WEBSITE: www.robots-everywhere.com
SUPPORT: support@robots-everywhere.com
OFFICE: +1-415-324-9827

L-CHEAPO APPLICATION NOTE

Installation on Taig Knee Mill

This appendix is credited to Bernard Brault, a valued customer. Bernard has put together an application note for installing an L-Cheapo on a CNC converted knee mill.

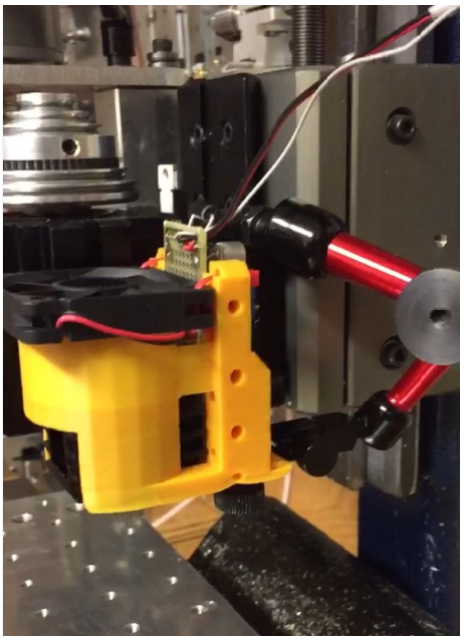


Illustration 1: L-Cheapo Mk3 Installed on Taig Mill

Below is a photo of the laser cutting black acrylic (mk3 will not cut transparent)

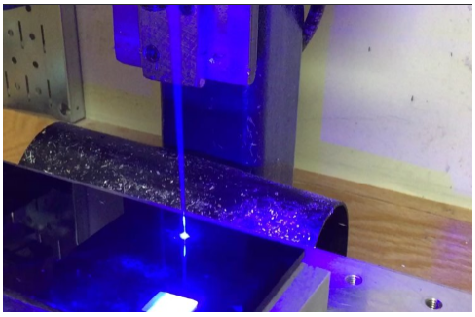


Illustration 2: Cutting Acrylic

Here is a cutout in black acrylic (Simon is my older son's name)

Illustration 4: Extracted Cutout in Black Acrylic

And an example of engraving in wood

Illustration 5: Mk3 Wood engraving

I am using a Taig CNC Mill, the Step Motor drive system is from Soigeneris model STDR-4C with the Ethernet SmoothStepper option. It is a very nicely packaged Geiko G540 4-axis Step Drive, a Warp9 Ethernet Smoothstepper, power supply, ports and Emergency stop.

http://www.soigeneris.com/stdr_4c-details.aspx

I use Mach3 Software as a CNC Machine Controller and CamBam to create the CAM files (G-Code).

Soigeneris provides all of the above, including the software.

I use CamBam to generate the Laser "Cutting/Engraving" code that will run in Mach3.

I don't like to write G-Code directly. CamBam is a 2.5D Cam package for milling and it also works very well with the Laser.

In this application note, I will cover the hardware, how to interface the Laser to the Ethernet Smoothstepper (Port 2) shown above and the software settings in Mach 3 and Cambam to make it work.

When milling, if the tool bit has to be repositioned, it's done by moving the bit above the stock surface (typically z=0) and then do a rapid move to the new position. That obviously does not work for a Laser. You need to be able to turn it off and then back on. CamBam can automatically generate code that will do just that. I will show you how to set this up below in the software section. For the hardware, a 5V output

pin on port 2 will provide the on-off control. An output pin on port 2 will go to High (5V) or Low (0V). When “laser cutting”, the pin will be set to 5V and when doing rapid positioning, it will be dropped to 0V. We are going to use this digital signal to activate a relay, a solid state relay that will be put in series with the Laser Power Input.

I used a cheap import Futek Solid State Relay that I found on Amazon.

Illustration 6: Futek SSR-25 DD

http://www.amazon.com/uxcell%C2%AE-Soild-SSR-25-3-32VDC-5-200VDC/dp/B019132CY8?ie=UTF8&psc=1&redirect=true&ref_=oh_aui_search_detailpage

The input of the SSR will be driven by the output pin I just described. It is active high and closes the contact side or the output that feeds the Laser power.

The L-Cheapo laser operates with an input voltage range of 12-24VDC but it is recommended to use 12VDC. Anything higher will simply dissipate heat on its built-in voltage regulator. And there is already plenty of heat that need to be dissipated.

Illustration 7: Power Supply for L-Cheapo

Since the SSR has a voltage drop, I am using a 14VDC 4A power supply normally used for LCD monitors.

That will give me around 12.5 V on the laser.

