

ArcPro Mach4 Plasma Screen User Guide

Document Revision 1.20

(Updated March 13, 2019)

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Phoenix, AZ USA

For more information please visit the product web page:

<http://www.vitalsystem.com/arcpro>

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License Agreement

Before using the “ArcPro 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 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 Plasma Control” package and any accompanying software. I understand that the “ArcPro 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 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 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 Integra User Guide*
- *Mach4 HiCON Integration Manual*
- *Compact THC 150 Manual*

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

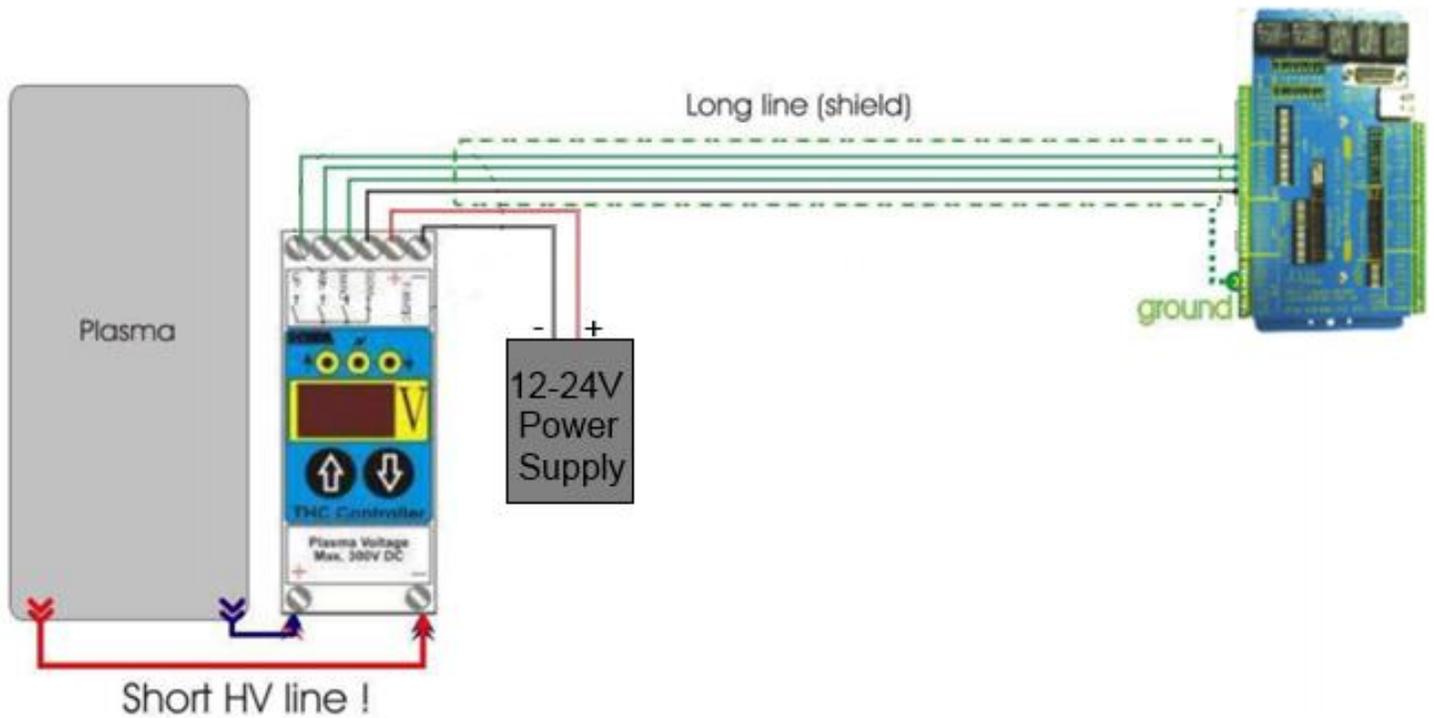
This document DOES NOT serve as a primer or tutorial for the use of Mach4. As such, readers without basic understanding of Mach4, and other software components not associated with Vital System Inc. are advised to consult the appropriate user manual and/or software vendor.

