User manual

JoyPad Plugin for Mach3

By Joakim Hjort and Nader Atifeh

Version 2

Index

Background

Mach3 from ArtSoft is a very flexible software solution, offering a lot of options for controlling CNC machines. After some use I found that jogging, probing and general operations was a problem – how was it possible monitor the machine and operate it with the keyboard, mouse and screen at the same time. Physically it was possible but certainly not practical.

A standard Joystick could solve the problem, but it was limited to only controlling two axes (X and Y), missing the third axe.

What I was looking for was:

- Jogging of at least 3 axes (X, Y and Z).
- Precision jog at low speeds not missing high speeds.
- Lots of programmable buttons for common functions.
- Some kind of safety mechanism preventing accidently operating the machine.
- A low budget solution.

I found that a standard low budget solution would be a standard USB game pad – it is simple to operate; has the needed axes and can be operated with one or two hands. And the CNC machine can be monitored at the same time.

I got my hands on a Logitech Dual Action JoyPad. A quality game pad that was compatible with all Windows versions - and at a low prize.

Great – now I only have to find the Mach3 plugin for the JoyPad… No luck…

As a software developer I decided to write my own plugin for the JoyPad. C++ is not my preferred programming language, but it could be fun and an opportunity to brush up my C++ programming skills. As said so done...

This was the base for version 0.5 and 1.0 of the JoyPad plugin which have been presented earlier in this forum, but things evolve and version 2.0 has a lot of improvements.

For most users the art of script writing is too hard to learn and can be very time consuming; even for simple tasks. The focus in this version is simplicity – making it easy to setup and do common tasks while still maintaining the depth of earlier versions. Even when doing scripts, it is easier to maintain an overview and reuse code between button scripts.

Standard setup templates have been devised - after the installation, you will be able to select a standard button assignment to suit your machine; eliminating the need for reading manuals, learning script or deciding which button layout to be used.

You could be up and running in a few minutes… ☺

What's new in version 2?

If your game device is supported in Windows *Control Panel→ Game Controllers* it is properly supported by this plugin.

New functionality:

- Added step jogging with joysticks.
- Jog speed is now scaled down with *Slow Jog Rate* from jogging screen.
- Easy button assignments via Windows setup program (JoyPadSetup).
- Build in standard templates with button layouts for common machines:
  Foam Cutter
  2 Axes Laser Cutter
  3 Axes Milling
  4 Axes Milling
  5 Axes Milling
- Buttons now works even when Mach is running G-Code or are in Reset mode.
- Buttons works in any screen (Screenset and view independent).
- Build in support for safety buttons (Shift + Alt)
- Support for all relevant build in Mach functions.
- Simplified button script programming in a single macro file.
- Simple hardware button mapping for different game devices.
- New extended User manual.
- Layouts can easily be shared with others via single layout file.

All this in addition to earlier functionality (Version 0.5 and 1.0):

- Jogging of up to 6 analog/digital axes.
- Each joystick axe can be scaled, inverted and mapped to any Mach3 axe.
- Precision jogging via third order dynamic scaling, which eliminates the need for additional scaling.
- Multi axe simultaneous jogging.
- Single axe jogging with automatic active axe selection (intelligent).
- Build in safety buttons preventing accidental jogging.
- Full power of script programming of POV and buttons or combination of buttons.
- SmoothStepper 1.2 full jogging support (SS).
- Works with standard Mach parallel port (PP).
- Low cost hardware requirements – standard game pads can be used.
- No additional software besides Mach3 is required.
- Works with all Windows versions supported by Mach3.
- Small footprint, low memory usage.
- And did I mention – It is free software ☺

While this manual covers most of the requirements for setting up and working with the JoyPad Plugin, it was prepared for the version 2 (2.0). Subsequent releases and updates will be reflected in a ReadMe file which will be associated with the newer versions of the plugin. This manual shall be updated to conform to the latest version, after felt inadequate.

Quick Setup Guide

You are strongly encouraged to read the full setup guide for a complete setup; however if you have experience from earlier versions or similar setups, use this Quick Setup Guide for a fast setup.

Install hardware JoyPad or game device

Usually the device is recognized by Windows and installed automatically – in some cases a driver from the vendor is required. When the device is listed in *Control Panel→ Game Controllers* it is installed and ready for use.

Install Pre-requisite files

You will need **Windows installer 3.1** and **dotnetfx 3.5** to be installed on your computer, prior to installing the JoyPad plugin. Download these components from Microsoft website:

http://www.microsoft.com/downloads/

Install JoyPad plugin in Mach3

Download the **JoyPad plugin** (version 2.0 or later). It is a single packed file with file extension .zip or .exe (self extracting) which contains all the necessary files.

Unpack the downloaded file and double-click the file with the extension .m3p – this will install the plugin into Mach3 plugin directory.

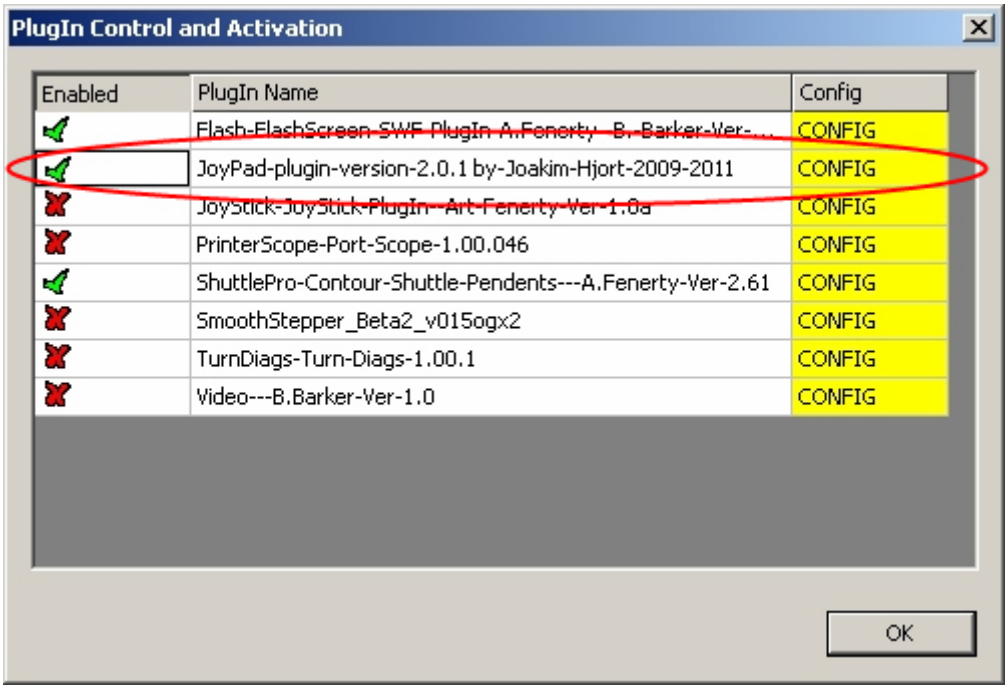
The JoyPadSetup.exe program can be placed anywhere on the disk, but a good place would be in Mach3 directory (C:\Mach3) or on the Desktop for easy access.

Activate the JoyPad Plugin

Start Mach3 program and from the *Config* menu.

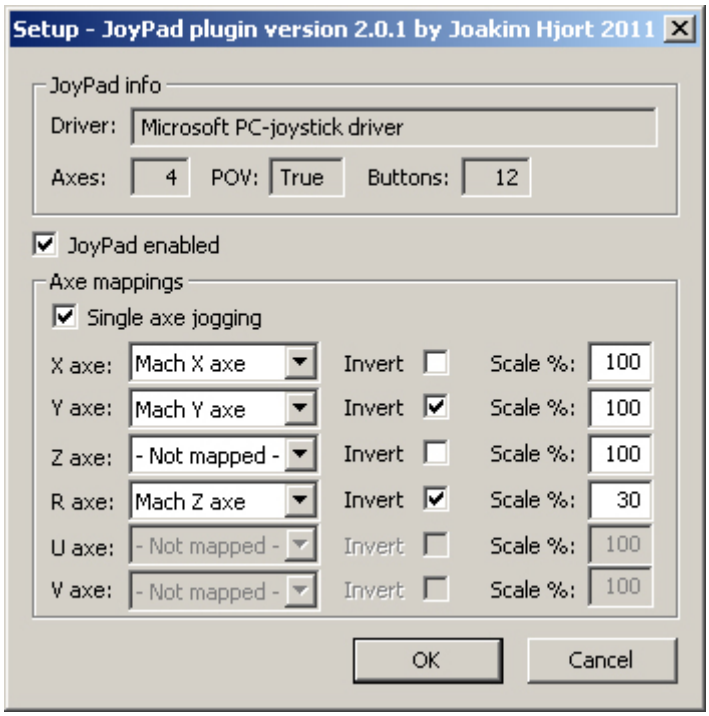
Select *Config Plugins* submenu.

This will bring up a list of installed plugins. Locate the JoyPad plugin and enable it (marked as✓):



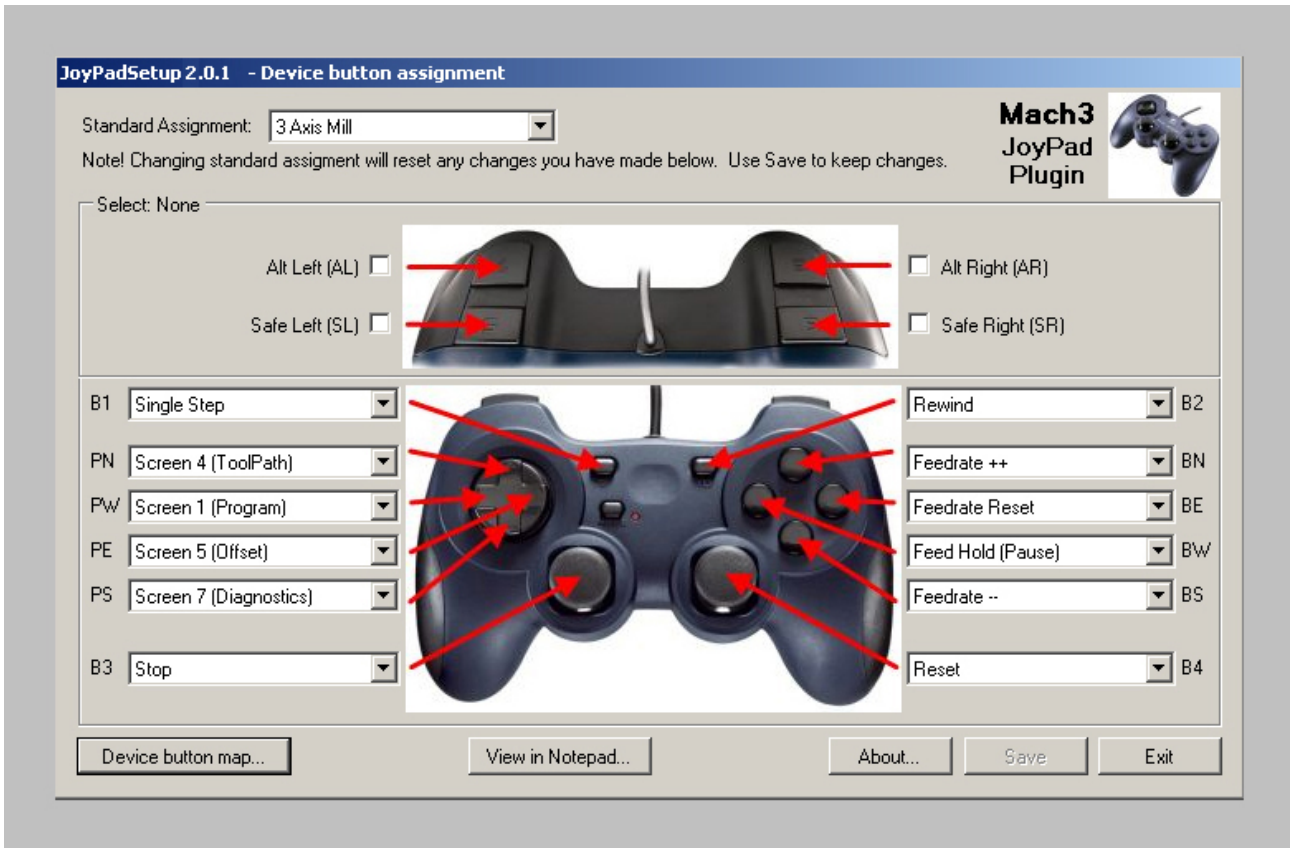
Disable all other plugins that may use the USB game device (ex. Joystick plugin) – failing to do so may result in unexpected behavior.

Select *CONFIG* to open JoyPad configuration and configure the *Axe mappings* to match your machine setup:



Configure Button Mapping

Open the *JoyPadSetup* program (on Desktop or Mach3 directory):



Press on the *Device Button Map* button at the bottom left side of the window and select a device which conforms to your game device and click OK.

Select a *Standard Assignment* from the top combobox to match your configuration and click Save.

Close Mach3.

Reopen Mach3.

Make a copy of the relevant *Standard Assignment* from appendices A to E.

Now you're on!

Installation (full setup guide)

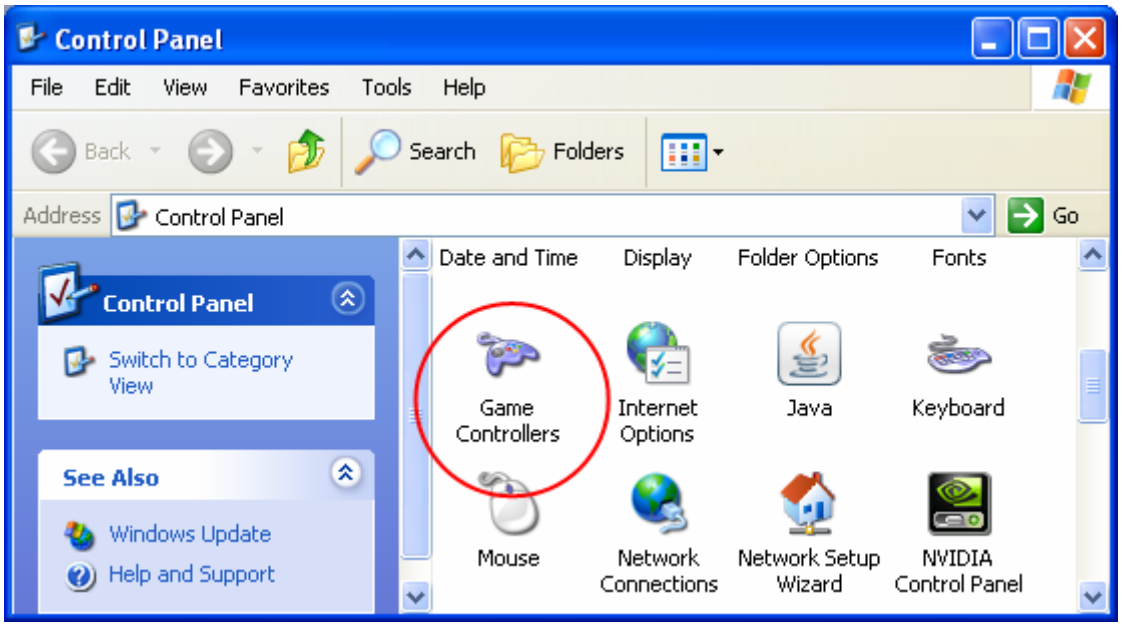
Installing the JoyPad or game device in Windows

First, make sure the game device, you intend to use, is recognized by Windows. Connect the device and let Windows try to recognize and install standard drivers before installing any software from the vendor.

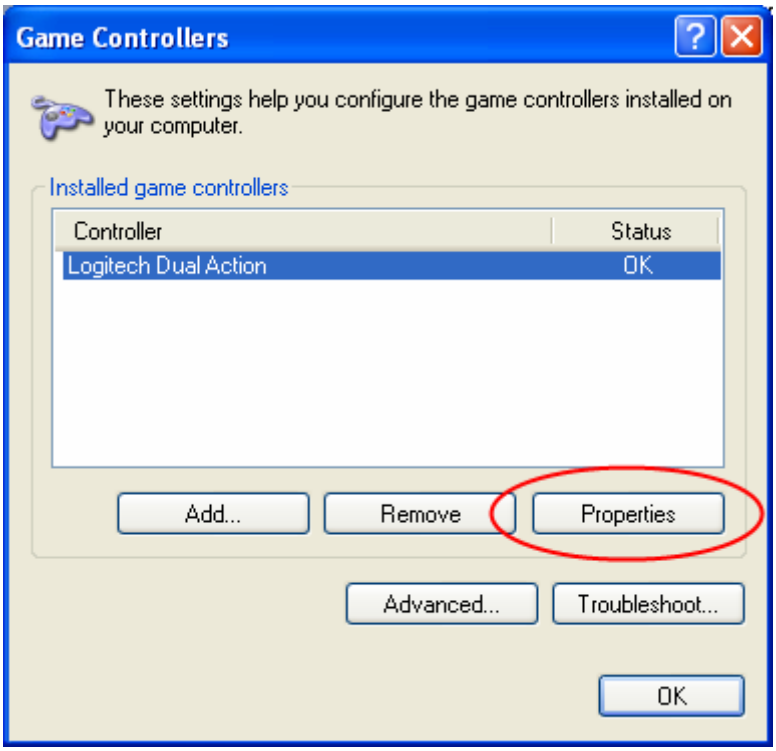
If the device is recognized and shows up in *Control Pane → Game Controllers* the device is installed and there should be no need for vendor specific drivers and software.

In Windows open the Control Panel:

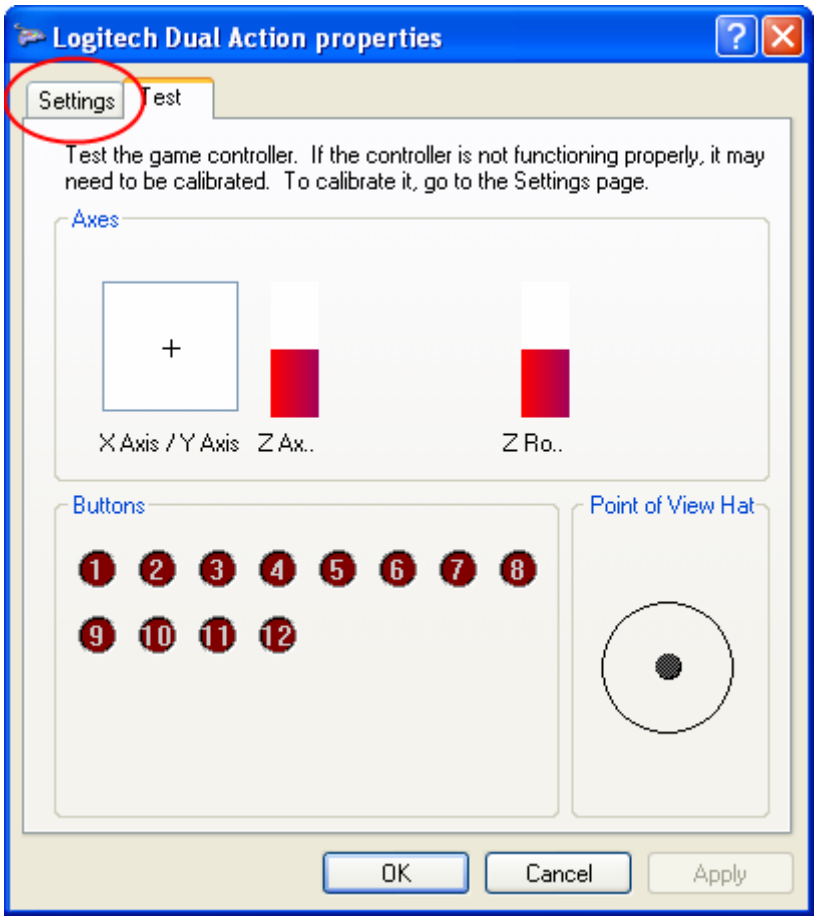
Select *Game Controllers*:



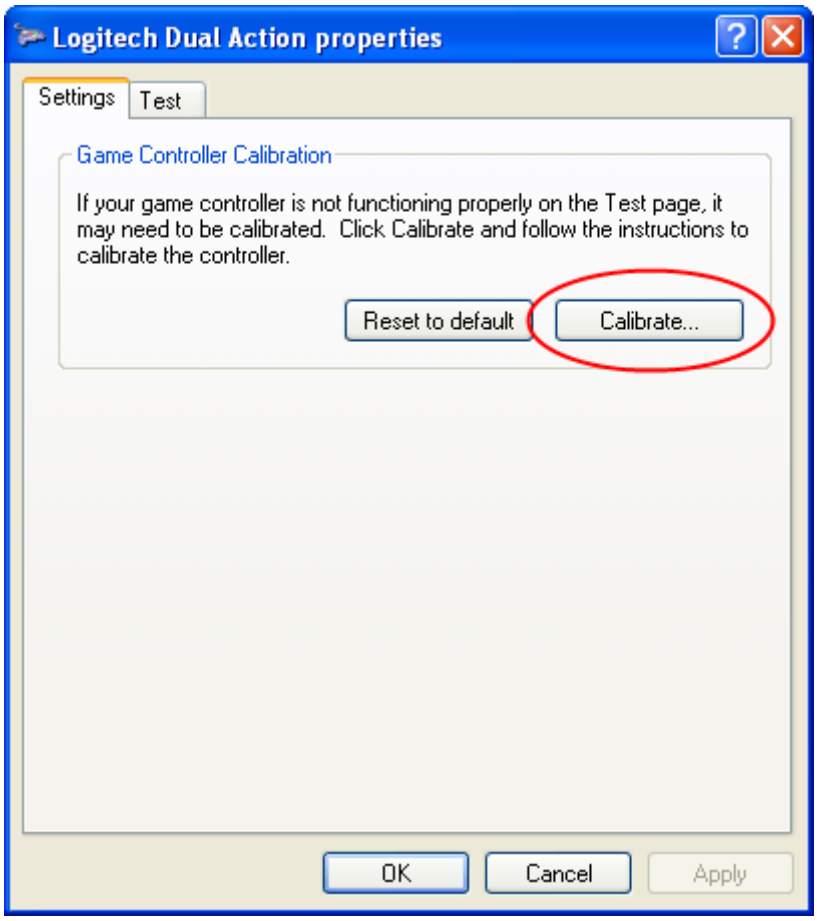
Select *Properties* for your game device (in this case the Logitech Dual Action):



Verify that the game device is functioning as expected.



