ArcPro v2 Mach4 Plasma Screen
User Guide

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Atlanta, GA USA

For more information please visit the product web page:

http://www.vitalsystem.com/arcpro

Contents

License Agreement

Before using the “ArcPro v2 Plasma Control” package and accompanying software tools, please take a moment to go thru this License agreement. Any use of this hardware and software indicate your acceptance to this agreement.

It is the nature of all machine tools that they are dangerous devices. In order to be permitted to use the “ArcPro v2 Plasma Control” package on any machine you must agree to the following license:

I agree that no-one other than the owner of this machine, will, under any circumstances be responsible, for the operation, safety, and use of this machine. I agree there is no situation under which I would consider Vital Systems, or any of its distributors to be responsible for any losses, damages, or other misfortunes suffered through the use of the “ArcPro v2 Plasma Control” package and any accompanying software. I understand that the “ArcPro v2 Plasma Control” package is very complex, and though the engineers make every effort to achieve a bug free environment, that I will hold no-one other than myself responsible for mistakes, errors, material loss, personal damages, secondary damages, faults or errors of any kind, caused by any circumstance, any bugs, or any undesired response by the board and its software while running my machine or device.

I fully accept all responsibility for the operation of this machine while under the control of the “ArcPro v2 Plasma Control” package, and for its operation by others who may use the machine. It is my responsibility to warn any others who may operate any device under the control of the “ArcPro v2 Plasma Control” package of the limitations so imposed.

I fully accept the above statements, and I will comply at all times with standard operating procedures and safety requirements pertinent to my area or country, and will endeavor to ensure the safety of all operators, as well as anyone near or in the area of my machine.

WARNING: Machines in motion can be extremely dangerous! It is the responsibility of the user to design effective error handling and safety protection as part of the system. VITAL System Inc. shall not be liable or responsible for any incidental or consequential damages. By using any product purchased from VITAL System Inc., you agree to the license agreement.

Introduction

IMPORTANT

This document makes the assumption that the reader has thoroughly reviewed the necessary documentation:

- *HiCON Mini User Guide*
- *Mach4 HiCON Integration Manual*

Has completed the proper hardware setup, and possesses basic knowledge and understanding of Mach4 CNC Software.

This document DOES NOT serve as a primer or tutorial for the use of Mach4. As such, readers without basic understanding of Mach4, and other software components not associated with Vital System Inc. are advised to consult the appropriate user manual and/or software vendor.

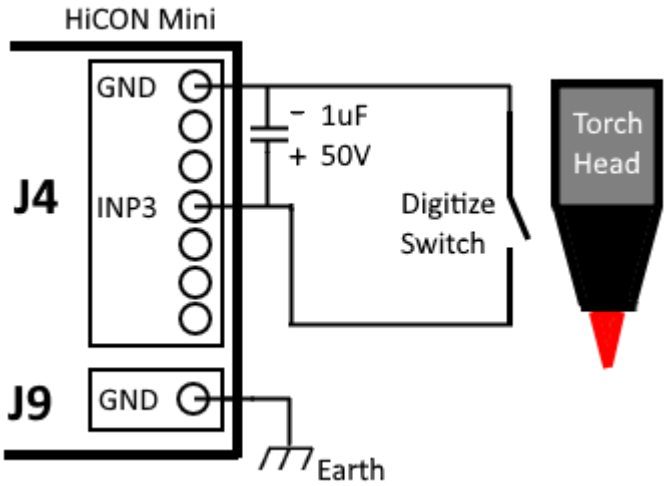
This document only serves as a supplemental user guide for the additional setup of integrating Torch Height Control with the HiCON and Mach4.

NOTE: *Several notes such as this can be found throughout this document which list key points and comments worth remembering.*