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

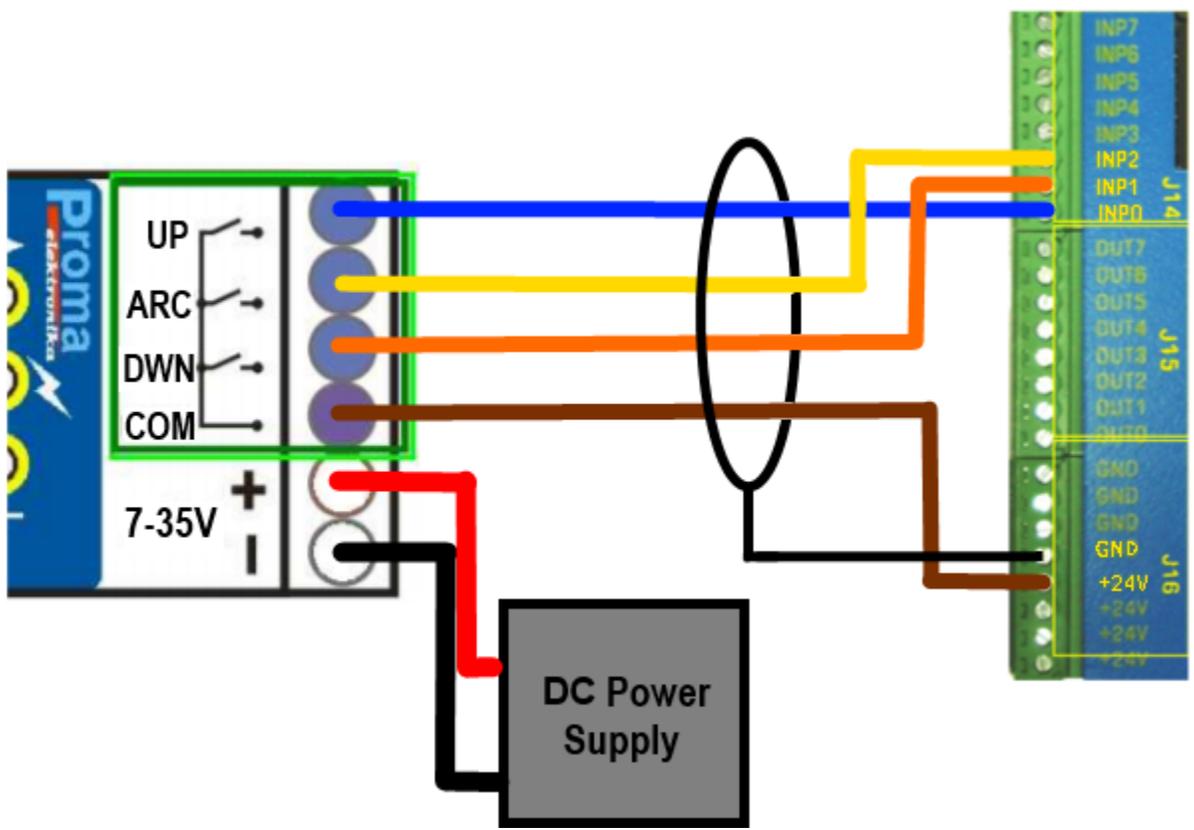
Wiring Diagrams

THC150 and HiCON Integra

NOTE: To reduce the possibility of the electrical interference entering into the Motion Controller, the connection should be made with a shielded cable - the shielding must be connected to ground terminals on the Motion Controller. **Do not connect the shielding to the THC unit side.**