To avoid drifting, the game devices need calibrating before usage, select the *Settings* tab:



Select *Calibrate...* and follow the directions to calibrate your game device.

The calibration process finds and sets the zero, min and max point for the joysticks, avoiding *floating* when the joysticks are centered.

We are now ready to install the JoyPad plugin in Mach3.

Install JoyPad plugin in Mach3

Be sure **Windows installer 3.1** and **dotnetfx 3.5** is installed prior to installing the JoyPad plugin. Download these components from Microsoft website:

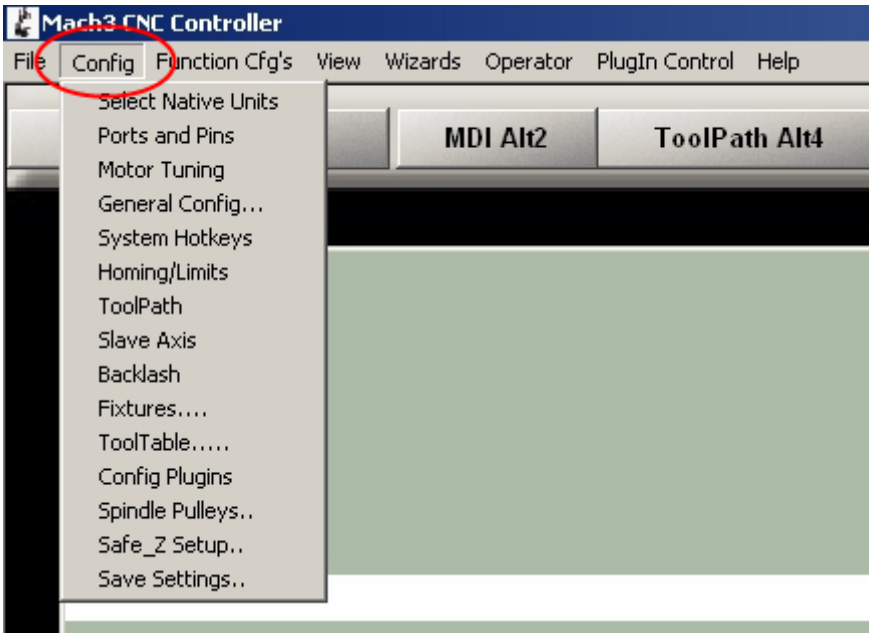
http://www.microsoft.com/downloads/

Download the **JoyPad plugin** (version 2.0 or later). It is a single packed file with file extension .zip or .exe (self extracting) which contains all the necessary files.

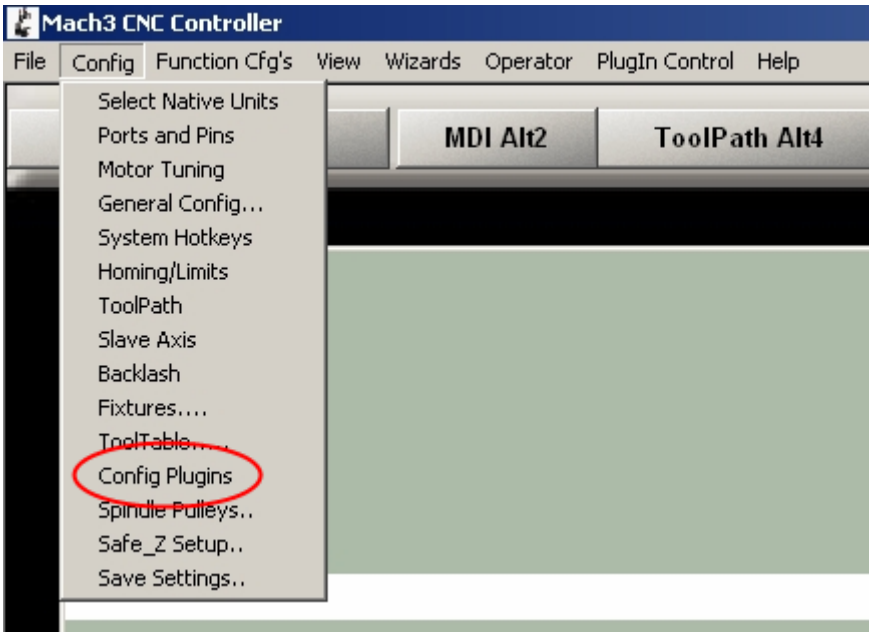
Unpack the downloaded file and double-click the file with the extension .m3p – this will install the plugin into Mach3 plugin directory.

The JoyPadSetup.exe program can be placed anywhere on the disk, but a good place would be in Mach3 directory (C:\Mach3) or on the Desktop for easy access.

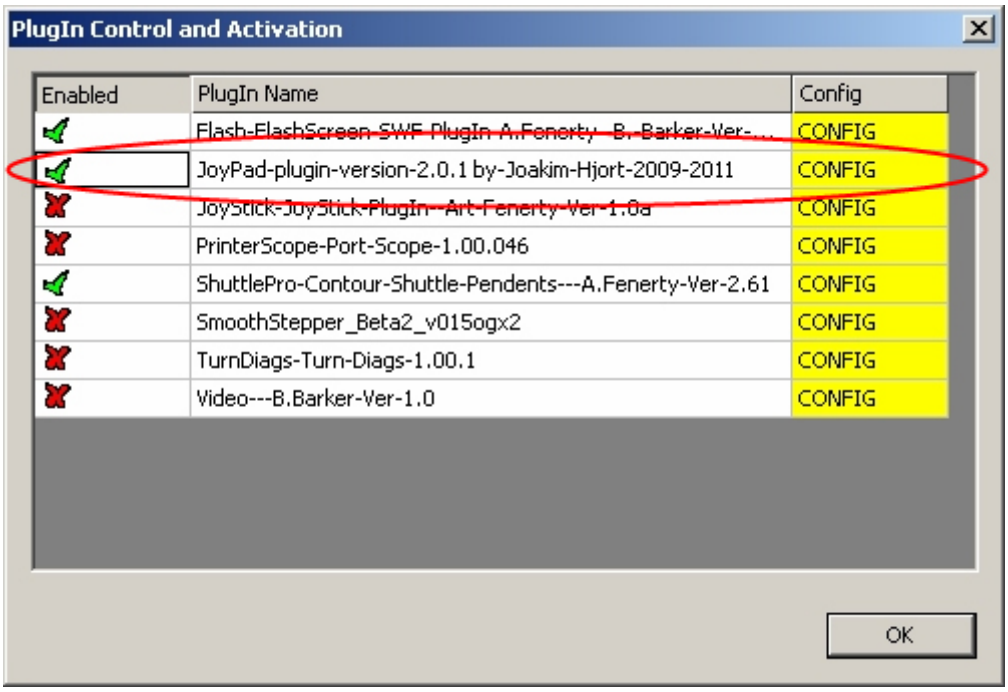
Start Mach3 program and select the *Config* menu:



Select *Config Plugins* submenu:



This will bring up a list of installed plugins. Locate the JoyPad plugin and enable it (marked as✓):



Be sure to disable all other plugins that may be using the game device (ex. Joystick plugin) as they may disturb the communication between the JoyPad plugin and the device. Failing to do so may give an unexpected behavior of the game device.

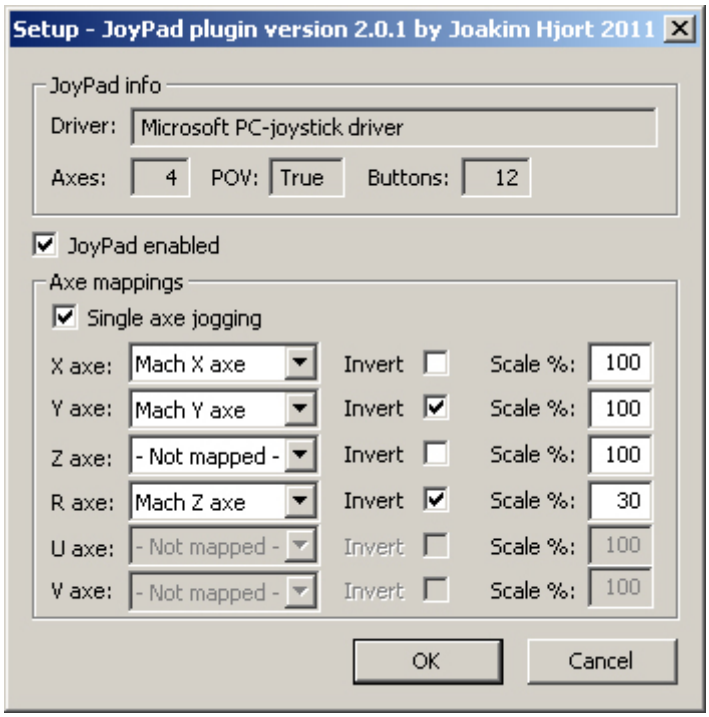
Always only enable plugins you intend to use, disable all other plugins.

Configure JoyPad plugin in Mach3

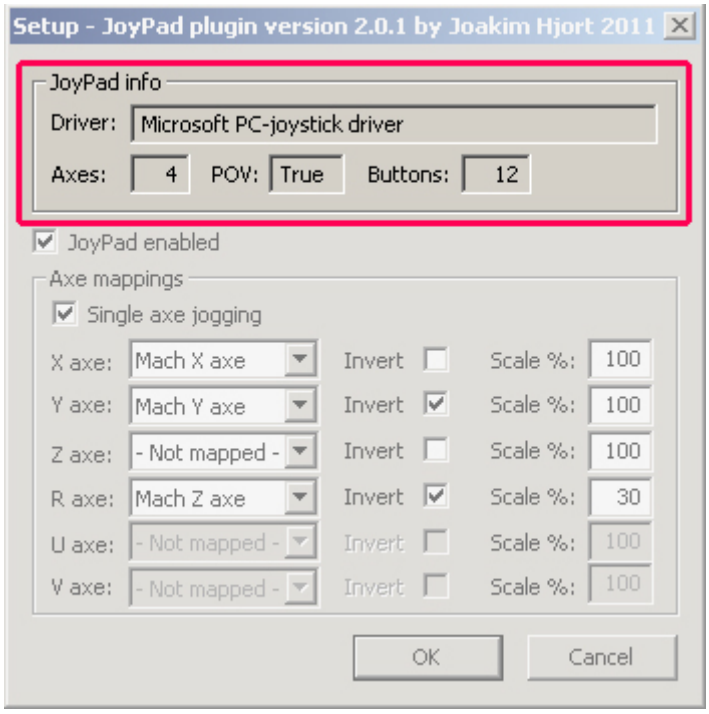
Select *CONFIG* to open JoyPad configuration:

If you get the below dialog, then the game device was not recognized. Please follow directions in previous chapter *Install JoyPad or game device in Windows* or you simply forgot to plug the device in ☺.

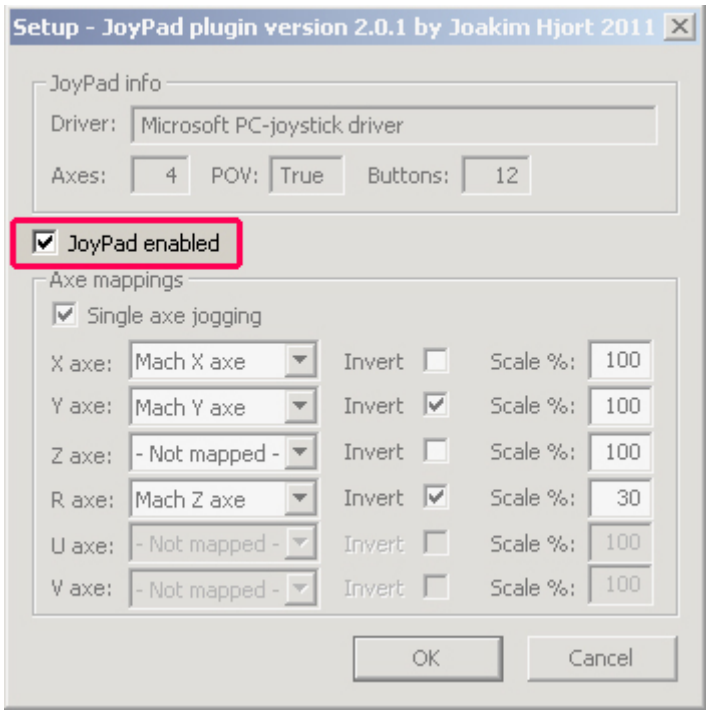
When the *JoyPad* or *game device* is properly installed, then this dialog will appear:



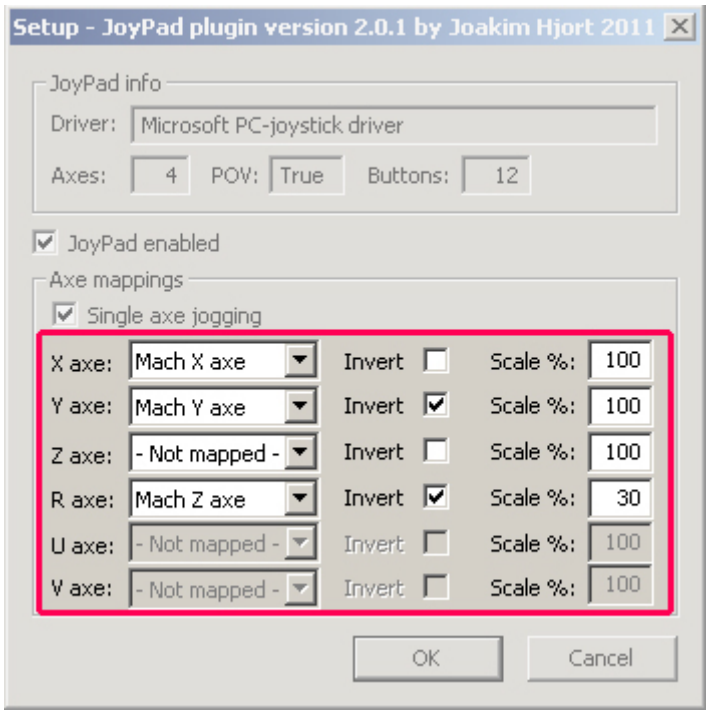
The top part of *JoyPad info* tells you the driver name, the number of axes, if a POV is present and the number of buttons detected.



Next you have the opportunity to enable/disable the plugin. For the device to function this field must be checked as shown.



Up to 6 axes can be mapped to any of the 6 Mach3 axes:



In this example the JoyPad X-axe is mapped to Mach3 X-axe, not inverted (direction not reversed) and max velocity is 100% of max speed for the given Mach3 axe (configured in Mach3).

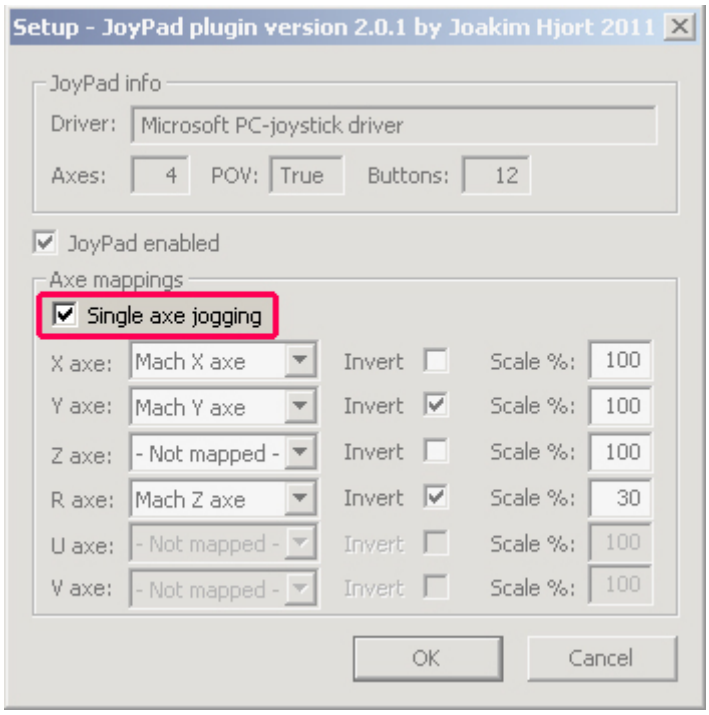
The same applies to JoyPad Y-axe, but here the direction is inverted (reversed).

JoyPad Z-axe is not mapped and is therefore ignored by the plugin.

JoyPad R-axe is mapped to Mach3 Z-axe, inverted and the speed is scaled to 30% of max velocity. This makes it possible to control a short fast axe, in this case the Z-axe.

The Logitech Dual Action JoyPad only has 4 axes resulting in the last two mappings being grayed out.

You can select two types of jog action: Single- or multi-axe.



Checking *Single axe jogging* will limit the jog to only one axe at a time. This is the recommended setting.

Multi axe jogging allows more than one axe to jog at the same time – this is fine for a skilled user and more undemanding moves.

For untrained user and precise movements any minute deviation from a straight line on action will activate the other axis. This would be frustrating if you are in for fine adjusting.

The selection of jog axe in single axe jogging is done automatically and reselection can only be done when the stick is at centered. This may sound complicated but in real life it feels natural and intuitive.

Press OK to save the configuration in Mach3.

Note: Mach3 only saves its configuration physically on disk when the program exits; until then, the configuration is saved internally in Mach3 memory.

The JoyPad is now configured for jogging!

Jogging with the game device

Using the JoyPad plugin, jogging is done with the joysticks on the game device. The purpose of jogging is typically to position the tool on the work piece before a cutting job, or moving it away to make room for handling the work piece.

To do that effectively the jogging must support both be fast and slow with high precision jogging. In JoyPad plugin this is achieved in two modes: Continuous and Step jogging.

Jogging is a potentially dangerous operation and is therefore only activated using the Safe or Alt buttons – this can prevent accidental activation if the game device is pushed.

Only one of the Safety/Alt button combinations SL/SR or AL/AR needs to be activated to enter Continuous or Step jogging, allowing for single hand operation – this is not advisable but may be needed to do the positioning job. Be very careful when operating machine and JoyPad at the same time!

Jogging operation is automatically blocked when Mach is in Reset state or running a GCode file - it doesn't make a lot of sense to jog in these situations.

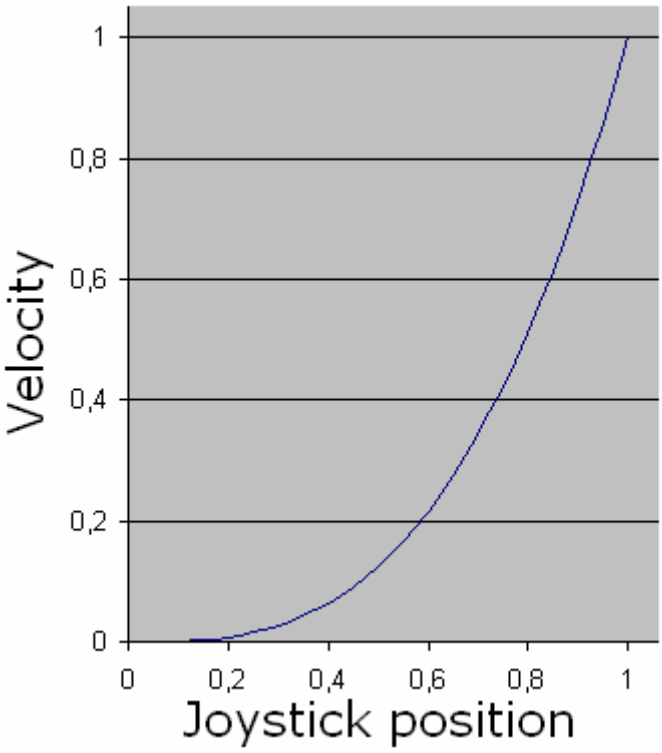
Continuous jogging

Continuous jogging is enabled when one or two of the Safety buttons SL/SR is pressed. Jogging will continue as long as you push the joystick and speed depends on how far it is pushed.

Depending on the configuration for *Single axe jogging* (See Configure JoyPad plugin in Mach3) jogging can be limited to one axe or allow multiple axes at the same time.