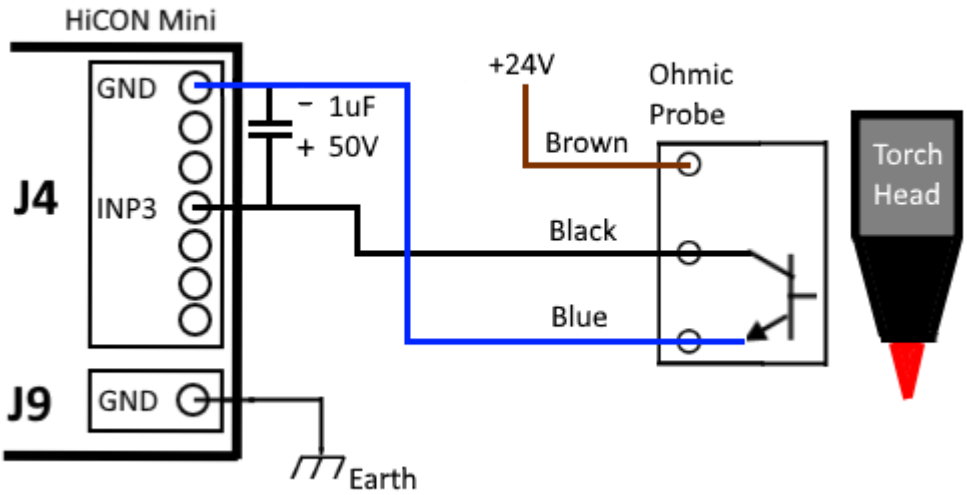
Wiring Diagrams

Plasma Electrical Noise Filter for Digitize Sensor

NOTE: *It is highly recommended to follow the circuit diagram below when using a Digitize sensor on the torch head. Because a Plasma Torch uses high-voltage for cutting, voltage spikes and electrical noise must be properly filtered in order to safely connect the sensor to a digitize input on the HiCON Mini.*



Connecting NPN Digitize Sensor (Ohmic Probe)

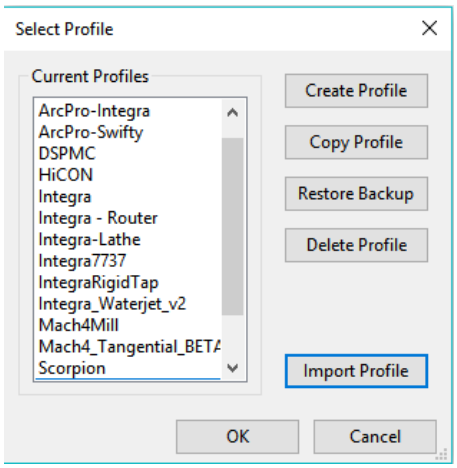


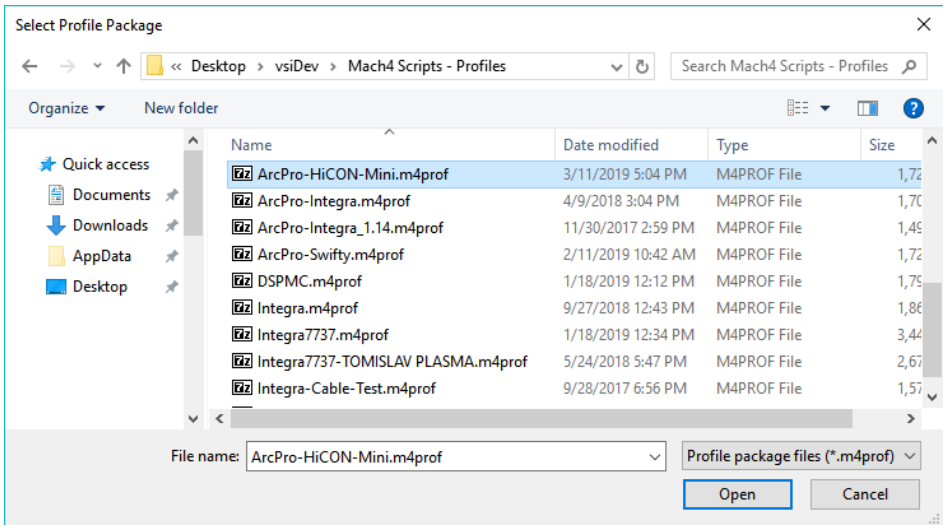
Mach4 Profile

Download the latest ArcPro Plasma v2 profile from the product website:

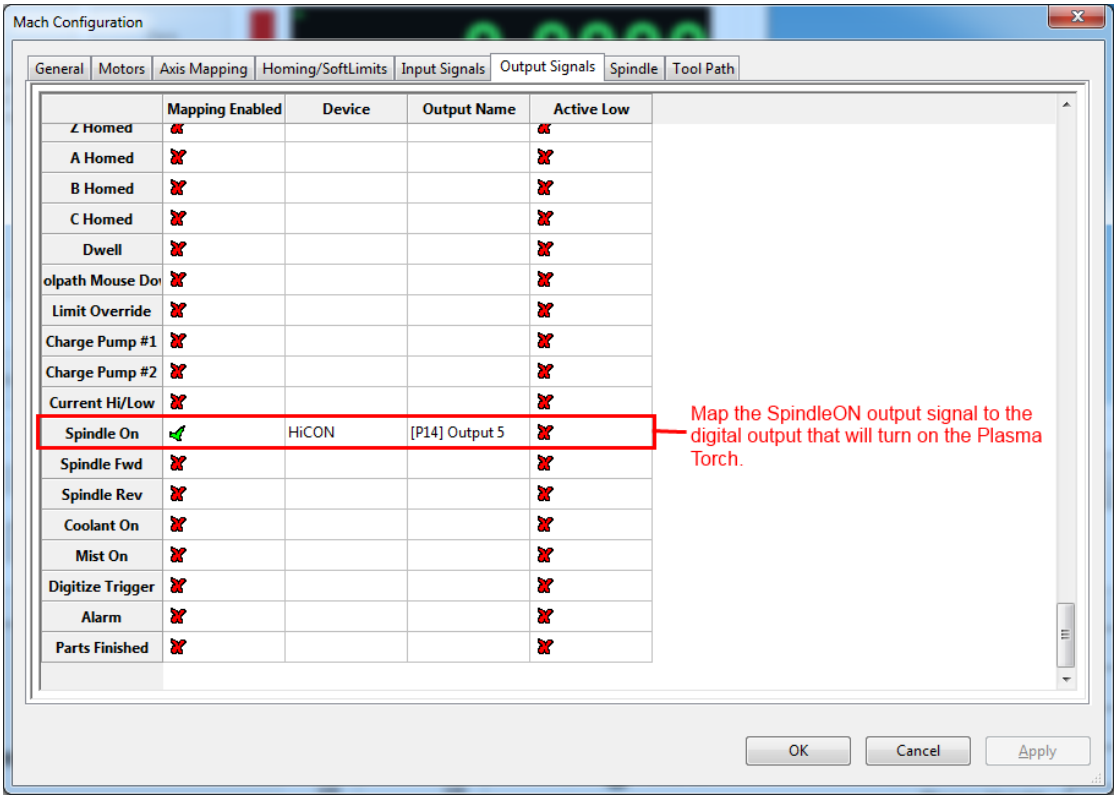
http://www.vitalsystem.com/arcpro

Open Mach4 loader and click on Import Profile. Browse for the downloaded profile (.m4prof) file and click Open. If you wish to rename the imported profile, change the name and click OK. Otherwise, press OK to finish.

