DLP based 3D printing is actually far simpler in its operation than many may think. The reason for this is that moving mechanical assemblies over the build platform to formulate a single layer is unnecessary and is done by the projector. This eliminates additional motion and time and only requires a synchronization between the projector and the Lift which lifts the model as it is being built.

Although there may be other software solutions to achieve the same result, the instructions in this tutorial are specifically written for controlling the Ilios HD Kit through a machine control software called MACH 3. The software can be freely downloaded through its website. Download and install the MACH 3 software on the computer that is going to be used for the Ilios HD Kit. Leave all settings in the installation as default.

Note: Please have in mind that Mach 3 shall operate on a Windows XP 32bit operating system. Installing Mach 3 on a 64bit operating system shall present problems and unpredictable behavior due to driver issues.

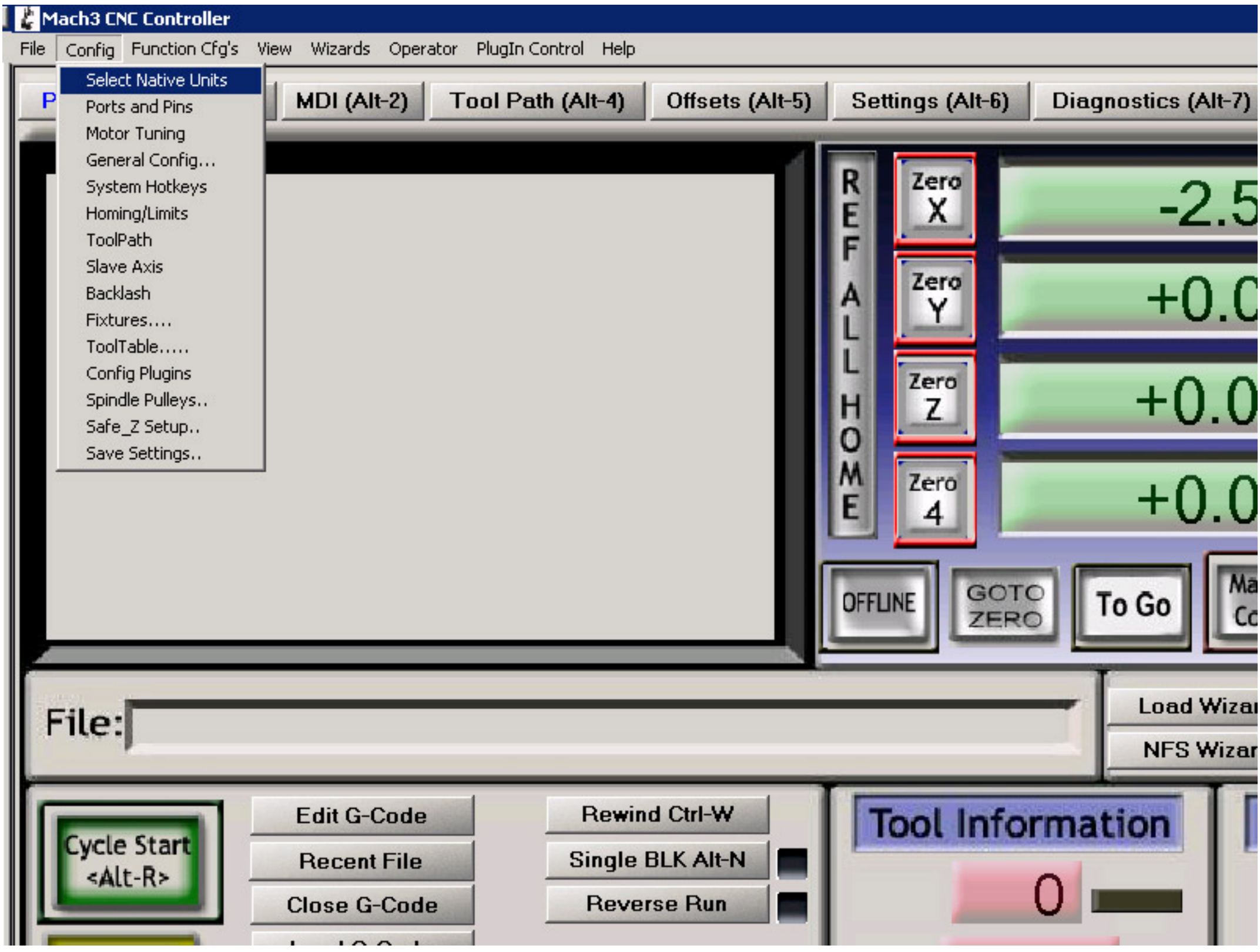
The only thing to note while installing MACH 3 is the machine profile at the very end of the installation. The setup shall ask you to create a new profile for your machine. Simply enter the name *Ilios HD Kit* in the text field, selecting the type of the machine to be *MILL* and finish the installation. A Shortcut with the name Ilios HD Kit shall be created on your desktop. This is what we shall be using to operate the Ilios Kit

Mach 3 Setup

Before we can use the software to control the Ilios Kit, we must tell it the control signals to be used, setup the motors and some other parameters. Follow the instructions below to set these settings. This is done only once and shall be saved in the Ilios HD Kit machine profile.

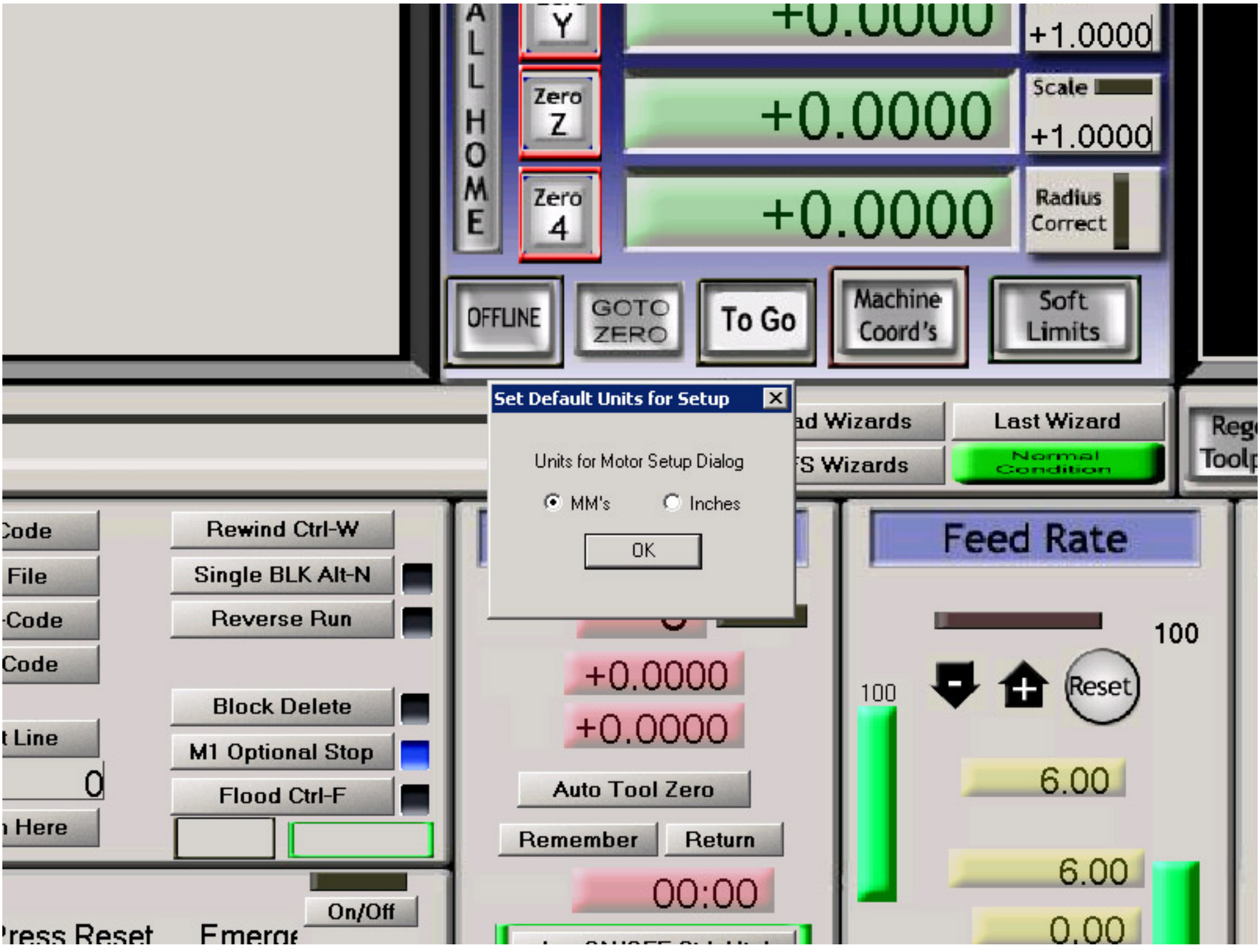
Don't be intimidated by all the buttons and text that you shall see. We only need to setup few things and shall not even bother with the rest. There is only one tab we shall be using to set everything up and this is the *Config* tab.

