HyCNC-4P (4 Axis) USB Motion Control Parallel Port Interface Instruction Manual



HyTechWorks 2010 - FW 2.0.0.3

Cautions



HyTechWorks provides its products and services "as it is". HyTechworks accepts no responsibility for performance of any machine or any damage or injury caused by using its products and services.

All computer controlled machine tools are potentially dangerous if they are incorrectly designedor operated. It is your responsibility to insure that you understand the implications of your design and build and the compliance requirements with any legislation and codesof practice applicable to your country. If you have any doubt, please consult qualified experts rather than take risks.

HyTechWorks reserves the right to change its designs without further notice.

Contents

Introduction1
Minimum System Requirements2
Shape and Connections3
DB25 Connector3
X/Y/Z/A Stepping Pulses4
X/Y/Z/A Direction Pulses5
PWM Outputs5
Relay Control Outputs6
Control Inputs6
USB Connector6
Working Status LED7
USB Driver Install8
Multiple Connection14
Mach3 Configurations16
HyCNC-4P PlugIns16
Relay Output Config19
X/Y/Z/A Axis Config21
Spindle and PWM2 Config24
Auto Zero/Soft Limits28
Auto Tool Setting
EStop Configuration42
Mach3 Watchdog Configuration45
Firmware Update47
Normal Operation47
Firmware Recovery52
Low Level API53
Device Identification and Opening53
Device Basic Information Reading54
Motion Control55

56
5

Introduction

HyCNC-4P is a 4-axis machine tool motion control USB interface, replacing traditional PC parallel port. Its operation features are as the follows:

- Connect to PC via USB port, suitable for any netbook, notebook, desktop and tablet PC with USB ports.
- ♦ USB kernel mode driver compatible with 32/64 bit Microsoft Windows XP/Vista/7 OS.
- Compatible with Mach3 PC based CNC software, including version 3.043.066.
- Simultaneous connection for control axis expansion using API (127 USB device with 508 axis in theory), or control of multiple machines with single PC running Virtual PC or VMWARE.
- ♦ 4 axis linkage operation with 250KHz(-250) / 125KHz(-125) / 60KHz(-60) / 30KHz(-30) maximum stepping pulse frequency for each axis, supporting GCode, jogging, homing, tool setting etc. operations.
- ♦ 2-stage fast auto zero on all axis.
- ♦ Support professional and low-cost automatic tool setters.
- ♦ Emergency stop (can optionally stop PWM1/PWM2).
- ♦ 2 relay control outputs.
- ♦ Small size and easy to use, similar to an usb-parallel port adapter.
- ♦ Online firmware updating.
- ♦ Firmware recovery mode to eliminate the danger of firmware updating.
- Control signals on DB25 connector are defined as a PC parallel port with 5V signal level.
- \diamond Working status LED.
- ♦ Motion control using a 32bit single chip microcontroller, greatly

reducing real time requirement for PC OS.

- All control pulses are generated using on-chip hardware, eliminating motor vibration caused by control signal jitters.
- ♦ Reliable design that can work under severe conditions.
- ♦ Software watchdog monitors Mach3's proper running.
- Providing Windows API to support special control system (i.e. motion control using LabView Windows).

Minimum System Requirements

- ♦ Pentium 1GHz or similar CPU, i.e. Atom N270.
- ♦ 512MB memory.
- \diamond 32/64 bit Microsoft Windows XP, Windows Vista or Windows7 OS.
- ♦ Mach3 software.

Shape and Connections

HyCNC-4P is assembled in a plastic cover with a DB25 and two fasten screws on one end, and an USB connector and working status LED on another end.



Size:

74mm(L) x 58mm(W) x 24mm (D)

DB25 Connector

The DB25 connector has 17 control signals as the following figure.



X/Y/Z/A Stepping Pulses

X/Y/Z/A Stepping Pulses are 0-5V position pulse with raising edge effective. The minimum pulse width us 1uS(-250)or 2uS(-125) or 4uS(-60) or 8uS(-30). Each output can be used to drive 15mA push and pull.

When connecting to a motor driver with low to high transaction, the following

connection should be used:



When connecting to a motor driver with high to low transaction, the following connection should be used (5V is not isolated from the HyCNC-4P):



X/Y/Z/A Direction Pulses

High level(5V) represents positive direction movement and low level (0V) represents negative direction movement. Each output can be used to drive 15mA push and pull.

The direction of a two-phase stepping motor can be changed by swapping connection of one of the coils. Therefore, the connection to the motor driver can be either one of the above connections.

If the motor direction can't be changed by an external switch, the first connection should be used for the motor moving position direction when the direction input is driven and the second connection should be used for the motor moving position direction when the direction input is not driven.

PWM Outputs

PWM1 and PWM2 have same base frequency (0.017-100000Hz adjustable by software). PWM1's duty cycle is proportional to spindle speed and PWM2's duty cycle can be adjusted by a M code. 0% duty cycle is low level and 100% duty cycle is high level output. Each output can be used to drive 15mA push and pull,

capable to drive an optical coupler like stepping pulse outputs do.

Relay Control Outputs

OUt1 and OUT2 can be used to control 2 relays with relay drivers. Each output can be used to drive 15mA push and pull. OUT1 is mapped to Mach3's digital output port 1 pin 0.

OUT2 is mapped to Mach3's digital output port 1 pin 1.

Control Inputs

There are X-axis zero, Y-axis zero, Z-axis zero, A-axis zero/tool setter and EStop 5 inputs. Each input is connected to a microcontroller (3.3V supply) pin via a 10K resistor without using voltage converters. The signal switching level is not compatible with 5V circuitry. It is low level when input voltage < 1.15V and high level when input voltage > 2.15V.

X-axis zero is mapped to Mach3 digital input port 1 pin 5.

Y-axis zero is mapped to Mach3 digital input port 1 pin 4.

Z-axis zero is mapped to Mach3 digital input port 1 pin 3.

A-axis zero/tool setter is mapped to Mach3 digital input port 1 pin 7.

EStop 5 is mapped to Mach3 digital input port 1 pin 12.

USB Connector

The USB connector is used to communicate with a PC. Please use a high quality USB2.0 cable for better resistance of disturbance.

Working Status LED

Flash Rate	Status
1 flash/s	Normal working, whithout motion instruction.
2 flash/s	Normal working, with motion instructions (including zero motions).
5 flash/s	Firmware update.

USB Driver Install

Attention: USB driver install requires "administrator" privilege.

Double click install.bat under "USB Driver" directory. The install program will choose proper driver depends on the OS.

The following window pops up. Click "Next".



Then the "Important Notice" window appears. Please read the "Important Notice" carefully. If agree, select "I accept" the click "Next".

Cinc USB D	evice Driver Installer
Important M	lotice
Ń	To continue, accept the following license agreement. To read the entire agreement, use the scroll bar or press the Page Down key.
	HyTechWorks provides its products and services "as it is". HyTechworks accepts no responsibility for performance of any machine or any damage or injury caused by using its products and services. All computer controlled machine tools are potentially dangerous if they are incorrectly designed or operated. It is your responsibility to insure that you understand the implications of your design and build and the compliance requirements with any legislation and codes of practice applicable to your country. If you have any doubt, please
	I do not accept
	Cancel

Windows Vista/7 will show the following warning. Click "Install this driver software anyway".



Then the driver install begins. The following window pops up when finish. Click

"Finish".



When plug in HyCNC-4P for the first time, the "Found New Hardware Wizard" window pops up. Select "Yes, this time only" the click "Next".

Found New Hardware Wiz	ard			
	Welcome to the Found New Hardware Wizard Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission). <u>Read our privacy policy</u>			
	Can Windows connect to Windows Update to search for software?			
	Click Next to continue.			
	< Back Next > Cancel			

Select "Install from a list or specific location" then click "Next".