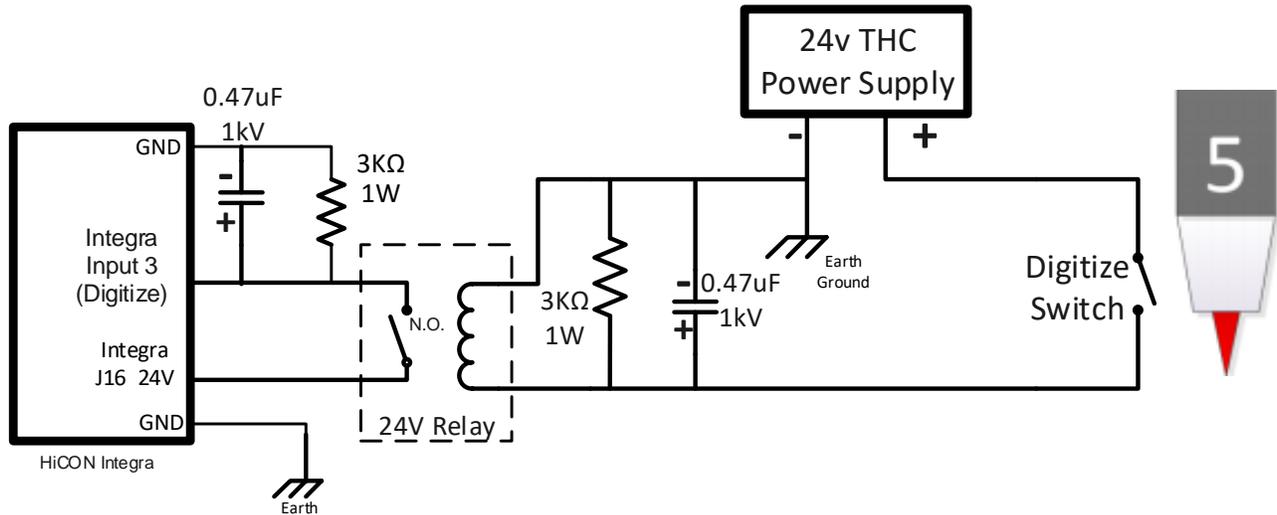


NOTE: It is highly recommended to use a separate 12V or 24V (1Amp) Power Supply for the Compact THC 150 to avoid high-voltage surges from feeding into the Motion Controller.

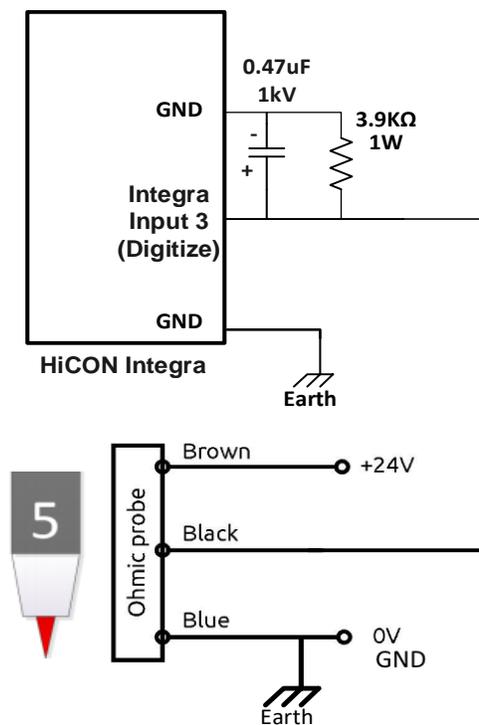


Plasma Electrical Noise Filter for Digitize Sensor

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 Integra.



Connecting PNP Digitize Sensor (Ohmic Probe)

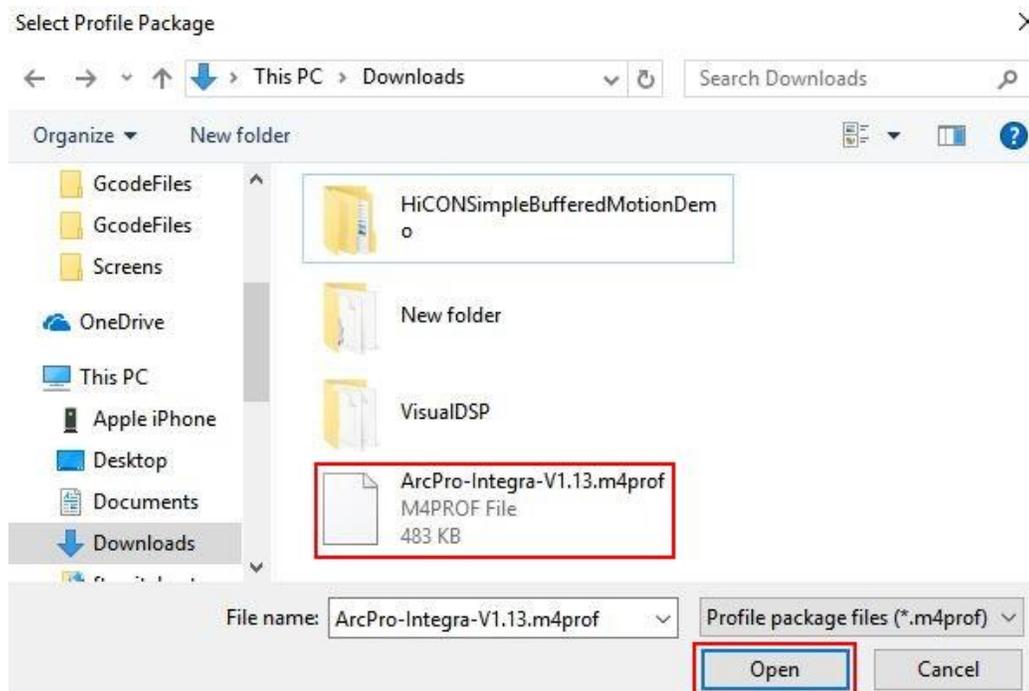
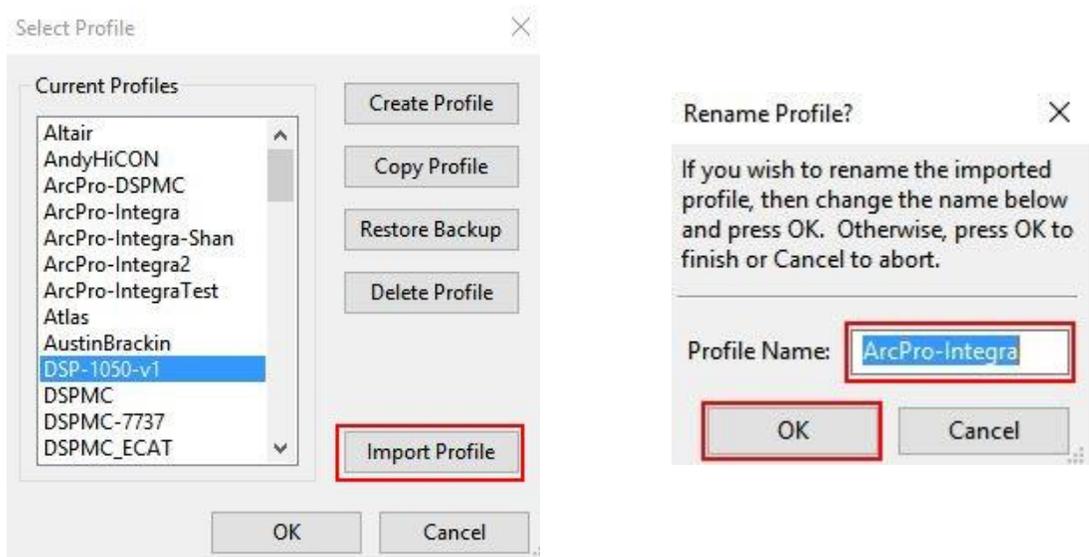