Phoca PDF



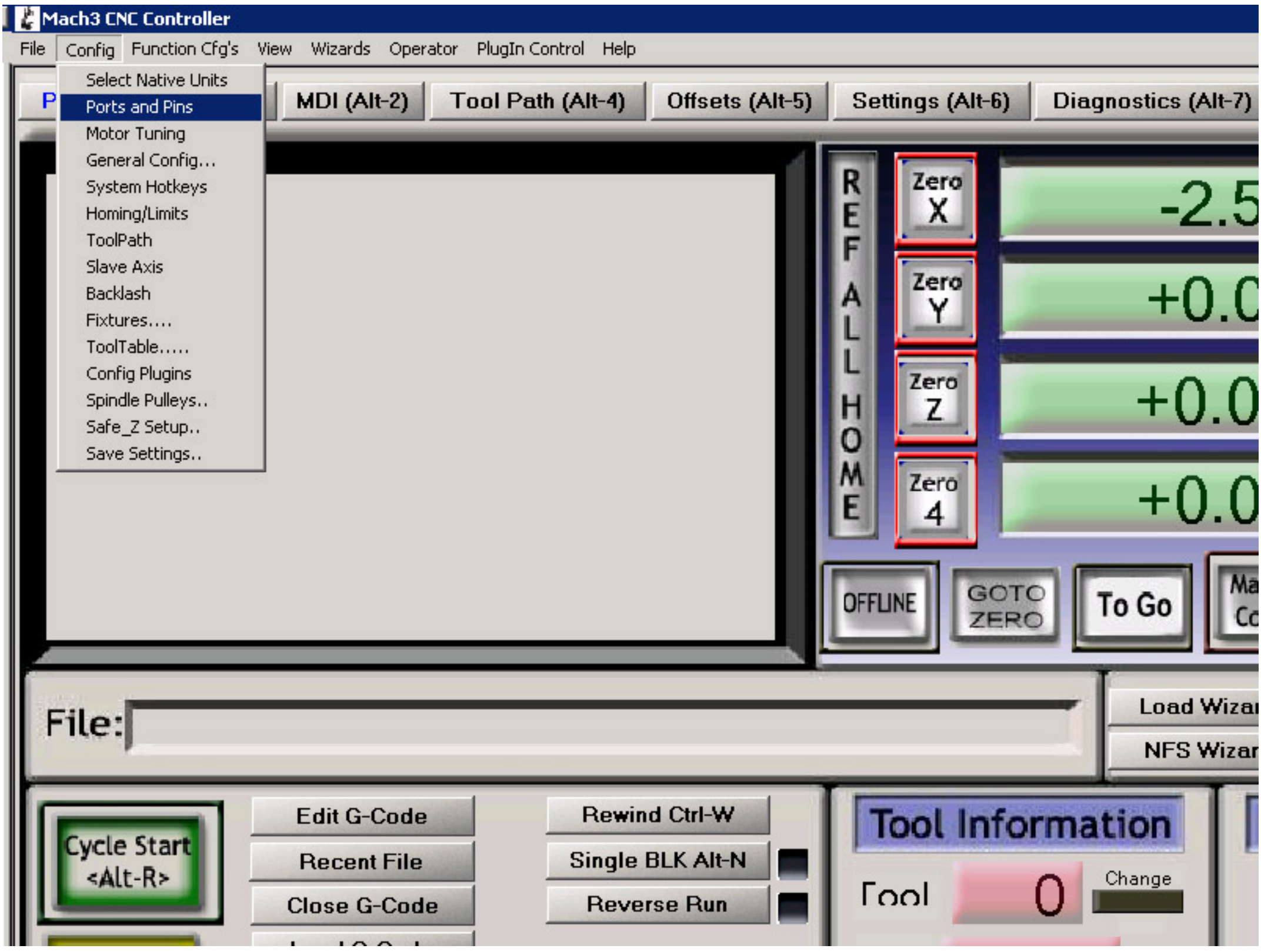
The first thing we need to setup are the units we shall be using. Please note that although many countries use different units, the Ilios Kit and all instructions for it as well as the script which runs the machine is in Metric units.

Phoca PDF



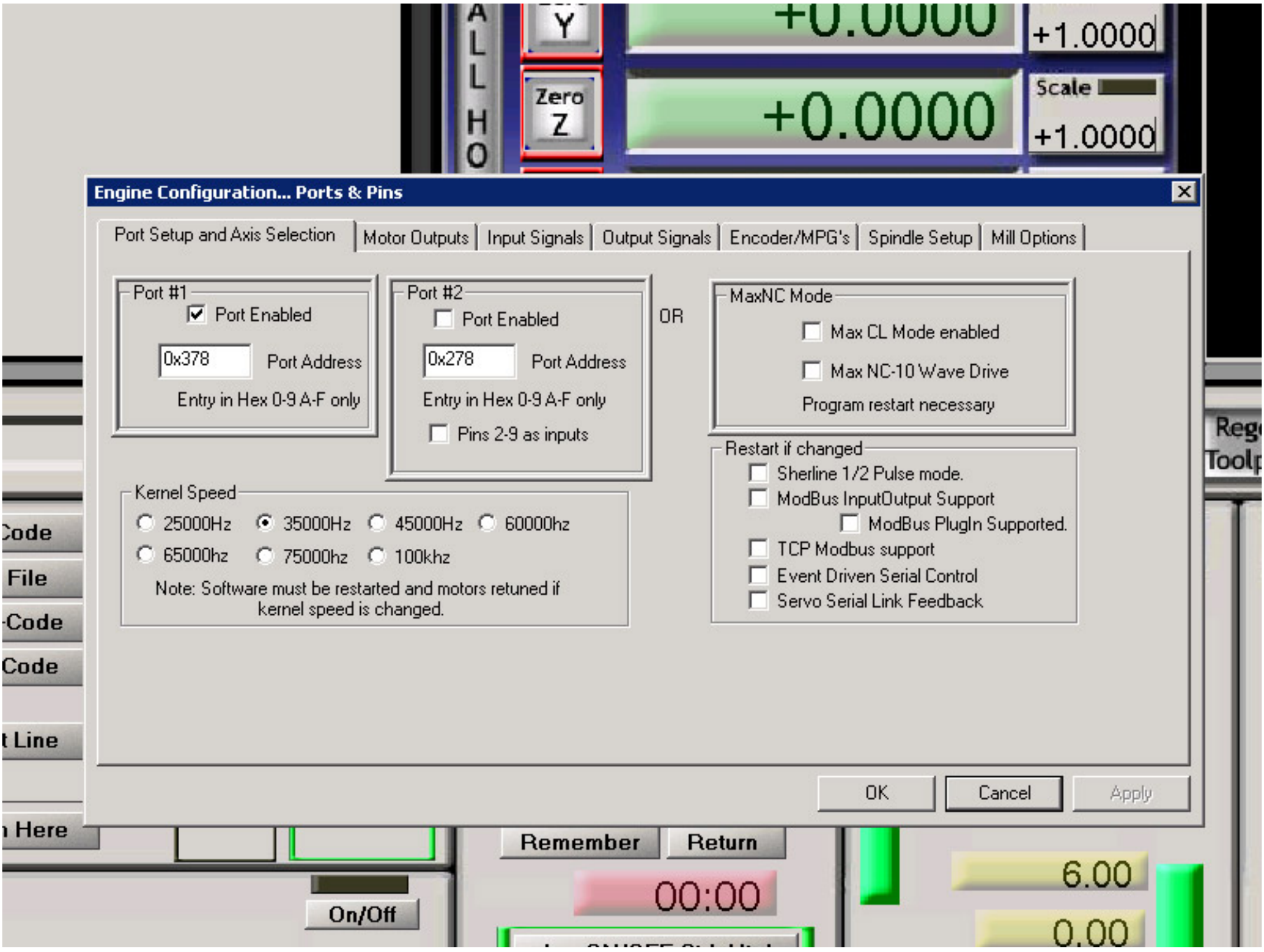
Set the units to MM as show on the image above. If you want to use Inches, please have in mind that you shall have to convert all units in the script and in any other description before using the Ilios HD Kit.

Phoca PDF



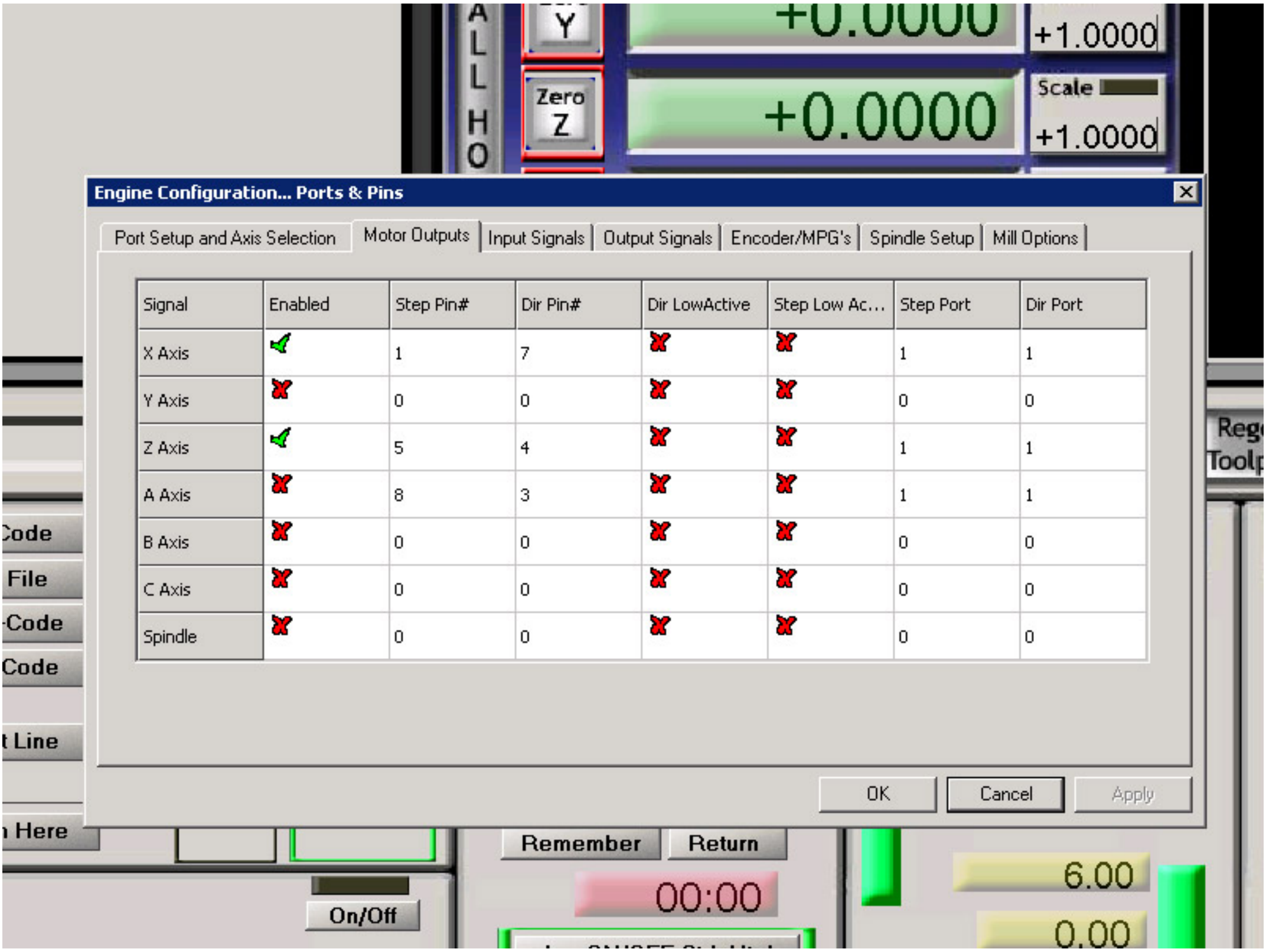
Next we need to setup the signals for the machine, so that Mach knows what to control and how. Use the Ports and Pins tab to configure this step.