Found New Hardware Wizard				
	This wizard helps you install software for: HyCNC-4P USB Interface If your hardware came with an installation CD or floppy disk, insert it now.			
	What do you want the wizard to do? Install the software automatically (Recommended) Install from a list or specific location (Advanced) Click Next to continue.			
	< Back Next > Cancel			

Select "Don't search. I will choose the driver to install" then click "Next".

und New Hardware Wizard			
Please c	hoose your search and installation options.		
○ Se	arch for the best driver in these locations.		
Us pal	e the check boxes below to limit or expand the default search, which includes local hs and removable media. The best driver found will be installed.		
	Search removable media (floppy, CD-ROM)		
	Include this location in the search:		
	E: Browse		
📀 Do	n't search. I will choose the driver to install.		
Ch the	pose this option to select the device driver from a list. Windows does not guarantee the driver you choose will be the best match for your hardware.		
	< Back Next > Cancel		

PC will show suitable drivers. Select "HyCNC-4P USB Interface" then click "Next".

Found New Hardware Wizard
Select the device driver you want to install for this hardware.
Select the manufacturer and model of your hardware device and then click Next. If you have a disk that contains the driver you want to install, click Have Disk.
Model
HyCNC USB Interface HyCNC-4P USB Interface
This driver is not digitally signed! Have Disk Have Disk
< Back Next > Cancel

PC starts installing the driver.

Found New Hardware Wizard			
Please wait while the wizard installs the	software		
HyCNC-4P USB Interface			
WdfCoInstaller01009.dll To C:\WINDOWS\system32	D		
(***************	< Back Next > Cancel		

When finish, the following window poops up. Click "Finish".



Note: the latest USB driver can be downloaded from http://www.hytechworks.com/Downloads/HyCnc/HyCNC 4P/index e.html

Multiple Connection

Total 127 USB device can be connected to a PC. They can be all HyCNC-4P if possible. The difference between 2 HyCNC-4P is the USB serial number. The USB serial number can be revealed by the following method.

Plug a HyCNC-4P in to PC. The open Windows' "Devcie Manager" shown below. Expend "HyTechworks Hardware" to show all plugged in interface. Right click the interface, select "Properties".



Then click "Details" page and select "Device Instance Id". The last 8 characters

following the VID and PID number is the USB serial number.



Mach3 Configurations

Please refer to proper materials regarding to Mach3 install. Mach3 software download: <u>http://www.machsupport.com/downloads.php</u> Mach3 document download: <u>http://www.machsupport.com/documentation.php</u>

There is no need to install Mach3 parallel port driver, which is not functional under 64 bit Windows. Normal USB-parallel port adapter cables don't work as well. The motion pulses have jitters because Windows' scheduling.

The following descriptions only address configuring HyCNC-4P for Mach3.

HyCNC-4P PlugIns

Open ZIP file contains HyCNC-4P.DLL and drag it to Mach3/PlugIns.

😂 Plugins					
File Edit View Fa	avorites	Tools	Help		.
G Back 🔹 🕥	D	De Se	arch 😥 Fold	ders 🛄 🔹	
Folders	×	Name		1	9
🖃 🚞 Mach3	~	🔊 Flash	.dll		1,070
🗷 🧰 Addon:	5	🔊 НуСР	IC_4L.dll		192
🕀 🫅 Bitmap:	s	NyCh 💽	IC_4P.dll	4	220
Distance Brains		🔊 JoyS 🔊 Print	HyCNC_4	4P. zip 💶 🕻	180 256
GCode		🔊 Shut	File Edit	iew »	P 28
Help		🔊 Turn	: _		» 256
E C macros		🔊 Video	🕴 🌏 Back		304
PlugIns	; tines		Name 🔺	Туре	
E C Turpéc	Idon«		HyCNC_4P	dli Appli	cation E
🖂 🛄 Tainka	all.				
	kuns				
E C MSOCache					
	>	<	<		> >

Note: the latest Mach3 plugin can be downloaded from

http://www.hytechworks.com/Downloads/HyCnc/HyCNC_4P/index_e.html

Click Mach3Mill icon on the desktop to start Mach3. The following window appear to allow user select proper motion control hardware. Select "HyCNC_4P" then click OK.

Motion Control Hardware PlugIn sensed!!	×
Your system is showing more than one control device Please pick the one you would like this profile to use.	
O Normal Printer port Operation.	
• HyCNC_4P-V1.0	
No Device	
No Device	
O No Device	
□ Dont ask me this again OK	

If there is no suitable hardware to run HyCNC-4P, the following error windows appears.



If there are more than on HyCNC-4P connected to the PC, another selection window appears. All available HyCNC-4P are listed in the window by their USB serial number. Select the one intend to use and click OK. If there is only one HyCNC-4P, no more windows will be shown and the only one HyCNC-4P will be used.

Motion Control Hardware PlugIn s	ensed!! 🗙
Your system is showing more th Please pick the one you would	nan one control device like this profile to use.
C Normal Printer port Op	peration.
HyCNC_4P-V1.0	HyCNC Select
C No Device	
No Device	e3c1a5e0
C No Device	e3c3a7e0 e3c6a6e0 e3c7a6ee
☐ Dont ask me this again	ОК

The firmware version and the hardware serial number of the HyCNC-P cab be read by operate Mach3 main menu "Config"->"Config PlugIns".

Enabled	PlugIn Name	Config
4	Flash=FlashScreen=SWF=PlugIn=A.Fenerty==BB	CONFIG
4	HyCNC_4P-V1.0	CONFIG
X	JoyStick-JoyStick-PlugInArt-Fenerty-Ver-1.Oa	CONFIG
X	PrinterScope=Port=Scope=1.00.046	CONFIG
X	TurnDiags=Turn=Diags=1.00.1	CONFIG
4	VideoB. Barker-Ver-1.0	CONFIG

Click "CONFIG" behind HyCNC_4P and a new windows shows up.

nabled	PlugIn Name		Config
4	Flash-FlashScreen	HyCNC-4P Config	CONFIG
2	HyCNC_4L-V2.0.5		CONFIG
1	HyCNC_4P-V1.0.5	FW 02.00.00.03	CONFIG
2	HyCNC_6L-V2.0.5	SN 0676FF515648854987072246	CONFIG
X	JoyStick-JoyStic	[CONFIG
X	PrinterScope-Por	PWM1=0 on EStop	CONFIG
X	TurnDiags-Turn-D:	PWM2=0 on EStop	CONFIG
4	VideoB. Barker	ATS Stop on Touch	CONFIG
rice.		📕 Watchdog on PWM2	a second s
		Homing Speed% 100	
		OK Cancel	

FW is the firmware version and SN is the hardware serial number.

Relay Output Config

Operate Mach3 main menu's "Config"->"Ports and Pins". Then click on "Output Signals" page. Click to put green tick on "Enabled" column of the "Output #1" and "Output #2" row. Their "Port #", "Pin Number" and "Active Low" should be set according to physical connection(referring to chapter "Shape and Connections", section "Relay Outputs"), put a green tick on "Active Low" if the output is effective when low. "Output #1" and "Output #2" can be further mapped further to control mist, coolant and spindle motor etc.

Signal	Enabled	Port #	Pin Number	Active Low	_
Enable3	*	1	0	2	
Enable4	8	1	0	X	
Enable5	X	1	0	X	
Enable6	X	1	0	*	
Output #1	4	1	0	X	
Output #2		1	1	X	
Output #3	X	1	0	X	
Output #4	X	1	0	X	
Output #5	X	1	0	X	
Output #6	X	1	0	X	
Charge Pump	X	1	0	X	~
Pi	ns 2 - 9 , 1, 14,	16, and 17 are ou	tput pins. No other	pin	

Coolant control can be used to test "Output #1" and "Output #2". Click on page "Spindle Setup". Set as the following figure for "Relay Control" and "Coolant Mist Control" blocks, in which "Output #1" is used to control mist and "Output #2" is used to control coolant.