Mach4 Profile

Download the latest ArcPro Plasma 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

Mach Configuration

General Motors Axis Mapping Homing/SoftLimits Input Signals Output Signals Spindle Tool Path

	Mapping Enabled	Device	Input Name	Active Low
Motor 28 --				
Motor 29 --				
Motor 30 --				
Motor 31 --				
Digitize		HiCON	[P11] Input 3	
Index				
Limit Override				
E-Stop				
THC On		HiCON	[P11] Input 2	
THC Up		HiCON	[P11] Input 0	
THC Down		HiCON	[P11] Input 1	
Timing				
Jog X+				
Jog X-				
Jog Y+				
Jog Y-				
Jog Z+				
Jog Z-				

Map this to the digitize signal on the torch head. Used for detecting the material's height.

Map this to the ArcOK input signal

Map this to the TorchUP input signal

Map this to the TorchDOWN input signal.

OK Cancel Apply

Mach Configuration

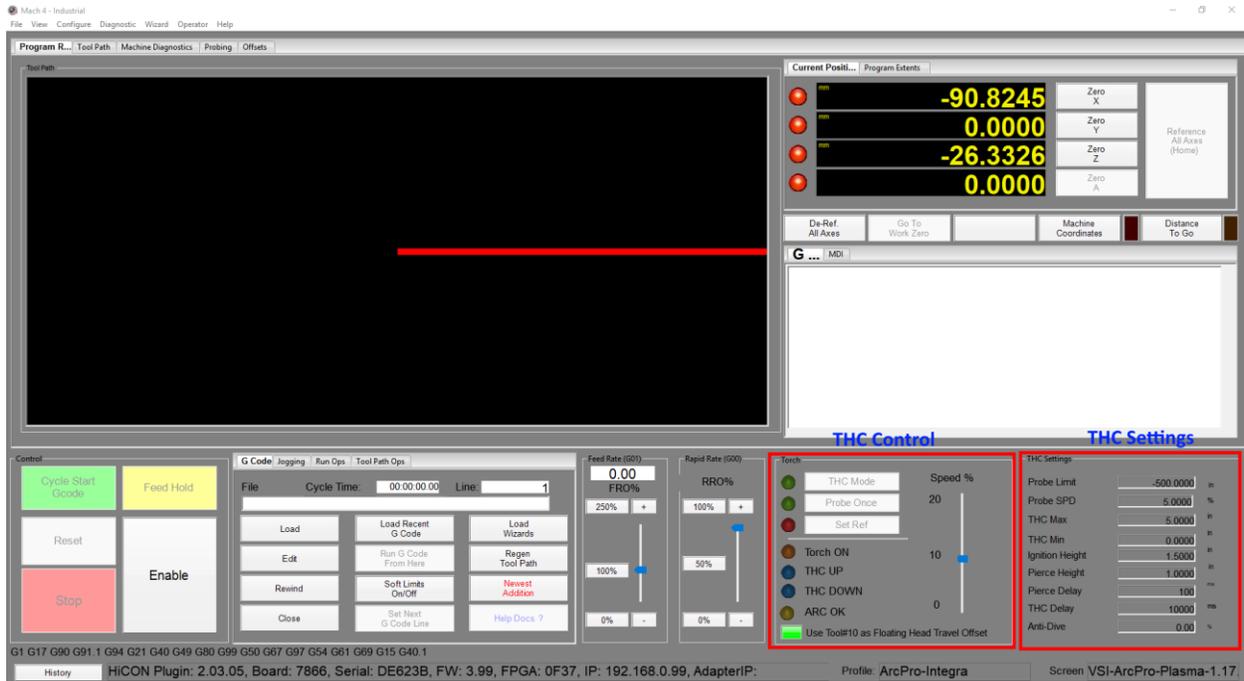
General Motors Axis Mapping Homing/SoftLimits Input Signals Output Signals Spindle Tool Path