Motion is scaled by a third order dynamic function to give it high precision at low speeds and still preserve the high speed moves.

This can be illustrated by the following graph, showing the relation between joystick position and the resulting velocity:



On the graph “1” means full stroke for joystick and max axe speed for velocity. The max axe speed is actually reduced by the configured percent in JoyPad configuration and current *Jog Slow Rate* in the Mach jog screen. This makes it possible to work with fast machines and machines with short axes.

The scaling with *Jog Slow Rate* gives more dynamic control over the jogging speed depending on the current job situation.

All moves honor the configured acceleration for each axe, preventing sudden direction changes and resulting position error. On machines with slow acceleration and high speed this will look like a delayed reaction, but is actually the effect of de-acceleration before direction change.

As you will see later, it is possible to program buttons with script code – this could be used to change the *Jog Slow Rate* at a push of a button…

Step Jogging

Step Jogging is enabled when one or two of the Alt buttons AL/AR is pressed. Jogging will be one step in one direction at a time. The step is taken when the joystick is approx half the way at full stroke.

To take the next step, the joystick must be moved towards zero and the in the desired direction. Fast stepping can be achieved holding the joystick in a selected direction and tapping one of the Alt buttons.

The step size is setup in Mach Jog Screen. To show/hide the Jog Screen, which is equivalent to pressing the TAB key on the keyboard, press BE with only one of the Safe or Alt button, i.e. SL, SR, AL and AR on the game device.

To cycle through the predefined step sizes, press BW with only one of the Safe or Alt button, i.e. SL,SR,AL and AR on the game device. This will set the active step size (0.0001 / 0.0010 / 0.0100 / 0.1000 / 1.0000 units).

Using AL or AR + BN or BS will increase/ decrease the step sizes by 0.1 units. This amount is fixed.

Multi axe moves are blocked to prevent unwanted moved in other directions. Axes have the same mapping as for Continuous Jogging, no special setup is needed.

Don't worry about the state of *Jog Mode* as step mode will be entered automatically by the plugin before stepping. Step Jogging works on any Mach screen; there is no need to show the jog screen before using step jogging.

Keyboard jogging is not affected and will work as usual.

To switch to continuous jogging just release the Alt button and use Safety button instead.

Assigning the Buttons

Gamepad Components Definition

Different gamepads have different features. For example the face buttons have different arrangement (so far 3 different layouts have been encountered which you will find in the *Device Button Mapping* within the *JoyPadSetup*). In addition, you have the option to define each button as appropriate.

The following terms are used in the JoyPadSetup button assignment:

The Face Buttons (i.e. 1-2-3-4 or  buttons), disregarding their shape and number are renamed as BN-BE-BS-BW, as referred to compass directions.

There are 2 buttons on the gamepads, i.e. 9 and 10, or Start and Select. These were renamed to B1 and B2 respectively.

The joysticks, when pressed also act as buttons. These are referred to as 11 and 12. These were renamed to B3 and B4 respectively.

Some gamepads have 4 directions on the POV (Point of View), HAT or D-Pad, while others have 8 directions. Only the 4 major directions are used, hence named PN-PE-PS-PW.

There are 4 more buttons at the front of the device, i.e. 5-6-7-8 (or in cases, 1-2 and 1-2). These were renamed as SL-AL-SR-AR, which refer to “Safe Left/Right” and “Alt Left/Right”.

The Analog button, which usually has a LED associated, should always be on.

All other buttons, such as Turbo, Clear, Macro or any other buttons that may reside on the gamepad will be disregarded. Using these buttons might give unpredictable results.

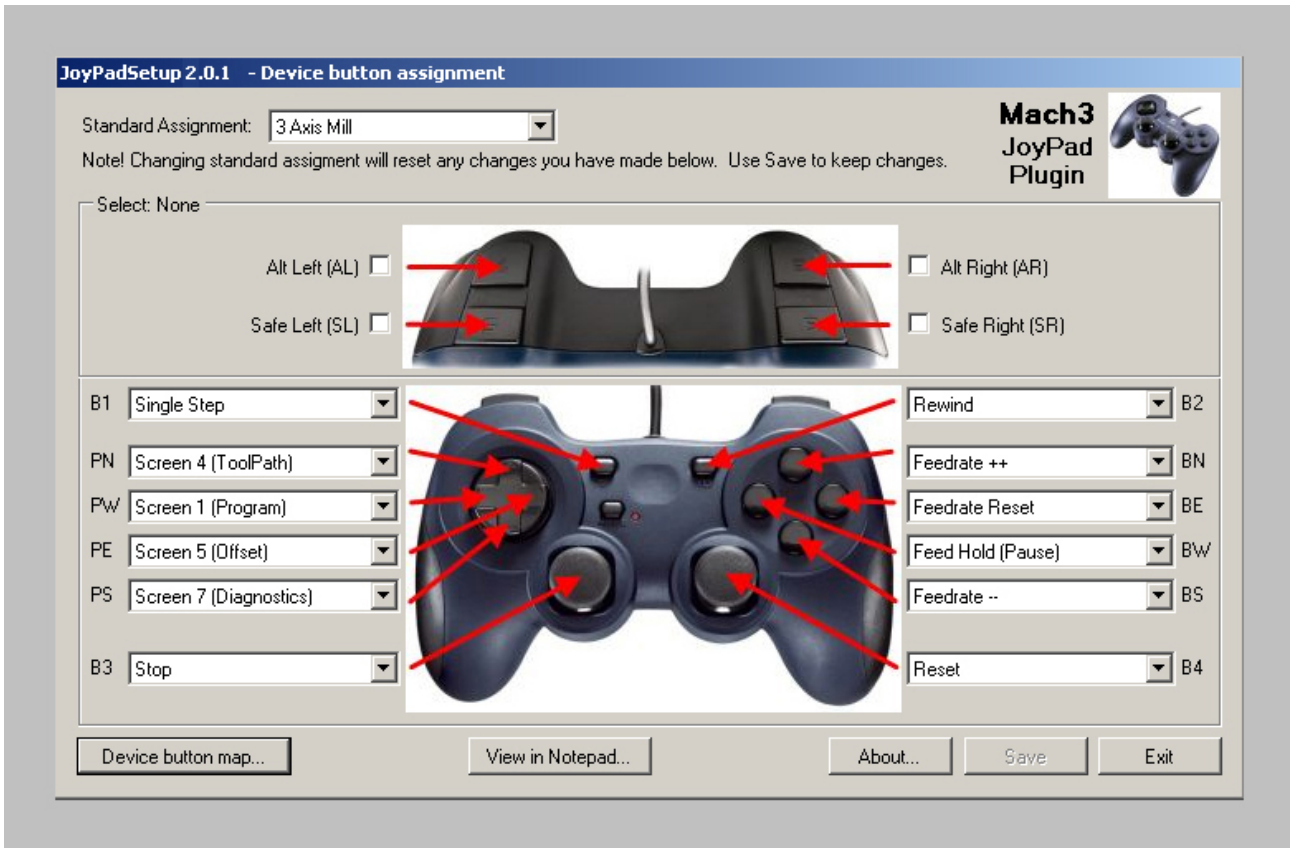
The following picture shows a typical gamepad with the defined buttons.

The JoyPad plugin supports up to 16 buttons, including SL, AL, SR and AR buttons (an ordinary gamepad has 12 buttons, including the POV and excluding the front buttons). All of which can be programmed alone or in combination with the “Safe” and/or “Alt” buttons, to any build in function supported by Mach3 (See Appendix F).

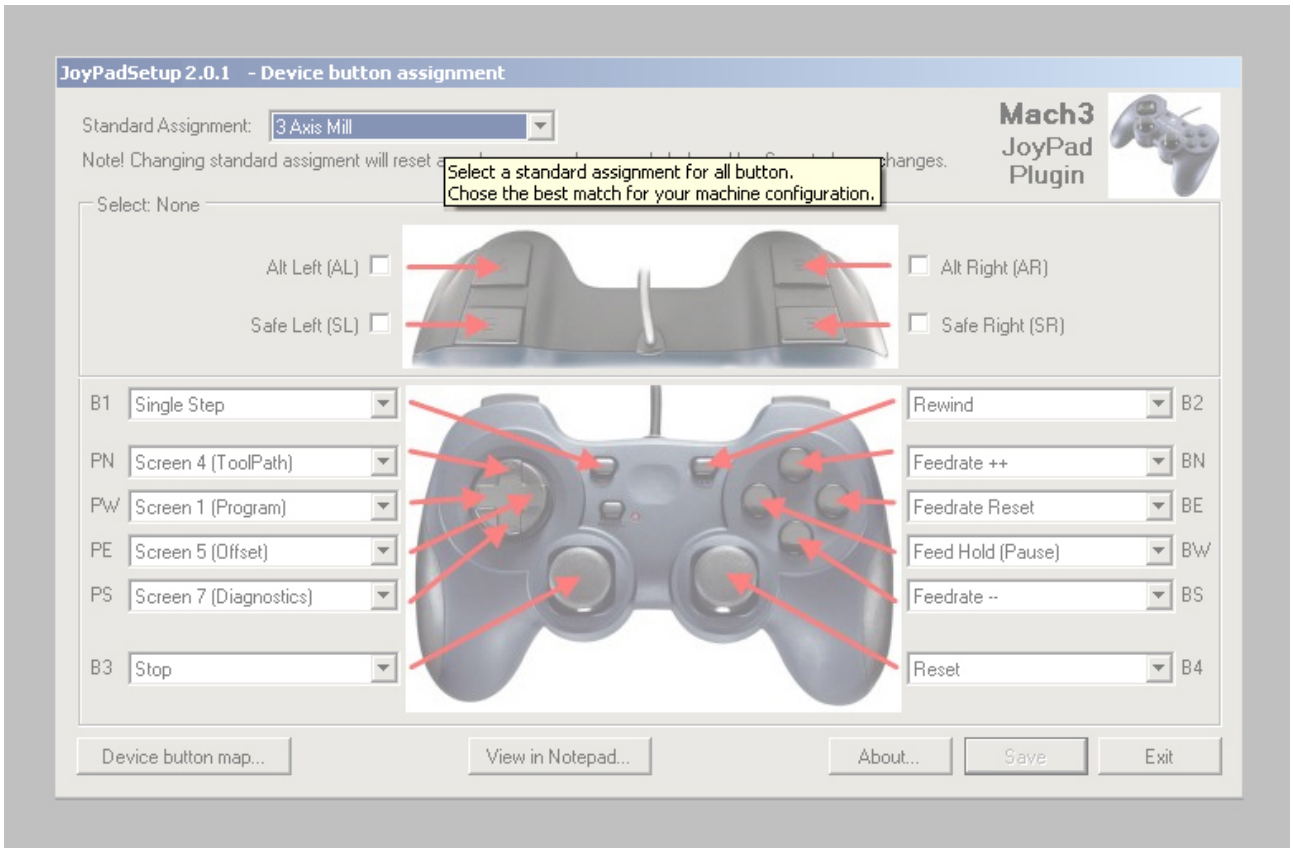
In order to assign the buttons, you need to open the JoyPadSetup program. But first...

Selecting Button Mapping

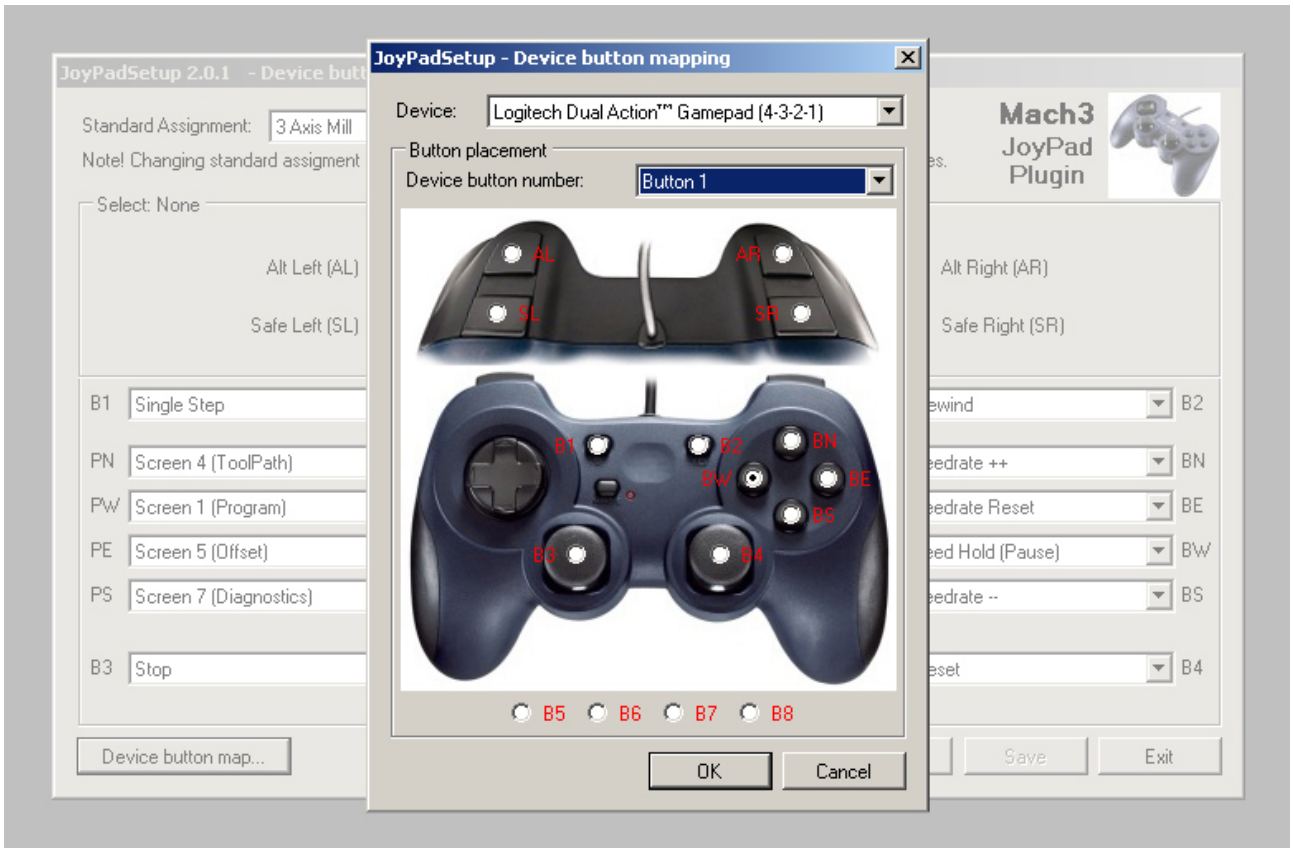
Open the *JoyPadSetup.* The following dialog will open:



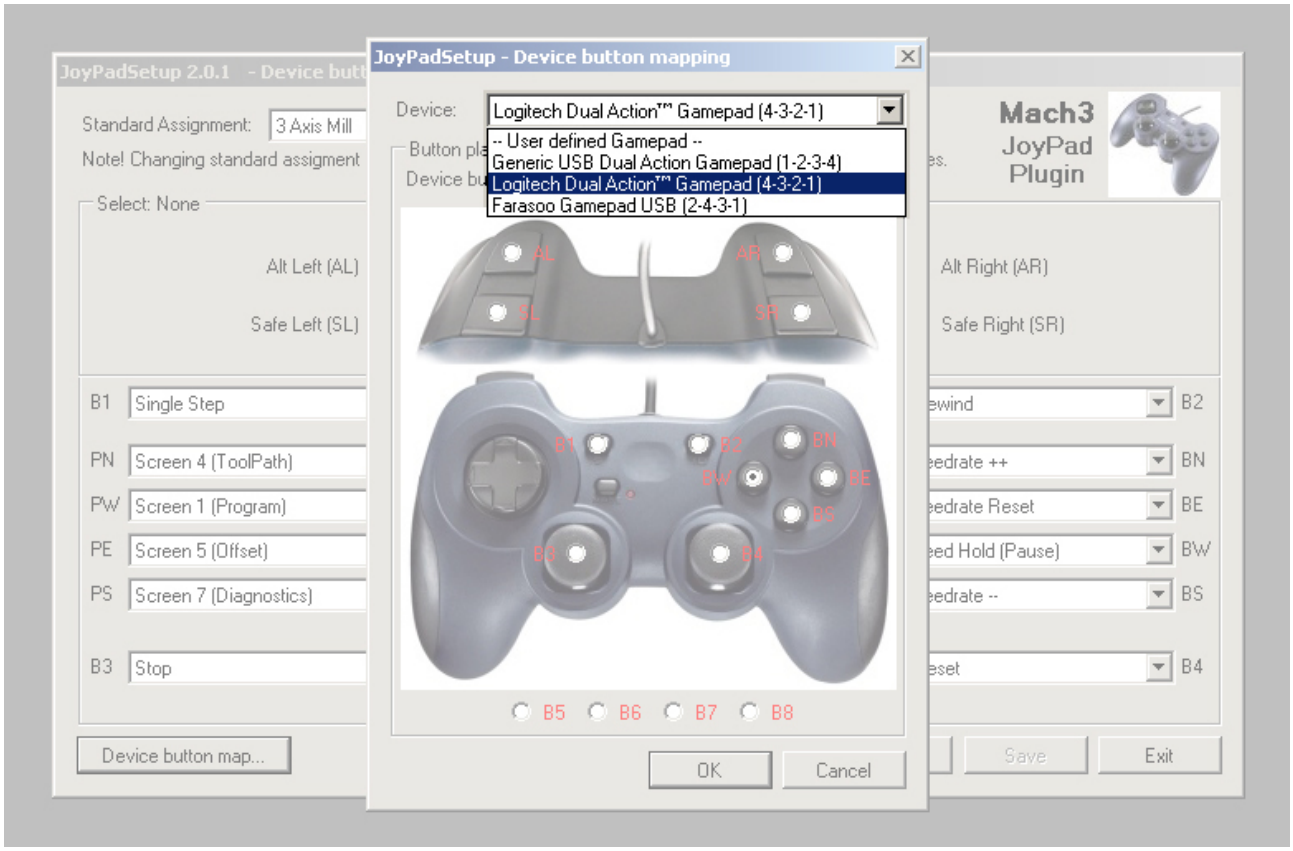
Help topics are associated with each component in this dialog box:



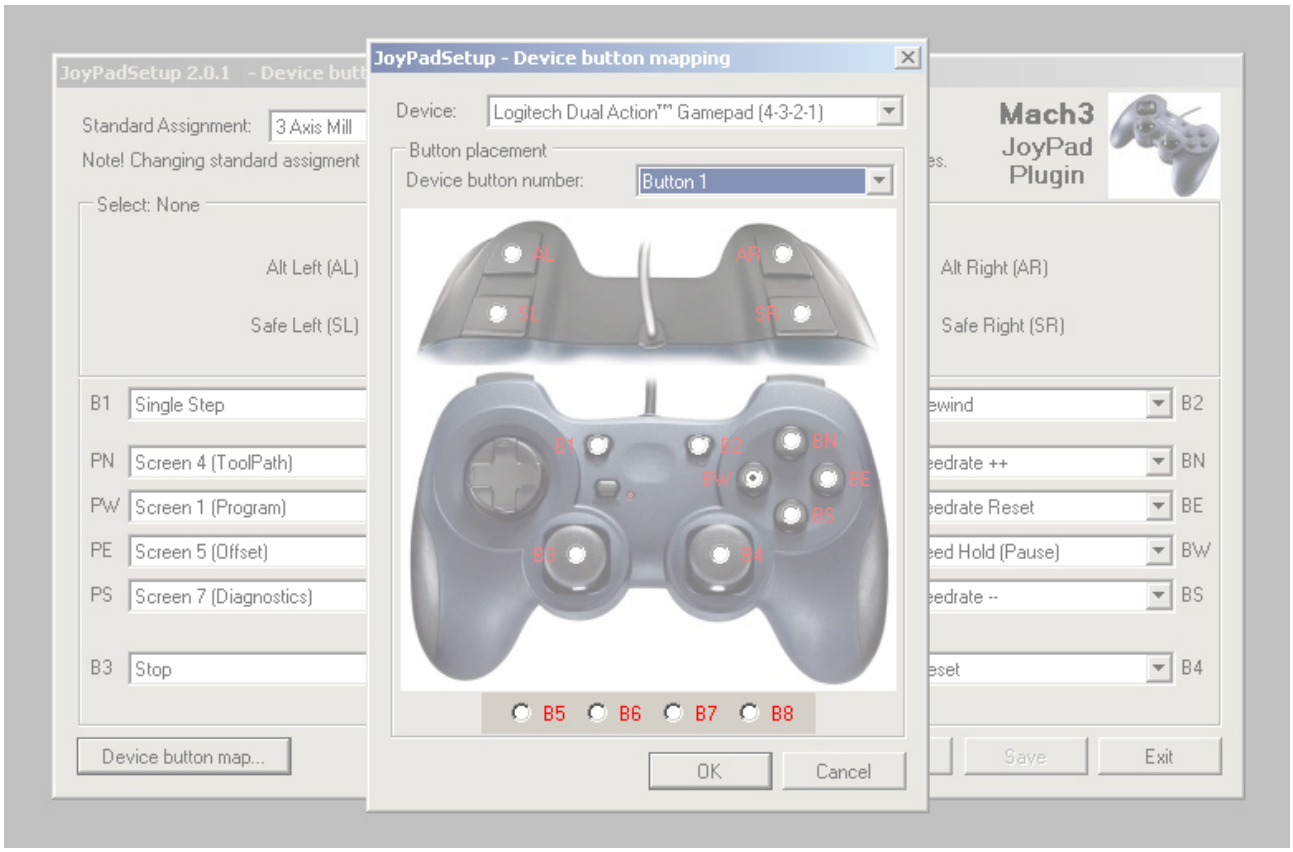
At the bottom left side there is a *Device Button Map….* Click on it. The Device Button Mapping dialog will open.