Fort Setup and Axis Selection	Motor Outputs	Inpu	t Signals	Output Signals
Encoder/MPG's	Spindle Setu	P		Mill Options
Relay Control V Disable Spindle Rel Clockwise Output 1 Output Signal #'s Flood Mist Control Disable Flood/Mist repelay Mist Output 1 Output 2 Output Signal #'s ModBus Spindle - Use Step/Dir as Max ADC Count 16380	Motor Control Vise Spindle Motor Outp PWMD Control Step/Dir Moto PWMBase Freq. 10 Minimum PWM 2 % General Parameters CW Delay Spin UP 1 CCW Delay Spin UP 1 CCW Delay Spin DOWN 1 CCW Delay Spin DOWN 1 CCW Delay Spin ODWN 1	Special Fun Use Spin Closed L P 0.25 Spindle Seconds Seconds Seconds Seconds Seconds	ctions dle Feedback in oop Spindle Con I I D Speed Averagi Special Optio HotWire He Laser Mode Torch Volt Torch Auto	n Syne M it 0.3 ns, Usually Off at for J . fr s Cont: Of

Then click Apply and OK to close the config window. Then switch to page "Diagnostics" of the Mach3's main interface and type "M7 \checkmark " to switch on mist,

"M8 \swarrow " to switch on coolant, "M9 \swarrow " to switch both off. Check output change accordingly.

🖗 Mach3 CMC Licensed To: Iv	van Todosijevic										E 🖬 🛛
Lile Config Punction Ofg's Hier T	Fizards Operator FlugIn Conts	rol Help					-				
Program Run (Alt-1)	MDI (Alt-2) Tool F	Path (Alt-4)	Offsets (Alt-5)	Se	ttings (Alt.6) Dia	ignostics (Alt.7)	P+	×G15 G1 G17 G40 G21	090 094 054 049 099 064	097	000000000000000000000000000000000000000
Zur All Cu	urrent Position	Ma	achine Coord		WorkOffset	0920	Ifset	То	ol Offset	abs	max x,y,z
Ref X Pos	+0.0000	=	+0.0000		+0.0000		+0	0000 -	+0.0000		+0.0000
Ref Y Pos	+0.0000	=	+0.0000	-	+0.0000	. —	+0	0000			+0.0000
Ref Z Z Pos	+0.0000	=	+0.0000	-	+0.0000		+0.	.0000 -	+0.0000		+0.0000
Ref A Pos	+0.0000	=	+0.0000	-	+0.0000		+0.	0000			Min Lo oppod
Ref B B Pos	+0.0000	=	+0.0000	-	+0.0000		+0.	0000			+0.0000
Ref C C Pos	+0.0000	=	+0.0000		+0.0000		+0.	0000			+0.0000
Edit											+0.0000
	Spindl	e Toggle	1					Port 1 Pipe our	ant Chata		+Ü
	Flood	Toggle	1		Jog ON/OFF	Ctrl-Alt-J		POIL THIS CON		Dubo D	
	Mist	Toggle			Time in Int.	+0	.0			FUSEFI	equency
-	Duplác	tion			Blended Spd	0.0	00	Input Signals cur	rent State		external
	Run				Buffer Load		0 %	EJogX++	EJogY+	EJogZ+	EJogA+
	💌 📕 Tool Re	quest			Queue Depth	+	-0	EJogX	EJogY-	EJogZ-	EJogA- Mildoma
	Cyc	le Start			Worst Case	+0.0000	00	Input 2	M2 ++Limit	M2Limit	M2Home
	Fee	dHold			PV/M Base	+	10	Input 3	M3++Limit	MB-Limit	M3Home
	Rev	vind			Time Scale	+1.000	0	Input 4	Mittelimit	M4-Limit	M4Home M5Home
	SI	op			Reduced			Index	M6++Limit	M6-Limit	M6Home
	Sir	igle			LookAhead	2	20	LimitOV	Torch On	Torch UP	Torch Dn
	M7				CPU Speed 95	5000000.000	00	Emergency			
Regen Jog Follow					Serve Freq.	Generator		Output Signals of	urrent State		
ToolPath on/off								Enable 1	Enable 2	Enable 3	Enable 4
Poset								Contract of	Exable 6		
Reset	G.Codes	M-Codes	1					Output 1	Output 2	Output 3	Output 4
			-						- output o	Digitize	
History Clear								Mach3Mill			
1 开始 🔰 nath3_9a 770 -	🔠 🧶 Bachd CBC Licen .									= 8 ℃	0 0 TO 8 0 0 19 34

X/Y/Z/A Axis Config

Operate Mach3 main menu's "Config"->"Ports and Pins". Click on page "Port Setup and Axis Selection". Disable using "Port #1" and "Port #2" and keep "Kernal Speed" at 25000Hz. This is only associated with PWM frequency setting and has nothing to do with motion control using HyCNC-4P.

Port Setup and Axis Selection Motor Outputs Fort #1 Fort Enable. DX378 Fort Entry in Hex 0-9 Fort #2 Dx278 Fort Entry in Hex 0-9 Fins 2-9 as inp Kernel Speed Secondra C 35000Hz C 45000Hz C 60000hz G 65000Hz C 7500Hz C 100khz Note: Software must be restarted and motors kernel speed is	Mill Options Input Signals Output Signals MaxNC Mode Max NC-10 Wave Drive Frogram restart Restart if changed Sherline 1/2 Pulse mo. ModBus InputQutput Suppo ModBus PlugIn Supported TCP ModBus Serial Con Servo Serial Link Feedb.
--	---

Then click on page "Motor Outputs". Put green ticks in column "Enabled" on "X Axis", "Y Axis", "Z Axis" and "A Axis" row. The rest column has no effect on HyCNC-4P's operation. The length unit used by Mach3 can be set by operation the main menu "Config"->"Select Native Units". The choose "MM's" or "Inches" as needed.

Set Default	Units 🔀
Units for Moto	r Setup Dialog
MM's	C Inches
	Ж

Finally, the motor operation characteristics need to be set. Operate the main menu "Config"->"Motor Tuning and Setup".



Click on "X Axis" button on the upper right corner. Then fill in "Ster per" (mm/inch) according to the following equation

step motor steps per revolution · driver microstep setting screw pitch

For example, the step has 200 steps per revolution. The driver microstep is 20. The screw pitch us 4mm. Then 1000 should be filled in "Set per" box.

"Velocity" is the maximum distance X-axis is allowed to move per minute. It is the maximum speed of GO code. It also limits the maximum value for F code. The machine mechanical and control system performance limit the "Velocity", as well as the "Acceleration" value after it.

The pulse width settings are not used by HyCNC-4P. Press "SAVE AXIS SETTINGS" to save X-axis settings. Then do same for "Y Axis", "Z Axis" and "A Axis".

The jogging can be used to test axis settings. Press "TAB" key on the keyboard to show jogging window as the following figure. First make sure Mach3 is not in "RESET" state by checking "RESET" button on the lower left corner not flashing

red-green box. If Mach3 is in reset state, click on "RESET" button to release the reset state (a steady green box encapsulate "RESET"). Press "X+" and "X-" in the jogging window to check X movement. Press "Y+" and "Y-" to check Y movement. Press "Z+" and "Z-" to check Z movement and press "A+" and "A-" to check A movement(if fitted).



Spindle and PWM2 Config

Operate the main menu "Config"->"Ports and Pins". Click on page "Motor Outputs". Put a green tick on the "Spindle" row's "Enabled" column. All other columns are not used by HyCNC-4P.

Simel	Frahlad	Stop Pin#	Dir Pin#	Dir Low	Stop I.o.	Stan Part	Dir Port
X Axis		2	6	X	8 CEP 10	1	1
Y Axis	4	3	7	×	×	1	1
Z Axis	4	4	8	X	X	1	1
A Axis	4	5	9	×	×	1	1
B Axis	X	0	0	X	X	0	0
C Axis	*	0	0	×	×	0	0
Spindle	4	0	0	X	X	0	0
pindle	4	0	0	x	X	0	0

Then click on page "Spindle Setup" page. If there is no circuit to control spindle rotating direction. Put a "X" on "Disable Spindle Relay". If spindle's rotating direction can be controlled by a H-bridge consisted by 2 relays, 2 relay outputs are needed. If spindle's rotating direction can be controlled by a H-bridge consisted by 1 relays, 1 relay outputs are needed and the other is set to the undefined output. The PWM1 and PWM2 base frequency is calculated by equation

$25000 \ge 10$

"PWM base Freq" value

The PWM1 and PWM2's duty cycle is controlled by the hardware. Its accuracy is has nothing to do with "Kernel Speed".

