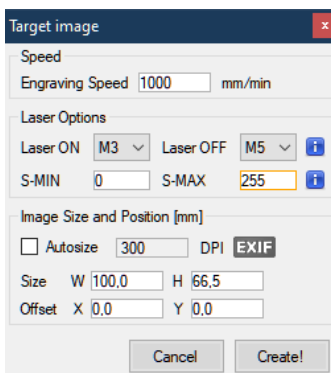
Parameter **\$20** activates software tests that prevent the machine from making movements that go beyond the length of the axes. Obviously you will have to correctly set the dimensions of the work surface, parameters **\$130**, **\$131**, and **\$132** and you must make sure that the laser head is in the zero position (lower left corner) when you turn on your marker. I recommend activating it, so let's set 1.

Hard limit and Homing (parameters from **\$21** to **\$27**) have to do with the limit switches, which are a very useful performance but which only a few machines have. Suffice it to say that they allow the machine to perform the "homing" operation, that is, to go to search for the position of the limit switches to obtain a reliable and repeatable zero position. If your machine does not have limit switches, you must set parameters **\$21** and **\$22** to zero. LaserGRBL will make the button disappear with the box that allows you to control homing.

The **\$30** parameter is often confusing. This number corresponds to the number to which GRBL will assign the code to be used to switch on the laser at maximum power. For example, if we assign 1000 LaserGRBL, it will have to send the S1000 code to turn on the laser at maximum power, while sending the S500 command we will turn on the laser at half power.

LaserGRBL will automatically generate the S codes in a manner consistent with this setting, according to the settings you give when uploading an image, so you don't have to worry too much about what number you put.

I suggest putting 255 which is the maximum number of nuances that the hardware can physically do. Another value that can have a meaning is 1000 (it can be understood as 100.0%) or the value in milliwatts of your laser, for example 4500.



When you go to load an image and you will have to set the S-MAX value consistently with the value of **\$30**, that is if $\$30=255$ you will go to set S-MAX to 255 if you want to use the maximum laser power for BLACK or a value a little It is lower if you notice that your laser is too powerful and the image is too dark.

For **\$31** value I recommend keeping it set to 0, and it makes practically no sense for the laser.

We now come to the big news of the **\$32** parameter that activates the laser mode. Why news? Because in the previous version of GRBL there was no Laser Mode. In fact, you should know that **GRBL was born for CNC machines** such as milling cutters and lathes, which have control needs other than lasers, for example when starting a section to be milled at a certain speed you have to wait a few milliseconds for the milling cutter to reach the number rpm required, while the laser can be turned on and off or its intensity can be changed instantly.

<https://github.com/gnea/grbl/wiki/Grbl-v1.1-Laser-Mode>

The developers of GRBL with version v1.1 have done a great job to adapt the functioning of GRBL to laser machines, therefore it is very important to activate the Laser Mode if you have this version of GRBL.

So let's put $\$32=1$.

I also suggest to those who had the previous version of Grbl, or 0.9 to update to version 1.1

The procedure is not without risks of incompatibility, and I don't want to go into talking about it in this video, but on the internet you can find many discussions and guides about it and maybe I'll make a video on how to carry out this update.

Laser Mode also enable you to use M4 Dynamic Laser Power Mode

This is a unique feature that automatically adjust laser power based on the current speed relative to the programmed rate. It essentially ensures the amount of laser energy along a cut is consistent even though the machine may be stopped or actively accelerating

The **\$100**, **\$101**, and **\$102** parameters are perhaps the most important to configure correctly, and are the ones that allow you to have your work in the perfect size, exact to the tenth of a millimeter.

These parameters tell how many rotation steps GRBL must command the motor to obtain the laser displacement of 1mm. In fact, the motors are not all the same, also when translating this angle into millimeters, pulleys and belts with different ratios come into play, and finally it comes into play the "microstepping" value set on the driver which allows for better resolution by commanding the motor to take intermediate steps.

If you notice that your works are not of the right size, you must therefore touch up this data. The account is very simple: if your works are twice the size you will have to halve this value, if they are half the size you will have to double this job.

It is a simple proportion: $\$100 = \$100 \times \text{Request Width} / \text{Measured Width}$

Each of these values controls the number of steps per millimeter, respectively for the X, Y and Z axis. If you do not have the Z axis, you can ignore the last value.

Parameters **\$110**, **\$111**, **\$112**. These parameters are also very important and determine the maximum speed at which the laser can move - without the motor blocking, tearing, hiccups - maintaining precise and reliable positioning.

If your marker is too slow, try to increase these values, vice versa if the positioning is inaccurate, or if the motors show problems at high speeds, try to lower these values.

LaserGRBL will use the maximum speed set here for all rapid movements when the laser is switched OFF, i.e. between one path to burn and another, so it is important to set a value that is not too high if precise positioning is desired.

Obviously a low value will be a limit because it will slow us down too much.

I did some tests and on my machine the motors work well up to 16'000 mm / min but for safety I prefer to set 10'000 as maximum value.

Always connected to this theme are the parameters **\$120**, **\$121**, **\$122** which affect the accelerations and decelerations that GRBL uses every time it has to change the speed of movement of the laser, i.e. when the laser stops moving or in direction changes .

If this value is too high, the inertia due to the weight of the laser head and the friction of the axes could cause the motor to lose steps, or the belts to slip, and therefore fail to perform a precise positioning.

Vice versa, if the value is too low, it could happen that the laser never manages to reach the target speed, because it is always engaged in acceleration and deceleration ramps.

I have found that for my machine a value of 4000 mm/sec² is a good compromise.

Finally come the parameters **\$130**, **\$131**, **\$132** which configure the length of the axes. I have already mentioned this when talking about the soft limit and how it is intuitive they must be configured by entering the dimensions of your workable surface, that is the stroke that the laser can do in the respective dimensions.

For now I'm done, I hope this guide has been helpful!

I remind you that LaserGRBL is free and if you want you can make a donation to support its development. It is the best way you have to say thank you and know that I really appreciate it!

<https://lasergrbl.com/donate>

Donate