Phoca PDF



Note how the settings are setup in the Port Setup tab. Configure your tab to look just like shown on the image. The most important configuration to note is the Kernel Speed, which should be set to 35000Hz.

Phoca PDF

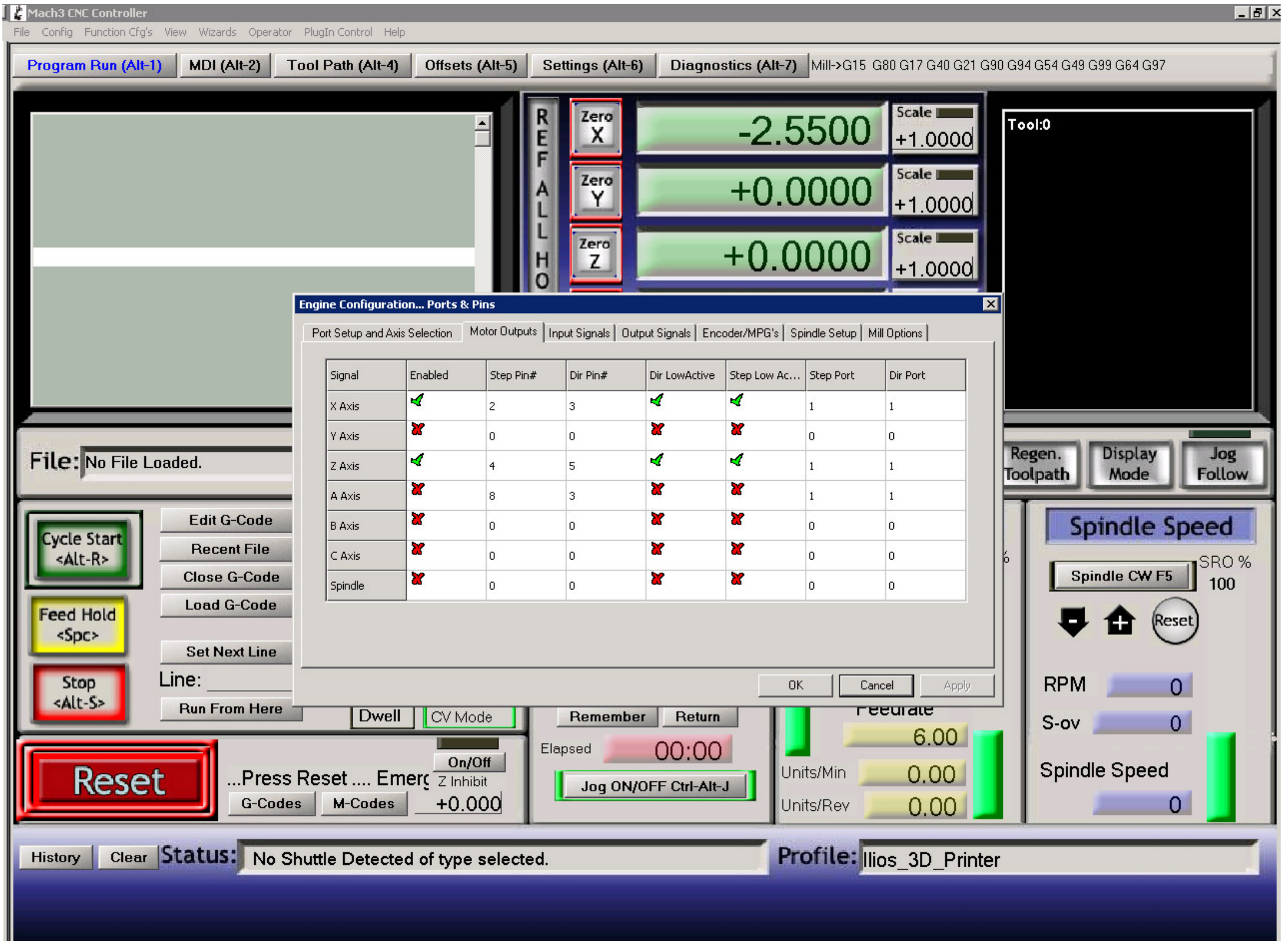


We now need to setup the actual signals that are going to be controlling our motors. Since both Z axis motors, as described in the Electronics Setup are connected together, we only need to setup two axises. Configure the signals and the Direction of your setup as shown on the image above.