Fort Setup and Axis Selection	Motor Outputs	Inpu	t Signals	Output Signals
Encoder/MPG's	Spindle Setu	p		Mill Options
elay Control Disable Spindle Rel Clockwise Output 1 CW (M4) Output 1 Output Signal #'s lood Mist Control Disable Flood/Mist rep _{elay} ist Output 1 Output 2 Output Signal #'s odBus Spindle - Use Step/Dir as Enabled Reg 54 64 - Max ADC Count 16380	Motor Control Vise Spindle Motor Outj PWM Control Step/Dir Moto PWMBase Freq. 10 Minimum PWM 3 % General Parameters CW Delay Spin UP 1 CCW Delay Spin dD0WN 1 CCW Delay Spin D0WN 1 CCW Delay Spin D0WN 1 Immediate Relay off 1	Special Fun Use Spir Closed I P 0.25 Spindle Seconds Seconds Seconds Seconds Seconds	Adde Feedback and Feedback T I D Speed Averagi Special Opti HotWire I Laser Mo Torch Vo Torch Au	in Sync M ont 0.3 ions, Usually Off Heat for J de. fr Lts Conts to Of

The ratio between PWM1's duty cycle and spindle speed is set by operating the main menu "Config"->"Pulley Selection". "Min Speed" is for 0% duty cycle and "Max Speed" is for 100% duty cycle. If "Min Speed" is for 100% duty cycle and "Max Speed" is for 0% duty cycle, put "X" on "Reversed".

Current Pulley	Min Speed	Max Speed	Ratio
Pulley Number 1	• 0	24000	1
- Deverced		1	1
Reversed			

The spindle operation can be tested by select the main menu "Function Cfg's"->"Spindle Calibration". Put a test value in RPM box and click "Spindle On/Off" button to start spindle. When spindle is rotating, the PWM1 duty cycle is shown in "Control Ratio" box. Click click "Spindle On/Off" button to stop spindle and the "Control Ratio" box shows 0.



When PWM2 is not used for Mach3 watchdog status output, PWM2 's duty cycle can be set by using a M code, i.e." M101". Create a new text file called m101.m1s under Mach3/Macros/Mach3Mill directory. Fill the following content by a text editor and save.

Declare Sub PWM2_SetDutyCycle Lib "HyCNC_4P"(ByVal duty As Double) PWM2_SetDutyCycle(Param1())

PWM2_SetDutyCycle is a function declared in HyCNC_4P.DLL. It takes a double input value between 0.0 – 1.0 that controls the PWM2's duty cycle. Such value is provided by P parameter of M101 code (via Param1()). To test this M code, click on page "MDI" of the Mach3's main interface. Type "M101 P0.3 \checkmark " on the MDI input box and check 30% duty cycle output on PWM2. This M code can be used in GCode file(*.TAP) as well.



Auto Zero/Soft Limits

The HyCNC_4P plugin implement auto zero function for all control axis. The auto zero process is divided into 2 stages. The first stage is to seek zero switches with acceleration to G0 speed's predefined percentage (plugin config's "Home Speed%") according to pre-defined direction. When zero switch is triggered, the moving speed is decelerated to 0 and the second stage starts. The second stage is to leaving the zero switch with acceleration to predefined % of the first stage speed towards the opposite direction. The position, which zero switch changes its state again, is the zero. HyCNC-4P will set its internal coordinate counter according to redefined zero switch offset at this moment. Then moving speed is

decelerated to 0 to end auto zero process on that axis. The order of the auto zero is also pre-defined. Operate the main menu "Operator"-> "Edit Button Script". The click on flashing "REF ALL HOME" to bring up the auto zero script edit window.



DoButton(22), DoButton(23), DoButton(24), DoButton(25), DoButton(26), DoButton(27) are used to execute auto zero on X/Y/Z/A/B/C axis. The above script execute auto zero on Z axis, then Y axis, then X axis and finally A axis.

DoOEMButton(133), DoOEMButton(134), DoOEMButton(134) are used to reset X/Y/Z encoder. For the machine without encoder, these 3 line of script can be removed. More code can be added to the script to suit a specific machine. For example, a fast move to a predefined coordinate, i.e. (10, 15, 5, 90) is required after auto zero. The script looks like this.

DoButton(24)	
DoButton(23)	
DoButton(22)	
DoButton(25)	
While IsMoving()	

Sleep(100)	
Wend	
code("G0 Z5")	
While IsMoving()	
Sleep(100)	
Wend	
code("G0 X10 Y15 A90")	

This script execute auto zero like before. After auto zero is finished, it first fast moves Z axis to coordinate 5. After Z axis movement is finished, it fast moves to X axis with coordinate 10, Y axis with coordinate 15 and A axis with coordinate 90 at the same time. After edit the script, save it to the system by operating menu "File" -> "Save". Clicking "REF ALL HOME" can run the saved script. If the auto zero needs to be run from a GCode file, save above script to a mXXX.m1s file (i.e. m299.m1s) under Mach3/Macros/Mach3Mill directory.

More settings are needed to get auto zero working properly.

Operating the main menu "Config"->"Ports and Pins" and click on page "Input Signals". Put green ticks in "X Home", "Y Home", "Z Home" and "A Home" row's "Enabled" column if zero is required on X/Y/Z/A axis. Their "Port #", "Pin Number" and "Active Low" should be set according to physical connections (referring to chapter "Shape and Connections", section "Control Inputs"). If the inputs are low level effective, put green ticks in "Active Low" columns.

Port Set	np and Axis Sel	lection	Motor Outp	outs	input Signals		utput Signals
Signal	Enabled	Port #	Pin Number	Active Low	Emulated	HotKey	~
X Home	4	1	5	4	X	0	
Y ++	*	1	0	X	X	0	
ү	X	1	0	X	X	0	
Y Home	4	1	4	4	X	0	2
Z ++	*	1	0	X	X	0	
Z	*	1	0	X	X	0	
Z Home	4	1	3	4	X	0	
A ++	X	1	0	X	X	0	
A	X	1	0	X	X	0	_
A Home	4	1	7	4	X	0	
	l be		1.0	i ha	ha	-	
	Pins 10-13 (and 15 are inp	uts. Only these	5 pin numbers	may be Automate	ed Setup of 1	Inputs

Then operating the main menu "Config"->"Motor Home/SoftLimits". For the axis equipped with a zero switch that requires auto zero process, put a green tick in their "Auto Zero" column (attention: A axis zero switch input shares the same input as the auto tool setting input. If auto zero is enabled on A axis, the auto tool setting can be enabled). "Home Neg" column defines the location of the auto zero switch. If the switch is on the negative direction (seeking towards negative direction for the zero switch in the first stage), put a green tick in this column. "Speed %" defined the maximum speed of the second stage as the percentage of the first stage. When this setting generates stepping pulses more than 1000Hz, the accuracy is also affected. In this case, the homing accuracy in theory is

$\frac{\text{distance per step} \cdot \text{pulse frequency}}{1000}$

"Home Off." is the machine coordinate of the zero switches. its value is set to HyCNC-4P coordinate when a zero switch is trigger again in the second stage.

"Soft Max" and "Soft Min" define the working range of an axis. "Slow Zone" define deceleration distance before each ends. These values should be set properly according to work range to avoid mechanical collision. For small CNC

machine tools using step motors, zero switches with soft limits provide an effective and low cost solution for safe machine operation.

			Entries a	are in setup u	nits.			
Axis	Reversed	Soft Max	Soft Min	Slow	Home	Home Neg	Auto	Speed %
X	X	100.00	-100.00	1.00	1.0000	4	4	10
Y	X	100.00	-100.00	1.00	2.0000	4	4	10
z	X	100.00	-100.00	1.00	3.0000	4	4	10
A	X	100.00	-100.00	1.00	4.0000	×	X	3
В	X	100.00	-100.00	1.00	0.0000	X	X	10
c	*	100.00	-100.00	1.00	0.0000	X	X	10

The first stage speed is defined by "Home Speed%" in plugin's config. Operate Mach3 main menu "Config" -> "Config PlugIns".

