DIY Machining - GRBL Settings - Pocket Guide

The following settings are specific to GRBL v0.9 - For more information visit www.DiyMachining.com/GRBL

Command	Definition	Explanation
$$	View Settings	Displays current GRBL settings stored in EEPROM (memory) of the Arduino
$0=10	Step Pulse Length (µsec)	This sets the length of the step pulse delivered to the stepper motors. The goal is to have the shortest step pulse your motors can reliably recognize. The data is available on some stepper motor data sheets otherwise 10 is a good default.
$1=25	Step Idle Delay (msec)	Sets the time delay in milliseconds that GRBL will power the stepper motors after a motion command is complete. A setting of 255 tells the motors to stay powered on to hold position.
$2=0	Step Pulse Configuration	Defines the step signal sent to the stepper motor drivers. By default the step signal starts low and goes high to denote a step pulse event. See **Axis Config. Table** below.

Axis Config. Table

Setting Value	Reverse X	Reverse Y	Reverse Z	Setting Value	Reverse X	Reverse Y	Reverse Z
0	NO	NO	NO	4	NO	NO	YES
1	YES	NO	NO	5	YES	NO	YES
2	NO	YES	NO	6	NO	YES	YES
3	YES	YES	NO	7	YES	YES	YES

$3=6	Axis Direction	Changes axis motion direction without changing wiring. See **Axis Config. Table** above.
$4=0	Step Enable Invert	Controls the signal sent to the enable pin of your stepper drivers. $4=1 sets the enable pin to high. (Invert)
$5=0	Limit Pins Invert	This refers to the limit switch pins which by default are set to high using the Arduino's internal pull up resistors. Grounding the pin tells GRBL the limit switch is tripped. For the opposite behavior use the setting $5=1 which tells the system that a high is the limit switch trigger. You must also install external pull down resistor with the $5=1 setting.
$6=0	Probe Pin Invert	This refers to the probe pins which by default are set to high using the Arduino's internal pull up resistors. Grounding the pin tells GRBL the probe is tripped. For the opposite behavior use the setting $6=1 which tells the system that a high is the probe trigger. You must also install external pull down resistor with the $6=1 setting.
$10=3	Status Report	Defines the real time data sent to the user. By default GRBL reports running state which cannot be turned off, machine position & work position. The table to the right details the settings. Note to send a combination of status reports, simply add the values of the desired report types and send this value to GRBL. For Example, say I want Work Position (2) & Limits (16), I would send $10=18.

Report Type	Value
Machine Position	1
Work Position	2
Planner Buffer	4
RX Buffer	8
Limit Pins	16

$11=0.020	Junction Deviation (mm)	Think of this as cornering speed. A high values allows for fast motion around corners but increases the risk of missed steps resulting in decreased accuracy. Conversely, lower values reduce the speed around a corner decreasing the risk of missing steps while potentially improving accuracy.
$12=0.002	Arc Tolerance (mm)	GRBL treats curves as a collection of small straight lines. This setting defines how smooth the curves will be. The default is .002mm and will not likely need to be changed as this value is below the accuracy of most machines.
$13=0	Feedback Units	Sets position feedback units from mm to inches. $13=1 for inches or $13=0 for mm
$20=0	Soft Limits (Enable/Disable)	Requires "Homing" be enabled and checks to see if gCode commands will exceed the travel limits of the machine. $20=1 Enable $20=0 Disable
$21=0	Hard Limits (Enable/Disable)	Requires limit switches be installed and looks for one of the limit switches to be activated which triggers "Alarm" mode. In this mode, all machine motion, the spindle and coolant are shutdown.
$22=0	Homing Cycle (Enable/Disable)	Requires limit switches be installed. Enabling this will lock out all gCode commands until a "Homing" cycle is run.
$23=1	Homing Cycle Direction	Allows the user to change the direction of the homing cycle us the values from the **Axis Config. Table** on page 1.