In device button mapping, you have the possibility to select from 3 predefined button setups, or defining your own by selecting a “User Defined Gamepad”. Most gamepads fall into one of these three types. Please note that the POV buttons are not assignable and are defined inside the plugin.



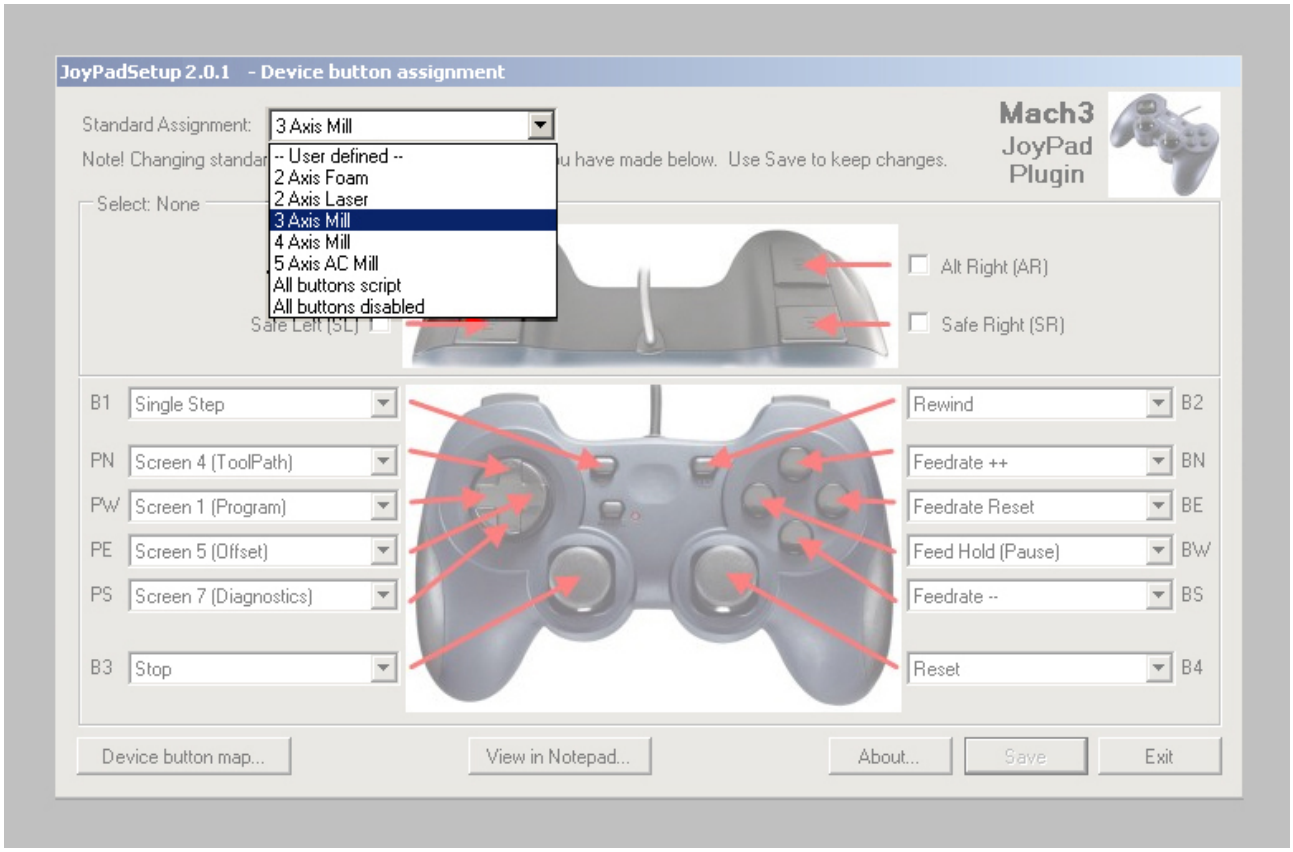
If your gamepad allows, you can assign 4 more buttons (B5 to B8), shown at the bottom part of the dialog box:



After selecting the suitable gamepad or assigning physically buttons positions, click OK.

Selecting Button Layout

With the *JoyPadSetup* program, there are a set of predefined standard button assignments (template). You have a choice of selecting between 2, 3, 4 and 5 axis machines. However it is also possible to define your own button layout, or to assign script to a button. The script and macros will be explained later.



By clicking inside the tick boxes for Right and Left, Safe and Alt buttons, you will see another set of definitions appear. Please note that some functions (mostly hazardous ones) will be activated only by pressing both SL and SR and the related button (ex. Cycle Start). Try different Safe and Alt combinations to see what happens.

To get an overview of all button assignments press the button *View in Notepad.* This will generate a text file with a short text description of all button assignments – The text file will be open in Notepad. The shown text file is saved in the plugin directory for future reference or to share with others (File: JoyPad.Button.txt).

Note: You have to close Notepad yourself.

Appendix A to E provides a quick overview of the embedded functions in the standard layouts.

Criteria for Assignments

The standard layouts have been designed considering the following aspects (rules).

Initially, all functions have been categorized into three groups:

1- Harmless functions. While in stand-by mode, activating the underlying commands has no harmful effect to the operator, machine or work piece.

2- Potentially hazardous. Activating the underlying commands, needs close attention of the operator.

3- Hazardous. Activating the underlying command can be dangerous or harmful.

Group 2 and 3 functions should be activated by an accompanying “Safe” or “Alt” button.

Appendix F lists the groups of commands. Groups 1, 2 and 3 are implemented in the JoyPadSetup. Other functions can be used by defining macros script in the *M800.m1s* file (see later for explanation of script).

Home, Zero, Offset and Referencing

When setting coordinates either by Zero, Home, Part Offset, Touching or Referencing the axes, there is a ruling logic. X and Y axis are in the same direction as in a coordinate system. Z-axis is downward, the left button will either serve for “All axes” or for A-axis in case you use a 4-axis machine. The following picture shows the axes directions.

North and south buttons are used to increase/decrease a value.

Outbound keys should be assigned to those keys that are used more frequently.

The beauty is that, in order to activate a function, you do not have to be on the relevant screen of Mach3. For example you can change the jogging mode between continuous or step, without opening the screen 50 jog visibility screen.

Appendix G shows the standard layout for a typical 3 Axis machine. It should be noted that you might not actually use its full potential. For example you might not have variable speed spindle, or a touch probe. Therefore you can change these buttons to --*Ignored*-- and save it as a user defined standard assignment.

There is also a “debug/run” template using SR + AR which will prevent joystick jogging (not activated with this combination). This mode will be used to test a Gcode. While all the necessary functions are available, Joysticks is disabled.

Another useful combination that also prevents any movement of the axes, is SL+AL. This combination is left blank for the user to make a complete level for some specific purpose.

Appendix H has a schema which you might wish to fill in, print and have it somewhere visible around your machine.

Assigning script function to buttons

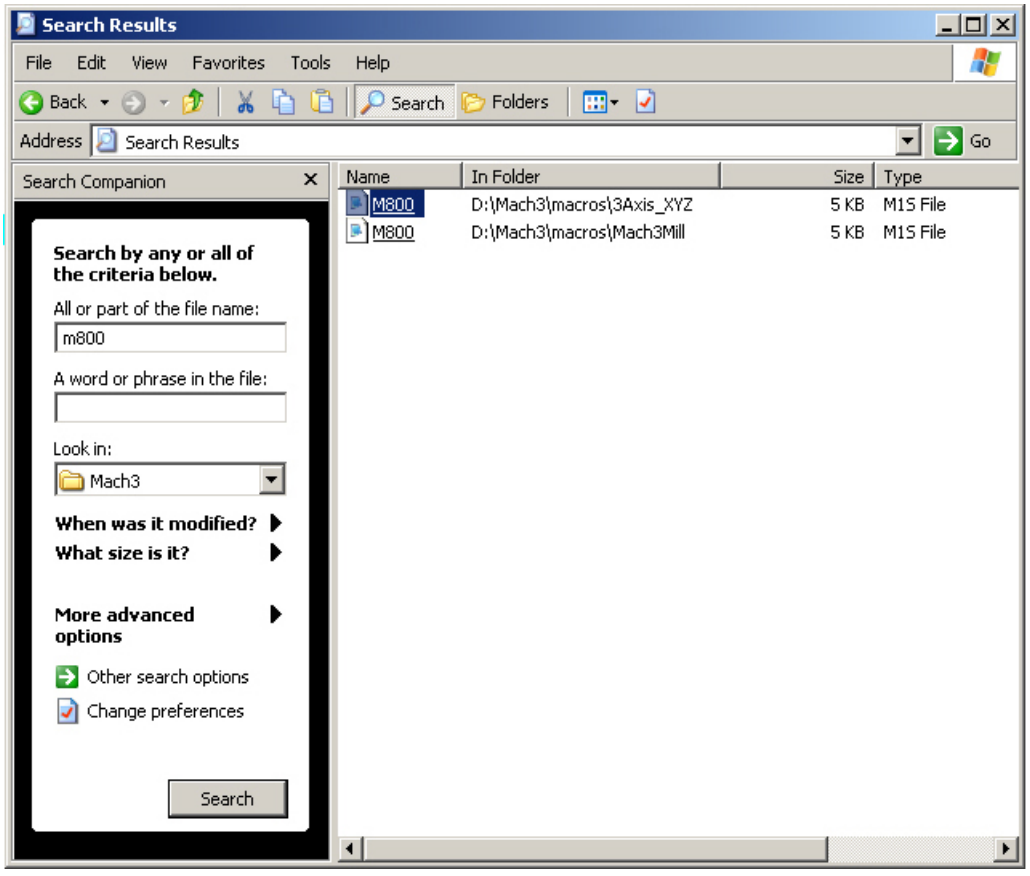
Unlike the previous versions, JoyPad plugin requires only one macro file. The macro file is created when the plugin is loaded and the M800.m1s file is missing. It can hold as many macros as you wish (only limited by file size, 64kb). This macro will be located in the: \Mach3\macros\[current profile]

If you are using more than one profile on your computer, there will be a macro file for each profile. Mach3 keeps track of each profile and only uses the macro associated with the current profile.

The JoyPad plugin will automatically create a default macro file (M800.m1s) if it is missing for a given profile.

Appendix I shows the standard M800.m1s macro for script

If the macro somehow gets messed up and you want to revert to the default macro, just delete the M800.m1s file and restart Mach3. This way the default macro file will be recreated.



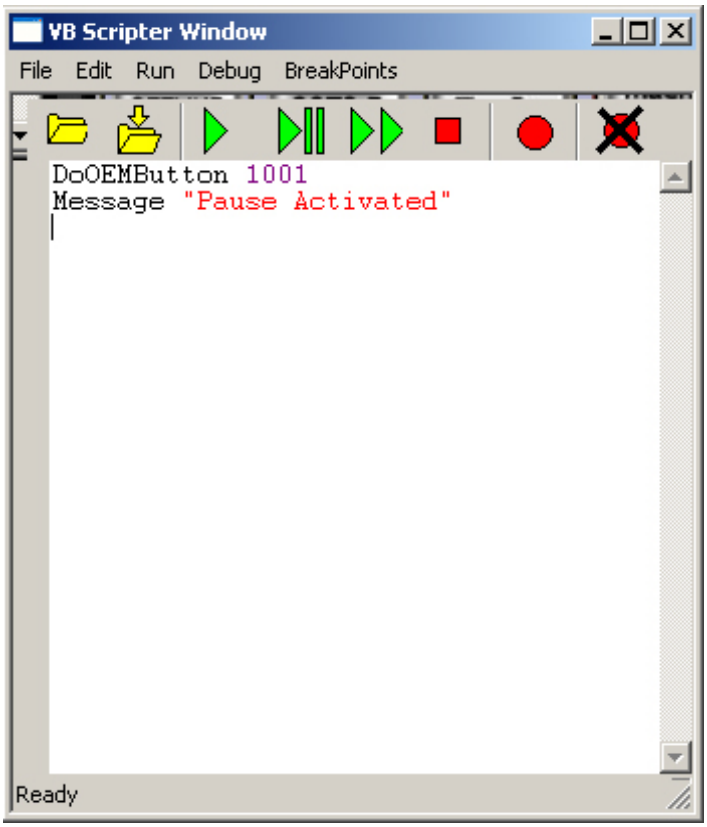
A macro is simply VBScript created and written in a text editor as Windows Notepad and saved with the macro name given in the table. You can write and test your macro from within the VB Script Editor inside Mach3, and after assuring its functionality, copy it into M800.m1s.

Example: Assigning script to an unused button

In this chapter we will see how macros can be assigned to an unused button.

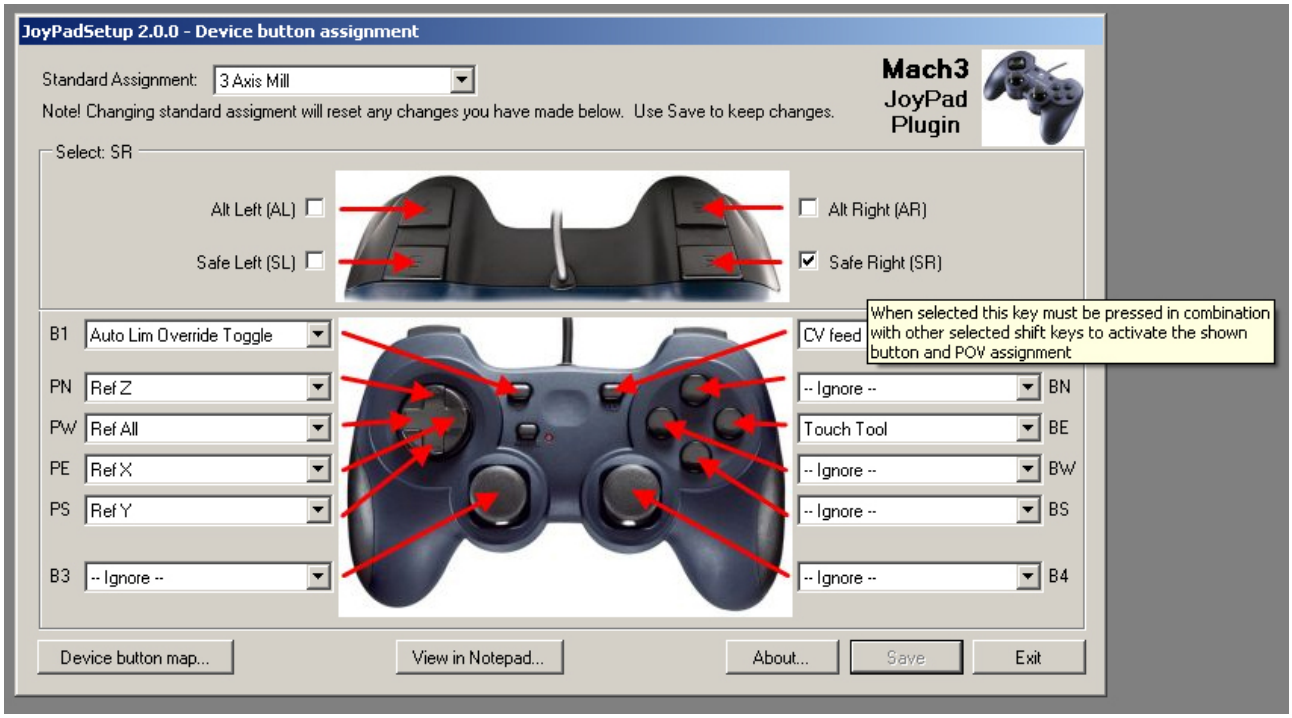
It is advisable that you first test and debug your macro, using the VB Scripter Window, within the Mach3 and then copy it to the M800.m1s.

Although there is a build in function for Pause or Feed Hold button, we will assign a script with the Pause function, in addition to the build in function we want it to display a message that the pause button is actually pressed.



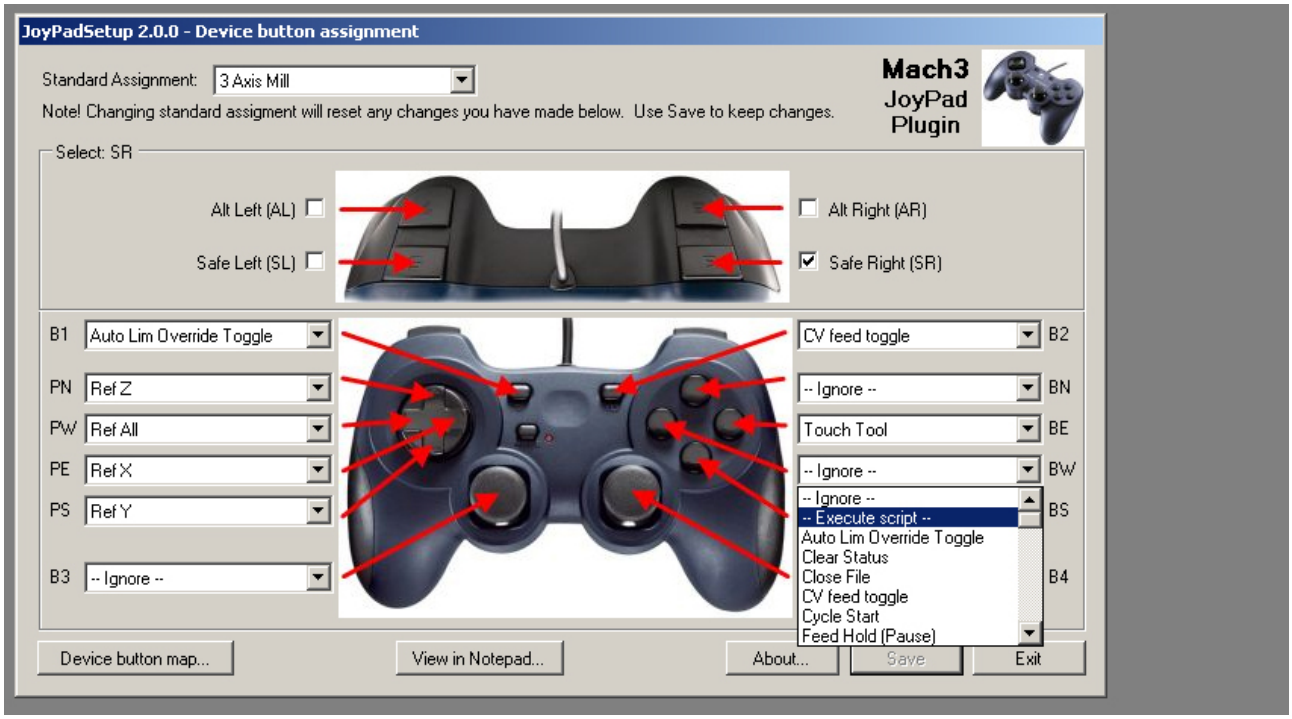
Open the JoyPadSetup.

Click on the Checkbox for *Safe Right (SR)*.



You will see that a combination of BW and SR is undefined and by pressing this combination, nothing happens.

Now, select the *BW* (Button West) button Combobox and select *--Execute script--*.



You will see that the Standard Assignments now shows *--User Defined--*.

Click on Save.

Open your M800.m1s which is located in C:\Mach3\macros\[current profile].

Scroll down to the following section:

```
'=========================================================================
' <-- Put your own script code here.

'END ' Uncomment END to end execution of script here.
     ' Or delete text to end of file.
'=========================================================================
```

Change it to the following:

```
'=========================================================================
' <-- Put your own script code here.

DoOEMButton 1001
Message "Pause Activated"

END  ' Uncomment END to end execution of script here.
     ' Or delete text to end of file.
'=========================================================================
```

Delete the preceding example in the macro and save it.

Open Mach3

Open a GCode file.

While your machine is off, start the program.

After it has executed a few lines press BW. You will see that the execution immediately pauses.

Click start again and this time press SR + BW. You will see that the execution pauses and a message appears, announcing “Pause Activated”.

Of course Pause function might not be the best example for assignment, as you have noticed that it will pause after executing several lines. This is a problem adherent to Mach3. When the macro is executed from the plugin it is inserted in the GCode execution list and Mach decides when to execute it.

It will always be faster and safer to use a build in functions rather than using a script version.

Note: It is not possible to execute a macro from a macro as Mach will only allow one macro to execute at a time.

How does it work?