The power range for the L-Cheapo is between 12V and 24V, so it is okay to use an old laptop or monitor power supply to run the laser. The voltage is clean, and they generally have the current. While the 4A supply used here is sufficient for the Mk3, please check the current rating for your L-Cheapo model, and account for the fact that most power supplies are rated for peak current, not continuous.

The L Cheapo also has a PWM input lead. Its optional to use this lead. But if you want to be fancy here is how to use it:

The step motors on a CNC cannot accelerate (Or change direction) instantly so Mach-3 has settings that will limit the acceleration. That means that the federate will slow down in corners and the Laser will spend more time above those corners than on other locations. And this can result in some overburn. Nothing major but if you are as picky as I am, there is a solution for that using the PWM of the laser connected to another Port 2 Pin. This one will be driven with a PWM signal normally used to control the spindle speed for the same reasons. It very rapidly turns the laser on-off proportionally to its feed rate, I set it to 5Khz, it is effectively dimming the Laser down in corners where the steppers have to slow down. This is a nice feature that has been implemented on the Ethernet Smooth Stepper. It will not work on the USB version of the smoothstepper.

Here is an example for the overburn on corners when not using the PWM signal to dim the laser on corners where Mach3 reduces the feed speed to avoid step skipping.

Zooming in on the letter K, you can see the overburn in the corners.

Illustration 8: Overburn if no PWM used

So here is the complete circuit diagram:

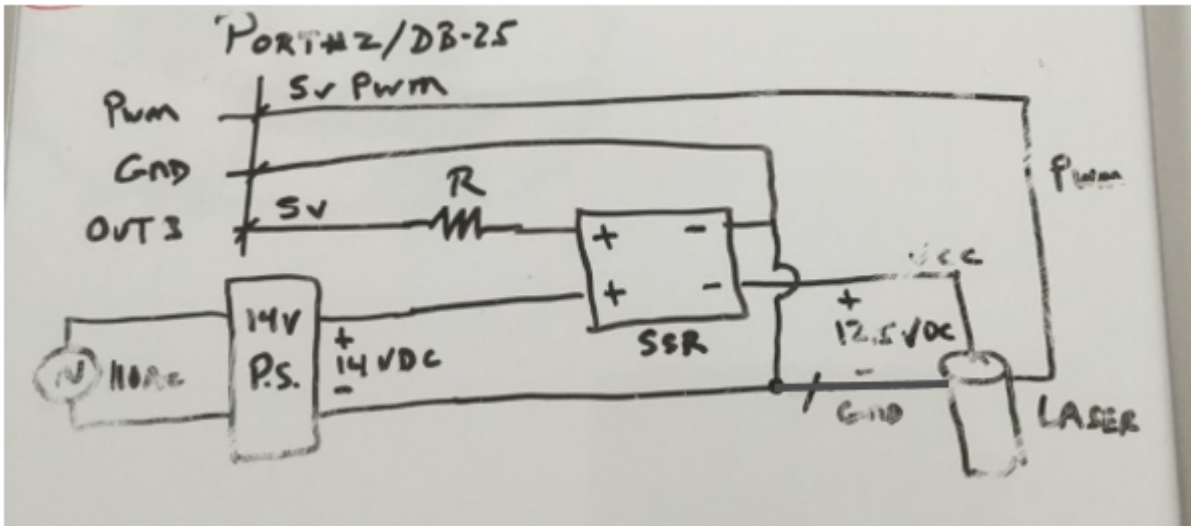


Illustration 9: Circuit by Bernard Brault for L-Cheapo Install

The resistor R between the Port 2 Output pin and the Solid State relay input is optional. I put it in to reduce the current load and spare the line driver.

