



Sain Smart Controller Board (GRBL) User Manual

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User Manual





Sain Smart Controller Board (GRBL)

SainSmart Genmitsu Controller Board (GRBL) with ABS case and built-in fan for Genmitsu CNC Router 3018, 3018-PRO, 1810-PRO

Preface

Dear customer,

Thank you for purchasing the SainSmart Genmitsu Controller Board. This controller board is designed for the Genmitsu 1810-PRO, 3018 and 3018-PRO CNC milling/engraving machines. It is also compatible with our blue SainSmart laser module. In general, it can also be used with other 3018 series CNC machines and laser modules of other manufacturers. For understandable reasons, however, we cannot guarantee this.

As always, the latest version of this user manual can be found at <https://docs.sainsmart.com/>.

You can also get help and support in the Facebook group (SainSmart Genmitsu CNC Users Group, <https://www.facebook.com/groups/SainSmart.GenmitsuCNC>).

In addition, as always, our superior SainSmart support is available to you at the e-mail address support@sainsmart.com.

We are always available for you, even after your purchase!

1 – Parts List

GRBL Controller	
USB cable (USB-A <-> mini-USB)	

2 – Control Module Design

The control module measures just 91mm x 87mm x 23mm. It has a very quiet, brushless fan which provides sufficient cooling for the three A4988 stepper motor drivers, which have a common aluminium heat sink. Each of these 3 stepper motor drivers can deliver a motor current of up to 2A at 12V. For the NEMA42 or NEMA57 stepper motors typically used in CNC milling/ engraving machines, these stepper motor drivers offer more than enough power and do not need to be operated at the upper end of their specification.



Hint:

During the first turn on, please set the current required for the stepper motors using the three miniature potentiometers located on the board. This is described in more detail in a later chapter under the heading “Setting Vref”.

Connection and operating elements

The following elements are located on the upper side of the control module, seen from left to right:

- Light emitting diodes for Spindle/Laser (blue), +12V (red), +24V(red)
- Connection for PWM-controlled 12V DC laser module (red)
- Connection for 24VDC spindle motor (white)
- Connection for stepper motor of X-axis (white)
- Connection for stepper motor of the Y-axis (white)
- Connection for stepper motor of Z-axis (white)



Connection for 24V spindle motor

The connection for the 24VDC spindle motor is controlled by an IRF024 N-channel MOSFET with a maximum load of 10A. Since the MOSFET is not cooled, the maximum load capacity should not be used. However, this is still quite sufficient to operate a 775ER type motor. The speed of the spindle motor is controlled by pulse width modulation (PWM).

Pin assignment:

PCB edge



Connection for 12V PWM laser module

A PWM-controlled laser module can be connected to the red, 3-pin connector. Please note that either the spindle motor or a laser module is connected to their respective connectors. Simultaneous connection and operation of spindle motor and laser module is not supported by the control module.

Pin assignment:

PCB edge



Connection for Stepper Motors

The module comes with 4-pin connectors for 3 stepper Motors. One for the X-, one for the Y- and another one for the Z-axis. The pin assignment is as follows.

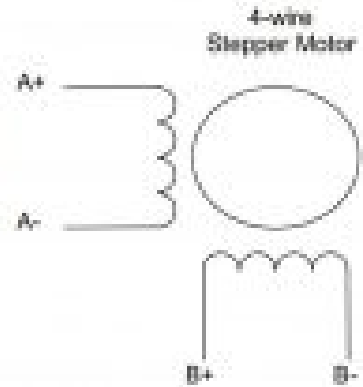
Pin assignment:
XH 2.54 type

PCB edge



Those stepper motors, that come with a built in 6-pin PH 2.00 type header do normally have their pins assigned as follows.

Pin assignment:
PH 2.00 type



Connection for external 24V power supply unit

On the left side of the control board there is a DC Power jack for connecting an external 24VDC power supply. The outer ring is connected to GND whilst the inner pin is connected to +24V.



Connection for PC

A PC can be connected via the mini-USB socket, which is also located on the left side of the control module. The USB port is connected to the central processor of type Atmel ATMEGA328P via a USB-to-serial converter of type CH340. The ATMEGA328P comes with a bootloader and the GRBL firmware version 1.1f already preinstalled at the factory.