High Torque Setup

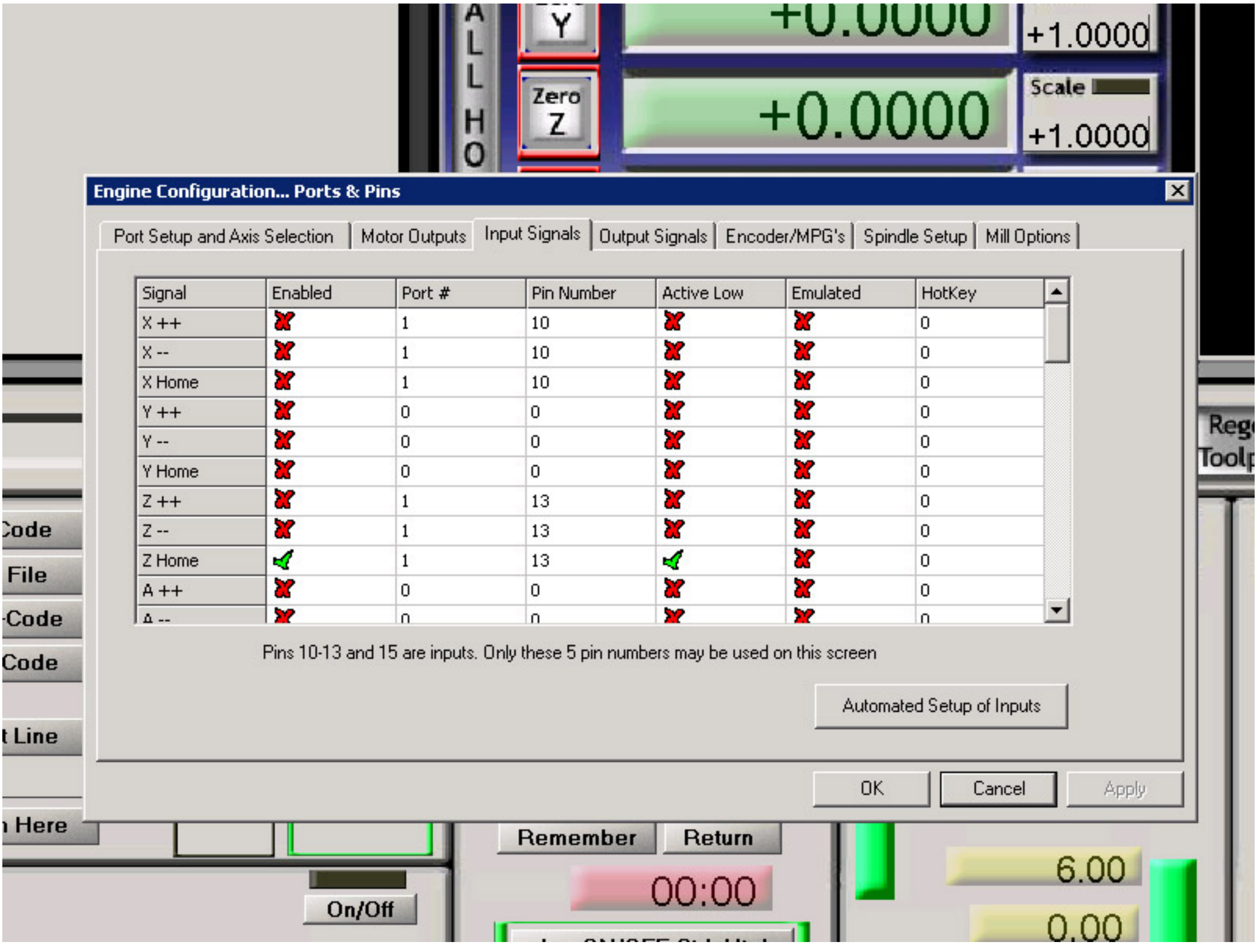
Phoca PDF

10 - Mach 3 Setup

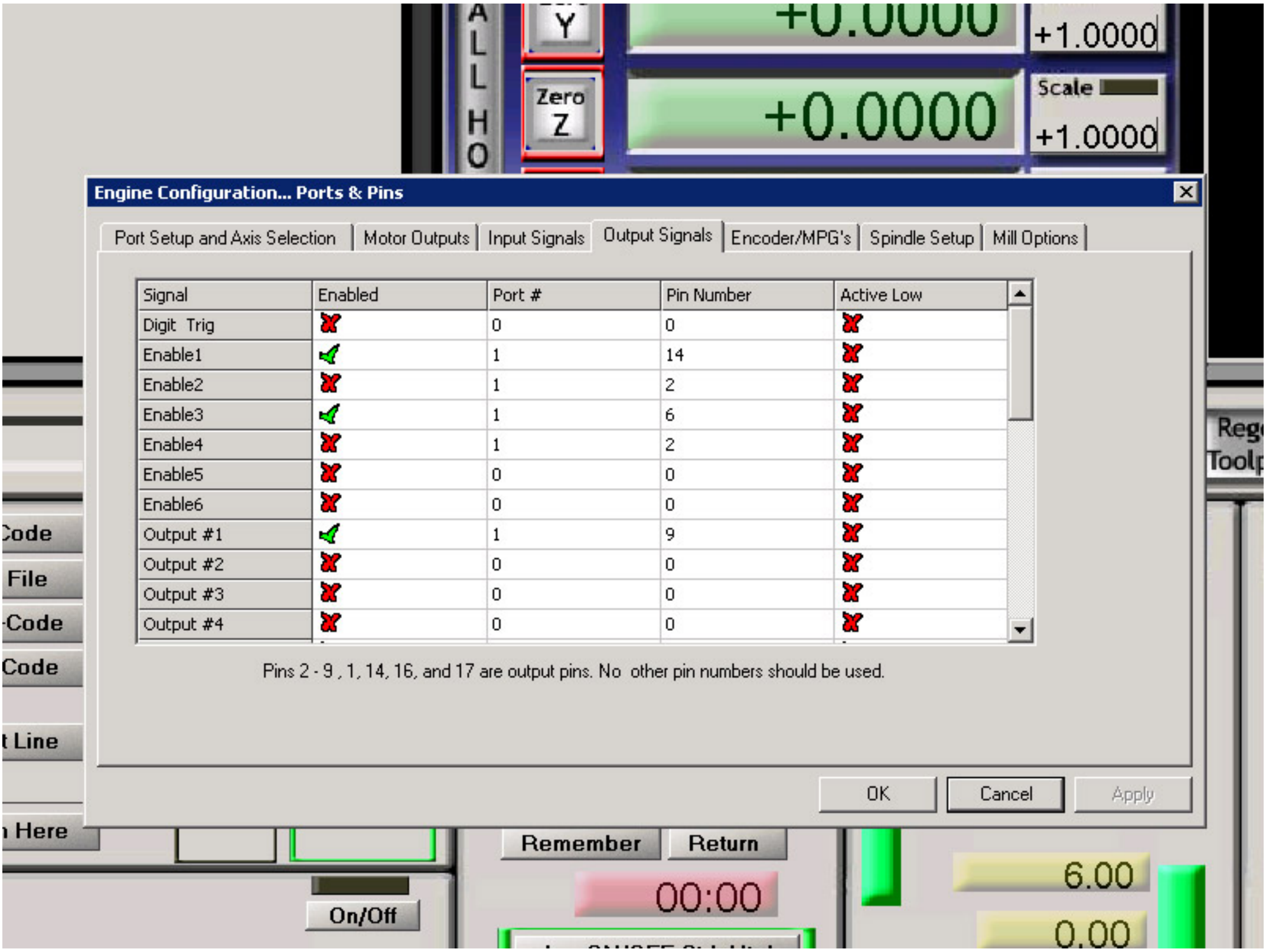


If you purchased the High Torque setup, set the signals and pins as shown on the image above.

Phoca PDF



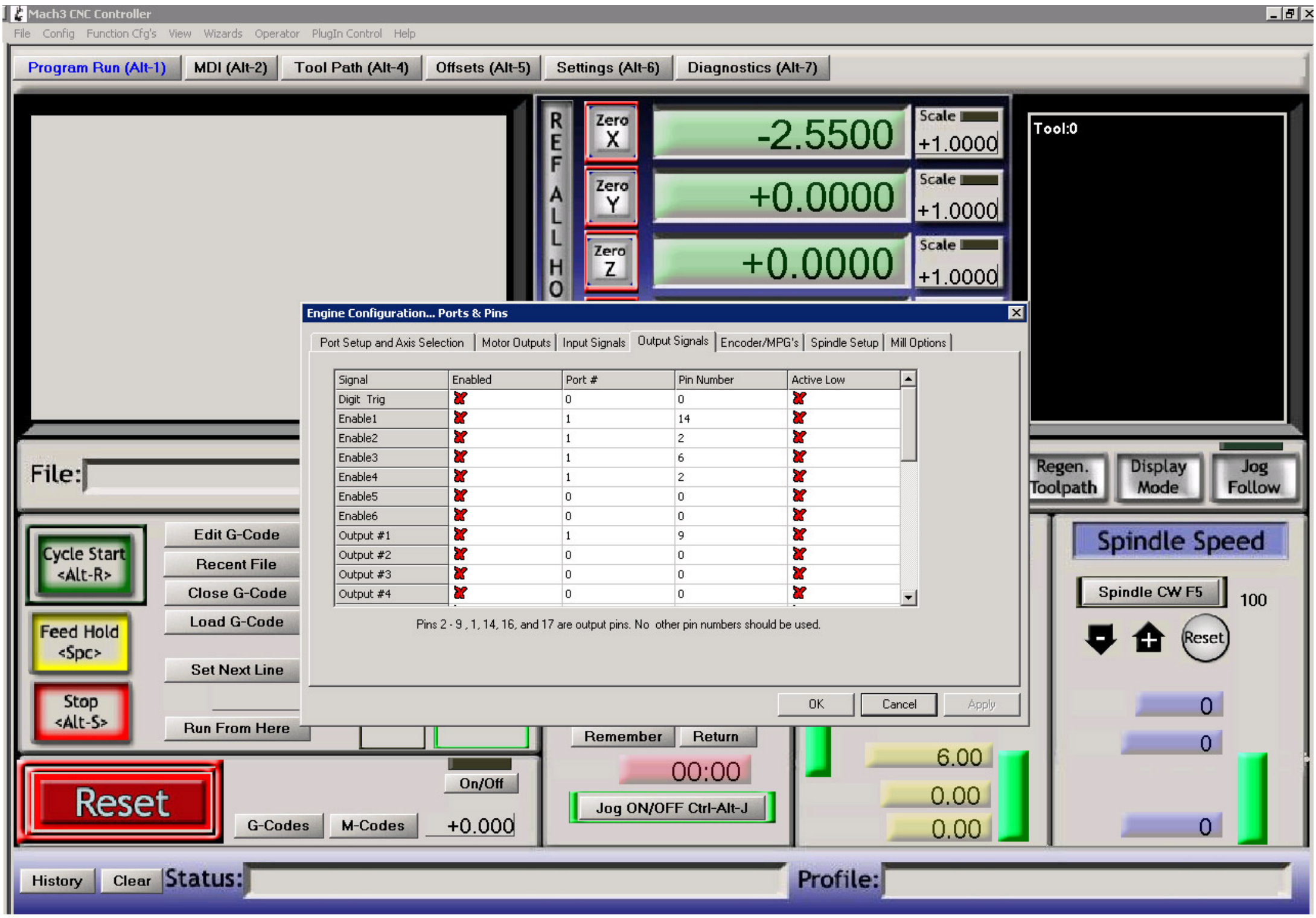
If you purchased the Complete Ilios HD Kit, you should have only one sensor, which determines the Home position of the machine. Set the signals as shown above to enable this sensor.



Besides the motor control, there are also additional signals which enable each motor and other hardware. In the Output Signals tab set everything up as shown. Although we are not using the Y axis, it is still a good idea to enable it for later use. As far as signals go, this is the only setup you need to do.