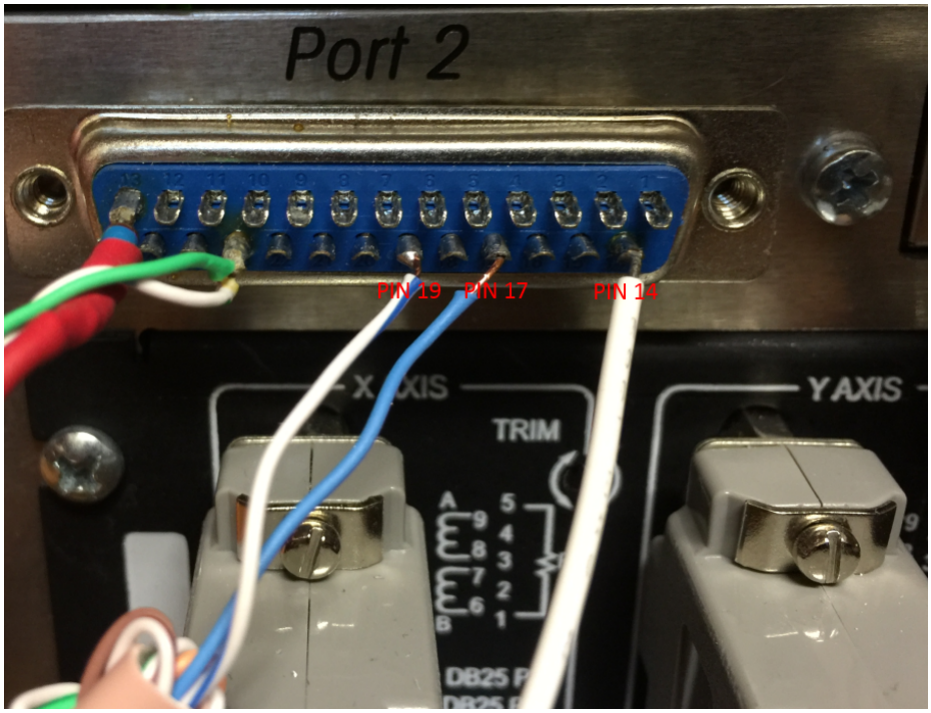


Illustration 10: Port 2 Output Pinout

Pin 19 above is a ground and goes to the Laser Ground wire and to the SSR input minus

Pin 17 is for the on-off control, and it goes to the SSR input + via an optional current limiting resistor.

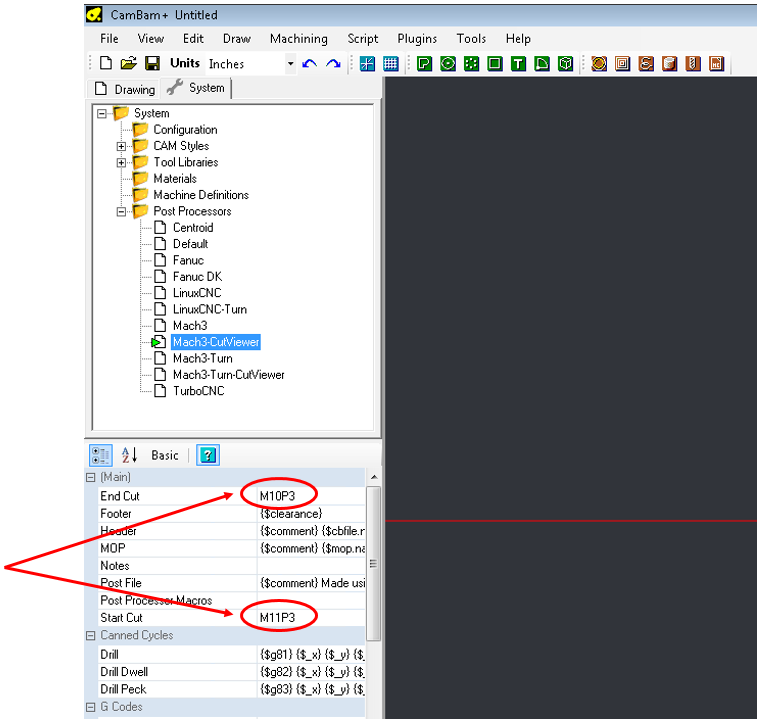
Pin 14 is the PWM signal and goes to the Laser PWM input.

SOFTWARE SETTINGS

I wanted the ability to use CamBam with the Laser. As I explained earlier, Cambam can generate code to turn off the laser (Via the SSR) for rapid moves. Normally Cambam moves the milling bit up above the stock at a safe distance to reposition it.

In the post processing, CamBam can generate M10 and M11 code that will trigger the Laser On-Off when the bit goes above or below the (Z=0) stock surface, indicating the start and stop of cuts. Using Cambam, if I create a machine operation that has a depth of .001in it will barely move the laser down from z=0 but it is sufficient to indicate a start of cut and it will turn on the laser. If I want to make 3 passes to cut something like Acrylic, I create a MOP with a target depth of .003in with depth increments of .001in That will effectively make 3 passes.

The CamBam settings for triggering the on-off on Port 3 are shown below: M10P3 for the end of cut and M11P3 for the start of cut. These M-Commands will be inserted automatically by CamBam in the G-Code.