	Mapping Enabled	Device	Output Name	Active Low
Z Homed				
A Homed				
B Homed				
C Homed				
Dwell				
olpath Mouse Do				
Limit Override				
Charge Pump #1				
Charge Pump #2				
Current Hi/Low				
Spindle On		HiCON	[P14] Output 5	
Spindle Fwd				
Spindle Rev				
Coolant On				
Mist On				
Digitize Trigger				
Alarm				
Parts Finished				

Map the SpindleON output signal to the digital output that will turn on the Plasma Torch.

OK Cancel Apply

ArcPro 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. Please use the [Plasma Cut Sequence](#) for reference.

THC Settings		
Probe Limit	-500.0000	in
Probe SPD	5.0000	%
THC Max	5.0000	in
THC Min	0.0000	in
Ignition Height	1.5000	in
Pierce Height	1.0000	in
Pierce Delay	100	ms
THC Delay	10000	ms
Anti-Dive	0.00	%

Probe Limit

This value is the ***target absolute position*** that the Z-Axis will move to in order to detect the material's surface. If the [DIGITIZE] signal is found, then the plasma cut sequence moves onto the next step. If the Z-Axis reaches this position, then the Plasma cut sequence fails and the system disarms.

NOTE: This value is also the Z-minimum soft limit. Changing the value from the ArcPro Screen will also change the value in the Mach4 config.

Probe Speed

This value indicates at what percent of the max velocity the will Z move down to locate the material surface height.

THC Max

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

THC Min

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

Ignition Height

The Ignition Height is used on thick material where the pierce height is higher than the plasma head can easily establish an arc. On thinner material the Ignition Height can be set to zero and the system will skip the feature. ***This value is relative to the detected material surface height.***

Pierce Height

The *Pierce Height* defines, in inches or millimeters, the height above the material that the cutter head will sit while conducting a pierce action. A good value for pierce height can be found by looking in the consumables chart for the system's plasma cutter. ***This value is relative to the detected material surface height.***

Pierce Delay

The time, in milliseconds, that the cutter head will pause while piercing. This gives time for the hole to go all the way through the material.

THC Delay

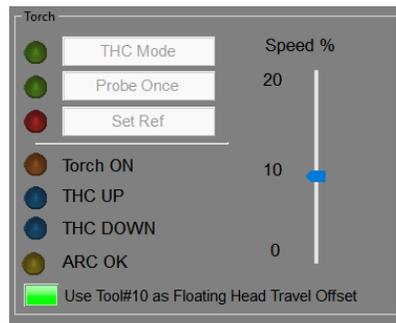
This value allows the cutting head to get away from the molten metal surrounding the initial pierce hole. This is used primarily for thick material or small holes.

Anti-Dive

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, Anti-Dive is engaged and the Z-Axis motion is disabled and stays locked in position.

THC Control

This interface serves as the operator control for initiating THC Mode and for turning on the torch.



THC Mode

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 off the cutting head will stay at the pierce height while running.

Probe Once

NOTE: This setting is recommended for cutting flat-surface materials where probing the material height multiple times is unnecessary.

This setting allows the THC to perform the surface height probe step only when the Torch is first turned on. Subsequent M3 commands will then move to the previously referenced surface height, then turn on the Torch at the Ignition Height. The probe move can be re-enabled by clearing the THC Reference with M3000 (or by clicking the “Set/Clear Ref” button). When this happens, the probe setup will be performed on the next M3 command.

Set/Clear Ref

This button is used alongside the “Probe Once” setting, to Set or Clear the current reference to the material’s surface height. If the “Probe Once” setting is disabled, then this setting will have no effect.