It is beyond the scope of this manual to cover general script writing in Mach3 but a lot of help can be found in Mach support forum and wiki:

http://www.machsupport.com/forum/index.php

http://www.machsupport.com/MachCustomizeWiki/index.php?title=Main_Page

Tutorial videos are found at:

http://www.machsupport.com/videos/

Some VBScript code for button macros

In the following table are some VBScript macro commands with description:

DoButton 8	Zero X-axe value
DoButton 9	Zero Y-axe value
DoButton 10	Zero Z-axe value
DoButton 11	Zero A-axe value
DoButton 12	Zero B-axe value
DoButton 13	Zero C-axe value
DoButton 17	Go to zero (all axes)
DoButton 22	Home X
DoButton 23	Home Y
DoButton 24	Home Z
DoButton 25	Home A
DoButton 26	Home B
DoButton 27	Home C
GoSafeZ	Go to safe Z
Code(“G00 X0”)	Rapid move X to 0
Code(“M7”)	Mist cool on
Code(“G28”)	Return machine home
Code(“G31”)	Straight probe
Code(“G01 X0 Y0”) Code(“X10”) Code(“Y10”) Code(“X0”) Code(“Y0”) Message “10 unit square”	Move in 10 unit square at federate and Display message
Message "Hi"	Displays the message Hi
SetOEMDRO 818, (GetOEMDRO 818 * 1.1)	Increase the feed rate by 10%
DoOEMButton 110	Toggle spindle on/off
DoOEMButton 113	Toggle flood on/off
DoOEMButton 114	Toggle mist on/off

These are only examples – only your imagination sets the limit for functionality in macros.

It is even possible to write macros performing complex operations such as pocket milling or surface milling, including dialogs setting up parameters.

Follow the links given earlier to read more about macro programming in Mach3 with VBScript.

Appendix F shows the commands that will be used to create macros.

Use and copying

You may use and copy the JoyPad plugin as long as User manual and all accompanying files is included in the distribution and the software remains free of charge.

Please don't remove any names from the distributions - I have put a lot of time and effort in developing this plugin along with Nader Atifeh…

The source code is closed and not public – I had plans to release the source to the public under an open source license, but can't find the spare time to do so… sorry…

Contact and support

Mach forum thread: ""Topic: USB JoyPad and game device plugin - new version!""

Nader Atifeh and I can be contacted at the Mach3 forum (http://www.machsupport.com), user Atifeh and Area51 respectively.

As the software is provided "*as is"* there is no direct support; post your requests on the forum or try searching it for answers.

Private messages will generally not be answered.

If you like the software, find errors or have suggestions to improvements, we would like to hear about it.

No guarantee that it will be implemented or the code corrected - this is a spare time project, but I feel pride in developing stable usable code ☺

During the development of this plugin I got a lot of help from skilled people at the MachSupport forum – Big thanks to you all!

Hope you found this User manual useful – happy CNC machining ;-)

Best Regards.

Appendices

Appendix A: 2 Axis Foam Cutting Machine

Function	OEMCode	Func:	SL	AL	SR	AR	Qualifier	Remarks
Flood toggle	113	B1						Hot wire On/Off
Softlimits Toggle	1029	B1	X					
--ignored--		B1		X				
Auto Lim Override Toggle	149	B1			X			
--ignored--		B1				X		
--ignored--		B1	X		X		AND	
--ignored--		B1		X		X	AND	
Regen Toolpath	160	B2						
Goto Safe Z	104	B2	X					
--ignored--		B2		X				
CV feed toggle	247	B2			X			
--ignored--		B2				X		
--ignored--		B2	X		X		AND	
--ignored--		B2		X		X	AND	
Stop	1003	B3						
Reset	1021	B4						
Function		**Func:**	**SL**	**AL**	**SR**	**AR**		**Remarks**
Machine Coordinates toggle	256	BE						
Feed raise	108	BN						
Feed lower	109	BS						
Feedrate reset	1014	BW						
Toggle visibility of screen 50	323	BE	X					
Slow Jog Up	111	BN	X					
Slow Jog Dn	112	BS	X					
Jog increment cycle	171	BW	X					
Toggle visibility of screen 50	323	BE		X				
Jog Inc Up	100	BN		X				
Jog Inc Down	101	BS		X				
Jog increment cycle	171	BW		X				
Toggle visibility of screen 50	323	BE			X			
Slow Jog Up	111	BN			X			
Slow Jog Dn	112	BS			X			
Jog increment cycle	171	BW			X			
Toggle visibility of screen 50	323	BE				X		
Jog Inc Up	100	BN				X		
Jog Inc Down	101	BS				X		
Jog increment cycle	171	BW				X		
--ignored--		BE	X		X		AND	
--ignored--		BN	X		X		AND	
--ignored--		BS	X		X		AND	
Cycle start	1000	BW	X		X		AND	
Clear error label	172	BE		X		X	AND	
Rewind	1002	BN		X		X	AND	
Re-load last file	170	BS		X		X	AND	
Close current file	169	BW		X		X	AND	
Function		**Func:**	**SL**	**AL**	**SR**	**AR**		**Remarks**
Program Run screen	1	PE						
Toolpath screen select	3	PN						
Diagnostics screen select	5	PS						
Offset Screen	7	PW						
Zero X	1008	PE	X					
Zero Y	1009	PN	X					
--ignored--		PS						
--ignored--		PW						

Part X Offset Touch	139	**PE**		X				
Part Y Offset Touch	140	**PN**		X				
--ignored--		**PS**						
--ignored--		**PW**						
Ref X	1022	**PE**			X			
Ref Y	1023	**PN**			X			
--ignored--		**PS**						
--ignored--		**PW**						
Function	**OEMCode**	**Func:**	**SL**	**AL**	**SR**	**AR**		**Remarks**
Jog X axis		**S1V**	X		X		OR	Stick 1 Vertical movement
Jog Y axis		**S1H**	X		X		OR	Stick 1 Horizontal movement
--ignored--		**S2V**					OR	Stick 2 Vertical movement
--ignored--		**S2H**					OR	Stick 2 Horizontal movement
Jog X axis in step		**S1V**		X		X	OR	Stick 1 Vertical movement
Jog Y axis in step		**S1H**		X		X	OR	Stick 1 Horizontal movement
--ignored--		**S2V**					OR	Stick 2 Vertical movement
--ignored--		**S2H**					OR	Stick 2 Horizontal movement

Appendix B: 2 Axis Laser Cutting Machine

Function	OEMCode	Func:	SL	AL	SR	AR	Qualifier	Remarks
Goto Safe Z	104	B1						Shut off laser beam
Softlimits Toggle	1029	B1	X					
Z inhibit toggle	167	B1		X				
Auto Lim Override Toggle	149	B1			X			
--ignored--		B1				X		
--ignored--		B1	X		X		AND	
--ignored--		B1		X		X	AND	
--ignored--		B1			X	X	AND	Debug/Run
Regen Toolpath	160	B2						
Goto Safe Z	104	B2	X					
--ignored--		B2		X				
CV feed toggle	247	B2			X			
--ignored--		B2				X		
--ignored--		B2	X		X		AND	
--ignored--		B2		X		X	AND	
--ignored--		B2			X	X	AND	Debug/Run
Stop	1003	B3						
Stop	1003	B3			X	X	AND	Debug/Run
Reset	1021	B4						
Reset	1021	B4			X	X	AND	Debug/Run
Function		**Func:**	**SL**	**AL**	**SR**	**AR**		**Remarks**
Machine Coordinates toggle	256	BE						
Feed raise	108	BN						
Feed lower	109	BS						
Feedrate reset	1014	BW						
Toggle visibility of screen 50	323	BE	X					
Slow Jog Up	111	BN	X					
Slow Jog Dn	112	BS	X					
Jog increment cycle	171	BW	X					
Toggle visibility of screen 50	323	BE		X				
Jog Inc Up	100	BN		X				
Jog Inc Down	101	BS		X				
Jog increment cycle	171	BW		X				
Toggle visibility of screen 50	323	BE			X			
Slow Jog Up	111	BN			X			
Slow Jog Dn	112	BS			X			
Jog increment cycle	171	BW			X			
Toggle visibility of screen 50	323	BE				X		
Jog Inc Up	100	BN				X		
Jog Inc Down	101	BS				X		
Jog increment cycle	171	BW				X		
--ignored--		BE	X		X		AND	
--ignored--		BN	X		X		AND	
--ignored--		BS	X		X		AND	
Cycle start	1000	BW	X		X		AND	
Clear error label	172	BE		X		X	AND	
Rewind	1002	BN		X		X	AND	
Re-load last file	170	BS		X		X	AND	
Close current file	169	BW		X		X	AND	
--ignored--		BE			X	X	AND	Debug/Run
Machine Coordinates toggle	256	BN			X	X	AND	Debug/Run
Single Step	1004	BS			X	X	AND	Debug/Run
Cycle start	1000	BW			X	X	AND	Debug/Run
Function		**Func:**	**SL**	**AL**	**SR**	**AR**		**Remarks**
Program Run screen	1	PE						
Toolpath screen select	3	PN						
Diagnostics screen select	5	PS						
Offset Screen	7	PW						
Zero X	1008	PE	X					

Zero Y	1009	**PN**	X					
--ignored--		**PS**						
--ignored--		**PW**						
Part X Offset Touch	139	**PE**		X				
Part Y Offset Touch	140	**PN**		X				
--ignored--		**PS**						
--ignored--		**PW**						
Ref X	1022	**PE**			X			
Ref Y	1023	**PN**			X			
--ignored--		**PS**						
--ignored--		**PW**						
CV feed toggle	247	**PE**			X	X	AND	Debug/Run
Feed raise	108	**PN**			X	X	AND	Debug/Run
Feed lower	109	**PS**			X	X	AND	Debug/Run
Rewind	1002	**PW**			X	X	AND	Debug/Run
Function	**OEMCode**	**Func:**	**SL**	**AL**	**SR**	**AR**		**Remarks**
Jog X axis		**S1V**	X		X		OR	Stick 1 Vertical movement
Jog Y axis		**S1H**	X		X		OR	Stick 1 Horizontal movement
--ignored--		**S2V**					OR	Stick 2 Vertical movement
--ignored--		**S2H**					OR	Stick 2 Horizontal movement
Jog X axis in step		**S1V**		X		X	OR	Stick 1 Vertical movement
Jog Y axis in step		**S1H**		X		X	OR	Stick 1 Horizontal movement
--ignored--		**S2V**					OR	Stick 2 Vertical movement
--ignored--		**S2H**					OR	Stick 2 Horizontal movement

Appendix C: 3 Axis Milling Machine

Function	OEMCode	Func:	SL	AL	SR	AR	Qualifier	Remarks
Machine Coordinates toggle	256	B1						
Softlimits Toggle	1029	B1	X					
Z inhibit toggle	167	B1		X				
Auto Lim Override Toggle	149	B1			X			
--ignored--		B1				X		
Flood toggle	113	B1	X		X		AND	
--ignored--		B1		X		X	AND	
Spindle CW, reset THC height	110	B1			X	X	AND	Debug/Run
Regen Toolpath	160	B2						
Goto Safe Z	104	B2	X					
Go Home	138	B2		X				
CV feed toggle	247	B2			X			
Touch button for Tool length offset	120	B2				X		
Mist toggle	114	B2	X		X		AND	
Single Step	1004	B2		X		X	AND	
Flood toggle	113	B2			X	X	AND	Debug/Run
Stop	1003	B3						
Stop	1003	B3			X	X	AND	Debug/Run
Reset	1021	B4						
Reset	1021	B4			X	X	AND	Debug/Run
Function		**Func:**	**SL**	**AL**	**SR**	**AR**		**Remarks**
Pause (Feed Hold)	1001	BE						
Feed raise	108	BN						
Feed lower	109	BS						
Feedrate reset	1014	BW						
Toggle visibility of screen 50	323	BE	X					
Slow Jog Up	111	BN	X					
Slow Jog Dn	112	BS	X					
Jog increment cycle	171	BW	X					
Toggle visibility of screen 50	323	BE		X				
Jog Inc Up	100	BN		X				
Jog Inc Down	101	BS		X				
Jog increment cycle	171	BW		X				
Toggle visibility of screen 50	323	BE			X			
Slow Jog Up	111	BN			X			
Slow Jog Dn	112	BS			X			
Jog increment cycle	171	BW			X			
Toggle visibility of screen 50	323	BE				X		
Jog Inc Up	100	BN				X		
Jog Inc Down	101	BS				X		
Jog increment cycle	171	BW				X		
Spindle CW, reset THC height	110	BE	X		X		AND	
Raise spindle speed	163	BN	X		X		AND	
Lower spindle speed	164	BS	X		X		AND	
Cycle start	1000	BW	X		X		AND	
Clear error label	172	BE		X		X	AND	
Rewind	1002	BN		X		X	AND	
Re-load last file	170	BS		X		X	AND	
Close current file	169	BW		X		X	AND	
Pause (Feed Hold)	1001	BE			X	X	AND	Debug/Run
Machine Coordinates toggle	256	BN			X	X	AND	Debug/Run
Single Step	1004	BS			X	X	AND	Debug/Run
Cycle start	1000	BW			X	X	AND	Debug/Run
Function		**Func:**	**SL**	**AL**	**SR**	**AR**		**Remarks**
Program Run screen	1	PE						
Toolpath screen select	3	PN						

Diagnostics screen select	5	**PS**						
Offset Screen	7	**PW**						
Zero X	1008	**PE**	X					
Zero Y	1009	**PN**	X					
Zero Z	1010	**PS**	X					
Zero All	1007	**PW**	X					
Part X Offset Touch	139	**PE**		X				
Part Y Offset Touch	140	**PN**		X				
Part Z Offset Touch	141	**PS**		X				
--ignored--		**PW**		X				
Ref X	1022	**PE**			X			
Ref Y	1023	**PN**			X			
Ref Z	1024	**PS**			X			
Home Z then X then Y - set machine coords	105	**PW**			X			
CV feed toggle	247	**PE**			X	X	AND	Debug/Run
Feed raise	108	**PN**			X	X	AND	Debug/Run
Feed lower	109	**PS**			X	X	AND	Debug/Run
Rewind	1002	**PW**			X	X	AND	Debug/Run
Function	**OEMCode**	**Func:**	**SL**	**AL**	**SR**	**AR**		**Remarks**
Jog X axis		**S1V**	X		X		OR	Stick 1 Vertical movement
Jog Y axis		**S1H**	X		X		OR	Stick 1 Horizontal movement
Jog Z axis		**S2V**	X		X		OR	Stick 2 Vertical movement
Jog A axis		**S2H**	X		X		OR	Stick 2 Horizontal movement
Jog X axis in step		**S1V**		X		X	OR	Stick 1 Vertical movement
Jog Y axis in step		**S1H**		X		X	OR	Stick 1 Horizontal movement
Jog Z axis in step		**S2V**		X		X	OR	Stick 2 Vertical movement
Jog A axis in step		**S2H**		X		X	OR	Stick 2 Horizontal movement

Appendix D: 4 Axis Milling Machine

Function	OEMCode	Func:	SL	AL	SR	AR	Qualifier	Remarks
Machine Coordinates toggle	256	B1						
Softlimits Toggle	1029	B1	X					
Z inhibit toggle	167	B1		X				
Auto Lim Override Toggle	149	B1			X			
--ignored--		B1				X		
Flood toggle	113	B1	X		X		AND	
--ignored--		B1		X		X	AND	
Spindle CW, reset THC height	110	B1			X	X	AND	Debug/Run
Regen Toolpath	160	B2						
Goto Safe Z	104	B2	X					
Go Home	138	B2		X				
CV feed toggle	247	B2			X			
Touch button for Tool length offset	120	B2				X		
Mist toggle	114	B2	X		X		AND	
Single Step	1004	B2		X		X	AND	
Flood toggle	113	B2			X	X	AND	Debug/Run
Stop	1003	B3						
Stop	1003	B3			X	X	AND	Debug/Run
Reset	1021	B4						
Reset	1021	B4			X	X	AND	Debug/Run
Function		**Func:**	**SL**	**AL**	**SR**	**AR**		**Remarks**
Pause (Feed Hold)	1001	BE						
Feed raise	108	BN						
Feed lower	109	BS						
Feedrate reset	1014	BW						
Toggle visibility of screen 50	323	BE	X					
Slow Jog Up	111	BN	X					
Slow Jog Dn	112	BS	X					
Jog increment cycle	171	BW	X					
Toggle visibility of screen 50	323	BE		X				
Jog Inc Up	100	BN		X				
Jog Inc Down	101	BS		X				
Jog increment cycle	171	BW		X				
Toggle visibility of screen 50	323	BE			X			
Slow Jog Up	111	BN			X			
Slow Jog Dn	112	BS			X			
Jog increment cycle	171	BW			X			
Toggle visibility of screen 50	323	BE				X		
Jog Inc Up	100	BN				X		
Jog Inc Down	101	BS				X		
Jog increment cycle	171	BW				X		
Spindle CW, reset THC height	110	BE	X		X		AND	
Raise spindle speed	163	BN	X		X		AND	
Lower spindle speed	164	BS	X		X		AND	
Cycle start	1000	BW	X		X		AND	
Clear error label	172	BE		X		X	AND	
Rewind	1002	BN		X		X	AND	
Re-load last file	170	BS		X		X	AND	
Close current file	169	BW		X		X	AND	
Pause (Feed Hold)	1001	BE			X	X	AND	Debug/Run
Machine Coordinates toggle	256	BN			X	X	AND	Debug/Run
Single Step	1004	BS			X	X	AND	Debug/Run
Cycle start	1000	BW			X	X	AND	Debug/Run
Function		**Func:**	**SL**	**AL**	**SR**	**AR**		**Remarks**
Program Run screen	1	PE						
Toolpath screen select	3	PN						

Diagnostics screen select	5	**PS**						
Offset Screen	7	**PW**						
Zero X	1008	**PE**	X					
Zero Y	1009	**PN**	X					
Zero Z	1010	**PS**	X					
Zero A	1011	**PW**	X					
Zero All	1007	**PW**	X		X		AND	
Part X Offset Touch	139	**PE**		X				
Part Y Offset Touch	140	**PN**		X				
Part Z Offset Touch	141	**PS**		X				
Part A Offset Touch	142	**PW**		X				
Ref X	1022	**PE**			X			
Ref Y	1023	**PN**			X			
Ref Z	1024	**PS**			X			
Ref A	1025	**PW**			X			
Home Z then X then Y, A, B, C - set machine coords	105	**PW**		X		X	AND	
CV feed toggle	247	**PE**			X	X	AND	Debug/Run
Feed raise	108	**PN**			X	X	AND	Debug/Run
Feed lower	109	**PS**			X	X	AND	Debug/Run
Rewind	1002	**PW**			X	X	AND	Debug/Run
Function	**OEMCode**	**Func:**	**SL**	**AL**	**SR**	**AR**		**Remarks**
Jog X axis		**S1V**	X		X		OR	Stick 1 Vertical movement
Jog Y axis		**S1H**	X		X		OR	Stick 1 Horizontal movement
Jog Z axis		**S2V**	X		X		OR	Stick 2 Vertical movement
Jog A axis		**S2H**	X		X		OR	Stick 2 Horizontal movement
Jog X axis in step		**S1V**		X		X	OR	Stick 1 Vertical movement
Jog Y axis in step		**S1H**		X		X	OR	Stick 1 Horizontal movement
Jog Z axis in step		**S2V**		X		X	OR	Stick 2 Vertical movement
Jog A axis in step		**S2H**		X		X	OR	Stick 2 Horizontal movement

Appendix E: 5 Axis Milling Machine

Function	OEMCode	Func:	SL	AL	SR	AR	Qualifier	Remarks
Machine Coordinates toggle	256	B1						
Softlimits Toggle	1029	B1	X					
Z inhibit toggle	167	B1		X				
Auto Lim Override Toggle	149	B1			X			
--ignored--		B1				X		
Flood toggle	113	B1	X		X		AND	
--ignored--		B1		X		X	AND	
Spindle CW, reset THC height	110	B1			X	X	AND	Debug/Run
Regen Toolpath	160	B2						
Goto Safe Z	104	B2	X					
Go Home	138	B2		X				
CV feed toggle	247	B2			X			
Touch button for Tool length offset	120	B2				X		
Mist toggle	114	B2	X		X		AND	
Single Step	1004	B2		X		X	AND	
Flood toggle	113	B2			X	X	AND	Debug/Run
Stop	1003	B3						
Stop	1003	B3			X	X	AND	Debug/Run
Reset	1021	B4						
Reset	1021	B4			X	X	AND	Debug/Run
Function		**Func:**	**SL**	**AL**	**SR**	**AR**		**Remarks**
Pause (Feed Hold)	1001	BE						
Feed raise	108	BN						
Feed lower	109	BS						
Feedrate reset	1014	BW						
Toggle visibility of screen 50	323	BE	X					
Slow Jog Up	111	BN	X					
Slow Jog Dn	112	BS	X					
Jog increment cycle	171	BW	X					
Toggle visibility of screen 50	323	BE		X				
Jog Inc Up	100	BN		X				
Jog Inc Down	101	BS		X				
Jog increment cycle	171	BW		X				
Toggle visibility of screen 50	323	BE			X			
Slow Jog Up	111	BN			X			
Slow Jog Dn	112	BS			X			
Jog increment cycle	171	BW			X			
Toggle visibility of screen 50	323	BE				X		
Jog Inc Up	100	BN				X		
Jog Inc Down	101	BS				X		
Jog increment cycle	171	BW				X		
Spindle CW, reset THC height	110	BE	X		X		AND	
Raise spindle speed	163	BN	X		X		AND	
Lower spindle speed	164	BS	X		X		AND	
Cycle start	1000	BW	X		X		AND	
Clear error label	172	BE		X		X	AND	
Rewind	1002	BN		X		X	AND	
Re-load last file	170	BS		X		X	AND	
Close current file	169	BW		X		X	AND	
Pause (Feed Hold)	1001	BE			X	X	AND	Debug/Run
Machine Coordinates toggle	256	BN			X	X	AND	Debug/Run
Single Step	1004	BS			X	X	AND	Debug/Run
Cycle start	1000	BW			X	X	AND	Debug/Run
Function		**Func:**	**SL**	**AL**	**SR**	**AR**		**Remarks**
Program Run screen	1	PE						
Toolpath screen select	3	PN						