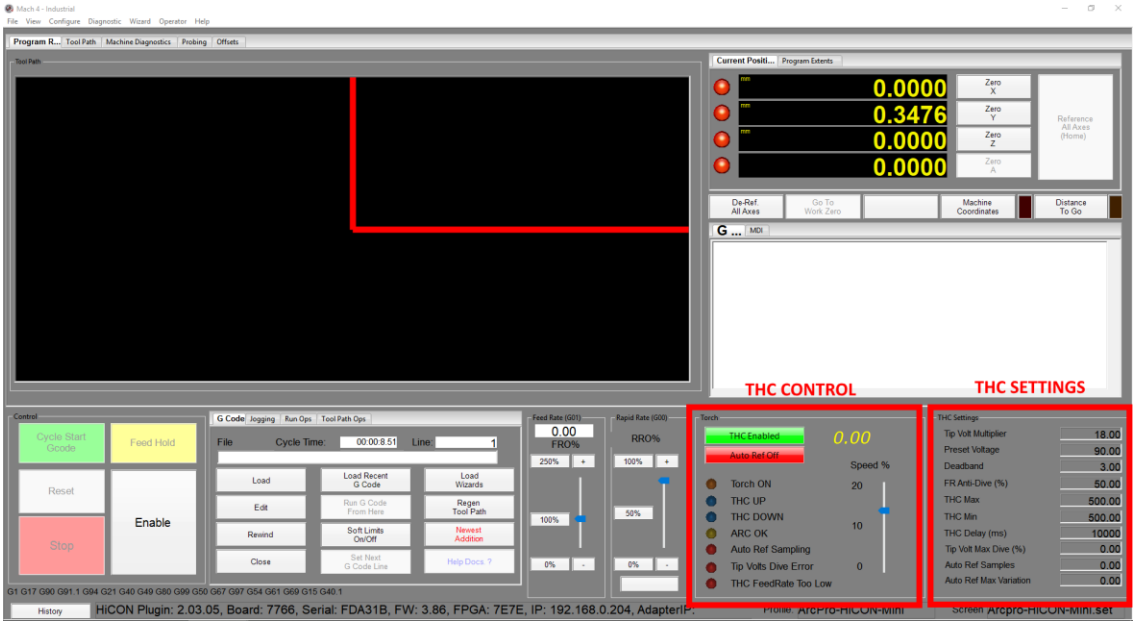




Mach4 I/O Configuration



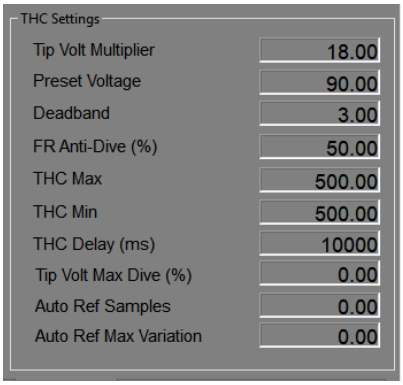
ArcPro v2 Mach4 Plasma Screen



THC Control – This panel serves as the control interface for starting/stopping THC Mode (e.g. the automatic adjustment of the torch height while cutting).

THC Settings – Settings for THC mode can be configured on this panel. Changes to these settings only take effect before starting THC mode, not during.

THC Settings



These settings affect how the Torch Height adjustments are made. Consult the Plasma Cut Sequence for more details.

Tip Volt Multiplier

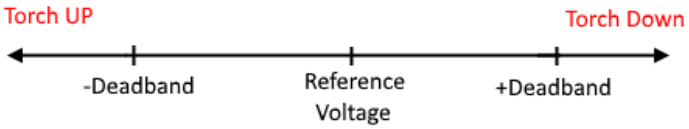
This value is a multiplier to the tip voltage value read in from the 0-10V analog input.

Preset Voltage

This value represents the reference voltage to use when auto reference mode is turned off.

Deadband

This value acts like an offset to the reference voltage. The deadband is added to or subtracted from the reference voltage and compared to the current tip voltage when making the determination to change the up, down, or no motion state of the torch height axis.



THC Max

The maximum correction distance ***above*** the pierce height reference position.

THC Min

The maximum correction distance ***below*** the pierce height reference position.

THC Delay

This is the amount of time in milliseconds to wait after finding the Arc OK signal in the M3 script. This value allows the cutting head to get away from the molten metal surrounding the initial pierce hole. This is used primarily for thick material or small holes.

FR Anti-Dive

Feedrate Anti-Dive prevents the THC from dropping the torch into a cut hole, diving into corners, or diving at the end of a cut. When the XY cutting speed slows down, the plasma tip voltage increases, and as a result, the response from the THC is to lower the torch. When the actual cutting feedrate drops below the ***specified percentage*** of the commanded feedrate, Feedrate Anti-Dive is engaged and the Z-Axis motion is disabled and stays locked in positon.

Tip Volt Max Dive

This value represents the maximum and minimum allowable change from the last stable tip voltage reading. The last stable tip voltage reading is recorded every 50 milliseconds while THC mode is running during a cut. If the current tip voltage falls out of this range, the torch height motion is disabled until the current tip voltage returns to a safe value. This is used to prevent the torch head diving when moving over a hole. Set this value to 100 if you do not want to use it.

Auto Ref Samples

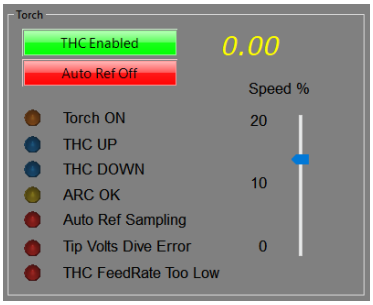
This value represents the amount of samples of the tip voltage to capture when finding the initial reference voltage in auto reference mode. *This value is used in conjunction with the Auto Ref Max Variation value.*

Auto Ref Max Variation

This value represents the maximum allowable variation of the individually sampled reference voltage readings. The variation is the difference from the individually sampled reference voltage readings and the current tip voltage. The auto reference sampling will restart the Auto Ref Samples counter if the difference exceeds the Auto Ref Max Variation. The auto reference sampling will continue to repeat until all of the individually sampled reference voltage readings fall within this range. This sampling process helps provide a more stable reading for the reference voltage in auto reference mode.