On the bottom side of the control module the following elements are located, as seen from left to right



- On/Off switch
- Reset button
- 8-pin connector for offline-controller
- Light emitting diode for TxD (blue)
- Light emitting diode for +5V (red)
- 16-pin connector for Z-Probe (measuring tool) as well as Z-, Y- and X-limit switches

Connection for offline-controller

An external offline-controller can be connected to the 8-pin tub connector. This makes it possible to operate the CNC milling/engraving machine connected to the control module independently without an additional PC. In such a case, the positioning data (g-code) are stored beforehand on a micro-SD card located in the offline-controller.



Connection for limit switches and Z-Probe

Limit switches as well as a measuring device for the Z-axis (Z-probe) can be connected via the 16-pin plug that is also available at the bottom edge of the control module.



Hint:

Please note that the labeling for the connections of the X- and Z-limit switches on the board is reversed.



Connection of limit switches

For each of the 3 axes there are connections for two limit switches on the control module. The connections of the limit switches of one axis are connected parallel to each other. The direction of movement enables the control module to differentiate which limit switch was triggered.



Activate homing using limit switches

In order for the control board to evaluate the limit switches in the context of a homing run, this must first be switched on in the control module. Homing is controlled by Grbl parameter \$22. If limit switches are used, enter "\$22=1" in the Grbl or LaserGrbl command line to activate them and "\$22=0" to deactivate them. A homing run

can then be triggered by entering “\$H”.

Connecting a Z-Probe (measuring tool)

To automatically determine the distance between the tip of the milling cutter and the surface of the workpiece to be milled, an additional measuring tool, a so-called Z-probe, can be used. This is connected to terminal A5 of the 16-pin connector and the opposite GND terminal.



ICSP interface

On the right side of the board there are 6 pads for the ICSP interface (in-circuit serial programming). They have been setup in a 1.27mm grid. Since a bootloader is already preinstalled on the ATMEGA328P at the factory, this interface is normally no longer required for later operation of the control board. Therefore, no pin header has been installed.

assignment:

MISO

MOSI

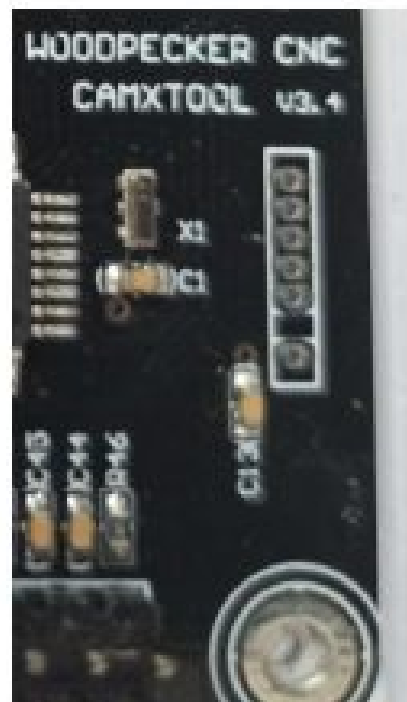
SCK

RST

GND

n.v.

+5V



3 – Setting Vref

Before connecting stepper motors to the control module, the maximum motor currents for the stepper motors used must first be set on the control module using the appropriate miniature potentiometers. For the stepper motor drivers of the type A4988 used in the control module, the formula for determining the maximum motor current is:

$$I_{max} \text{ (maximum motor current)} = V_{ref} / (8 \times R_{sense})$$

R_{sense} has a resistance value of 0.1Ω for this control module.

Converted to V_{ref} it makes the following formula:

$$V_{ref} = I_{max} \text{ (maximum motor current)} \times 0.8\Omega$$

Thus, for an ordinary stepper motor with a maximum motor current of 0.8A, this results to a V_{ref} value of $0.8A \times 0.8\Omega = 640mV$.