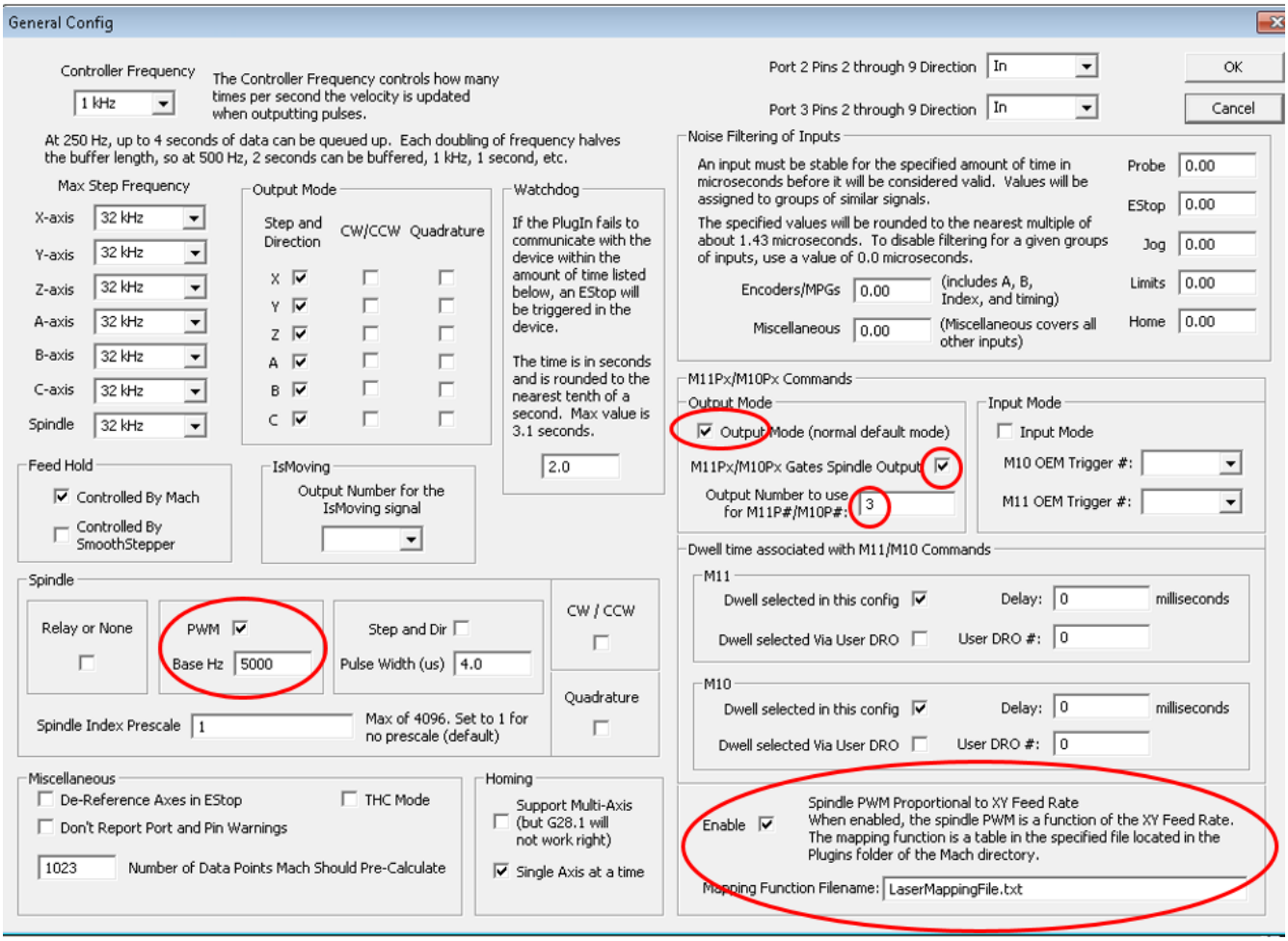


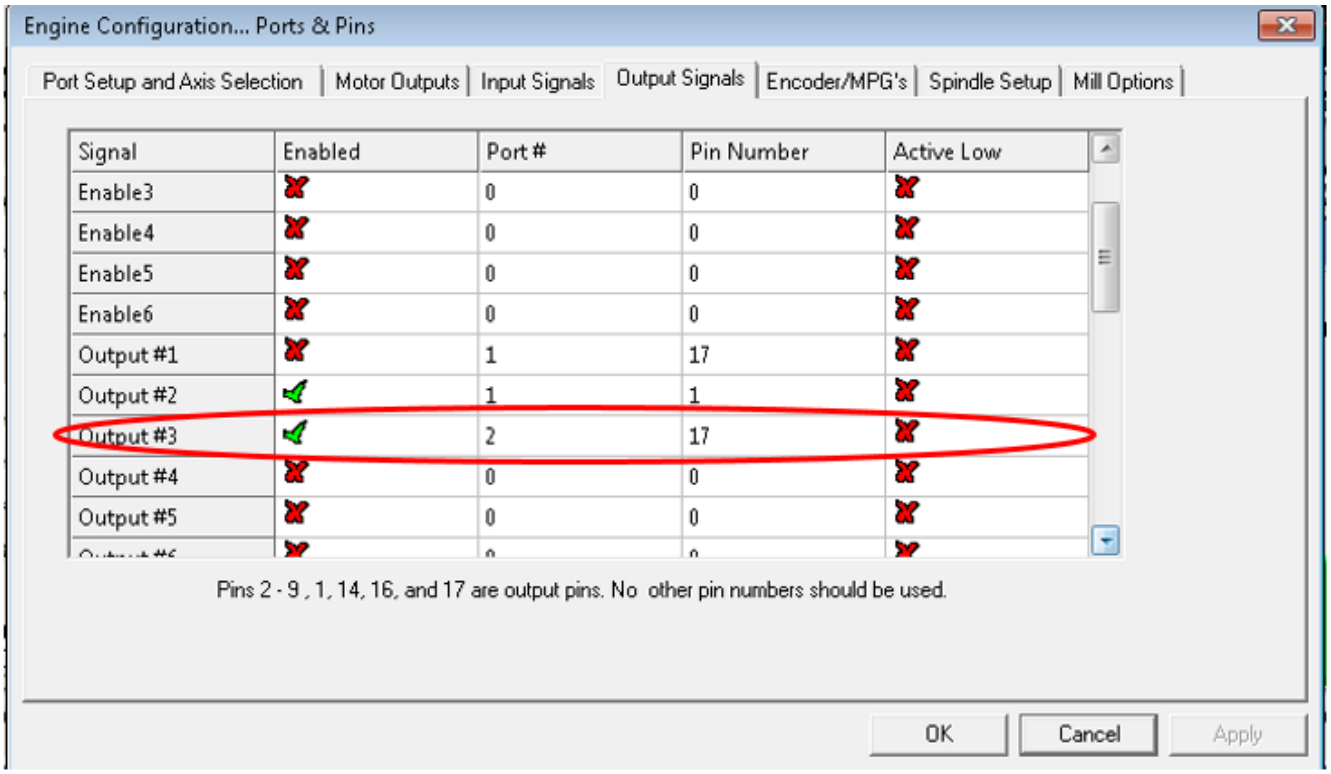
Mach 3 Ethernet Smooth Stepper PlugIn settings