THC Control

This interface serves as the operator control for initiating THC Mode and for turning on auto reference mode.



THC Enabled/Disabled

The Torch Height Control (THC) reads the tip voltage while cutting and automatically adjusts the cutting head up and down to maintain a constant height above the material. If THC is disabled the cutting head will only move when commanded using Gcode.

Tip Voltage Reading

Displays the current tip voltage reading from the 0-10V analog voltage input sensor multiplied by the Tip Volt Multiplier. *The DRO is located directly above the Speed control slider*.

Speed

This value controls the THC up/down feedrate.

#130 (Mach4 pound variable)

This variable enables or disables the torch height control during a cut. It can be set in the Gcode by calling #130=1 or #130=0. When the value is 1 the torch height control is enabled. If the value is 0 the torch height control is disabled.

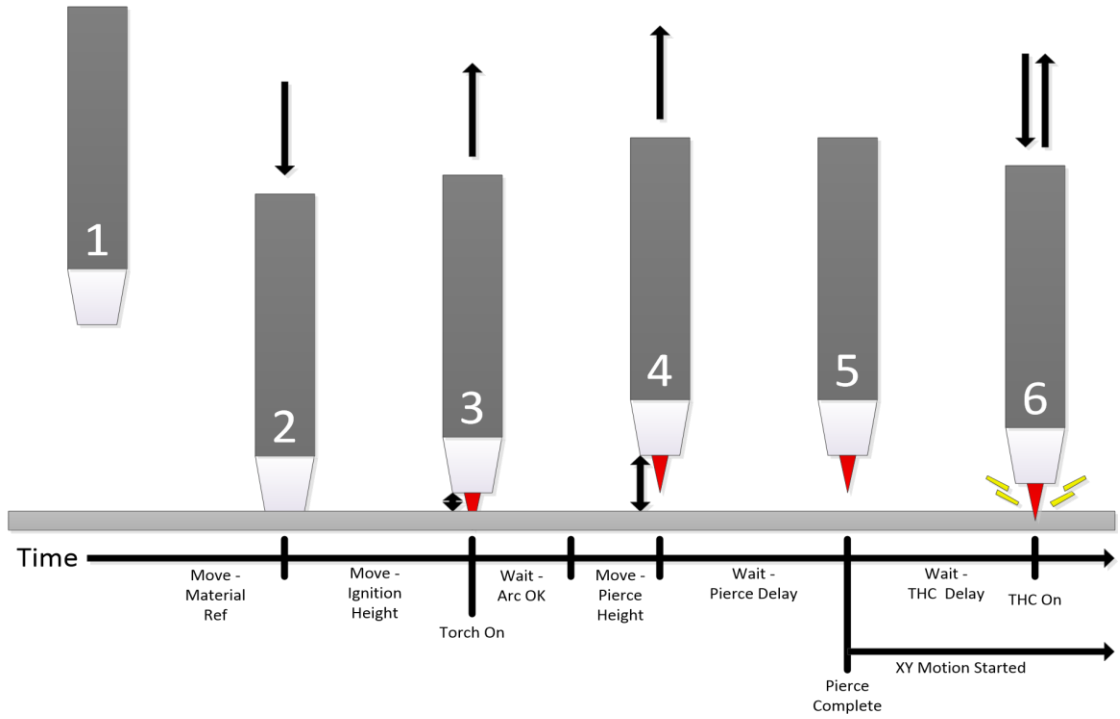
Plasma Cut Sequence

The typical plasma cut sequence starts with a probe to locate the material. The probing sequence is performed by using the G31 Gcode cycle. After the probe, the torch is raised to ignition height and the M3 script starts the torch on sequence. The M3 script included in the ArcPro v2 screen-set checks to see if THC mode is enabled, turns the torch output on, and waits for up to five seconds until the Arc OK signal is found. Once the Arc OK signal is found, the THC delay counter is started. The Z axis moves to the pierce height and the pierce delay starts. Immediately following the pierce delay, the XY motion starts and the torch height control begins once the THC delay expires.