Diagnostics screen select	5	**PS**						
Offset Screen	7	**PW**						
Zero X	1008	**PE**	X					
Zero Y	1009	**PN**	X					
Zero Z	1010	**PS**	X					
--ignored--		**PW**	X					
Zero All	1007	**PW**	X	X			AND	
Zero A	1011	**PE**		X				
Zero C	1013	**PN**		X				
--ignored--		**PS**		X				
--ignored--		**PW**		X				
Part X Offset Touch	139	**PE**			X			
Part Y Offset Touch	140	**PN**			X			
Part Z Offset Touch	141	**PS**			X			
--ignored--		**PW**			X			
Part A Offset Touch	142	**PE**				X		
Part C Offset Touch	144	**PN**				X		
--ignored--		**PS**				X		
--ignored--		**PW**				X		
Ref X	1022	**PE**	X		X		AND	
Ref Y	1023	**PN**	X		X		AND	
Ref Z	1024	**PS**	X		X		AND	
--ignored--		**PW**						
Ref A	1025	**PE**		X		X	AND	
Ref C	1027	**PN**		X		X	AND	
--ignored--		**PS**						
Home Z then X then Y, A, B, C - set machine coords	105	**PW**		X		X	AND	
CV feed toggle	247	**PE**			X	X	AND	Debug/Run
Feed raise	108	**PN**			X	X	AND	Debug/Run
Feed lower	109	**PS**			X	X	AND	Debug/Run
Rewind	1002	**PW**			X	X	AND	Debug/Run
Function	**OEMCode**	**Func:**	**SL**	**AL**	**SR**	**AR**		**Remarks**
Jog X axis		**S1V**	X					Stick 1 Vertical movement
Jog Y axis		**S1H**	X					Stick 1 Horizontal movement
Jog Z axis		**S2V**	X					Stick 2 Vertical movement
Jog A axis		**S2H**	X					Stick 2 Horizontal movement
Jog C axis		**S2H**		X				Stick 2 Horizontal movement
Jog X axis in step		**S1V**			X			Stick 1 Vertical movement
Jog Y axis in step		**S1H**			X			Stick 1 Horizontal movement
Jog Z axis in step		**S2V**			X			Stick 2 Vertical movement
Jog A axis in step		**S2H**			X			Stick 2 Horizontal movement
Jog C axis in step		**S2H**				X		Stick 2 Horizontal movement

Appendix F: Mach3 commands and groups

100	Not included as selectable command (special commands)		
1	Harmless function		
2	Potentially harmful		
3	Harmful		
DoButton 1 = DoOEMButton 1001			
Total			
Group:	**Action:**	**DoOEMButton:**	**Function (shown in Tooltip):**
1	-- Ignore --	-1	Ignore this button
1	-- Execute script --	0	Execute script in M800
1	Auto Lim Override Toggle	149	Auto Lim Override Toggle
1	Clear Status	172	Clear status line
1	Close File	169	Close loaded G-code file
1	CV feed toggle	247	CV feed toggle
3	Cycle Start	1000	Run/continue G-code execution
1	Feed Hold (Pause)	1001	Pause G-code execution
1	Feedrate --	109	Feedrate decrease (override)
1	Feedrate ++	108	Feedrate increase (override)
1	Feedrate Reset	1014	Turn off feedrate override
2	Flood Toggle	113	Toggle flood cooling on/off
3	Go Home	138	Go Home
2	Goto Safe Z	104	Goto safe Z position
1	Jog --	112	Jog pct. Down
1	Jog ++	111	Jog pct. Up
1	Jog Inc Cycle	171	Jog increment cycle
1	Jog Incr --	101	Jog step decrement
1	Jog Incr ++	100	Jog step increment
1	Jog Screen Toggle	323	Jog screen show/hide
1	Machine Coordinates toggle	256	Machine Coordinates toggle
2	Mist Toggle	114	Toggle mist cooling on/off
3	Part A Offset Touch	142	Part A Offset Touch
3	Part C Offset Touch	144	Part C Offset Touch
3	Part X Offset Touch	139	Part X Offset Touch
3	Part Y Offset Touch	140	Part Y Offset Touch
3	Part Z Offset Touch	141	Part Z Offset Touch
2	Ref A	1025	Reference A axe
2	Ref C	1027	Reference C axe
3	Ref All	105	Reference Z then X then Y, A, B and C
2	Ref X	1022	Reference X axe
2	Ref Y	1023	Reference Y axe
2	Ref Z	1024	Reference Z axe
1	Regen Toolpath	160	Regen toolpath in display
1	Reload Last File	170	Reload last G-code file
1	Reset	1021	Reset (activate EStop)
2	Rewind	1002	Rewind G-code file
1	Screen 1 (Program)	1	Select Program screen 1
1	Screen 4 (ToolPath)	4	Select Toolpath screen 4
1	Screen 5 (Offset)	5	Select Offset screen 5
1	Screen 7 (Diagnostics)	7	Select Diagnostics screen 7
2	Single Step	1004	Execute single line

1	Softlimits Toggle	1029	Toggle softlimits on/off
1	Spindle --	164	Spindle speed decrease
1	Spindle ++	163	Spindle speed increase
2	Spindle Toggle	110	Toggle spindle on/off
1	Stop	1003	Stop G-code execution
2	Touch Tool	120	Touch button for Tool length offset
1	Z Inhibit Toggle	167	Toggle Z inhibit on/off
1	Zero A	1011	Zero A axe on current position
1	Zero C	1013	Zero C axe on current position
1	Zero All	1007	Zero all axes on current position
1	Zero X	1008	Zero X axe on current position
1	Zero Y	1009	Zero Y axe on current position
1	Zero Z	1010	Zero Z axe on current position
100	Jog Toggle ON/OFF	103	Toggle jog on/off
100	Screen 2 (MDI)	2	Select MDI screen 2
100	Screen 3	3	Select screen 3
100	Screen 6 (Settings)	6	Select Settings screen 6
100	RS274 Init	102	RS274 Init
100	mm/inch	106	Set units mm/inch (G20/G21)
100	Machine Coords Toggle	107	Toggle machine coordinates on/off
100	Edit G-code	115	Edit loaded G-code
100	Zero radius DRO on X	116	Zero radius DRO on X
100	Zero radius DRO on Y	117	Zero radius DRO on Y
100	Zero radius DRO on Z	118	Zero radius DRO on Z
100	SoftLimits Toggle	119	Toggle softlimits on/off
100	Tool Tab Save	121	Tool Tab Save
100	Fixture Tab Save	122	Fixture Tab Save
100	THC on/off	123	Toggle THC
100	Zero THC	124	Zero THC
100	Enc Load X	125	Encoder Load X
100	Enc To X	126	Encoder To X
100	Enc Load Y	127	Encoder Load Y
100	Enc To Y	128	Encoder To Y
100	Enc Load Z	129	Encoder Load Z
100	Enc To Z	130	Encoder To Z
100	Toggle Mill/Turn mode	131	Toggle Mill/Turn mode
100	Toolpath Toggle	132	Toggle toolpath on/off
100	Zero X Encoder	133	Zero X Encoder
100	Zero Y Encoder	134	Zero Y Encoder
100	Zero Z Encoder	135	Zero Z Encoder
100	Tool Offset Tog	136	Tool Offset Tog
100	Fixture Off	137	Fixture Off
100	Tool X Offset Touch	145	Tool X Offset Touch
100	Tool Z Offset Touch	146	Tool Z Offset Touch
100	Joy Throttle select	147	Joy Throttle select
100	Touch Corr Enable Toggle	148	Touch Corr Enable Toggle
100	Auto Lim Override Toggle	149	Auto Lim Override Toggle
100	Override Limits	150	Override limits
100	SS on Act4 Toggle	151	SS on Act4 Toggle
100	Units/rev - Units/min toggle	155	Units/rev - Units/min toggle
100	Set this line as next to execute	156	Set this line as next to execute
100	Jog Follow	157	Jog Follow
100	Joystick On	158	Joystick On

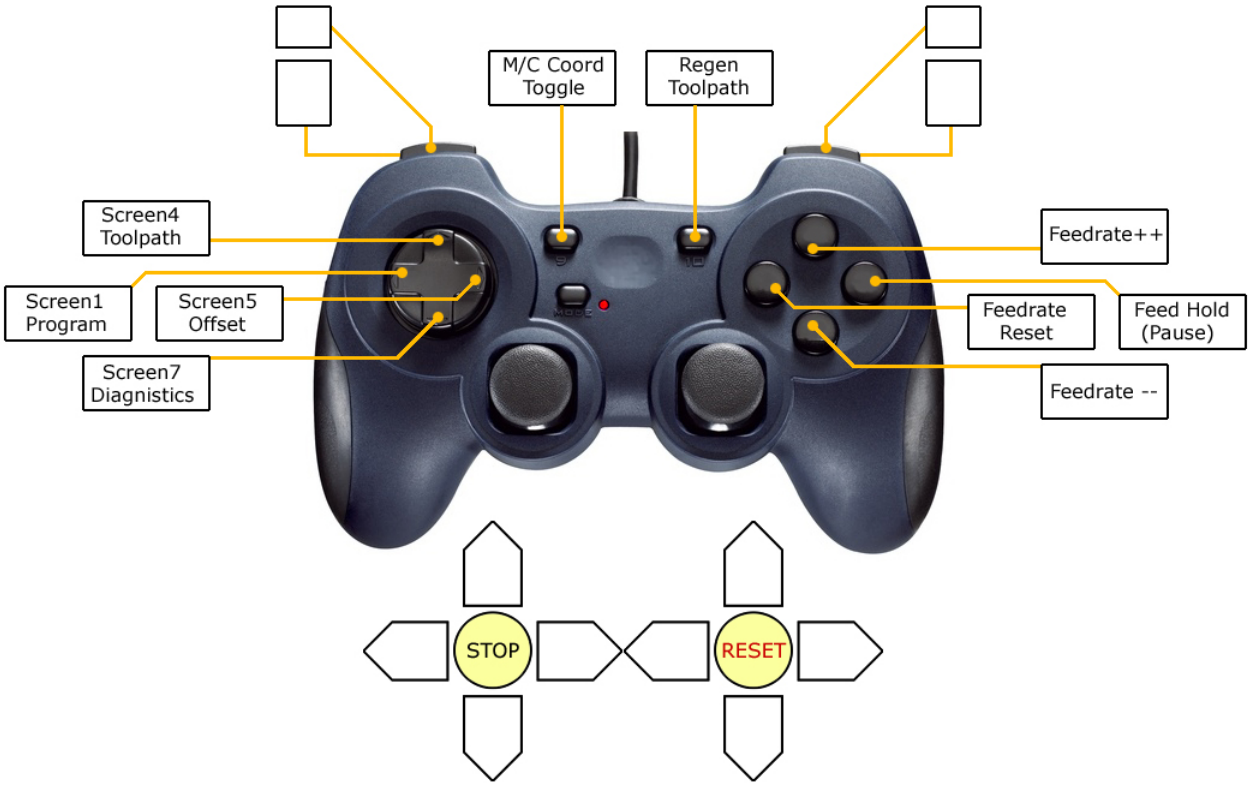
100	Joystick Off	159	Joystick Off
100	Zero X-Z to Stock	161	Zero X-Z to stock as defined in DROs (Turn)
100	Coord Mode Toggle	162	Coordinate mode toggle (G90/G91)
100	Laser Probe Enable Toggle	165	Laser Probe Enable Toggle
100	Zero laser grid at current location	166	Zero laser grid at current location
100	Ignore Tool Change toggle	168	Ignore Tool Change toggle
100	Spindle CCW Toggle	173	Toggle spindle CCW on/off
100	Parallel Port Encoder3 MPG Jog Toggle	174	Parallel Port Encoder3 MPG Jog Toggle
100	Cycle axis controlled by MPG 1	175	Cycle axis controlled by MPG 1
100	Block Delete Toggle	176	Toggle block delete on/off
100	Optional Stop Toggle	177	Toggle optional stop on/off
100	Online Toggle	178	Toggle online on/off
100	Display Abs Machine coordinates	179	Display Abs Machine coordinates
100	Display Work + G92 coordinates	180	Display Work + G92 coordinates
100	Display Work coords	181	Display Work coords
100	??? Toggle Spindle actual	182	??? Toggle Spindle actual
100	Home X, Home Z (Turn)	184	Home X, Home Z (Turn)
100	Select X for MPG 1	185	Select X for MPG 1
100	Select Y for MPG 1	186	Select Y for MPG 1
100	Select Z for MPG 1	187	Select Z for MPG 1
100	Select A for MPG 1	188	Select A for MPG 1
100	Select B for MPG 1	189	Select B for MPG 1
100	Select C for MPG 1	190	Select C for MPG 1
100	Select Jog Increment 1	191	Select Jog Increment 1
100	Select Jog Increment 2	192	Select Jog Increment 2
100	Select Jog Increment 3	193	Select Jog Increment 3
100	Select Jog Increment 4	194	Select Jog Increment 4
100	Select Jog Increment 5	195	Select Jog Increment 5
100	Select Jog Increment 6	196	Select Jog Increment 6
100	Select Jog Increment 7	197	Select Jog Increment 7
100	Select Jog Increment 8	198	Select Jog Increment 8
100	Select Jog Increment 9	199	Select Jog Increment 9
100	Select Jog Increment 10	200	Select Jog Increment 10
100	Feed override Off	201	Feed override Off
100	Feed override Jog	202	Feed override Jog
100	Feed override Feed	203	Feed override Feed
100	Jog Mode Continuous	204	Set jog mode to continuous
100	Jog Mode Step	205	Set jog mode step
100	Joystick On	206	Joystick On
100	Joystick Off	207	Joystick Off
100	Clear Z tool offset (Turn)	208	Clear Z tool offset (Turn)
100	Clear X tool offset (Turn)	209	Clear X tool offset (Turn)
100	Set stock correction to Zero (Turn)	210	Set stock correction to Zero (Turn)
100	Home X Home Z (Turn)	211	Home X Home Z (Turn)
100	Home X (Turn)	212	Home X (Turn)
100	Home Z (Turn)	213	Home Z (Turn)
100	Show Recent Files	214	Show recent G-code files
100	Display History	215	Display status history in notepad
100	Load File	216	Load G-code file from File Open dialog
100	Tool flip toggle (Turn front/rear toolposts)	217	Tool flip toggle (Turn front/rear toolposts)
100	Z-inhibit ON	218	Z-inhibit ON
100	Z-inhibit OFF	219	Z-inhibit OFF
100	Port Bit-Test Set (diagnostic)	220	Port Bit-Test Set (diagnostic)

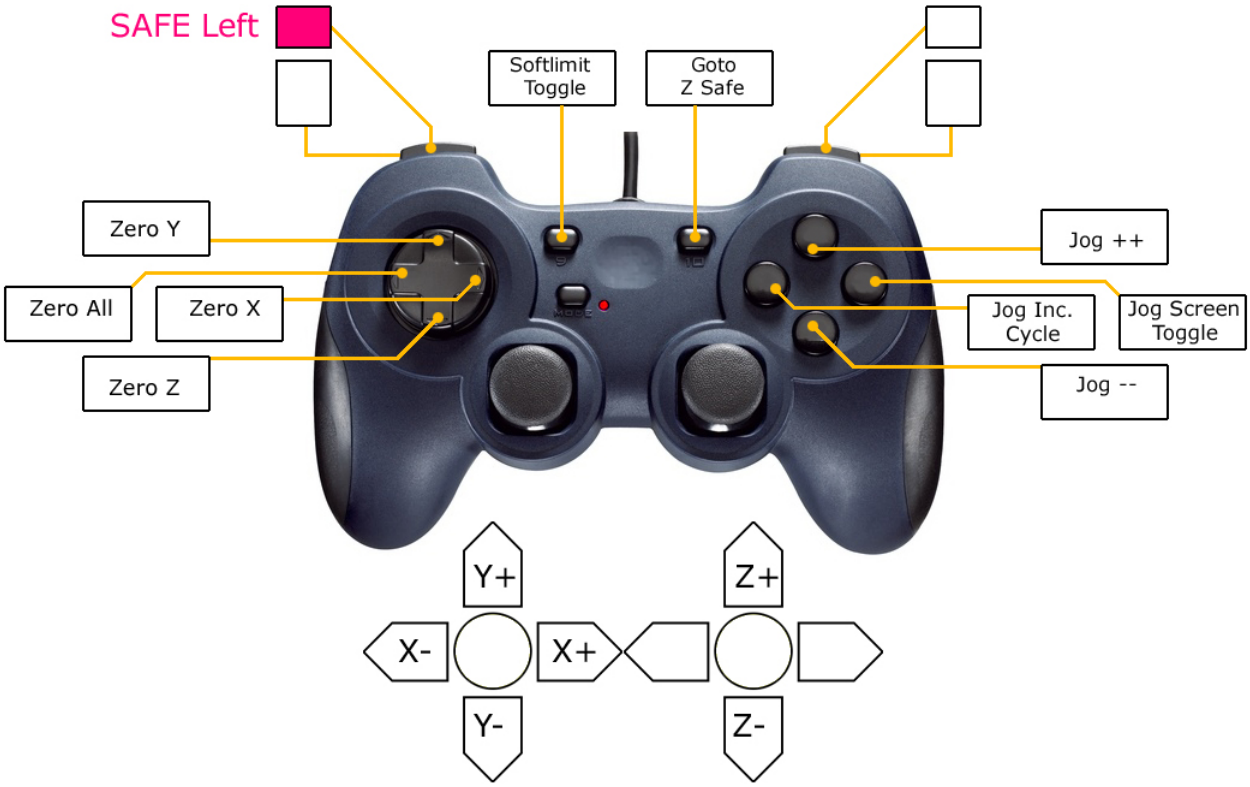
100	Anti-dive enabled toggle	221	Anti-dive enabled toggle
100	THC Anti-dive OFF	222	THC Anti-dive OFF
100	THC Anti-dive ON	223	THC Anti-dive ON
100	Flood ON	224	Flood ON
100	Flood OFF	225	Flood OFF
100	Mist ON	226	Mist ON
100	Mist OFF	227	Mist OFF
100	Load Teach File	228	Load teach file
100	Toolpath Machine/Job toggle	229	Toolpath Machine/Job toggle
100	Display Wizard selection window	230	Display Wizard selection window
100	Load the normal screens when Wizard done	231	Load the normal screens when Wizard done
100	Simple Complex screen toggle	232	Simple Complex screen toggle
100	Output 4 ON	233	Output 4 ON
100	Output 4 OFF	234	Output 4 OFF
100	Output 5 ON	235	Output 5 ON
100	Output 5 OFF	236	Output 5 OFF
100	Output 6 ON	237	Output 6 ON
100	Output 6 OFF	238	Output 6 OFF
100	Set Help context	239	Set Help context
100	Def-Ref all axes	240	Def-Ref all axes
100	Tangential toggle	241	Tangential toggle
100	Save XYZ to G59.254 work offset	242	Save XYZ to G59.254 work offset
100	do G0G53 to G59.254 offset location	243	do G0G53 to G59.254 offset location
100	Move to G59.254 with midpoint selection	244	Move to G59.254 with midpoint selection
100	Jog Mode Cont/Step/MPG	245	Toggle between jog modes continuous/step/MPG
100	Force Referenced on all axes	246	Force Referenced on all axes
100	CV feed OFF	248	CV feed OFF
100	CV feed ON	249	CV feed ON
100	Disable movement on axis X	250	Disable movement on axis X
100	Disable movement on axis Y	251	Disable movement on axis Y
100	Disable movement on axis Z	252	Disable movement on axis Z
100	Disable movement on axis A	253	Disable movement on axis A
100	Disable movement on axis B	254	Disable movement on axis B
100	Disable movement on axis C	255	Disable movement on axis C
100	Engine Offline	257	Engine Offline
100	Engine Online	258	Engine Online
100	Select encoder jog on axis X	259	Select encoder jog on axis X
100	Select encoder jog on axis Y	260	Select encoder jog on axis Y
100	Select encoder jog on axis Z	261	Select encoder jog on axis Z
100	Select encoder jog on axis A	262	Select encoder jog on axis A
100	Select encoder jog on axis B	263	Select encoder jog on axis B
100	Select encoder jog on axis C	264	Select encoder jog on axis C
100	Select Step value 1	265	Select Step value 1
100	Select Step value 2	266	Select Step value 2
100	Select Step value 3	267	Select Step value 3
100	Select Step value 4	268	Select Step value 4
100	Select Step value 5	269	Select Step value 5
100	Select Step value 6	270	Select Step value 6
100	Select Step value 7	271	Select Step value 7
100	Select Step value 8	272	Select Step value 8
100	Select Step value 9	273	Select Step value 9
100	Select Step value 10	274	Select Step value 10