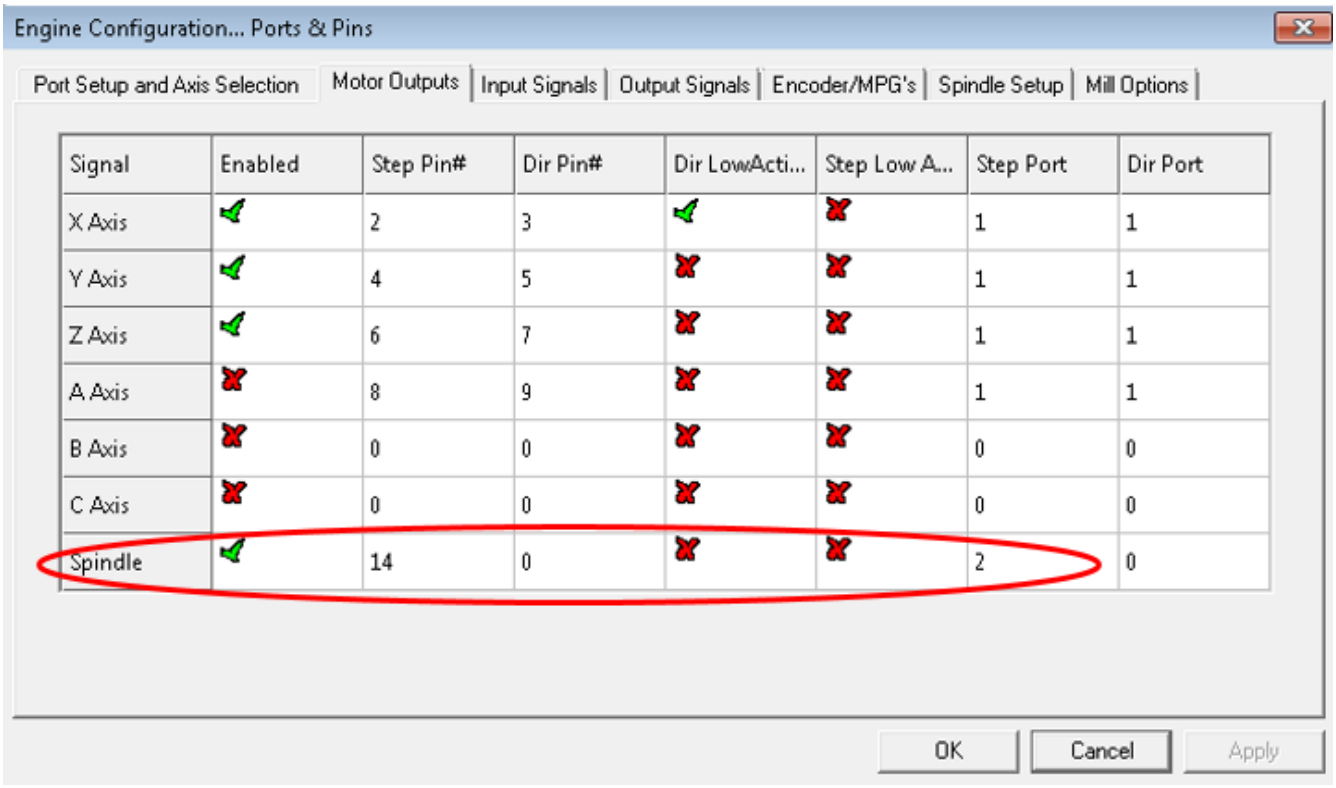
Notice that the Spindle PWM is selected and the frequency is set to 5000Hz.