The following Gcode shows how a typical plasma cut sequence can be programmed:

```
#130=1 (enable torch height control motion)
G0 G90 G54 G18 G40 G49 G80  (safe start line)
G0 X0Y0Z5      (Z axis starting point)
G31 X0Y0Z-4   (Z axis Probe to max depth of -4)
G0 X0Y0Z0.5   (move Z axis to ignition height)
M3             (turn torch on & wait for arc ok)
G0 X0Y0Z1.5   (move Z axis to pierce height)
G04 P1.0       (wait for pierce delay)
G0 X5Y5        (begin XY motion)
G0 X10Y10
M5             (end torch height control sequence)
M30
%
```

The figure below shows the plasma cut sequence.



Step 1: The height that the Z-Axis was at when the cut sequence began

Step 2: The torch head comes down to contact the material to determine the material height

Step 3: The torch head lifts to ignition height and turns on.

Step 4: Once the Arc Ok signal turns on, and the torch lifts to the pierce height

Step 5: Pierce delay is complete and XY motion begins

Step 6: THC delay is complete and the THC takes over Z-Axis control

How to Launch GCode File for Plasma Cut:

1. Load your GCode file. Make sure file contains M3/M5 macros to turn ON/OFF the torch.
2. Enable Mach4 (click the enable button).
3. Enable THC Mode (click the "THC Mode" Button)
4. Click Cycle Start to launch the GCode file.

How to Launch Start and Stop THC Motion via MDI

1. Enable Mach4 (click the enable button).
2. Enable THC Mode (click the "THC Enabled/Disabled" Button)
3. Turn on the Torch (use the M3 command)
4. Wait for the Torch ON sequence to complete successfully.
5. XY motion can now be performed with the Torch Height being automatically adjusted.
6. The Torch can be turned OFF by clicking the "Torch Enabled/Disabled" Button, or with the M5 command.
7. The Z axis can now be controlled from Mach.

Enable THC Motion through Scripts

The following lines of script can be called in order to enable THC Mode:

```
local inst = mc.mcGetInstance()
local valueReg = mc.mcRegGetHandle(inst, "VSIRegisters/thcModeState")
mc.mcRegSetValue(valueReg, 1) -- turn on
```

NOTE: *Disabling THC Mode will also turn off the Torch.*

Testing With Emulated THC Signals

The motion controller commands motion to the Z axis based on the tip volt changes when operating in THC mode. The change in the tip volts reading can be emulated by changing the value in the Tip Volt Multiplier field.

NOTE: *The "Anti-Dive" feature will lock the Z motion if no motion is present on any X & Y axes. Setting the Anti-Dive value to zero will prevent the Anti-Dive from engaging (will not prevent diving).*

1. Make sure ***all wiring and configuration are properly setup*** (wiring is done properly, digital I/O are mapped to Mach4 signals, and THC settings are configured according to the specifications of the system).

2. Click on the "Enable" button at the lower left of the ArcPro screen to arm the system.

3. Click **THC Enabled** button on the screen (if the button does not say "THC Enabled", then THC mode is turned off).

4. Click **Auto Ref Off** button on the screen (if the button does not say "Auto Ref Off", then Auto Ref mode is on).

5. Move the Z axis to the torch ignition height (by jogging or using GCode).

6. Set the Tip Volt Max Dive (%) field to 100.

7. Set the Preset Voltage to 90.

8. Set the THC delay to 500.

9. Run your GCode that has #130=1 followed by an M3 command and a long XY motion. The #130 variable will enable torch height control and the M3 script will activate the torch.

10. Trigger the **[ArcOK]** signal and keep it activated for the duration of the test.

11. While the XY motion is happening, change the Tip Volt Multiplier field to 100 or 80.

12. The torch height axis will respond to the voltage settings and you will see the THC UP/DOWN LED's in the Torch control light up accordingly.

Testing with Jogging

Before automating the process of cutting parts, the THC may also do manually controlled cutting by using jogging or MDI in Mach4.