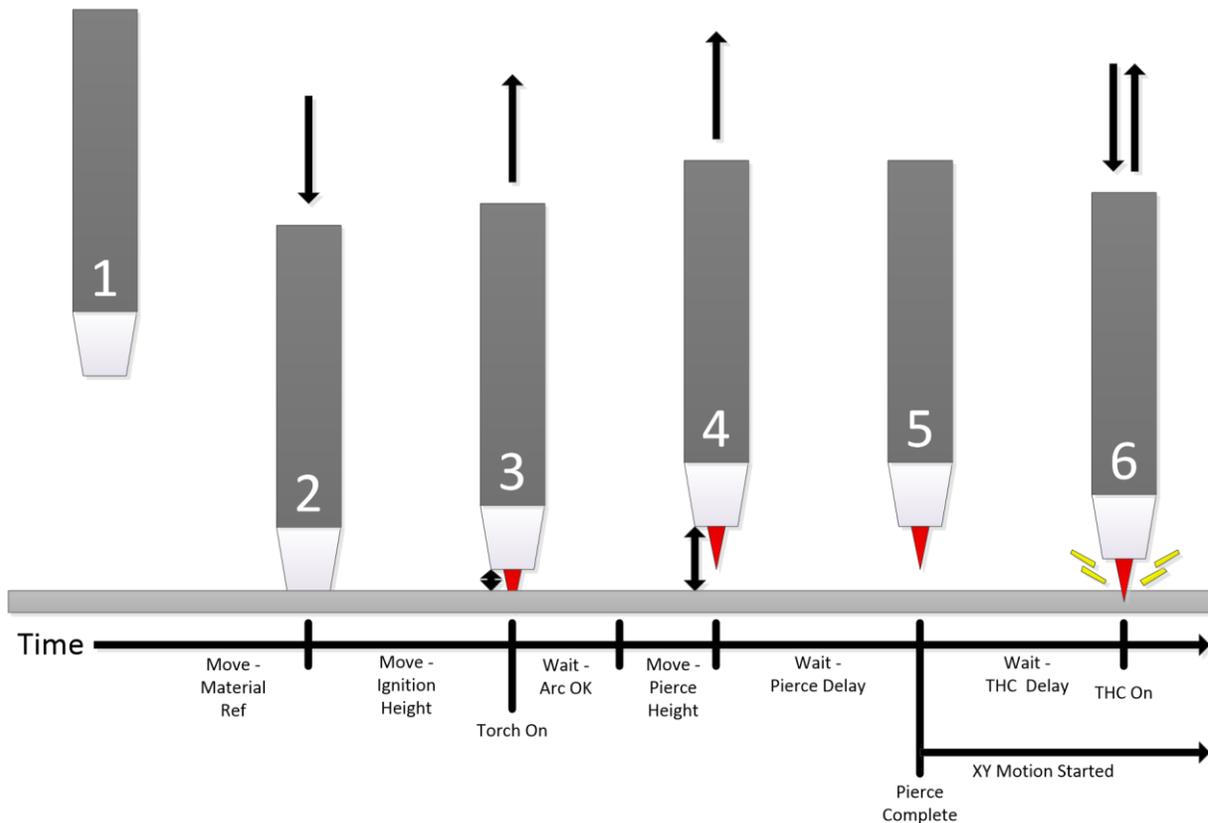
Speed

This value controls the THC up/down feedrate.

Plasma Cut Sequence

The Plasma Cut Sequence is executed when a command is made to turn ON the Torch, via the Screen Interface, or through the **M3 Command** in MDI or while running a GCode file. This sequence allows the torch to be positioned correctly above the material before any XY motion is performed.

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

NOTE: This sequence in the diagram above requires the use of a **[DIGITIZE]** input mapped to Mach4 that will activate when the torch head makes contact with the material in order to determine the material surface height.

If the **[DIGITIZE]** signal is **unmapped** in Mach4, then the probe move is skipped, and the THC uses the current Z location as the reference height and resumes from Torch Ignition (step3) onwards.

NOTE: The Torch ON sequence will fail if one of the following errors are detected:

- The **[ARC OK]** or **[DIGITIZE]** input signals are currently active.
- The Z-Axis did not detect the **[DIGITIZE]** input signal during Step 2.
- One of the THC settings has an invalid value.
- The motion controller is currently executing another process and cannot start the sequence.