To set the reference voltage V_{ref} , you need a multimeter and an adjustment screwdriver. Connect the COM port of your multimeter to GND. GND is, for example, on all pins of the 16-pin male connector pointing to the lower edge of the board. Hold the V connector tip of your multimeter to the middle connector of the corresponding miniature potentiometer (X, Y or Z). Then set the required voltage value V_{ref} on the miniature potentiometer with the adjustment screwdriver.

4 – Assembly and Operation

Assembly

Please refer to the manual of your milling / engraving machine for assembly instructions. Pay attention to the required cable lengths of the supply lines to all movable elements. If possible, use additional fabric hoses to protect the supply lines. Mounting material is not included in the package of the control module.

Power supply

The control module requires a 24VDC supply for operation. The required current depends on the connected CNC milling / engraving machine. Usually a DC power supply with 24V rated at 5A is sufficient.

Operation

Connect up to three stepper motors to the terminals labeled “X-MOTOR”, “Y-MOTOR” and “Z-MOTOR”.



A spindle motor is connected to the 2-pole “SPINDLE” connection. Pay attention to the polarity. The plus pole is usually marked red whilst the minus pole is marked black.



A PWM laser module, such as the blue SainSmart 5500MW laser module, can be connected to the red 3-pin connector labeled “LASER” using the 3-core cable supplied with the laser module. Note that either a spindle motor is connected to the “SPINDLE” connector or a laser module is connected to the “LASER” connector, but never both at the same time.



In addition, limit switches for the X-, Y- and Z-axes can be connected to the 16-pin connector.

In order to put the device into operation, either an offline controller can be connected to the 8-pin post socket or a PC can be connected to the USB port of the control module.

When operating with an offline controller, it is possible to manually move the 3 axes (jogging) after turning on the device. The on/off switch is located at the lower left edge of the control module.

Additional software is required for operation with a PC. For CNC milling/engraving work we recommend Grbl for laser work it would be LaserGRBL. Both programs are OpenSource.

We wish you much pleasure and success when operating a device connected to this control module.

5 – Update Firmware

Grbl v1.1f comes preinstalled on the control module. Should it become necessary to replace the delivered firmware with a newer one, this is also possible at any time thanks to the built-in bootloader.

CH340 device driver

For Windows 7 users, the CH340 driver must be installed first in order to communicate with the control board. For Windows 10 users, this driver is automatically installed the first time the control board gets connected to the computer via a USB connection.

Download Update-Archive

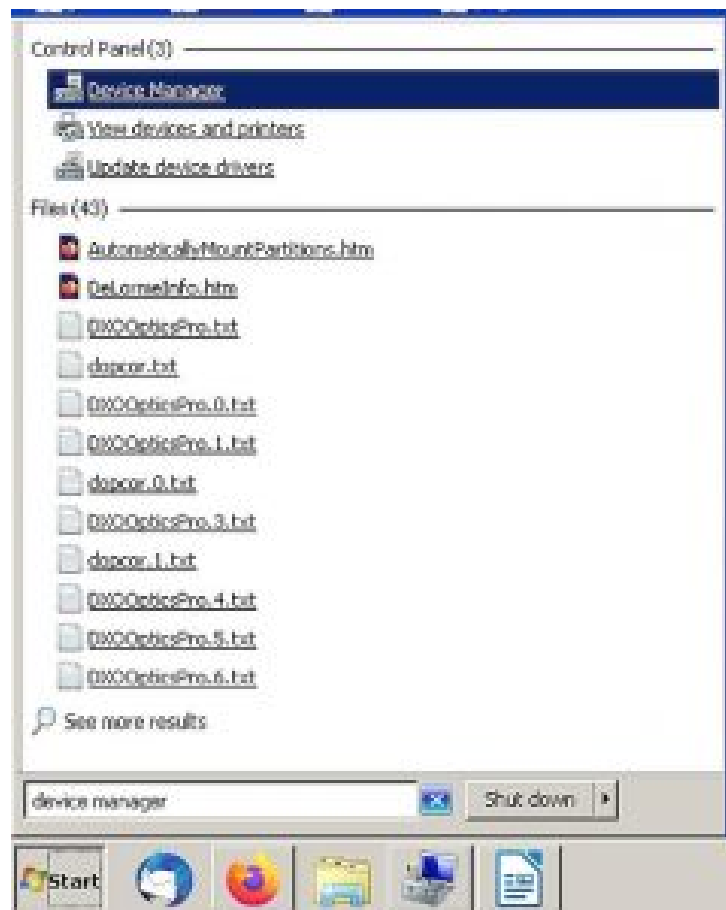
Now download the appropriate firmware for your CNC milling/engraving machine, preferably directly from the manufacturer's website. Usually this is an archive file. It contains both the required firmware file of type ".hex" and the "xloader" program required for transfer. If the xloader is not included in your update archive, you can also find it on the Internet by searching for "xloader arduino".