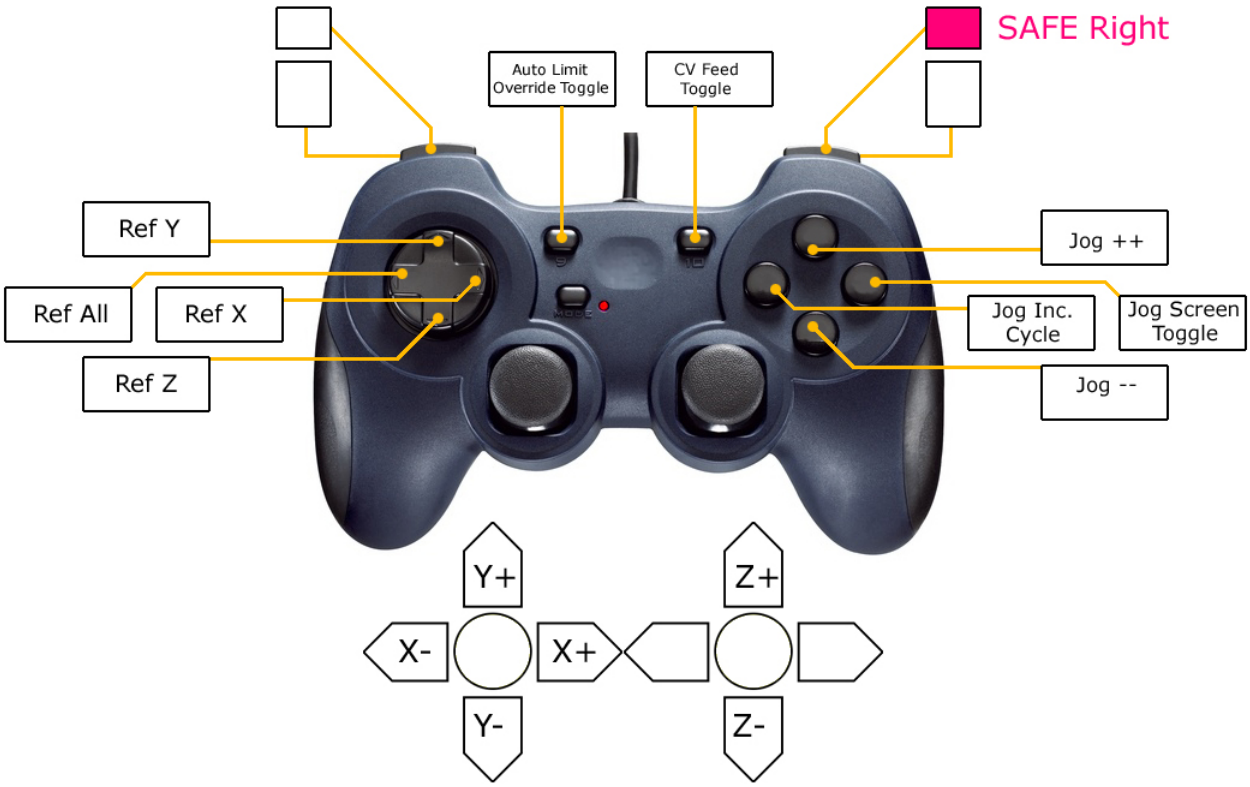
100	Set Jog mode STEP (same as button 205)	275	Set Jog mode STEP (same as button 205)
100	Set Jog mode CONT (same as button 204)	276	Set Jog mode CONT (same as button 204)
100	Increment feedrate	277	Increment feedrate
100	Decrement feedrate	278	Decrement feedrate
100	Run reverse	279	Run reverse
100	Switch to last used Wizard	280	Switch to last used Wizard
100	Cycle axis controlled by MPG 2	281	Cycle axis controlled by MPG 2
100	Toggle taper mode on MPG 2	282	Toggle taper mode on MPG 2
100	Toggle dual MPG flag	283	Toggle dual MPG flag
100	Toggle shuttle mode for MPG	284	Toggle shuttle mode for MPG
100	Return to paused state	285	Return to paused state
100	Remember paused state	286	Remember paused state
100	Toggle override of rapid feeds	287	Toggle override of rapid feeds
100	Crop current dwell now	288	Crop current dwell now
100	Inhibit jog of X axis	290	Inhibit jog of X axis
100	Inhibit jog of Y axis	291	Inhibit jog of Y axis
100	Inhibit jog of Z axis	292	Inhibit jog of Z axis
100	Inhibit jog of A axis	293	Inhibit jog of A axis
100	Inhibit jog of B axis	294	Inhibit jog of B axis
100	Inhibit jog of C axis	295	Inhibit jog of C axis
100	Do screw calibration routine	296	Do screw calibration routine
100	Unconditional crop any dwell now	297	Unconditional crop any dwell now
100	reserved	298	reserved
100	Toggle bypass feed (enables value in OEM DRO 122)	299	Toggle bypass feed (enables value in OEM DRO 122)
100	Toggle current tool is in front toolpost	300	Toggle current tool is in front toolpost
100	Code for OEMTriggers runs the macro in SetTriggerMacro	301	Code for OEMTriggers runs the macro in SetTriggerMacro
100	Cycle MPG jogging mode	302	Cycle MPG jogging mode
100	Set MPG jogging mode = Velocity	303	Set MPG jogging mode = Velocity
100	Set MPG jogging mode = Velocity/Step	304	Set MPG jogging mode = Velocity/Step
100	Set MPG jogging mode = do single exact steps	305	Set MPG jogging mode = do single exact steps
100	Set MPG jogging mode = do multiple exact steps	306	Set MPG jogging mode = do multiple exact steps
100	Jog X+	307	Push jog X+
100	Jog X-	308	Push jog X-
100	Jog Y+	309	Push jog Y+
100	Jog Y-	310	Push jog Y-
100	Jog Z+	311	Push jog Z+
100	Jog Z-	312	Push jog Z-
100	Jog A+	313	Push jog A+
100	Jog A-	314	Push jog A-
100	Calibrate MPGs	315	Calibrate MPGs
100	Save tool table	316	Save tool table
100	Save work offset table	317	Save work offset table
100	Drag on toolpath does Zoom toggle	318	Drag on toolpath does Zoom toggle
100	Drag on toolpath does Pan toggle	319	Drag on toolpath does Pan toggle
100	Display Wizard select dialog	320	Display Wizard select dialog
100	Run Newfangled Wizard	321	Run Newfangled Wizard
100	Emergency bailout - tester use only	322	Emergency bailout - tester use only
100	Turn mode tool touch off X axis	324	Turn mode tool touch off X axis
100	Toggle use of spindle step line to control Torch volts	325	Toggle use of spindle step line to control Torch volts
100	Turn mode tool touch off Z axis	326	Turn mode tool touch off Z axis

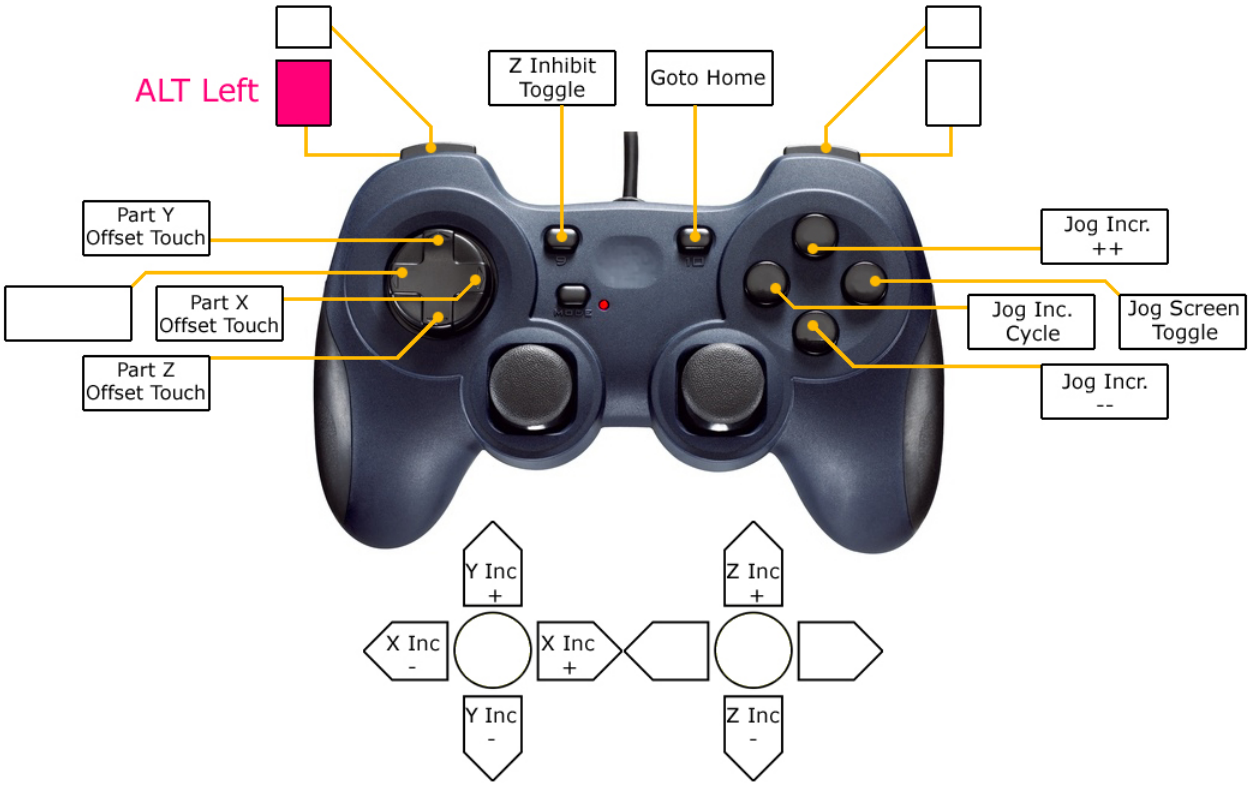
100	Select MPG jog mode	327	Select MPG jog mode
100	Toggle axis DROs display Dist to Go	333	Toggle axis DROs display Dist to Go
100	Toggle X jog off	334	Toggle X jog off
100	Toggle Y jog off	335	Toggle Y jog off
100	Toggle Z jog off	336	Toggle Z jog off
100	Toggle A jog off	337	Toggle A jog off
100	Set a temporary softlimit minimum at current location	340	Set a temporary softlimit minimum at current location
100	Set a temporary softlimit maximum at current location	341	Set a temporary softlimit maximum at current location
100	Turn off display of menu bar	348	Turn off display of menu bar
100	Turn on display of menu bar	349	Turn on display of menu bar
100	Increment spindle speed by value not % (Turn)	350	Increment spindle speed by value not % (Turn)
100	Decrement spindle speed by value not % (Turn)	351	Decrement spindle speed by value not % (Turn)
100	Jog X and A axis ++ together (foam machines)	352	Jog X and A axis ++ together (foam machines)
100	Jog X and A axis -- together (foam machines)	353	Jog X and A axis -- together (foam machines)
100	Jog Y and A axis ++ together (foam machines)	354	Jog Y and A axis ++ together (foam machines)
100	Jog Y and A axis -- together (foam machines)	355	Jog Y and A axis -- together (foam machines)
100	Resume	1005	Resume G-code execution
100	Edit File	1006	Edit G-code file
100	Zero B	1012	Zero B axe on current position
100	Zero C	1013	Zero C axe on current position
100	Simulate (Estimate)	1015	Simulate program run to estimate
100	Run from here	1016	Execute G-code from here
100	Goto Z's	1017	Goto Z
100	Coord System	1018	Coord system
100	Verify	1020	Verify
100	Ref B	1026	Reference B axe
100	Ref C	1027	Reference C axe
100	Joystick Toggle	1028	Toggle joystick enable/disable
100	Radius Tracking Toggle	1030	Toggle radius tracking on/off
100	Jog on/off	1031	Toggle jogging

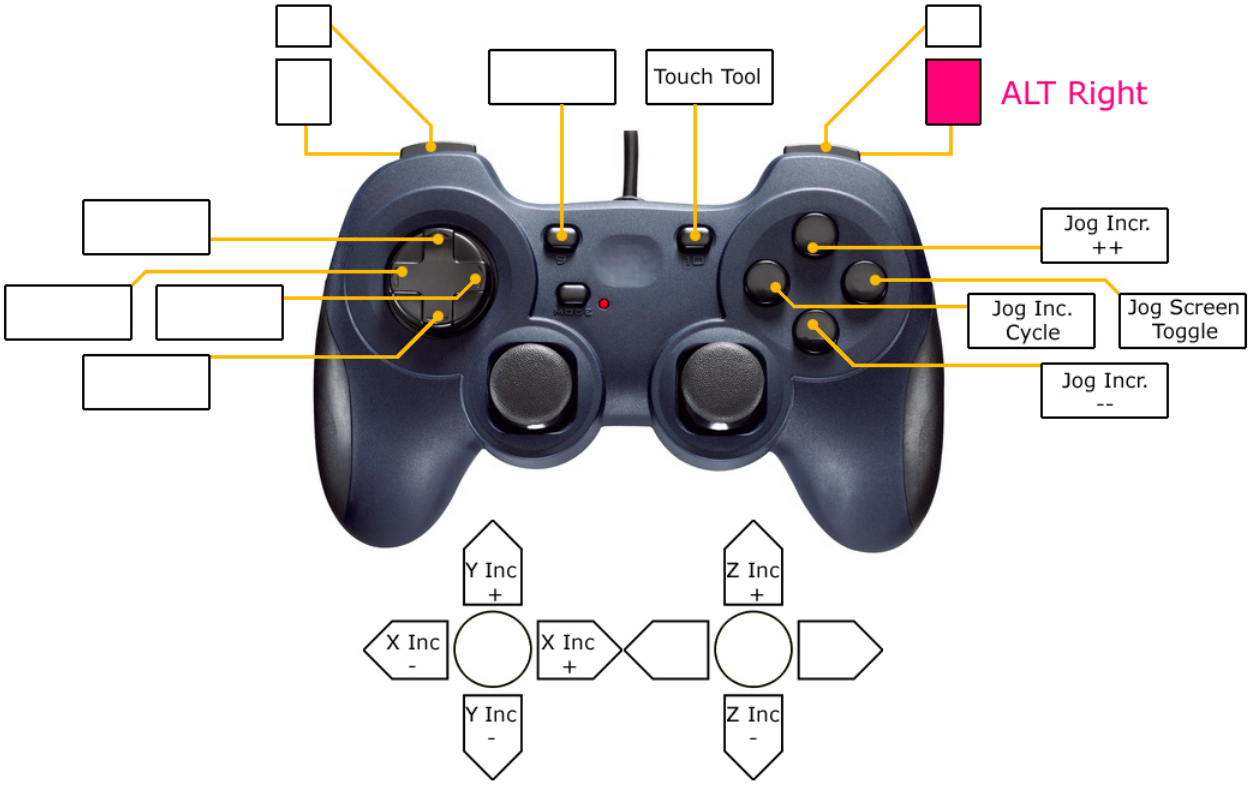
Appendix G: Button assignment for a 3 Axis machine

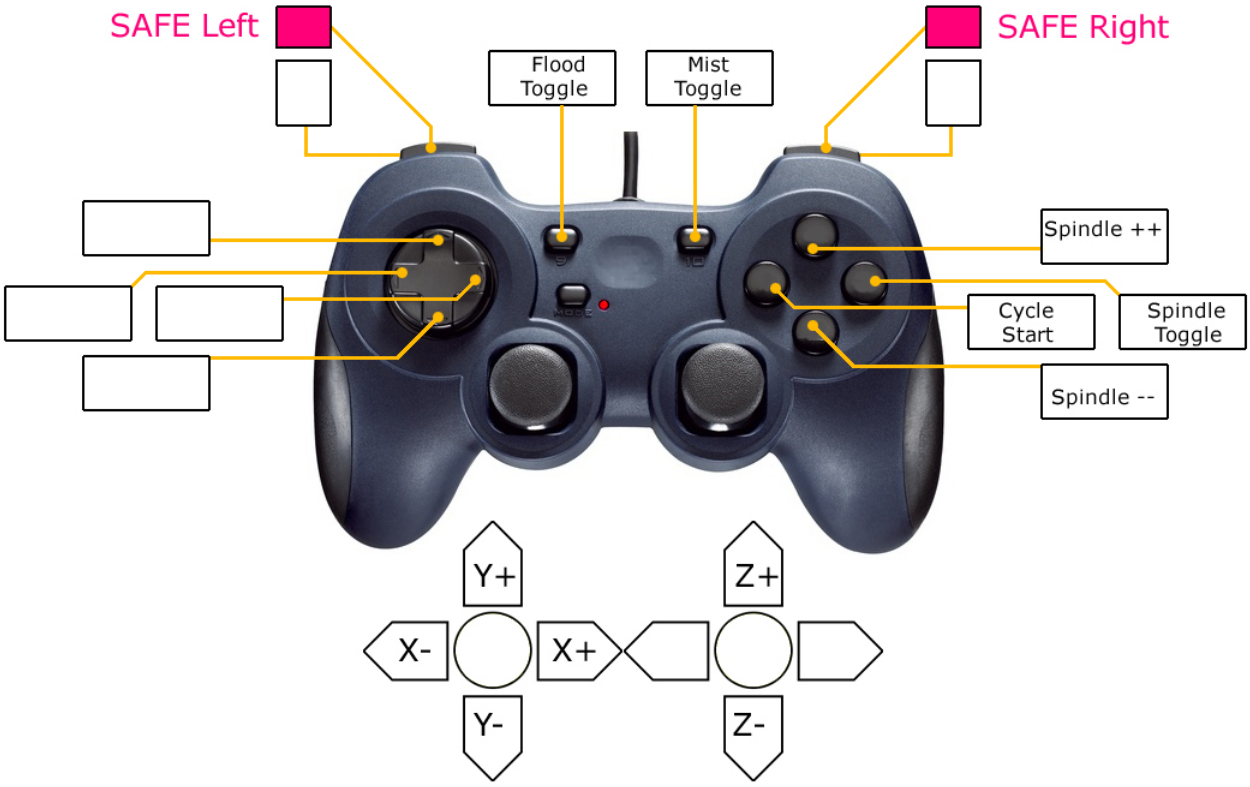


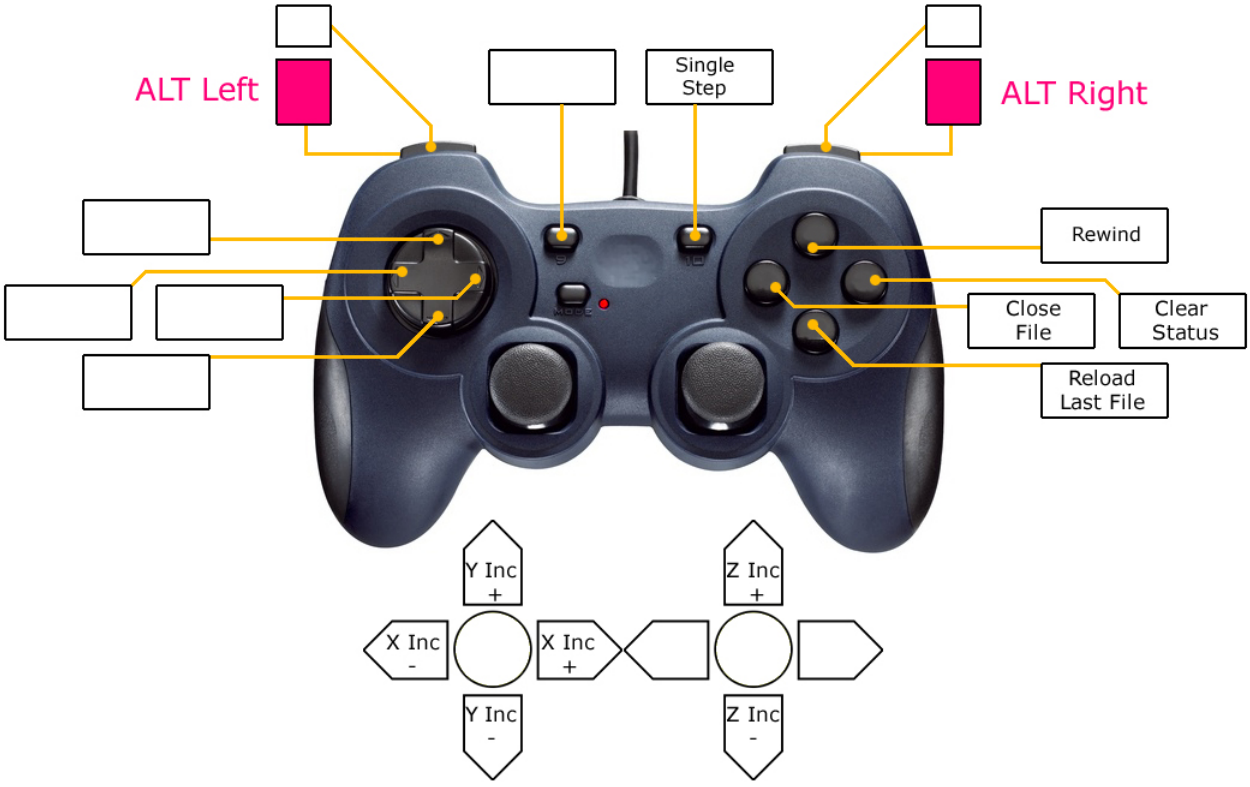

SAFE Left
Softlimit Toggle
Goto Z Safe
Zero Y
Zero All
Zero X
Zero Z
Jog ++
Jog Inc. Cycle
Jog Screen Toggle
Jog --
Y+
Z+
X-
X+
Y-
Z-