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 Mode" Button)
3. Turn on the Torch (use the M3 command)
4. Wait for the Plasma cut setup sequence to finish 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 now "Torch OFF" 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 thcModeRegister = mc.mcRegGetHandle(m4Instance, "HiCON/THC_ModeEnabled");  
mc.mcRegSetValue(thcModeRegister, 1); -- Enable THC Mode  
  
mc.mcRegSetValue(thcModeRegister, 0); -- Disable THC Mode
```

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

Testing With Emulated THC Signals

Because the Torch Height Controller simply provides the up, down, and ArcOK signals to the motion controller, it is possible to emulate these signals for testing purposes.

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. Make sure the **[ARCOK]** and **[DIGITIZE]** signals are turned OFF.
3. Click on the “Enable” button at the lower left of the ArcPro screen to arm the system.
4. Click **THC Mode** button on the screen (if the LED is not ON, then THC mode is turned off).
5. Move the Z axis to a reasonable height above the “Probe Limit” value (by jogging or through GCode).
6. Run your GCode that has an M3 command. This should activate the Plasma Cut Sequence that will setup the Torch Height Control operation.
7. At Step1 of the plasma cut sequence, the torch should start descending and will wait for the **[DIGITIZE]** input signal. If the **[DIGITIZE]** signal is not triggered when the Z axis position reaches the indicated value in the probe limit, then the system will disarm.
8. Trigger the **[DIGITIZE]** signal to register the material’s surface height. The Z axis should now start moving up to the ignition height.
9. When the torch rises to the ignition height after successfully detecting the material’s height, it will turn on the **[SpindleON]** output (to turn on the plasma torch). In this case, it will wait for the **[ArcOK]** before resuming.
10. Trigger the **[ArcOK]** signal and keep it activated for the duration of the test.
11. After moving to the Pierce height, and waiting for the Pierce delay and THC delay, the torch should now be setup and will respond accordingly to the up and down signals.

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 the “**THC Mode**” button on the screen (if the LED is not ON, then THC mode is turned off).
3. Enter “M3” in the MDI and press Cycle Start to turn on the torch.
4. The Torch ON setup sequence should start (probe, ignition, pierce, etc.).
5. 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.
6. 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.

Testing with Proma THC150 Test Mode

The THC150 has an integrated test mode to verify ARC OK and Up and Dow Signals. In order to use this test feature follow these steps. Make sure this test mode is OFF to begin with:

NOTE: *Because this is an uncontrolled Z motion test, proper precautions are required to avoid Z axis crashing in to the table. It is also recommended to temporarily disconnect the output that turns on the Plasma Torch as it is not needed for the THC150 test mode.*

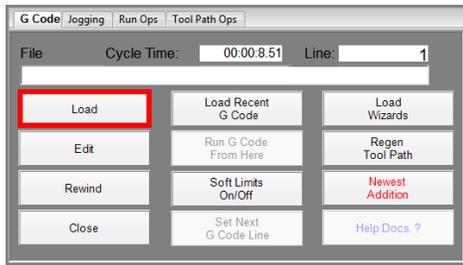
1. Set the “Anti-Dive” value to 0%.