Enabled	PlugIn Name	Config
4	Flash-FlashScreen-SWF-PlugIn-A.FenertyBB	CONFIG
4	HyCNC_4P-V1.0	CONFIG
X	JoyStick-JoyStick-PlugInArt-Fenerty-Ver-1.Oa	CONFIG
X	PrinterScope=Port=Scope=1.00.046	CONFIG
X	TurnDiags=Turn=Diags=1.00.1	CONFIG
4	VideoB. Barker-Ver-1.0	CONFIG

Click "CONFIG" behind HyCNC_4P and a new window shows up.

Enabled	PlugIn Name		Config
4	Flash-FlashScreen	HyCNC-4P Config 🛛 🔀	CONFIG
×	HyCNC_4L-V2.0.5		CONFIG
4	HyCNC_4P-V1.0.5	FW 02.00.00.03	CONFIG
2	HyCNC_6L-V2.0.5	SN 0676FF515648854987072246	CONFIG
X	JoyStick-JoyStic	[]	CONFIG
X	PrinterScope-Por	PWM1=0 on EStop	CONFIG
X	TurnDiags-Turn-D:	PWM2=0 on EStop	CONFIG
4	VideoB. Barker	ATS Stop on Touch	CONFIG
27(c)	- 14	Watchdog on PWM2	and the second s
		Homing Speed% 100	
		Cancel	

Set and test "Home Speed%". It is percentage of the speed limits.

Auto Tool Setting

Two commonly used auto tool setting processes are implemented. One for professional tool setter (one with retreatable spring loading surface) and one for low cost tool setter (one with hard non-retreatable surface).

A professional tool setter normally has 2 wires, working like a precision micro switch. It uses magnets to stick on the bench top stably. When the tool presses the surface down to a fix point, the switch changes its status. The switch is usually isolated from the mechanical parts electrically. It can connected to the tool setter input pin without using an optical coupler.



Low cost tool setter can simply be constructed by a piece of PCB board or a block of metal with isolation layer on one of its surface. This kind of tool setter requires conductive tool bits, forming a close circuit when tool bits touch the tool setter surface. An optical coupler is required to interface with tool setter input safely, as shown in the following figure. GND2 is the ground of +24V. It is connected to the machine and tool using the black crocodile clip. 1800 ohm resistor limit the current through the LED to 10-20mA when the tool touches the PCB surface. The closing circuit status optically coupled to the transistor side, grounding the tool setter input.



There is an improved low cost tool setter shown in the figure below. It requires the same connection and optical coupler circuit as the low cost tool setter described above. However, its setting method should be as same as the professional one.



Two tool setting methods are selected by operating Mach3 main menu "Config" -> "Config PlugIns".

Enabled	PlugIn Name	Config
4	Flash-FlashScreen-SWF-PlugIn-A.Fenerty-BB	CONFIG
4	HyCNC_4P-V1.0	CONFIG
X	JoyStick-JoyStick-PlugInArt-Fenerty-Ver-1.Oa	CONFIG
×	PrinterScope-Port-Scope-1.00.046	CONFIG
X	TurnDiags=Turn=Diags=1.00.1	CONFIG
4	VideoB. Barker-Ver-1.0	CONFIG

Click "CONFIG" behind HyCNC_4P and a new window shows up.



Putting "X" before "ATS Stop on Touch" selects auto tool setting using low cost tool setter. Removing "X" before "ATS Stop on Touch" selects auto tool setting using professional tool setter.

Process of using professional tool setter is similar to auto zero. The first stage is to seek tool setter with acceleration to G0 speed according to pre-defined direction. When tool setter is triggered, the moving speed is decelerated to 0 and the second stage starts. The second stage is to leaving the tool setter with acceleration to predefined % of the G0 speed towards the opposite direction. When tool setter changes its status, the difference between Z-axis coordinate and predefined tool setter surface coordinate is used as the tool length offset and save in tool library database. The movement decelerates to 0 then accelerates to G0 speed to the coordinate where tool setter surface. This process have overshot when tool touches tool setter surface at first stage. Therefore, tool setter with retreatable surface is required to avoid tool and/or machine damage.

A low cost tool setter has hard non-retreatable surface isolated from the machine electrically. It doesn't allowed overshot (or allows every small overshot), It requires movement to stop immediately when the tool touch tool setter surface. Setting process is to seek tool setter with acceleration to % of GO speed according to pre-defined direction. When tool touch the tool setter, movement stops within 1/1000s. The difference between Z-axis coordinate and predefined tool setter surface coordinate is used as the tool length offset and save in tool library database. Then machine accelerates to GO speed to move the coordinate to where tool setting started. Please pay attention, even with control system stops within 1/1000s, the mechanical system may not stop fast enough to avoid tool and/or machine damage. The % of GO speed should be set small enough to avoid such damage.

The tool setter input shares same input as the A-axis zero switch input. When auto tool setting is used, A-axis auto zero can't be used. Operate the main menu "Config"->"Ports and Pins". Click on page "Input Signals" shown below. The tool setting is enabled by putting a green tick in the "OEM Trig #1" row's "Enable" column. "Port #", "Pin Number" and "Active Low" should be set according to physical connections (referring to chapter "Shape and Connections", section "Control Inputs"). If the input is low level effective, put a green tick in "Active Low" column. Then click "Apply" and "OK" to save the settings.

Enco	der/MPG's and Avis Sal	leation	Spindle Motor Outr	e Setup 	 Input Signals	Mill Op	tions trut Signals
Tort Setup	and Axis De	rection	motor outp	uts .			icput bignars
Signal	Enabled	Port #	Pin Number	Active Low	Emulated	HotKey	~
Probe	X	1	0	X	X	0	
Index	X	1	0	8	X	0	
Limit Ovrd	X	1	0	X	X	0	
EStop	4	1	12	4	X	0	
THC On	X	1	0	×	X	0	
THC Up	X	1	0	X	X	0	
THC Down	X	1	0	X	X	0	
OEM Trig #1	4	1	7	4	X	0	
OEM Trig #2	X	1	0	X	X	0	
OEM Trig #3	X	1	0	×	X	0	100
	1		(d		h.n	1.5	
	Pins 10-13 :	and 15 are inp	uts. Only these	5 pin numbers	may be Automate	ed Setup of I	nputs

The operate the main menu "Config"->"Motor Home/SoftLimits". The A-axis settings are used for tool setting operation. If the tool setter is located on the negative direction on Z-axis (moving negatively to seek tool setter), put a green tick in column "Home Neg". "Speed %" defines the % of GO speed on Z-axis slow movement. When this setting generates stepping pulses more than 1000Hz, the accuracy is also affected. In this case, the homing accuracy in theory is

 $\frac{\text{distance per step} \cdot \text{pulse frequency}}{1000}$

			Entries a	are in setup u	nits.			
Axis	Reversed	Soft Max	Soft Min	Slow	Home	Home Neg	Auto	Speed %
X	X	100.00	-100.00	1.00	1.0000	4	4	10
Y	X	100.00	-100.00	1.00	2.0000	4	4	10
Z	X	100.00	-100.00	1.00	3.0000	4	4	10
A	X	100.00	-100.00	1.00	4.0000	X	X	3
в	X	100.00	-100.00	1.00	0.0000	X	X	10
с	X	100.00	-100.00	1.00	0.0000	X	X	10

The tool setter surface Z-axis coordinate is defined using "Gauge Block Height" box in main interface's "Offset" page. Click on the box and type in the height and return, as shown below.