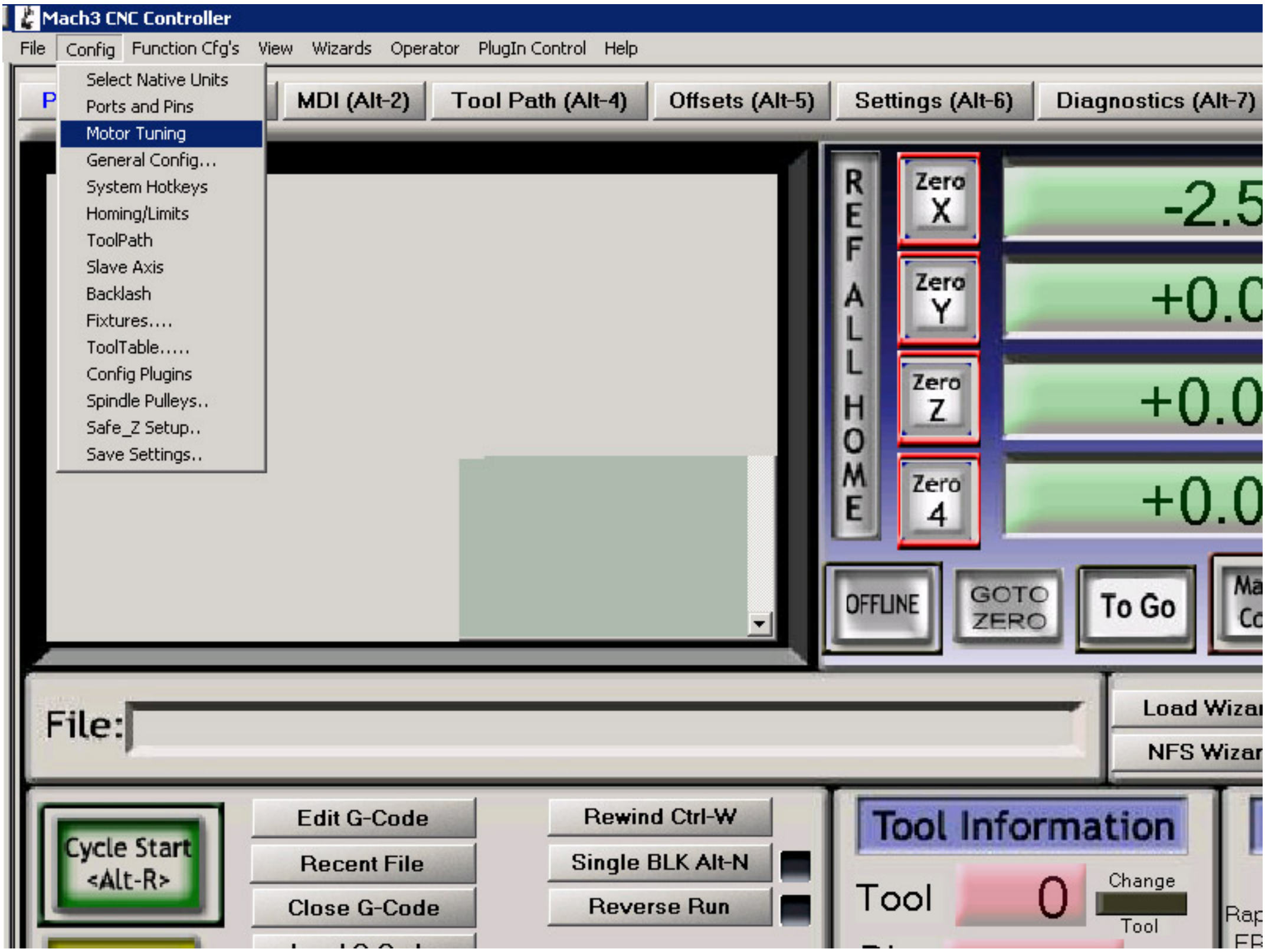
High Torque Setup

Phoca PDF



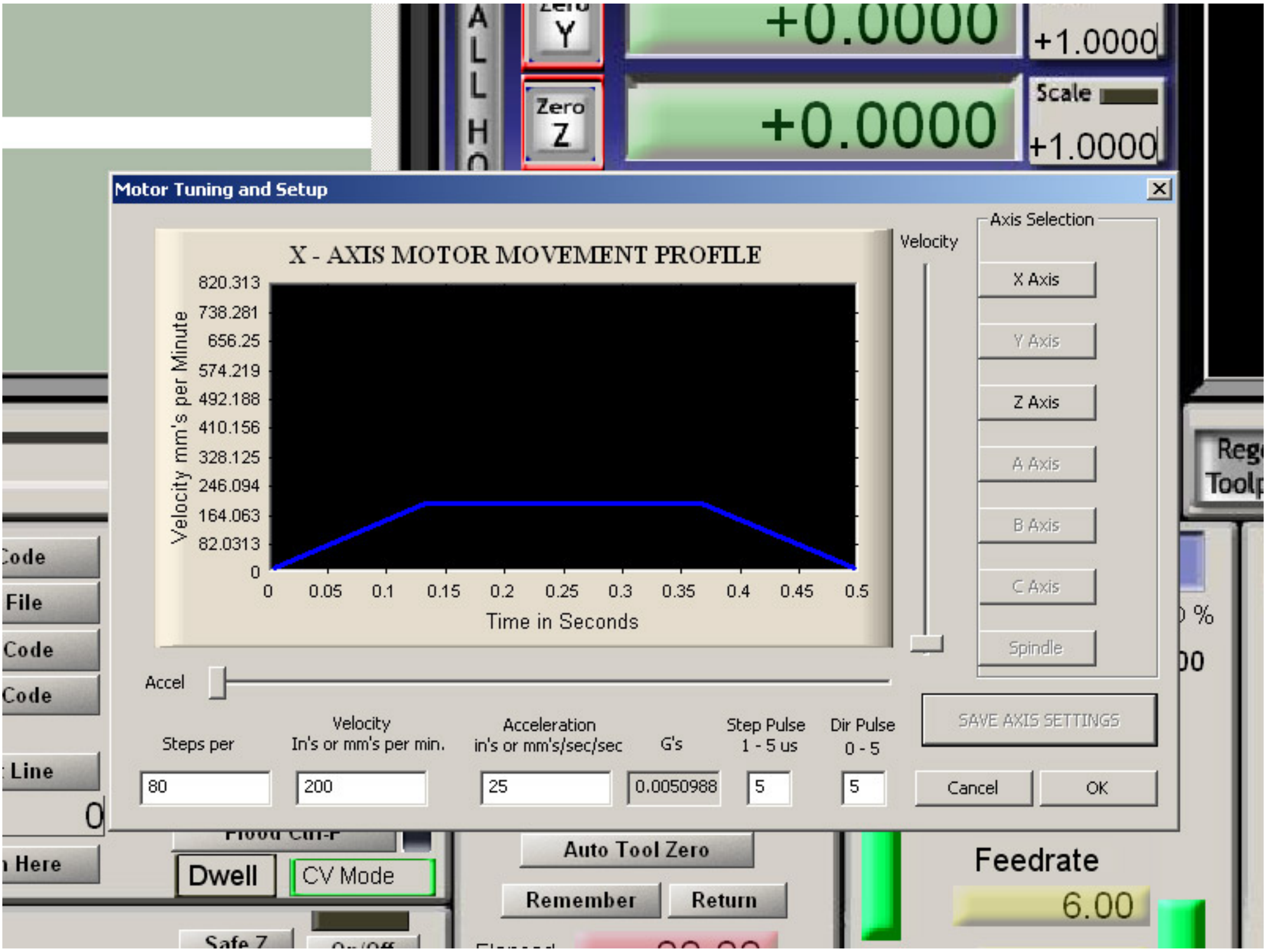
Once again, for the High Torque setup set the signals as shown above.

Phoca PDF



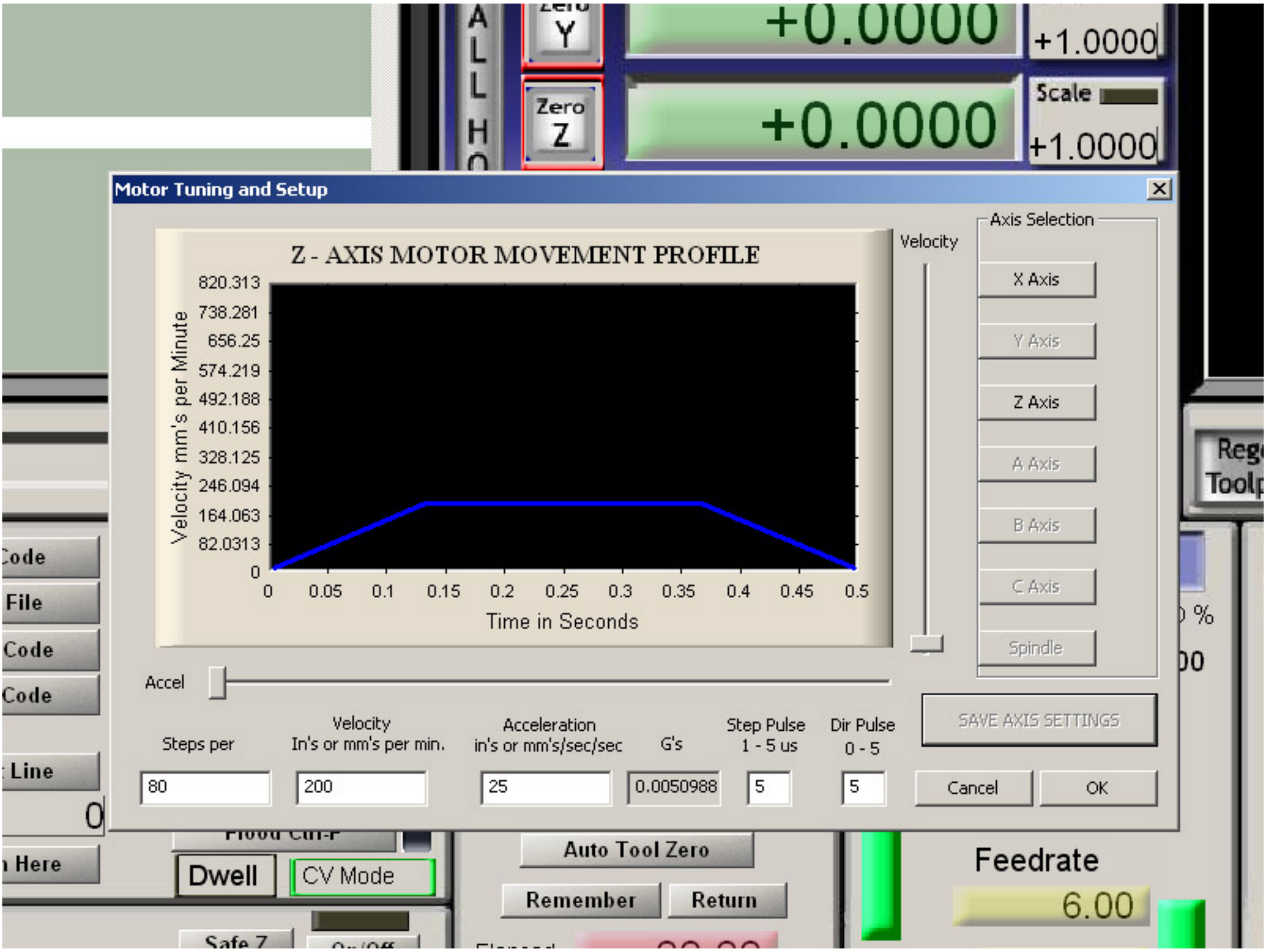
In the next step, we tell Mach the motor specifications and set some boundaries for the acceleration and motion of each axis. Use the Motor Tuning tab to set this up.

Phoca PDF



The Motors provided in the Complete Kit produce 200 steps per revolution. The default setup of the controller board is already set so that we do each step and not use Half step or other configuration. So after some simple math we can determine that since every full revolution of our Z spindle raises the platform 2.5mm, for the platform to rise 1mm we need to do 80 steps. Set the Velocity and Acceleration as shown. You can also experiment with acceleration to be as low as 25mm/sec for a smoother motion, although we move the platform quite slowly so it should not be necessary. Note the Step Pulse and Dir Pulse as well. this can also be as low as 5us but it has been tested to work fine with 15us. Save the X Axis and repeat the process for the Z axis.