2. Set the “Probe SPD” value to 1%.
3. Set the “THC Min” to 0, and the THC Max to a safe arbitrary value to give some correction allowance for Z movement. And to prevent the torch head from crashing into the table.
4. Reduce the THC Speed slider bar to a low value (e.g. 2 to 3 percent) in order to provide some allowance in case the ESTOP needs to be triggered (e.g. Z crashing into the table).
5. Make sure the THC150 test mode is initially turned OFF and the ARC OK and DIGITIZE signals are not active.
6. Enable Mach4.
7. Click on the “THC Mode” button in the ArcPro Screen.
8. Enter “M3” in the MDI and press Cycle Start to initiate the THC Startup Sequence. The Z axis will start the Probe move to detect the DIGITIZE signal. (Make sure you have a good value in the “Probe Limit” field to allow this motion)
9. While Z is moving, turn on the test mode on the Proma THC150 unit.
10. Activate the DIGITIZE signal manually to complete the Probing move.
11. The torch should move to the pierce height and follow the UP/DOWN signals from the THC150 test accordingly.



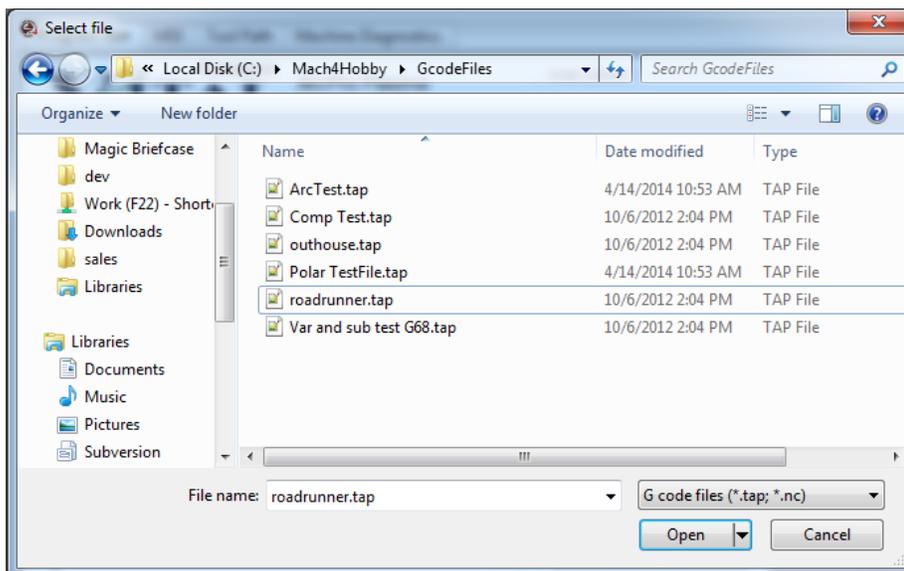
Loading and Starting a Job with a GCode File

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

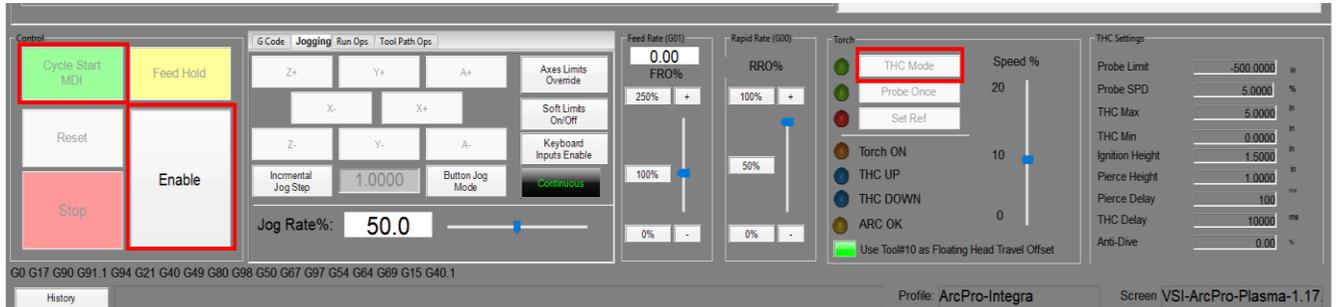
1. Click on the “Load” button in the Gcode tab in the ArcPro screen



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



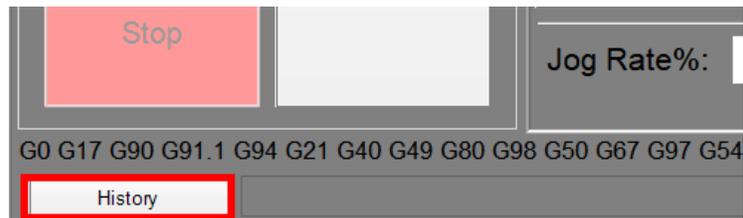
3. Once the GCode file is loaded, click on the “Enable” button at the lower left of the ArcPro screen to Arm the system.
4. Click the “**THC Mode**” button on the screen (if the LED is, then THC mode is turned off).
5. Click on “**Cycle Start**” to initiate the job.



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 Up] , [THC Down] , and [THC On] are all enabled and mapped to digital inputs on the Integra.
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 THC 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 TorchON/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. <div data-bbox="755 1596 1396 1732" style="border: 1px solid black; background-color: yellow; padding: 5px;"> <p>NOTE: It is also recommended to go through the wiring diagram for safely connecting the digitize sensor to the HiCON Integra.</p> </div>
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 [THC On] 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 THC150 unit may need to be appropriately configured for the application.	Check the signal LEDs for the Torch UP/DOWN on the THC150, and make sure that they change correctly (i.e. the UP/DOWN commands are correctly sent in response to the detected feedback voltage). See the THC150 manual for more details
The THC UP/DOWN wiring has problems.	The THC UP/DOWN signals may be connected in reverse (i.e UP from the THC150 is connected to DOWN on the Integra). Make sure that the wires are correctly stripped at each end when connecting them to the screw terminals.
The THC UP/DOWN signal polarity is incorrectly set in Mach4	Check the "Input signals" tab in the Mach4 Config, and follow this section .

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 Integra User Guide](#)
- [Mach4 HiCON Integration Manual](#)
- [Compact THC 150 Manual](#)