Command	Definition	Explanation
$24=50.000	Homing Feed (mm/min)	Feed rate used in the "Homing" cycle once the limit switches are located. The lower the value the more repeatable the zero position.
$25=635.000	Homing Seek (mm/min)	Feed rate used in the "Homing" cycle to locate the limit switches. Set this to the highest value that does not cause the machine to crash into the limit switches.
$26=250	Homing Debounce (msec)	Length of the software delay in milliseconds that minimizes switch noise. A value between 5 an 25 is typical.
$27=1.000	Homing Pull-off (mm)	Tells the machine how far to move away from the limit switches after finding the "Home" position so as not to trigger the hard limits.
$100=314.961	X (steps/mm)	Tells GRBL how many steps are required to move the machine a given distance. **Steps/mm** = **(Steps per Revolution)*(Microsteps) / (mm per Revolution)** 1) **Steps per Revolution** = 200 Typical - This is the number of steps required for your stepper motor to make 1 complete revolution. 2) **Microsteps** - 1,2,4,8,16 - Is a setting on your stepper motor driver. A higher value means lower torque but higher accuracy. 3) **mm per Revolution -** Determined by your machine setup. (lead screw pitch)
$101=314.961	Y (steps/mm)	
$102=314.961	Z (steps/mm)	
$110=635.000	X - Max Rate (mm/min)	Defines the maximum speed for a given axis. This is found experimentally for each axis by incrementally increasing the value and then sending a test gCode command to move the axis. Be sure the command allows the axis to move enough to reach the maximum rate. You will know the maximum speed when the stepper motors stalls. Reduce the value by 10-20% These values may be different for each axis.
$111=635.000	Y - Max Rate (mm/min)	
$112=635.000	Z - Max Rate (mm/min)	
$120=50.000	X - Max Acceleration (mm/sec^2)	Defines the maximum acceleration for a given axis. This is found experimentally for each axis by incrementally increasing the value and then sending a test gCode command to move the axis. Be sure the command allows the axis to move enough to reach constant motion. If you decide to use a jog command make sure the jog increment is several inches. You will know the maximum value when the stepper motors stalls. Reduce the value by 10-20% These values may be different for each axis.
$121=50.000	Y - Max Acceleration (mm/sec^2)	
$122=50.000	Z - Max Acceleration (mm/sec^2)	
$130=225.000	X - Max Travel (mm)	Used when soft limits are enable to tell GRBL the maximum travel for each axis. This also requires the use of a homing cycle.
$131=125.000	Y - Max Travel (mm)	
$132=170.000	Z - Max Travel (mm)	
GRBL Commands		
$#	View gCode Parameter	Lists work coordinate offsets (G54-G59), Predefined positions (G28 & G30), Coordinate offset (G92), Tool Length Offset (TLO) & Probing cycle (PRB).
$G	View Parser State	Displays the active gCode modes in the GRBL parser. **Example** - [G0 G54 G17 G21 G90 G94 M0 M5 M9 T0 S0.0 F500.0]
$I	View Build Info	Shows the GRBL version and source code build date.
$N	View Startup Blocks	Displays the startup blocks run each time GRBL is powered on or reset.
$N0=line $N1=line	Save Startup Block	Command used to save startup blocks. Substitute valid gCode commands for the "line" portion and these will executed each time GRBL is powered on or reset.
$x=value	Save GRBL Setting	Command used to save a GRBL setting. Replace the "X" with a number from the list above and the "value" with the corresponding setting.
$C	Check gCode Mode	Processes all incoming gCode commands but does not move the axis, spindle or coolant so the user can check a gCode program.
$X	Kill Alarm Lock	Overrides the alarm lock to allow for axis movement.
$H	Run Homing Cycle	Executes the homing cycle.
Real Time GRBL Commands		
~	Cycle Start	Starts buffered gCode commands. Used to resume cutting after a "Feed Hold."
!	Feed Hold	Stops active cycle by controlled deceleration preventing position lose from missed steps.
?	Current Status	Returns the active GRBL state & current machine & work positions.
ctrl-x	Reset GRBL	Soft reset command retains machine position without powering down the Arduino.