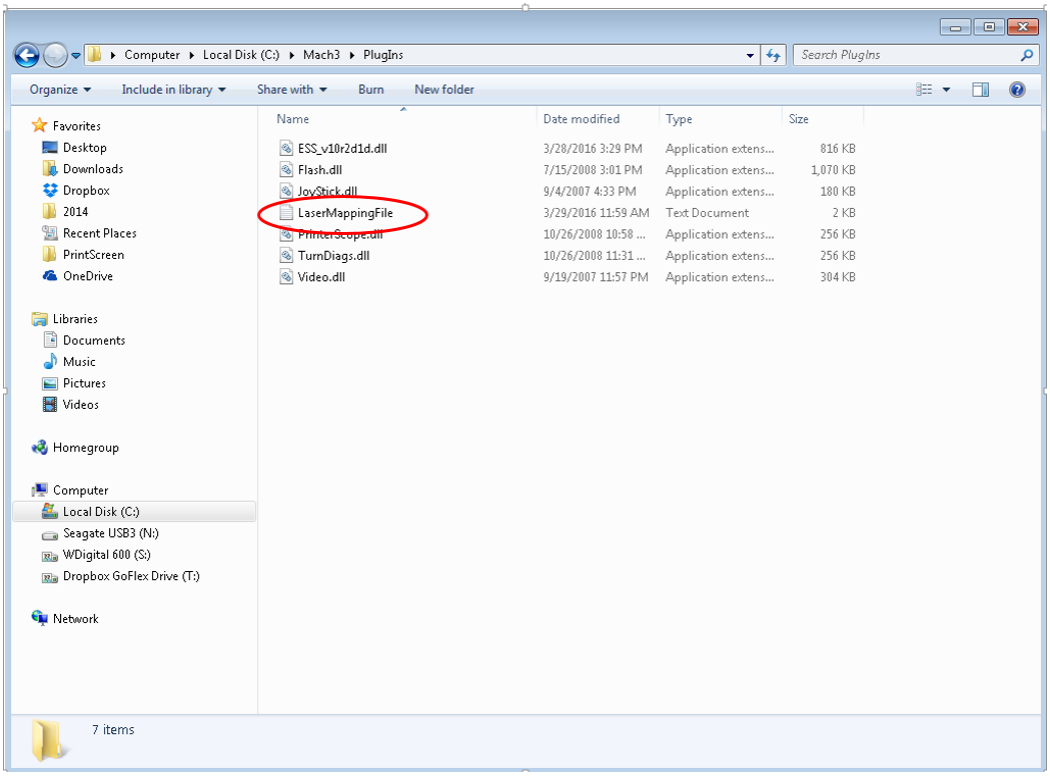
Spindle PWM proportional to the XY rate is also selected.