🖗 Mach3 CMC Licensed To: Ivan Todosijevic 🚽				
Eile Config Function Cfg's Eier Vizurds Operator Flag	gin Control Help		-	4
Program Run (Alt.1) MDI (Alt.2)	Tool Path (Alt-4) Offsets (Alt-3) So	ettings (Alt-6) Diagnostics (A	MIL>615 01 617 040 621 0	990 694 664 643 699 684 697
Gage Block Height	Current Work Offset	1 Act Work	offset R Zero	+0.0000
+0.0000 Set Z	+0.000	G54	F Zero	+0.0000
T	+0.000	Fixture Fixture	1 (654)	-1.0000
U FF	Z +0.000	DO Fixture	3 (656) O Zero 4	+0.0000
	+0.000	00 Fixture	5 (G58) 6 (G59)	Machine Coord's
Please S	elect Edge Finder Location	n	Gage Block He	right Tool Information
Select If Indica	ating Select	HELP - Work Offsets	+5.0000	HELP - Tool Offsets
		Edge Finder Dia.		Tool Offset On/Off
	o 🖉 🖉 🚽	+0.0000	8	7 Offset 1 000
I.v.				
Select	Select			Diameter 3.000
			Save Offset Table	es Here to Make Them Permanent
Reset	M.Codes	Jog ON/OFF CutAltJ	Save Work Off:	sets Save Tool Offsets
History Clear Status:			Profile: Mach3Mill	
1 井谷 (Q tao) (C Los) (Q 未約3-3	FC			

Finally, script for auto tool setting needs to be updated. Operate the main menu "Operator"->"Edit Button Script". Then click on flashing "Auto Tool Zero" button, as shown below.



Type the following script in the new window.

Declare Sub AutoToolSetting Lib "HyCNC_4P"(ByVal ctool As Integer)

AutoToolSetting(GetOEMDRO(824))

AutoToolSetting is a function define in HyCNC_4P.DLL. The input parameter is the tool number (the green circle in above figure), provided by GetOEMDRO(824) standard function. Then click menu "file"->"Save". When auto tool setting is required, click on the tool number box (the green circle in above figure). Type in tool number other 0 followed by return (tool 0 always has 0 offset). Then put tool setter on the machine bench and jog the tool above center of the tool setter. Press "Auto Tool Zero" to start tool setting process. After tool setting is finished, the box indicated by the blue arrow (see above figure) is updated with the measured tool length. Please pay attention, the new tool length won't be used immediately. To use the new value, either type G43 in MDI or click on page "Offset" of the main interface. There is a button called "Turn Offset on/Off" and a green indicator beside it. If the indicator is on, click "Turn Offset on/Off" twice to use the new tool length offset. If the indicator is off, click "Turn Offset on/Off"

The tool setting script can further adapted to the machine. For example, if the tool setter is fixed at a location, i.e. machine coordinate (100, 50) and new tool length is always used after tool setting, the script can be update as the following.

Declare Sub AutoToolSetting Lib "HyCNC_4P"(ByVal ctool As Integer)
code("G53 G0 X100 Y50")
While IsMoving()
Sleep(100)
Wend
AutoToolSetting(GetOEMDRO(824))
While IsMoving()
Sleep(100)
Wend
code("G43 ")

"G53 G0 X100 Y50" moves quickly to the center of the tool setter. When movement is done, auto tool setting is executed. When setting process is finished, G43 force the new tool length to be used.

If a manual tool change followed by auto tool setting is required from the GCode file, save the following script to a mxxx.m1s file, i.e. m900.m1s, in Mach3/Macros/Mach3Mill directory.

Declare Sub AutoToolSetting Lib "HyCNC_4P"(ByVal ctool As Integer)
code("G53 G0 Z200")
While IsMoving()
Sleep(100)
Wend
DoSpinStop()
code("G53 G0 X500 Y500")
MsgBox ("Press OK after tool change.", 0)
code("G53 G0 X100 Y50")
While IsMoving()
Sleep(100)

Wend
AutoToolSetting(GetOEMDRO(824))
While IsMoving()
Sleep(100)
Wend
code("G43 ")
DoSpinCW();
Call M000 in CCade eventta following energtions: "CE2 CO 7200" meyes the

Call M900 in GCode execute following operations: "G53 G0 Z200" moves the current to a safe height suitable for manual tool change. Then spindle is stopped. Then move to tool change located at machine coordinate (500, 500) by "G53 G0 X500 Y500". The a window with confirm button pops up on the screen, waiting manual tool change to be carried out. After tool changing, click on the confirmation button to continue the program. The machine moves to the tool setter center to start tool setting process. After the setting is finished, the new tool length offset is used and spindle rotates again.

Attention: the safety of the manual tool changing operator is depend on the proper running of the above script by the PC control system. If a safer condition is required (even the malfunction of the PC control system doesn't start spindle to hurt the operator), install safety switches or consult experts or HyTechWorks for a proper solution.

EStop Configuration

Attention: it is suggested to use the EStop provided by the PC control system as the secondary or backup solution and use direct hardware solution as the primary solution to guarantee stopping of the machine under critical conditions. The following configuration of the EStop is all based on using PC and HyCNC-4P interface. It is provided as it is for a reference only.

The EStop is enabled by operating the main menu "Config"->"Ports and Pins", clicking on page "Input Signals" and putting a green tick on EStop's "Enabled" column. "Port #", "Pin Number" and "Active Low" should be set according to physical connections (referring to chapter "Shape and Connections", section "Control Inputs"). If the input is low level effective, put a green tick in "Active Low" column. Then click "Apply" and "OK" to save the settings.

Enco	der/MPG's	1	Spindl	e Setup	 Taawa Si	Mill Op	tions
Fort Setup	and Axis Sel	ection.	Motor Uutp	outs	Tubut Signars	· Ui	itput Signal:
Signal	Enabled	Port #	Pin Number	Active Low	Emulated	HotKey	~
Probe	2	1	0	X	X	0	
Index	X	1	0	X	X	0	
Limit Ovrd	X	1	0	*	X	0	
EStop	4	1	12	4	X	0	
THC On	X	1	0	×	X	0	
THC Up	X	1	0	X	X	0	
THC Down	X	1	0	X	X	0	
OEM Trig #1	4	1	7	4	X	0	
OEM Trig #2	X	1	0	X	×	0	
OEM Trig #3	X	1	0	*	X	0	100
	1		d -	-	has	1	
	Pins 10-13 :	and 15 are inp	uts. Only these	5 pin numbers	may be Automate	ed Setup of I:	nputs
					-		

When EStop is trigged, the GCode execution is stopped. If 2 PWM outputs also required to stop, put "X" on "PWM1=0 on EStop" and "PWM2=0 on EStop" in "HyCNC-4P Config" window. The "HyCNC-4P Config" window can be shown by operating the main menu "Config"->"Config PlugIns".

Enabled	PlugIn Name	Config
4	Flash-FlashScreen-SWF-PlugIn-A.Fenerty-BB	CONFIG
4	HyCNC_4P-V1.0	CONFIG
2	JoyStick-JoyStick-PlugInArt-Fenerty-Ver-1.Oa	CONFIG
X	PrinterScope=Port=Scope=1.00.046	CONFIG
X	TurnDiags=Turn=Diags=1.00.1	CONFIG
4	VideoB. Barker-Ver-1.0	CONFIG

Then click on "CONFIG" box behind the "HyCNC-4P" .