NOTE: *The "Anti-Dive" feature will lock the Z motion if no motion is present on the XY axes. For this example, it is recommended to set the "Anti-Dive" to a non-zero value (example: 5% - 10%).*

1. Click on the "**Enable**" button at the lower left of the ArcPro screen to arm the system.

2. Click **THC Enabled** button on the screen (if the button does not say "THC Enabled", then THC mode is turned off).

3. Move the Z axis to the torch ignition height (by jogging or through GCode).

4. Move the Z axis to the torch ignition height (by jogging or using GCode).

5. Run your GCode that has #130=1 followed by an M3 command.

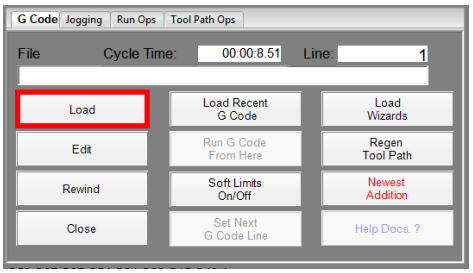
6. When the Setup Sequence is done the Z motion will be locked by the anti-dive feature until XY motion occurs. Make sure that the Anti-dive % is set to a non-zero value.

7. The X and Y axes can be jogged through the on-screen controls, or MPG Pendant, and the Z height should be corrected in response to the material surface height.

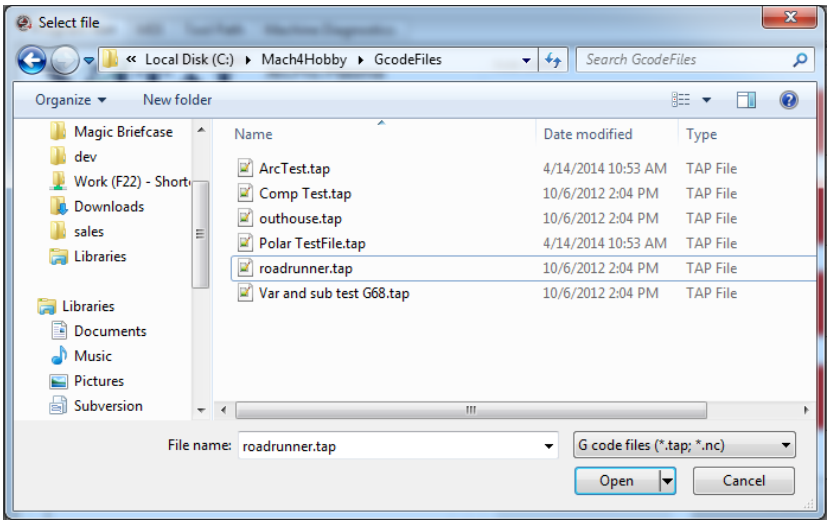
Loading and Starting a Job with a GCode File

NOTE: *It is recommended to properly setup all hardware and software components, and perform some of the testing steps above before following this section.*

1. Click on the "Load" button in the Gcode tab in the ArcPro v2 screen.



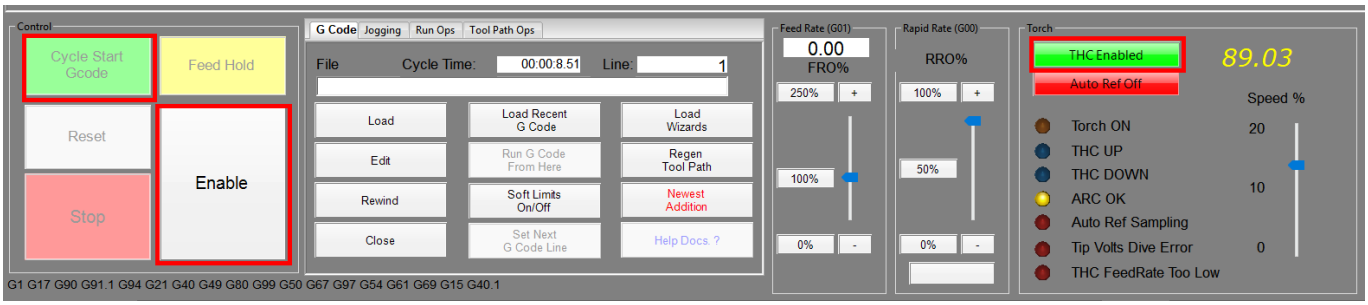
2. Select the desired pre-made GCode file and click Open.