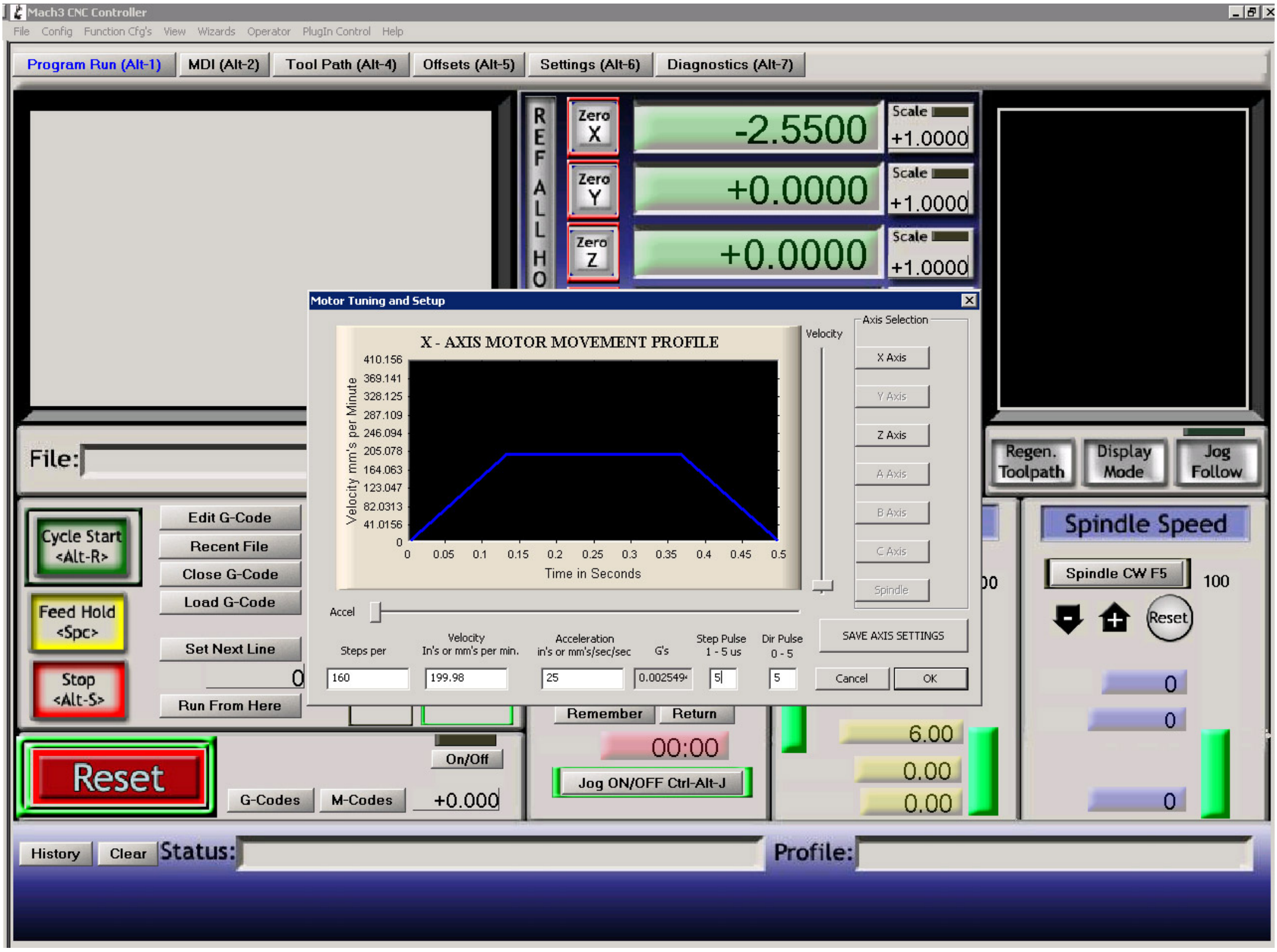
Phoca PDF



Use the same settings for the Z axis as you did for the X. The motors and all the hardware is the same. Don't forget to Save the Axis before exiting.

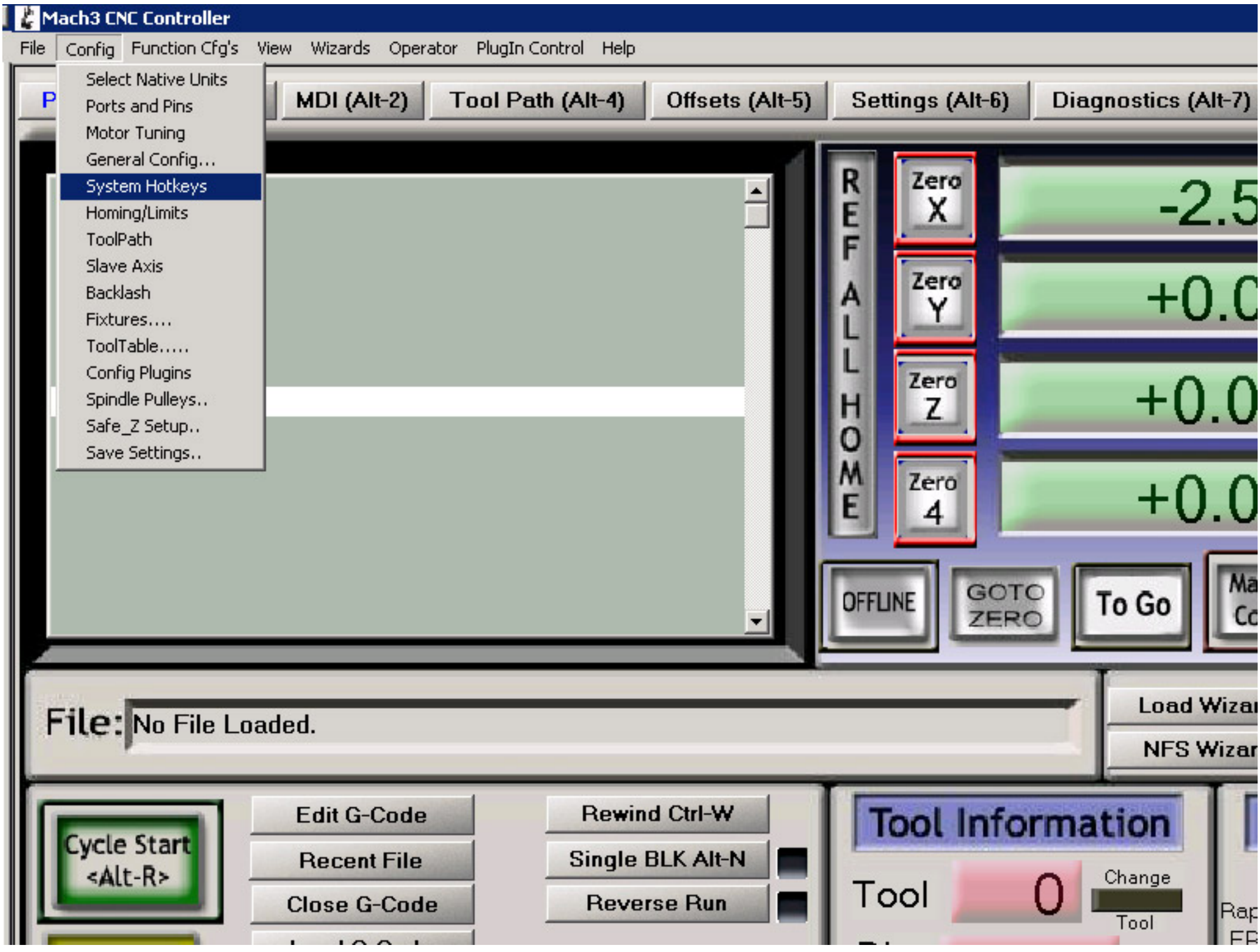
High Torque Setup

Phoca PDF



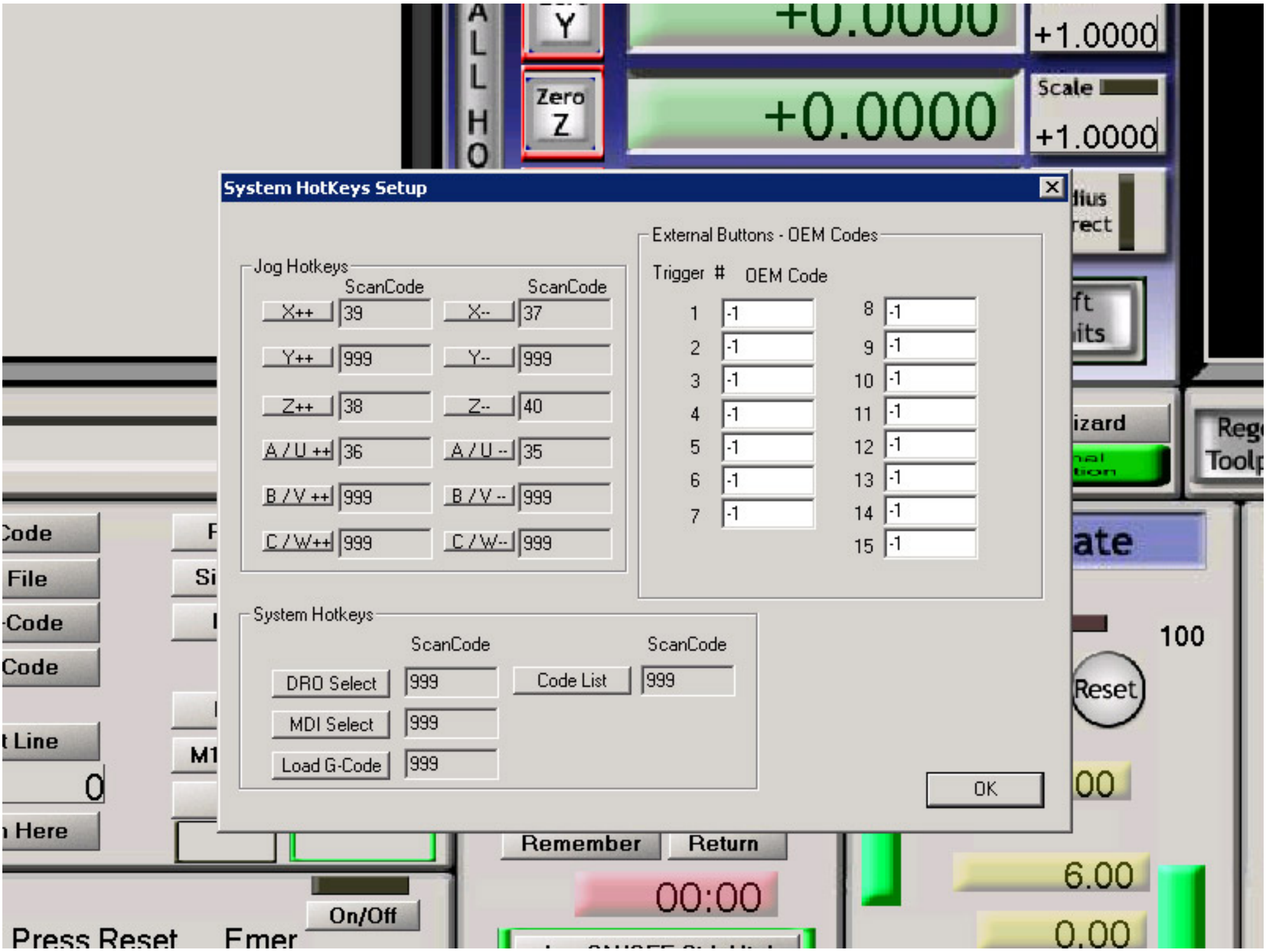
Note that for the High Torque setup, the "*Steps per*" parameter should be 160 and NOT 80 as with the default setup. High Torque motors do twice as many steps for the same distance, thus provide higher resolution by default.