Flash-FlashScree HyCNC-4P Config CONFIG HyCNC_4L-V2.0.5 FW 02.00.00.03 CONFIG HyCNC_6L-V2.0.5 SN 0676FF515648854987072246 CONFIG JoyStick-JoyStic FW 02.00.00.03 CONFIG TurnDiags-Turn-D VideoB. Barker PWM1=0 on EStop CONFIG Watchdog on PWM2 Homing Speed% 100	Inabled	PlugIn Name		Config
HyCNC_4L-V2.0.5 FW 02.00.00.03 CONFIG HyCNC_4P-V1.0.5 SN 0676FF515648854987072246 CONFIG HyCNC_6L-V2.0.5 SN 0676FF515648854987072246 CONFIG JoyStick-JoyStic FV PWM1=0 on EStop CONFIG TurnDiags-Turn-B: VideoB. Barker VideoB. Barker CONFIG Watchdog on PWM2 Homing Speed% 100 100 CONFIG	4	Flash-FlashScreen	HyCNC-4P Config 🛛 🛛 🛛	CONFIG
HyCNC_4P-V1.0.5 FW 02.00.00.03 CONFIG HyCNC_6L-V2.0.5 SN 0676FF515648854987072246 CONFIG JoyStick-JoyStic FrinterScope-Por V PWM1=0 on EStop CONFIG TurnDiags-Turn-D: V PWM2=0 on EStop CONFIG VideoB. Barker V ATS Stop on Touch CONFIG Watchdog on PWM2 Homing Speed% 100 100	X	HyCNC_4L-V2.0.5		CONFIG
HyCNC_6L-V2.0.5 SN 0676FF515648854987072246 CONFIG JoyStick-JoySticl Image: Configuration of the state	4	HyCNC_4P-V1.0.5	FW 02.00.00.03	CONFIG
JoyStick-JoyStic CONFIG PrinterScope-Por ✓ PWM1=0 on EStop CONFIG TurnDiags-Turn-D ✓ PWM2=0 on EStop CONFIG VideoB.Barker ✓ ATS Stop on Touch CONFIG Watchdog on PWM2 Homing Speed% 100	X	HyCNC_6L-V2.0.5	5N 0676FF515648854987072246	CONFIG
PrinterScope-Por ✓ PWM1=0 on EStop CONFIG TurnDiags-Turn-D: ✓ PWM2=0 on EStop CONFIG VideoB. Barker ✓ ATS Stop on Touch CONFIG Watchdog on PWM2 Homing Speed% 100 100	2	JoyStick-JoyStic		CONFIG
TurnDiags-Turn-D: ✓ PWM2=0 on EStop CONFIG VideoB. Barker ✓ ATS Stop on Touch CONFIG Watchdog on PWM2 Homing Speed% 100 100	X	PrinterScope-Por	PWM1=0 on EStop	CONFIG
VideoB. Barker ✓ ATS Stop on Touch CONFIG ✓ Watchdog on PWM2 Homing Speed% 100	X	TurnDiags-Turn-Di	PWM2=0 on EStop	CONFIG
Watchdog on PWM2 Homing Speed% 100	1	VideoB. Barker	ATS Stop on Touch	CONFIG
Homing Speed% 100	area.		🔲 Watchdog on PWM2	a province and the
			Homing Speed% 100	
OK Cancel			OK Cancel	

When external EStop is triggered, the Mach3 will be locked to stop state even external EStop is released. The red "RESET" button continues having a green-red box flashing. Click on the "RESET" button to release Mach3's internal stop state. If the external EStop is still engaged when the "RESET" button is clicked, the internal stop can't be released.

Mach3 Watchdog Configuration

A software watchdog can be enabled to monitor the proper working of the Mach3. Operate the main menu "Config"->"Config PlugIns".

Enabled	PlugIn Name	Config
4	Flash-FlashScreen-SWF-PlugIn-A.FenertyBB	CONFIG
4	HyCNC_4P-V1.0	CONFIG
X	JoyStick-JoyStick-PlugInArt-Fenerty-Ver-1.0a	CONFIG
X	PrinterScope-Port-Scope-1.00.046	CONFIG
X	TurnDiags=Turn=Diags=1.00.1	CONFIG
4	VideoB. Barker-Ver-1.0	CONFIG

Then click on "CONFIG" box behind the "HyCNC-4P" .

Flash-FlashScree HyCNC-4P Config CONFIG HyCNC_4L-V2.0.5 FW 02.00.00.03 CONFIG HyCNC_6L-V2.0.5 SN 0676FF515648854987072246 CONFIG JoyStick-JoySticl SN 0676FF515648854987072246 CONFIG TurnDiags-TurnDi VideoB. Barker PWM1=0 on EStop CONFIG WideoB. Barker Watchdog on PWM2 CONFIG CONFIG	nabled	PlugIn Name		Config
HyCNC_4L-V2.0.5 FW 02.00.00.03 CONFIG HyCNC_4P-V1.0.5 SN 0676FF515648854987072246 CONFIG JoyStick-JoySticl V OPWM1=0 on EStop CONFIG TurnDiags-Turn-D VideoB. Barker Video on PWM2 CONFIG	1	Flash-FlashScree	HyCNC-4P Config	CONFIG
HyCNC_4P-V1.0.5 FW 02.00.00.03 CONFIG HyCNC_6L-V2.0.5 SN 0676FF515648854987072246 CONFIG JoyStick-JoyStic FrinterScope-Por PWM1=0 on EStop CONFIG TurnDiags-Turn-D V PWM2=0 on EStop CONFIG VideoB. Barker V ATS Stop on Touch CONFIG Watchdog on PWM2 Units Graed 0/2 Units Graed 0/2	×	HyCNC_4L-V2.0.5		CONFIG
HyCNC_6L-V2.0.5 SN 0676FF515648854987072246 CONFIG JoyStick-JoySticl Image: Configuration of the state of the stat	4	HyCNC_4P-V1.0.5	FW 02.00.00.03	CONFIG
JoyStick-JoyStic PrinterScope-Por TurnDiags-Turn-D: ✓ PWM1=0 on EStop CONFIG CON	X	HyCNC_6L-V2.0.5	SN 0676FF515648854987072246	CONFIG
PrinterScope-Por V PWM1=0 on EStop CONFIG TurnDiags-Turn-D: V PWM2=0 on EStop CONFIG VideoB. Barker ATS Stop on Touch CONFIG Watchdog on PWM2 Watchdog on PWM2 Config	X	JoyStick-JoyStic		CONFIG
TurnDiags-Turn-D: ✓ PWM2=0 on EStop CONFIG ✓ VideoB. Barker ✓ ATS Stop on Touch CONFIG ✓ Watchdog on PWM2 ✓ Variation State dW Construction	X	PrinterScope-Por	PWM1=0 on EStop	CONFIG
VideoB. Barker Video ATS Stop on Touch	X	TurnDiags-Turn-Di	PWM2=0 on EStop	CONFIG
Watchdog on PWM2	4	VideoB. Barker	ATS Stop on Touch	CONFIG
United Canador Line	arice.		Watchdog on PWM2	a state of the second
Homing Speed% 100			Homing Speed% 100	
Cancel			OK Cancel	

Tick "Watchdog on PWM2" to enable the watchdog function. When Mach3 works properly, PWM2 output a 50% duty cycle signal. When Mach3 works abnormally, PWM2 output a 0 duty cycle signal. When watchdog is enabled, PWM2 can't be controlled by a M code. As soon as watchdog is enabled, it can't be disabled until USB interface's power is recycled. To disable the watchdog, untick "Watchdog on PWM2", exit Mach3, recycle the USB interface's power and restart Mach3.

Firmware Update

The HyCNC-4P's firmware can be updated online by the final users for function extension and bug fix. The latest firmware can be downloaded from http://www.hytechworks.com/Downloads/HyCnc/HyCNC_4P/index_e.html

Normal Operation

Run HyCncFlash.exe to start firmware updating process. First, select the firmware image file that need to be programmed into the HyCNC-4P interface. All firmware image files have extension of "fbl". Please use firmware matching to the hardware. Incorrect firmware may cause malfunction and damage.

Open					? 🔀
Look in:	🗢 Removable	Disk (E:)	•	- 🗈 💣 📰	•
My Recent Documents	hycnc_a.fbl				
My Documents					
	File name:	hycnc_a.fbl			Open
My Computer	Files of type:	FBL Files (*.fbl)		•	Cancel
0		C Open as read-only			

Firmware update process starts, a window pops up to show the progress.



When firmware update process finishes, the following window pops up. Click "OK".

Info		
Flas	h update suo	esses.
Ε	OK]

When the firmware update process runs the first time on a PC, HyCncFlash.exe can't run properly because the firmware update USB driver has not been installed. The following failure windows will appear. It is normal. Click "OK" to end HyCncFlash.exe.

Error		
Fail to connect to H	YCNC FBL devi	ice. Exit flash process.