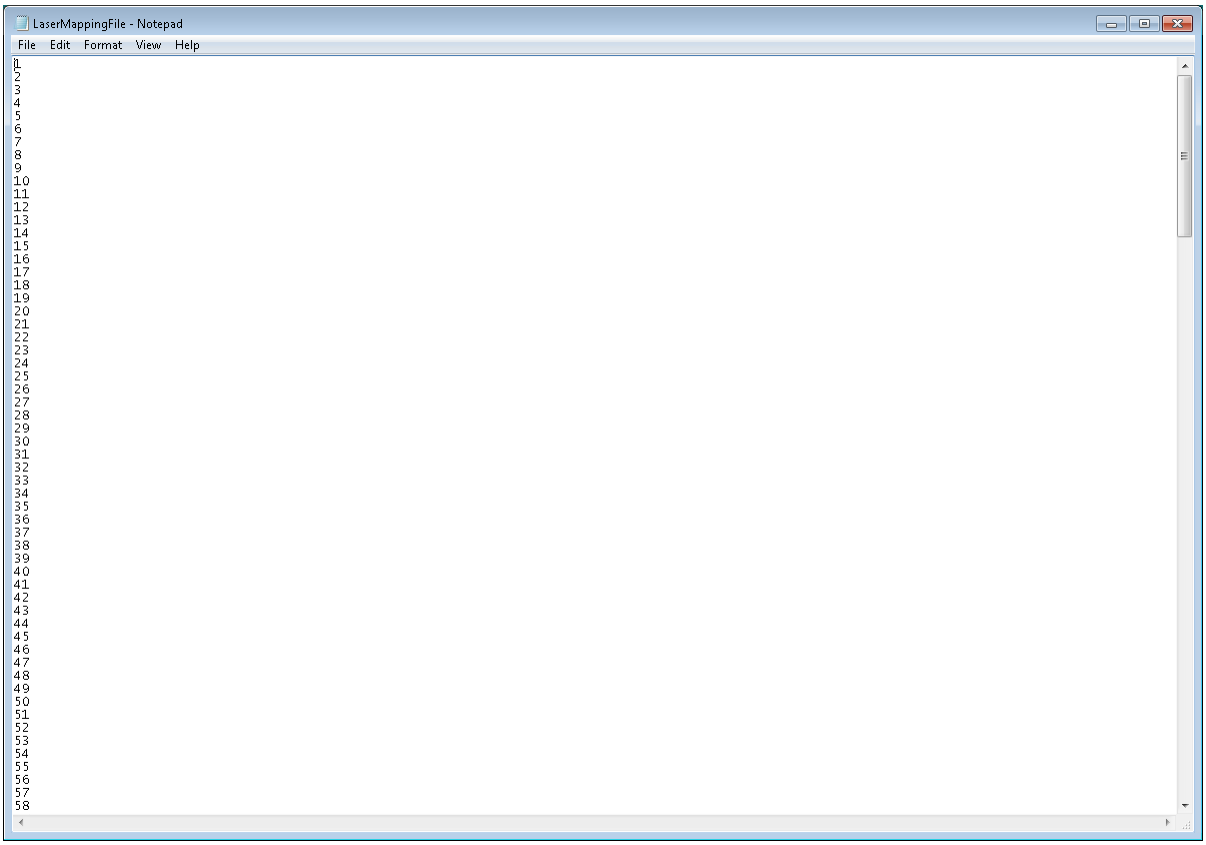
The LaserMappingFile.txt is below

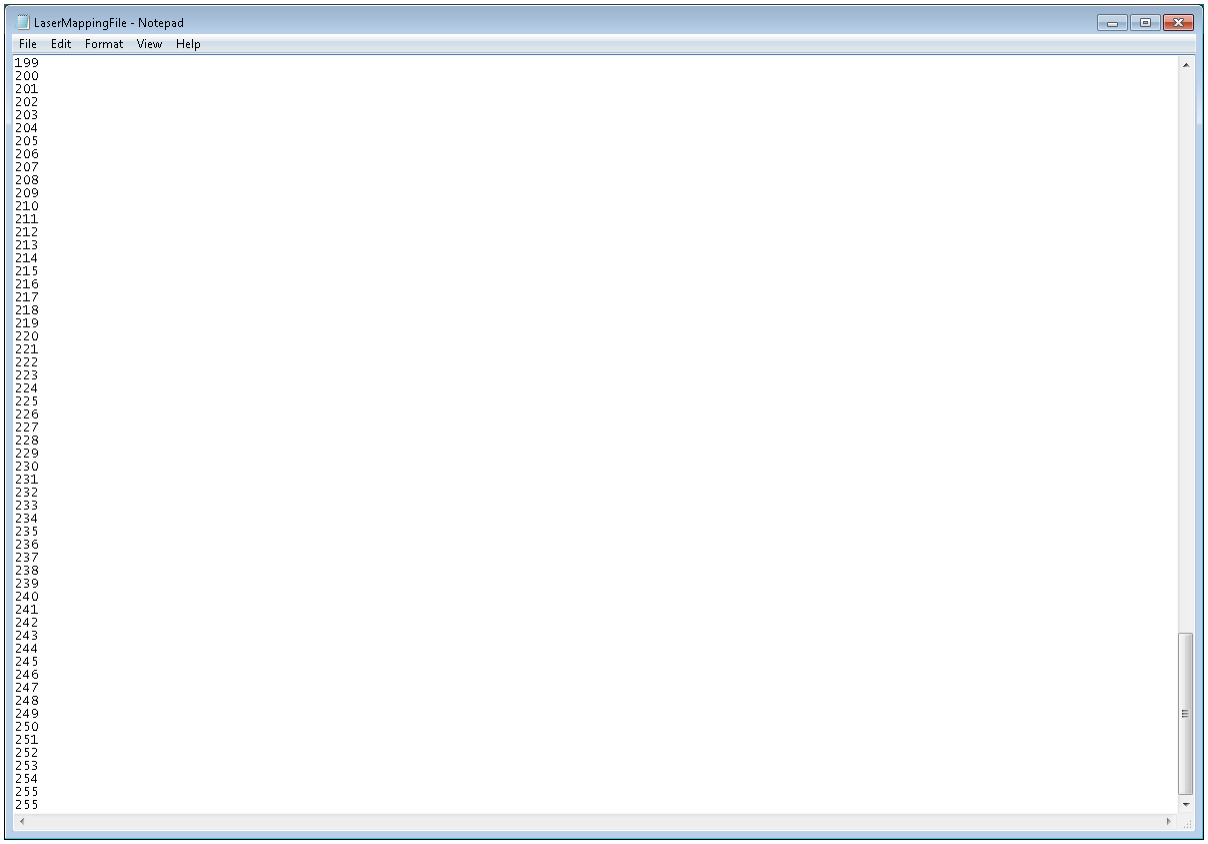



Engine Configuration... Ports & Pins
Port Setup and Axis Selection
Motor Outputs
Input Signals
Output Signals
Encoder/MPG's
Spindle Setup
Mill Options
Signal | Enabled | Port # | Pin Number | Active Low
Enable3 | 0 | 0
Enable4 | 0 | 0
Enable5 | 0 | 0
Enable6 | 0 | 0
Output #1 | 1 | 17
Output #2 | 1 | 1
Output #3 | 2 | 17
Output #4 | 0 | 0
Output #5 | 0 | 0
Pins 2 - 9 , 1, 14, 16, and 17 are output pins. No other pin numbers should be used.
OK
Cancel
Apply


Engine Configuration... Ports & Pins
Port Setup and Axis Selection
Motor Outputs
Input Signals
Output Signals
Encoder/MPG's
Spindle Setup
Mill Options
Signal | Enabled | Step Pin# | Dir Pin# | Dir LowActi... | Step Low A... | Step Port | Dir Port
X Axis | 2 | 3 | 1 | 1
Y Axis | 4 | 5 | 1 | 1
Z Axis | 6 | 7 | 1 | 1
A Axis | 8 | 9 | 1 | 1
B Axis | 0 | 0 | 0 | 0
C Axis | 0 | 0 | 0 | 0
Spindle | 14 | 0 | 2 | 0
OK
Cancel
Apply


Computer ▸ Local Disk (C:) ▸ Mach3 ▸ PlugIns
Search PlugIns
Organize
Include in library
Share with
Burn
New folder
Favorites
Desktop
Downloads
Dropbox
2014
Recent Places
PrintScreen
OneDrive
Libraries
Documents
Music
Pictures
Videos
Homegroup
Computer
Local Disk (C:)
Seagate USB3 (N:)
WDigital 600 (S:)
Dropbox GoFlex Drive (T:)
Network
Name
Date modified
Type
Size
ESS_v10r2d1d.dll 3/28/2016 3:29 PM Application extens... 816 KB
Flash.dll 7/15/2008 3:01 PM Application extens... 1,070 KB