Phoca PDF



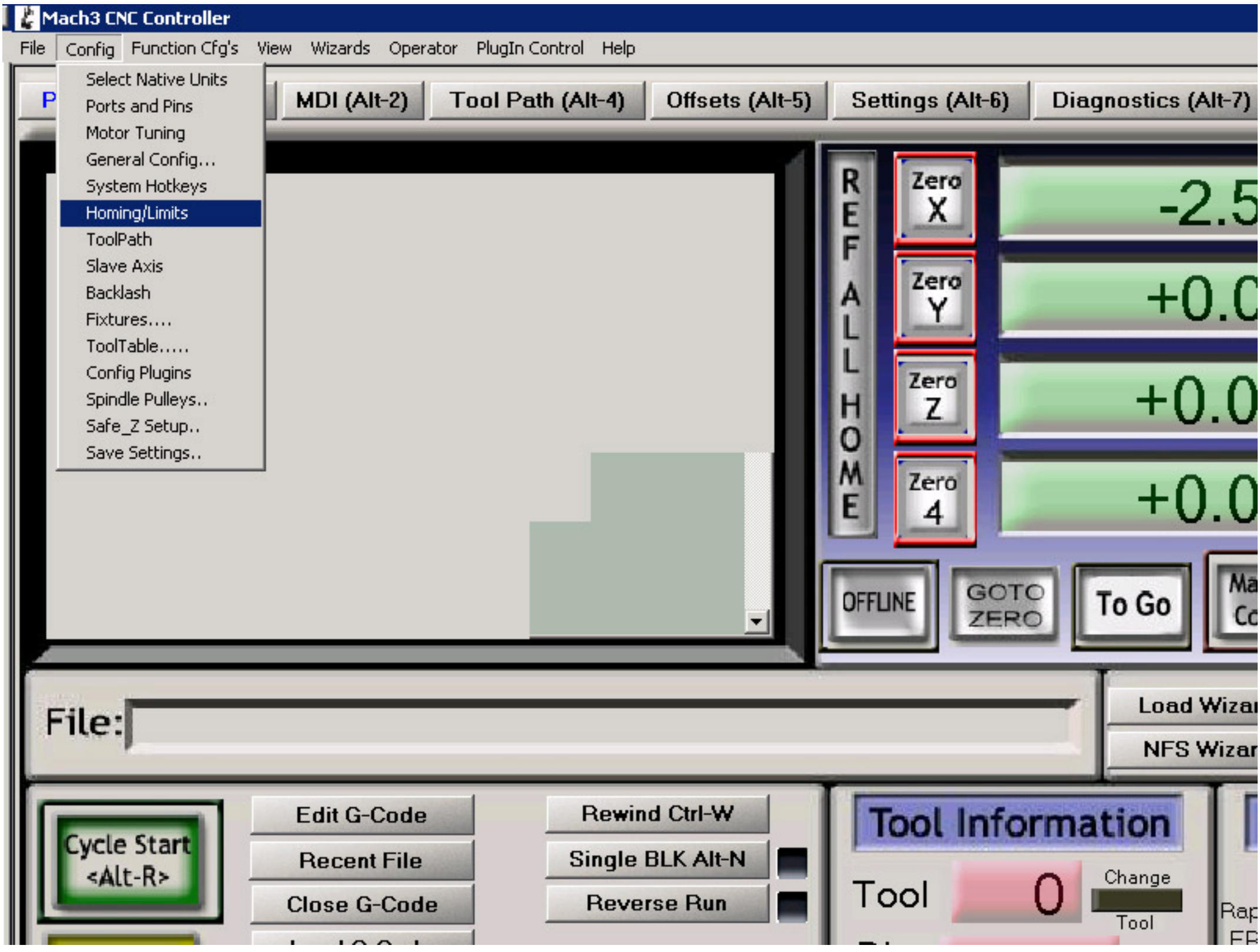
This step is Optional but very useful. Mach allows you to setup the Keyboard as a control unit for your motors. This can become handy when you just want to test your motion by pressing a simple key. Use the System Hot keys tab to set this up. (There are also plugins for Mach 3 which allow you to control it even with an Xbox controller, i use a wireless one and controlling the machine is even more fun)

Phoca PDF



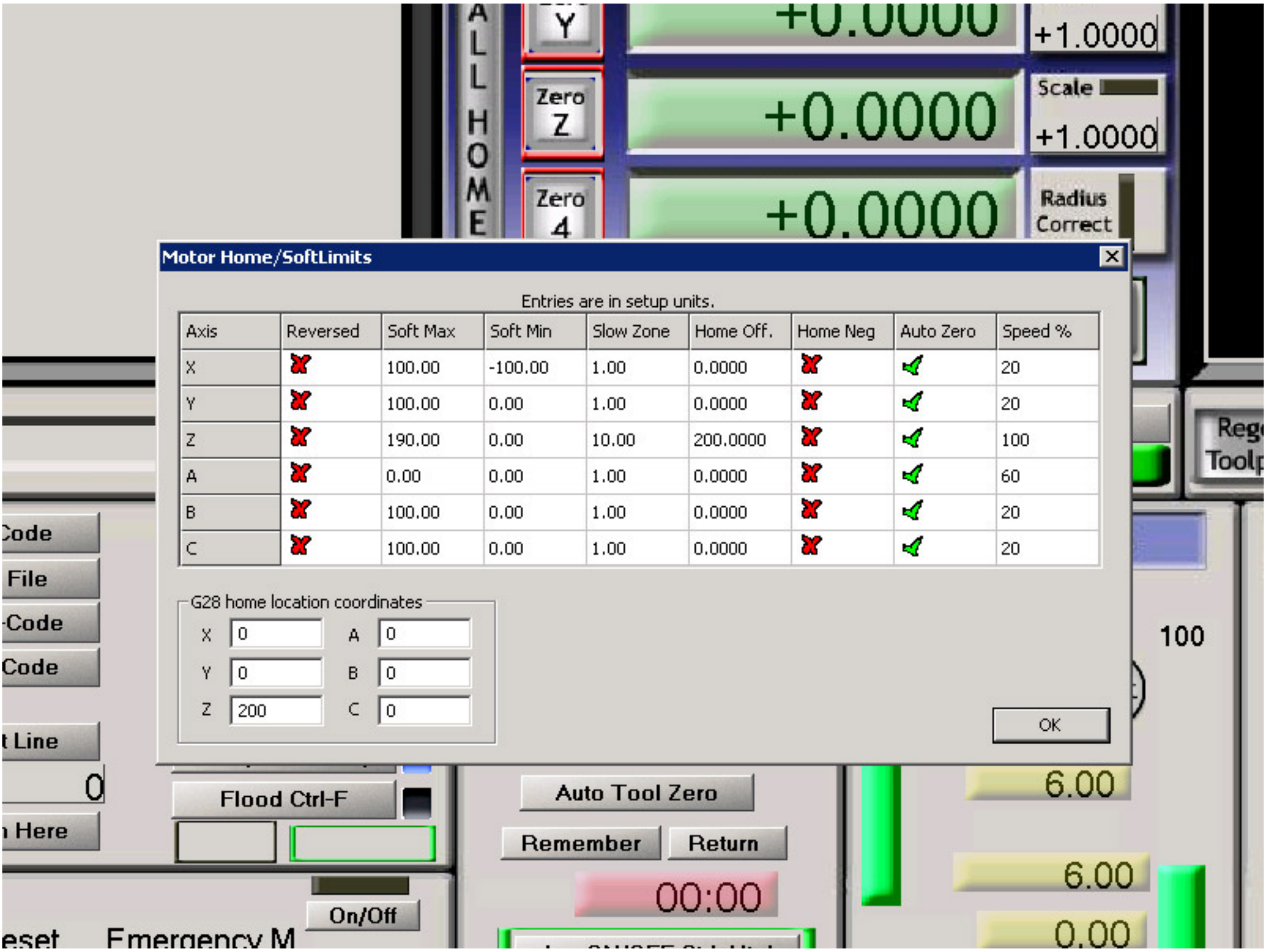
This is quite simple. We need to control only the Z+ and Z- as well as X+ and X- movements. Press the button on the screen for each motion and then press the key on your keyboard to acknowledge your selection. Normally these movements are set to the Up/Down and Left/Right arrow keys on your keyboard. Press OK to save your setup.

Phoca PDF



One last setup before we can use Ilios. We need to set some boundaries for the machine, so it knows where to stop and where to go to Home the platform. Use the Homing/Limits tab to set this up.