"New Hardware Wizard" window pops up. Click "Yes, this time only" and "Next".

Found New Hardware Wiz	ard
	Welcome to the Found New Hardware Wizard Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission). <u>Read our privacy policy</u>
	Can Windows connect to Windows Update to search for software?
	Click Next to continue.
	< Back Next > Cancel

Then click on "Install from a list or specific location" and "Next".

Found New Hardware Wiz	ard
	This wizard helps you install software for: HyCnc USB Bootloader If your hardware came with an installation CD or floppy disk, insert it now.
	What do you want the wizard to do? O Install the software automatically (Recommended) O Install from a list or specific location (Advanced) Click Next to continue.
	< Back Next > Cancel

Then click "Don't search. I will choose the driver to install" and "Next".



"New Hardware Wizard" will find the suitable driver and list it. Click on "HyCnc USB Bootloader" and "Next".

Found New Hardware Wizard	
Select the device driver you want to install for this hardwa	re.
Select the manufacturer and model of your hardware device an have a disk that contains the driver you want to install, click Ha	d then click Next. If you ve Disk.
Model HyCnc USB Bootloader	
This driver is not digitally signed! <u>Tell me why driver signing is important</u>	Have Disk
K Back	lext > Cancel

The USB driver is then installed to PC.



When the installation is finished, the following window pops up. Click "Finish".



After install the USB driver, run HyCncFlash.exe again to perform firmware

update.

Firmware Recovery

For any reason that HyCncFlash.exe fails to run properly in normal mode, firmware recovery need to be performed to force re-programming a correct firmware that can recover the normal working condition. First, disconnect HyCNC-4P from the PC's USB. Then connect a 7-10V DC voltage source (i.e. using a 9V battery) between EStop (pin 10) and the ground (pin 18-25), as shown in the following drawing.



Connect HyCNC-4P to PC USB. If the firmware update mode USB driver has not been installed, the driver install process starts automatically (described in the last section). After the driver is installed, run HyCncFlash.exe to normally. After update process starts, the external DC voltage source can be removed. After updating process is finished, the HyCNC-4P should work properly.

Low Level API

Windows programs can use HyCNC-4P to generate motion and other control signals via API functions. API consists of HyCNC_4P.LIB and its header file HyCNC_4P.H. The latest API can be downloaded from

http://www.hytechworks.com/Downloads/HyCnc/HyCNC_4P/index_c.html

The API has following functions.

Device Identification and Opening

BOOL HyCNC_GetDevicePathByGUID(LPGUID DeviceGuid, char *DevicePath, DWORD DeviceIndex)

HyCncLib_GetDevicePathByGUID identifys the path of a HyCNC-4P interface by its driver GUID.

DeviceGuid – pointer to the device GUID.

DevicePath – pointer to store the device path string found according to the GUID and device index.

DeviceIndex – index to the number of the device in system list, starting with 0.

If the function succeeds, the return value is true. Otherwise, it returns false.

HANDLE HyCNC_OpenDeviceByPath(char *DevicePath)

HyCncLib_OpenDeviceByPath opens HyCNC-4P interface by its path obtained from calling HyCncLib_GetDevicePathByGUID.

DevicePath – pointer to the device path string.

If the function returns the device handle. If it fails, the handle is INVALID_HANDLE_VALUE.

Device Basic Information Reading

BOOL HyCNC_GetStatus(HANDLE hUsb, LPOVERLAPPED olp, HyCNC_StatusStruct *status)

HyCNC_GetStatus reads essential status from HyCNC-4P interface.

hUsb – the handle of the HyCNC interface.

olp – pointer to OVERLAPPED structure (see FileRead Visual C++ function for overlapped I/O access)

status – status data read from HyCNC interface.

If the function succeeds, the return value is true. Otherwise, it returns false.

The status data have the following fields:

num – number of way point to fill the FIFO buffer in the HyCNC inteface.

cx – 32 bit x-axis coordinate count value in motor step.

cy – 32 bit y-axis coordinate count value in motor step.

cz – 32 bit z-axis coordinate count value in motor step.

ca – 32 bit a-axis coordinate count value in motor step.

cb – 32 bit b-axis coordinate count value in motor step.

cc – 32 bit c-axis coordinate count value in motor step.

din – port #1 inputs.

BOOL HyCNC_GetHardwareInfo(HANDLE hUsb, HyCNC_HardwareInfoStruct *info);

HyCNC_GetHardwareInfo reads HyCNC-4P hardware information.

hUsb - the handle of the HyCNC interface.

info - hardware infomation data.

If the function succeeds, the return value is true. Otherwise, it returns false.

hardware infomation data have the following fields:

type – hardware type.

axis - number of axis.

option – hardware option.

features - functional features

fwv – firmware version sn1 – serial number 1 sn2 – serial number 1

sn3 – serial number 1

Motion Control

BOOL HyCNC_SetMovement(HANDLE hUsb, LPOVERLAPPED olp, double *points, unsigned char axis, unsigned short num)

HyCNC-4P generates interpolated stepping pulses with 1ms time base. HyCNC_SetMovement sends the motor 1ms based movement vector data to HyCNC-4P through USB.

hUsb – the handle of the HyCNC interface.

olp – pointer to OVERLAPPED structure (see FileWrite Visual C++ function for overlapped I/O access)

points – pointer to the vector data. The vector data is organized in (x0,[[[y0],z0],a0]), (x1,[[[y1],z1],a1]), (x2,[[[y2],z2],a2])...order.

axis - number of axis in vector.

num – number of vectors in data (no more than num return by HyCNC_GetStatus).

If the function succeeds, the return value is true. Otherwise, it returns false.

BOOL HyCNC_PurgeMovement(HANDLE hUsb)

HyCNC_PurgeMovement clears all pending movement data in HyCNC-4P so that stepping pulse can be stopped immediately.

hUsb – the handle of the HyCNC interface.

If the function succeeds, the return value is true. Otherwise, it returns false.

BOOL HyCNC_SetCoordinate(HANDLE hUsb, int* coordinate, int* mode)

HyCNC_SetCoordinate manipulates coordinate counters in HyCNC-4P.

hUsb – the handle of the HyCNC interface.

coordinate – pointer to 4 element coordinate array that used to modify the coordinate counters.

mode – pointer to 4 element mode array that defines the mode for coordinate counter modifications. 0 – relative mode – the coordinate value is added to current coordinate counter. 1 – absolute mode - the coordinate value is set to current coordinate counter.

If the function succeeds, the return value is true. Otherwise, it returns false.

Other Controls

BOOL HyCNC_SetSwitch(HANDLE hUsb, unsigned int val)

HyCNC_SetSwitch sets relay output on/off.

hUsb – the handle of the HyCNC interface.

val – output level. Bit 0 –OUT1. Bit 1 – OUT2.

If the function succeeds, the return value is true. Otherwise, it returns false.

BOOL HyCNC_SetSpindle0(HANDLE hUsb, unsigned short period, unsigned short prescale)

HyCNC_SetSpindle0 sets base frequency for PWM1 and PWM2.

hUsb – the handle of the HyCNC interface.

 $Freq = \frac{72000000}{\text{period } \cdot \text{prescale}}$

BOOL HyCNC_SetSpindle1(HANDLE hUsb, unsigned short duty)

HyCNC_SetSpindle1 sets PWM1's duty cycle.

hUsb – the handle of the HyCNC interface.

Duty Cycle = $\frac{\text{duty}}{\text{period}}$

BOOL HyCNC_SetSpindle2(HANDLE hUsb, unsigned short duty)

HyCNC_SetSpindle2 sets PWM2's duty cycle.

hUsb – the handle of the HyCNC interface.

Duty Cycle = $\frac{\text{duty}}{\text{period}}$

BOOL HyCNC_KickWatchdog(HANDLE hUsb)

This function send a normal working signal to USB interface. The first signals enable the watchdog if it is not enabled. This function needs to be called every 0.1 second. If it is not called in 0.5 second, the watchdog times out. hUsb – the handle of the HyCNC interface.