JoyStick.dll 9/4/2007 4:33 PM Application extens... 180 KB
LaserMappingFile 3/29/2016 11:59 AM Text Document 2 KB
PrinterScope.dll 10/26/2008 10:58 ... Application extens... 256 KB
TurnDiags.dll 10/26/2008 11:31 ... Application extens... 256 KB
Video.dll 9/19/2007 11:57 PM Application extens... 304 KB
7 items


LaserMappingFile - Notepad
File Edit Format View Help



I used Excel to create the LaserMappingFile.txt

LaserMapping file has 256 lines as shown, note that the last entry is 255, not 256

This file can be modified to tweek the dimming of the laser.

Its basically a lookup file that the ESS uses to generate the PWM output.

The PWM input value is a byte (hence the 256 entries 2^8=256)

If the XY feed speed slows down to 50% of its nominal value, the input byte will be 128

The PWM will use the 128^{th} entry in this file to set the PWM output duty cycle.

In this case, it is linear so the output value will be 128 and 128/256 = 50% so the laser output will be reduced by 50%. It works just fine for this application.

WARRANTY

This information is provided without any guarantee or warranty supported by Robots Everywhere. The installation instructions and test results were 100% provided to us, voluntarily and free of charge, by a third party.

Any user following this guide is doing so at his or her own risk, with the assumption that the user has the knowledge and experience sufficient to follow the given instructions.

See the L-Cheapo product warranty for information on the L-Cheapo itself.