Phoca PDF



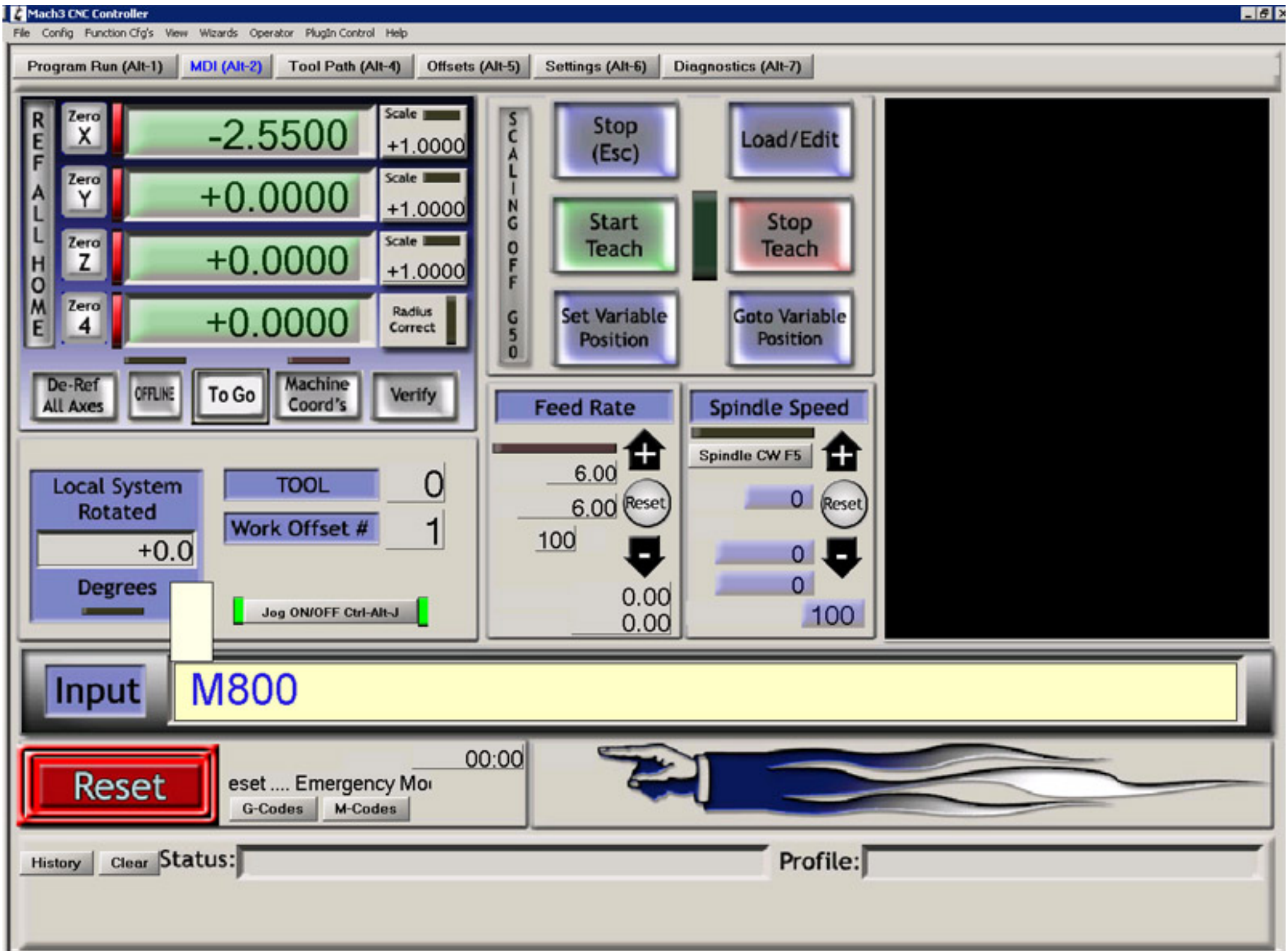
Set the numbers and other settings as shown on the screen. Don't forget the Reversed, home Neg and Auto Zero checks. Note that the number 200 is the Absolute Maximum position to which the Lift can go. To check this you can do the following:

1. After you have set this window and saved your settings, power up the Ilios Electronics box.
2. Press the large RESET button on the Bottom Left corner of the software window. (if something goes wrong you can always stop the machine motion by pressing this button again)
3. Press the ZERO Z button on the Middle Top side of the screen.
4. Press REF ALL HOME button (The long one on the left side of the screen)
5. You should see the lift moving. To check if the Home button works, just press it while it is moving. The lift should stop and set the Z value to 200. This is normal.
6. Repeat step 3 and let the lift press the Home switch for it self.
7. Now the position should be 200.
8. To find out the exact distance your Lift can travel (depending on the VAT and Lift assembly you have) move the lift with the arrow keys until it barely touches the VAT floor. You should see the springs compress a bit when it starts touching it. Back a bit on the lift. Note the position.
9. So from 200 we went to something like 20 or similar (the position should decrease as the lift goes down)
10. Using common logic, 200 - The position you are at when touching the VAT Floor = your total Lift motion.
11. Instead of the 200 you set in the Motor Home/Limits, set this number to be your Home. This way, the machine knows when it

Phoca PDF

reached Zero.

Although all this is quite exciting, i personally don't bother with the Homing since i tinker with the VAT and my machine all the time and simply Zero the Z position after i have lowered it to the VAT floor. This is naturally my choice and you can follow it if you think you mastered the control over Ilios or just don't want to bother with automated movements.

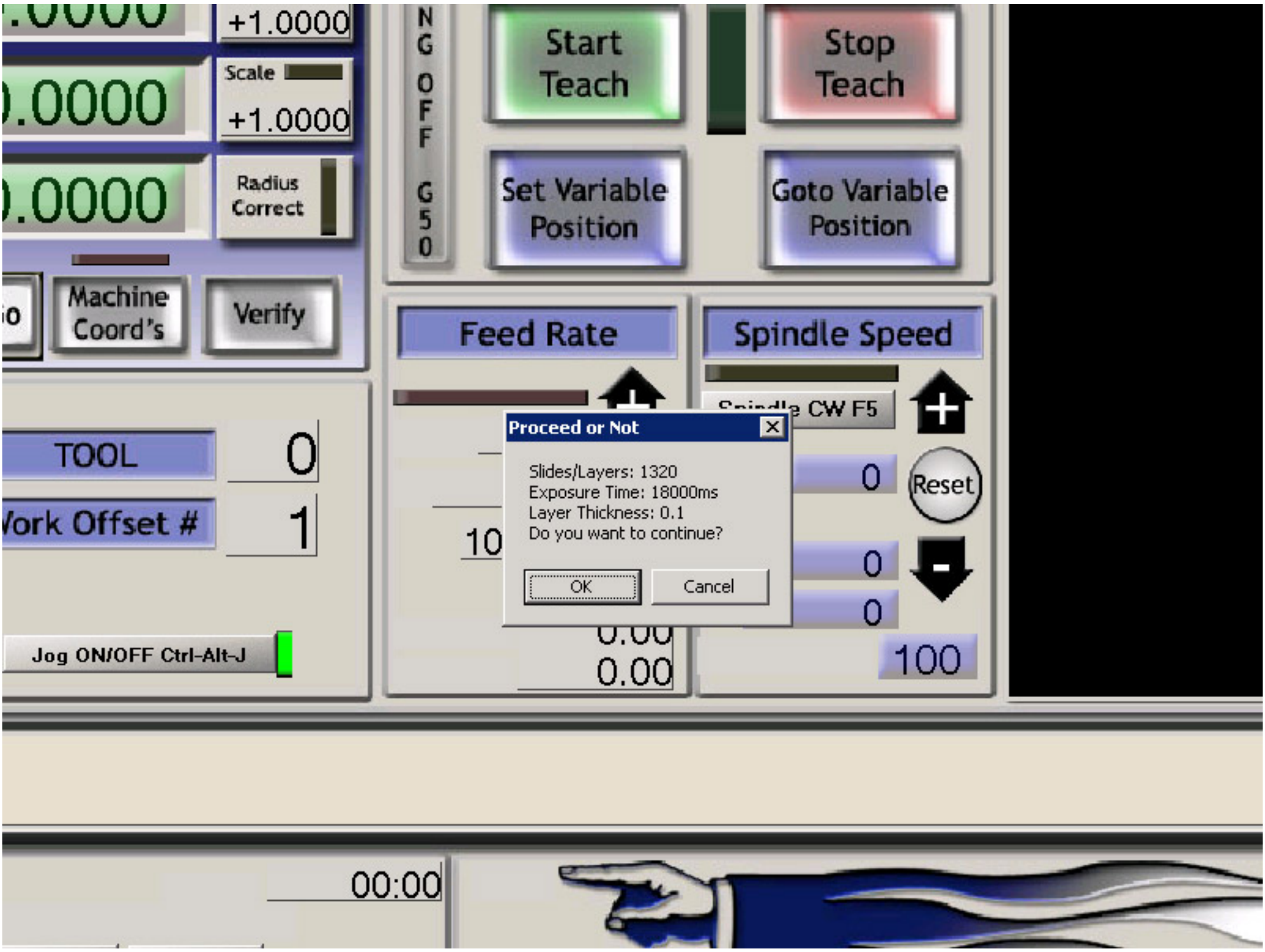


Before we begin making models, we need to copy the Ilios HD Script to the Mach 3 folder, so it knows where to find it. Download the Ilios HD Mach 3 Script configured for a NON moving VAT or Moving VAT from the Files section of the website. Note that it doesn't mean that because you have the ability to tilt the VAT for detachment, you should always use it. In small models which don't take up more than 1 - 5 cm it would simply be a waste of time since the surface they cover doesn't stick too much to the PDMS surface and can simply detach it self with the Lift motion. Tilting the VAT is only recommended for large Flat areas where it will surely stick merely due to its large vacuum, created when the resin hardens.

Copy the *M800.m1s* file to your Mach3 Macros folder. Usually, if you used the default setup settings it shall be located at *C:\Mach3\macros\Ilios Hd Kit*

All that is left to do now is activate the script and let it run. On the TOP side of the screen, press the **MDI (Alt-2)** button. In the Input text field type the name of the script - M800 and press Enter.

Phoca PDF



Before the script begins its task, it shall ask you if the parameters that are set are correct. For the time being the parameters of the script like the Layer Thickness, Power Point folder, Number of layers and exposure time are set manually by simply opening the script with a Text editor.

In simple terms, the script opens a Power Point SlideShow in **.pps** format with all you layers. It displays each layer while it moves the lift according to your preferences. You shall need to install a Power Point Viewer or Power Point it self to be able to use the script since it shall have to open it to display each layer.

Please note that the script has bee written so that in its first 4 layers, the exposure time is greater than the rest. By default it is set to 18 seconds for the first 4 layers and then 5 seconds for each one. Based on the material you have these timings might vary slightly. The timing described here is for the Hard and Tough resin in its Clear form.

To get used to the idea of working with Ilios and the script, let it run few times so you understand what is happening and how everything works. No need to use material on these runs. You also can always press the RESET button to stop everything and try again.

Signal Description

Phoca PDF

10 - Mach 3 Setup

For those who used Mach 3 before and want to tinker with the board and set up the machine in a different configuration, below you shall find the signal descriptions for the board and which pin does what through the Parallel port, input connector and manual control.

Parallel 25 Pin Port

Pin 9	Pin 14	Pin 7	Pin 1	Pin 2	Pin 3	Pin 8	Pin 6	Pin 4	Pin 5	Pin 16	Pin 17
Spindle Motor (Relay)	X Enable	X Dir	X Step	Y Enable	Y Dir	Y Step	Z Enable	Z Dir	Z Step	Expand - Output 1	Expand - Output 2

The 4 Inputs that also host the Home Signal

Input 1	Input 2	Input 3	Input 4
Pin 10	Pin 11	Pin 12	Pin 13

15 Pin Manual Interface signals

Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9	Pin 10	Pin 11	Pin 12	Pin 13	Pin 14	Pin 15
X Step	X Enable	Spindle	X Dir	Y Enable	Z Dir	Z Step	Z Enable	Y Limit	Z Limit	Y Dir	Y Step	STOP	GND	5v/Vdd

Phoca PDF