3. Once the GCode file is loaded, click on the “Enable” button at the lower left of the ArcPro v2 screen to Arm the system.

4. Click the “**THC Enabled”** button on the screen (if the button says “THC Disabled” and is red, then THC mode is turned off).

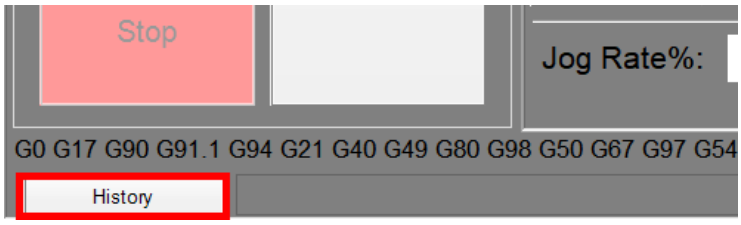
5. Click on “**Cycle Start**” to initiate the job.



Troubleshooting

Most error messages can be viewed in the history log of Mach4 and can indicate problems with the configuration or the runtime operation.

NOTE: *Please follow the proper setup instructions for wiring, Mach4 configuration, and the setting the on-screen THC parameters before attempting any tests.*



The system disarms when calling the M3 command

Cause	Solution
One of the THC settings may be bad.	Review the THC settings on the ArcPro screen and make sure that the ***[THC On]*** is enabled and mapped to a digital input on the motion controller.
The ***[ArcOK]*** or ***[DIGITIZE]*** signal is currently active.	Check the Mach4 Input signal mapping, and make sure that the polarities (Active Low/High), are set to the correct values. Inspect the wiring and make sure that the LEDs on the Arc Pro screen toggle properly.
The controller was busy executing another motion sequence.	In most scenarios, this error shouldn't occur. Check the GCode File or MDI command being executed before the M3 command.
The probe move reached the indicated limit without detecting the digitize signal.	Check that the ***[Digitize]*** signal in Mach4 is mapped to the correct digital input, and that the ***[Digitize]*** signal toggles correctly by checking the signal state in the diagnostic tab on the Mach4 screen. **NOTE:** *It is also recommended to go through the wiring diagram for safely connecting the digitize sensor to the motion controller.*
The THC feature is currently not activated on the unit.	Please contact the vendor of your unit, or Vital System Inc.

The system hangs up during the M3 sequence

Cause	Solution
The [ArcOK] signal is not being detected after Torch Ignition.	Check that the ***[ArcOK]*** input signal is enabled and mapped to the correct digital input on the HiCON Integra. Also, check that the ArcOK signal LED on the ArcPro screen changes state when toggling the digital input.

The Torch does not move toward the designated probe limit position

Cause	Solution
The displayed coordinates have a "Work Offset" applied.	Refrain from using the "Zero X", Y or Z buttons and instead use the appropriate homing routine to go back to machine zero, or manually jog or issue a GCode move through MDI. Make sure that the display is showing the machine coordinates in order to verify if a work offset is being used. If a work offset is applied, the offset values may be set to zero from the "View->Fixture Offsets" window.
Mach4 is not configured with the correct unit of measurement.	Go to the Mach4 config screen and set it to use the appropriate unit of measurement (inches or metric). Also, check if G20 or G21 is being called from the GCode file.

The Torch completes the M3 setup sequence, but does not move up or down afterwards

Cause	Solution
The THC max or THC min parameters values are too small.	The THC max and THC min control the maximum and minimum up/down correction distance from the pierce height that the torch will be allowed to move while cutting. Set these two parameters to larger values to allow a greater window for height correction.
The THC Speed is set to a very small value	This parameter controls the speed at which the torch will move up or down. Set the THC speed to a greater value. (NOTE: speeds that are too high may stall stepper motors).

The Torch only moves in one direction, or the wrong direction while cutting

Cause	Solution
The system was not configured correctly.	Perform the tests using Emulated THC Signals, as well as Jogging in order to diagnose the problem. Before placing the Z axis under THC control, it is also highly recommended to manually jog the Z axis to test if the axis direction is correct.

The Z axis moves too fast while cutting

Cause	Solution
The THC Speed slider is set to a large value	Decrease the THC speed value as necessary

Additional References

- HiCON Mini User Guide
- Mach4 HiCON Integration Manual
- Compact THC 150 Manual