Hint:

SainSmart is not liable for damage to the control module or other modules and devices connected to it resulting from improper or incorrect firmware installation. SainSmart is also not liable for any other damage to persons or property.

Installing the firmware

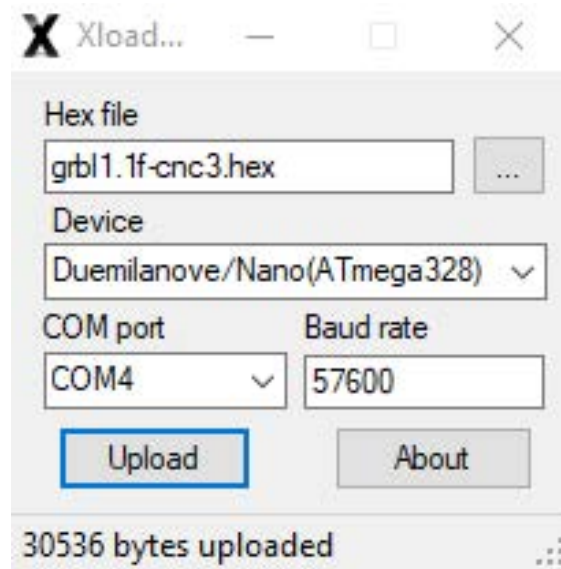
1. Connect the control module to a Windows PC with USB connection. The USB port of the PC supplies the microprocessor of the control module with sufficient voltage. Therefore, make sure that the CNC controller's external power supply is disconnected or switched off.
2. Find the Device Manager application by typing "Device Manager" in the Windows 7 "Start" window. For Windows 10, type "Device Manager" in the search window. Start the Device Manager application by left-clicking it.



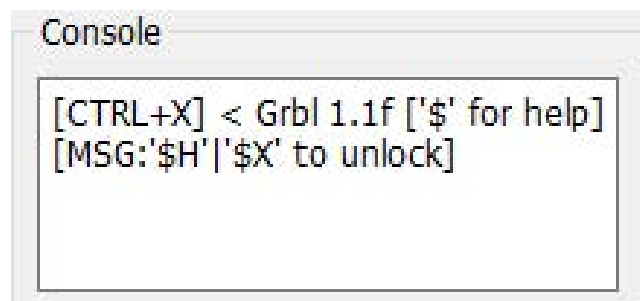
3. In Device Manager, locate the "Ports (COM & LPT)" entry and click it to display the active driver that is in use. For this CNC control boards, it should be "CH340", but it may display different COM port numbers. Make a note of the COM port number as it will be needed later.



4. Double-click the highlighted driver line to expand it. When expanded, it will display multiple tabs, click the Port Settings tab and set it to transfer at 115200 bits per second.



7. Start Grbl (Candle) on your PC and in the status window check whether a version number is displayed. This final check completes the upgrade process of the control module.



6 – Optional Accessories



Accessories for your milling/engraving machine are best purchased from SainSmart:




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support@sainsmart.com 2711 Centerville Road, Wilmington, DE, 19808, United States

Documents / Resources

	Sain Smart Controller Board (GRBL) [pdf] User Manual Controller Board GRBL
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References

- support@sainsmart.com
- [SainSmart | Desktop CNC, 3D Printing & DIY Tools | Power to the Makers – SainSmart.com](#)
- [SainSmart | Desktop CNC, 3D Printing & DIY Tools | Power to the Makers – SainSmart.com](#)
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