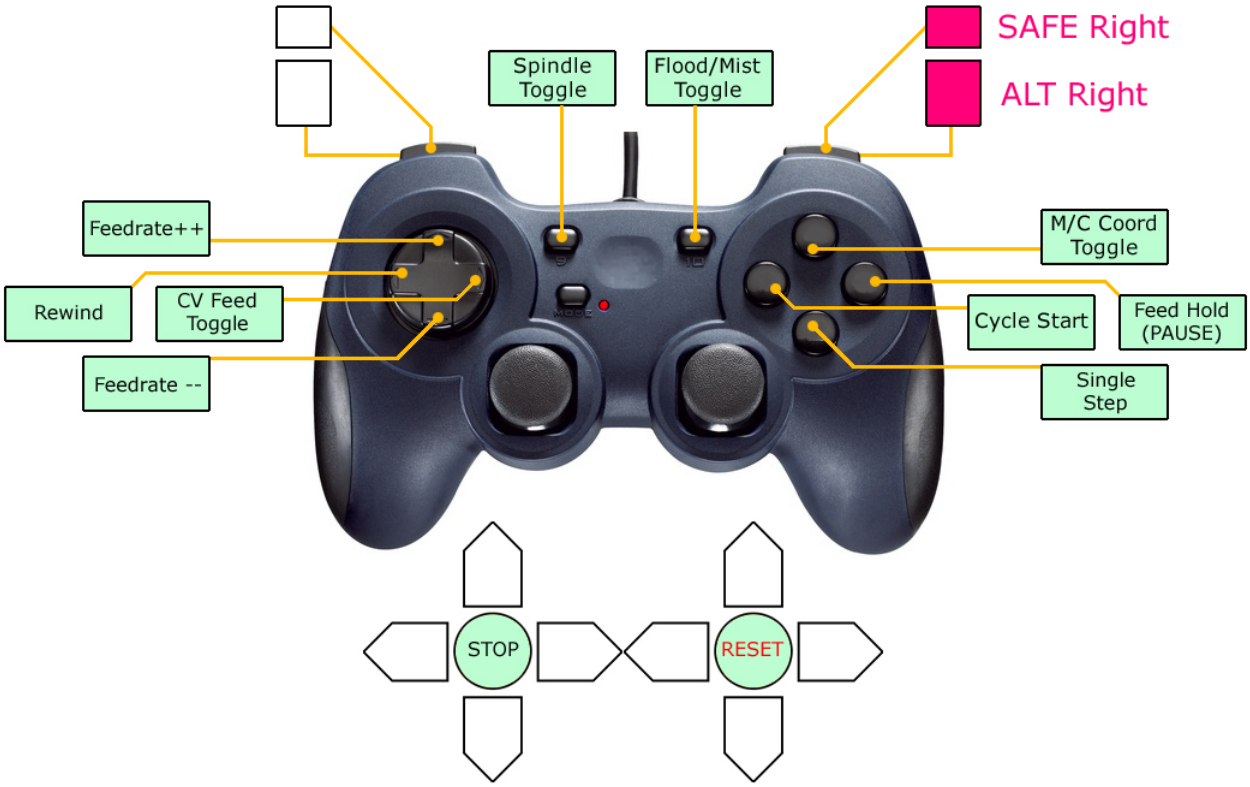

SAFE Right
Auto Limit Override Toggle
CV Feed Toggle
Ref Y
Ref All
Ref X
Ref Z
Jog ++
Jog Inc. Cycle
Jog Screen Toggle
Jog --
Y+
Z+
X-
X+
Y-
Z-


ALT Left
Z Inhibit Toggle
Goto Home
Part Y Offset Touch
Part X Offset Touch
Part Z Offset Touch
Jog Incr. ++
Jog Inc. Cycle
Jog Screen Toggle
Jog Incr. --
Y Inc +
Z Inc +
X Inc -
X Inc +
Y Inc -
Z Inc -

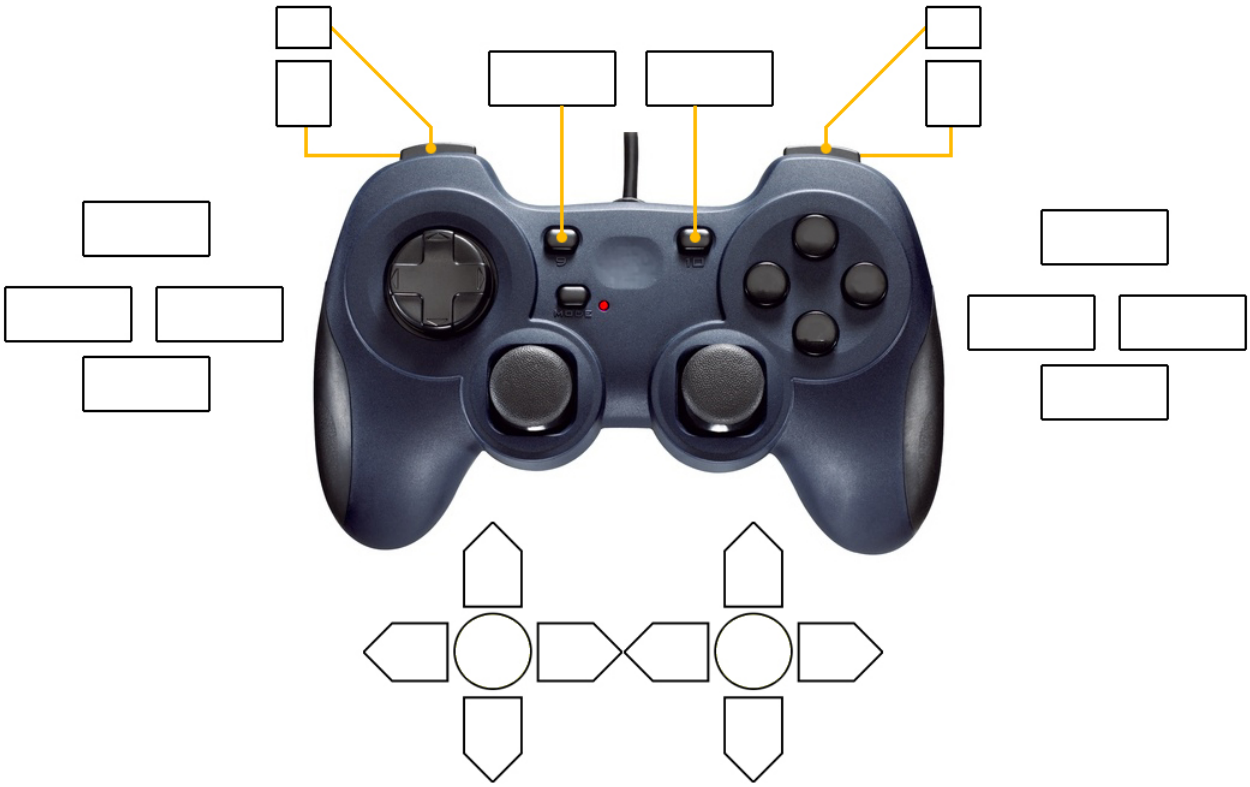

Touch Tool
ALT Right
Jog Incr. ++
Jog Inc. Cycle
Jog Screen Toggle
Jog Incr. --
Y Inc +
Z Inc +
X Inc -
X Inc +
Y Inc -
Z Inc -

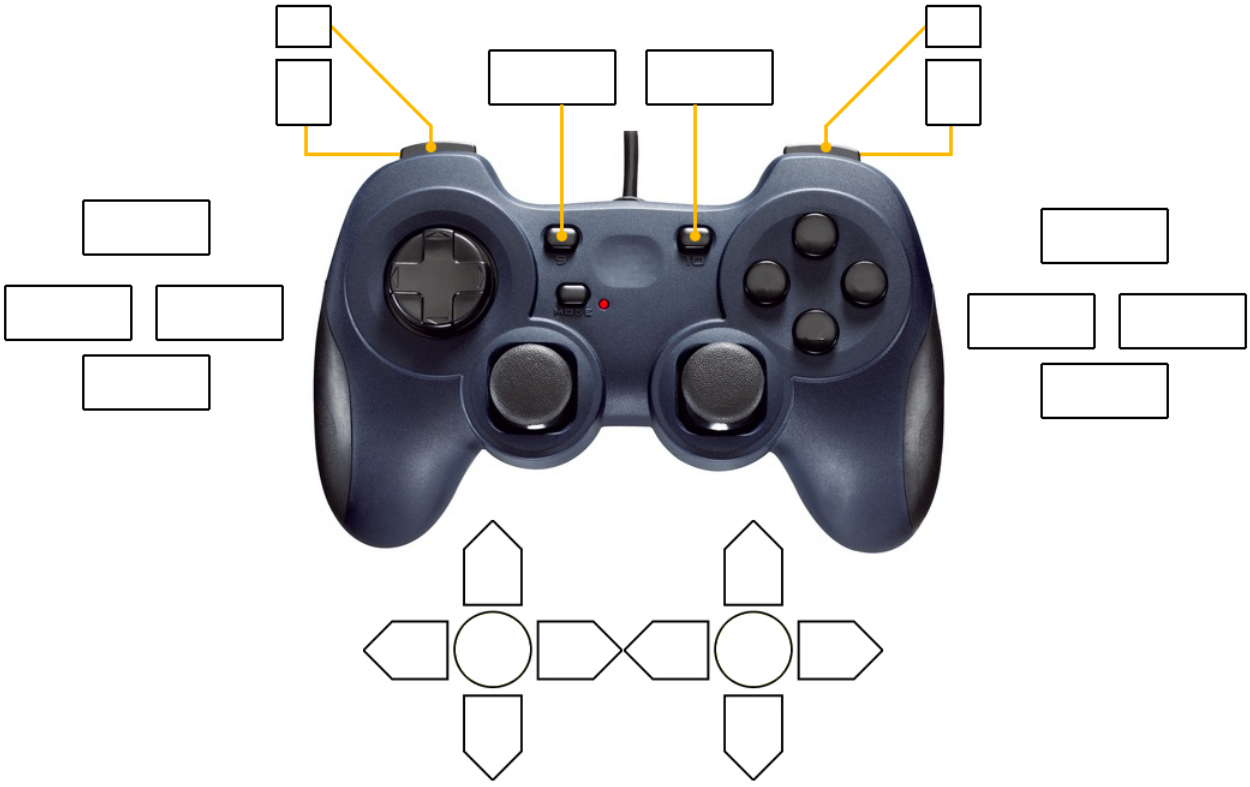

SAFE Left
SAFE Right
Flood Toggle
Mist Toggle
Spindle ++
Cycle Start
Spindle Toggle
Spindle --
Y+
Z+
X-
X+
Y-
Z-


ALT Left
ALT Right
Single Step
Rewind
Close File
Clear Status
Reload Last File
Y Inc +
Z Inc +
X Inc -
X Inc +
Y Inc -
Z Inc -


SAFE Right
ALT Right
Spindle Toggle
Flood/Mist Toggle
Feedrate++
Rewind
CV Feed Toggle
Feedrate --
M/C Coord Toggle
Cycle Start
Feed Hold (PAUSE)
Single Step
STOP
RESET

Appendix H: Custom button assignments





Appendix I: M800.m1s standard macro for script

The JoyPad plugin automatically generates a standard macro (M800.m1s) when it's missing for the current profile. It will be the base for developing your own script code for buttons actions on your game device.

In contrast to earlier versions of the plugin, there is now only one macro to handle all button actions.

This simplifies things and makes it easier to reuse code between different button actions.

Each Mach profile will have its own M800 macro – Mach will keep track of which macro to use for a given profile. This means that changes made in a macro for one profile will not reflect on M800 macros for other profiles.

Normally M800 is located in C:\Mach3\macros\[current profile]\M800.m1s:

```
'----------------------------------------------------------------------
' JoyPad plugin version 2.0
' By Joakim Hjort 2009 - 2011.
'
' Auto generated macro from JoyPad plugin, M800.m1s.
'
' This macro is executed if a button is pressed and assigned script
' function in JoyPadSetup program.
'
' M800.m1s must be placed in Mach3 macros folder under the active
' machine profile.
'
' Documentation for JoyPad plugin can be found in JoyPad User manual.
' Script documentation can be found at Mach support web:
'   http://www.machsupport.com
'
' Three parameters are passed to this script:
'
'   EState: Mach engine state
'   Button: The button pressed, 0 .. 15
'   SState: Shift buttons pressed (SL, SR, AL and AR)
'----------------------------------------------------------------------
Option Explicit

' Constants for EState.
Const ESTOP      = 0 ' STOP
Const ERUN       = 1 ' RUN
Const EPAUSE     = 2 ' PAUSE
Const EFINISHING = 3 ' FINISHING
Const EMDISTATE  = 4 ' MDISTATE
Const EWAITING   = 5 ' WAITING
Const ESINGLE    = 6 ' SINGLE

' Constants for Button.
Const BN =  0
Const BE =  1
Const BS =  2
Const BW =  3
Const B1 =  4
Const B2 =  5
Const B3 =  6
Const B4 =  7
Const B5 =  8 ' B5 to B8 not on standard game pads
Const B6 =  9
Const B7 = 10
Const B8 = 11
Const PN = 12 ' POV buttons
Const PE = 13
```

```
Const PS = 14
Const PW = 15

'------------------------------------------------------------------------
' Variables to hold parameters passed from JoyPad plugin.
Dim EState As Integer ' Engine state (RUN, STOP, ...)
Dim Button As Integer ' Button pressed (BN, BE, BS, ...)
Dim SState As Integer ' Shift buttons pressed (SL, SR, AL and AR)

' SL, SR, AL and AR. True if pressed:
Dim SL As Boolean
Dim SR As Boolean
Dim AL As Boolean
Dim AR As Boolean

' True if mach is acceptiong commands
Dim Idle as Boolean

'------------------------------------------------------------------------
' Read parameters passed from JoyPad plugin. Don't edit.
EState = CInt(Param1())
Button = CInt(Param2())
SState = CInt(Param3())

SL = (SState And &h01) > 0
SR = (SState And &h02) > 0
AL = (SState And &h04) > 0
AR = (SState And &h08) > 0

Idle = (EState = EStop)

'========================================================================
' <-- Put your own script code here.

'END ' Uncomment END to end execution of script here.
     ' Or delete text to end of file.
'========================================================================

'------------------------------------------------------------------------
' The following script code is an example/test acript and can be deleted.
'
' Writes a message to Mach with the parameters received from the plugin:
' Engine state, shift pressen and button pressen.
'
' To activate script for all buttons; run JoyPadSetup and select Standard
' Assignment: All buttons script
' Save and restart Mach3.
' Pressing POV or buttons will activate this macro and send message to Mach
' message field.

' Convert Engine state to text in EText
Dim EText as String
Select Case EState
  Case ESTOP:      EText = "STOP"       ' Is idle
  Case ERUN:       EText = "RUN"        ' Running GCode
  Case EPAUSE:     EText = "PAUSE"      ' Paused in GCode
  Case EFINISHING: EText = "FINISHING"  ' Plugin loading ?
  Case EMDISTATE:  EText = "MDISTATE"   ' ?
  Case EWAITING:   EText = "WAITING"    ' ?
  Case ESINGLE:    EText = "SINGLE"     ' Single step ?
End Select

' Convert Safety and Alt buttons to text in SText.
' There can be zero or more pressed at once.
Dim SText as String
If SL Then ' Is Safety Left pressed?
  SText = "SL"
End If
```

```
If SR Then ' Is Safety Right pressed?
  If Len(SText) > 0 Then SText = SText & "+"
  SText = SText & "SR"
End If

If AL Then ' Is Alt Left pressed?
  If Len(SText) > 0 Then SText = SText & "+"
  SText = SText & "AL"
End If

If AR Then ' Is Alt Right pressed?
  If Len(SText) > 0 Then SText = SText & "+"
  SText = SText & "AR"
End If
If Len(SText) = 0 Then SText = "None"

' Convert button to text in BText.
Dim BText as String
Select Case Button
  Case BN: BText = "BN" ' 4 face buttons
  Case BE: BText = "BE"
  Case BS: BText = "BS"
  Case BW: BText = "BW"
  Case B1: BText = "B1" ' 2 center buttons
  Case B2: BText = "B2"
  Case B3: BText = "B3" ' Under joystick buttons
  Case B4: BText = "B4"
  Case B5: BText = "B5" ' 4 extra buttons
  Case B6: BText = "B6"
  Case B7: BText = "B7"
  Case B8: BText = "B8"
  Case PN: BText = "PN" ' 4 POV buttons
  Case PE: BText = "PE"
  Case PS: BText = "PS"
  Case PW: BText = "PW"
 End Select

' Write parameters to Mach as a text message.
Message "JoyPad plugin -> Engine: " & EText & ", Shift: " & SText & ", Button: " &
BText

' End of example/test script.
'------------------------------------------------------------------------
```

The macro is called when a button is pressed and assigned *-- Execute script--* with the JoyPadSetup program. Example of output from the standard script:

```
Wed - 01:17:52 ---JoyPad plugin -> Engine: STOP, Shift: SL+SR, Button: BW
Wed - 01:17:55 ---JoyPad plugin -> Engine: STOP, Shift: AL, Button: BW
Wed - 01:17:58 ---JoyPad plugin -> Engine: STOP, Shift: AL, Button: BE
Wed - 01:17:59 ---JoyPad plugin -> Engine: STOP, Shift: AL, Button: BN
Wed - 01:18:00 ---JoyPad plugin -> Engine: STOP, Shift: AL, Button: BS
Wed - 01:18:02 ---JoyPad plugin -> Engine: STOP, Shift: AR, Button: BW
Wed - 01:18:04 ---JoyPad plugin -> Engine: STOP, Shift: AR, Button: BN
Wed - 01:18:05 ---JoyPad plugin -> Engine: STOP, Shift: AR, Button: BE
Wed - 01:18:06 ---JoyPad plugin -> Engine: STOP, Shift: AR, Button: BS
Wed - 01:18:07 ---JoyPad plugin -> Engine: STOP, Shift: None, Button: PN
```

The macro is called for all script assigned buttons and to know which button was pressed, a set of parameters is passed to the macro:

Estate: Mach engine state

BState: Code for button pressed

SState: State of Safety and Alt buttons

These parameters tell the script writer what happened at the moment the macro was called.

To help read the passed parameters, a set of constants is defined:

```
' Constants for EState.
Const ESTOP      = 0 ' STOP
Const ERUN       = 1 ' RUN
Const EPAUSE     = 2 ' PAUSE
Const EFINISHING = 3 ' FINISHING
Const EMDISTATE  = 4 ' MDISTATE
Const EWAITING   = 5 ' WAITING
Const ESINGLE    = 6 ' SINGLE

' Constants for Button.
Const BN =  0
Const BE =  1
Const BS =  2
Const BW =  3
Const B1 =  4
Const B2 =  5
Const B3 =  6
Const B4 =  7
Const B5 =  8 ' B5 to B8 not on standard game pads
Const B6 =  9
Const B7 = 10
Const B8 = 11
Const PN = 12 ' POV buttons
Const PE = 13
Const PS = 14
Const PW = 15
```

The constants can be used with the variables EState and Button, example:

```
' Test if Mach is running GCode
If EState = ERUN then
  Message "Mach is running GCode"
End If

' Test if Mach accepts commands (idle)
If EState = ESTOP then
  Message "Mach is idle"
End If
```

And Button:

```
' Test if button B4 under joystick 2 is pressed
If Button = B4 then
  Message "Joystick 2 button pressed"
End If
```

To read the state of Safety and Alt buttons 4 Boolean variables is defined: SL, SR, AL and AR. They can either be True or False depending on there state when the macro was called.

To test if POV North (PN) and Safety Left (SL) was pressed you could write:

```
If SL Then ' Safety left pressed
  If Button = PN then ' POV north pressed
    Message "SL + PN pressed"
  End If
End If
```

Or more compact:

```
If SL And (Button = PN) Then
  Message "SL + PN pressed"
End If
```

Instead of the shown messages you would put your own action code, like:

```
' Rapid move Z to +10 when SL + PN pressed and turn off spindle
If SL And (Button = PN) Then
  Code("G0 Z10")
  DoSpinStop()
  Message "Now in safe Z position and spindle stopped."
End If
```

To develop script code the internal Mach script editor can be used or you can use an external editor as Notepad or the Freeware Notepad++. The later supports color coding of your code as in Mach and can be downloaded from:

http://notepad-plus-plus.org/

Note: When you are editing script macro M800 there is no need to restart Mach to call the new macro as Mach always uses the macro file.

Don't forget to visit Mach support forum and Wiki as there is a lot of help writing scripts. It is a complete programming environment and only your imagination sets the limits for what can be done with script.

Happy scripting… ☺

Notes: