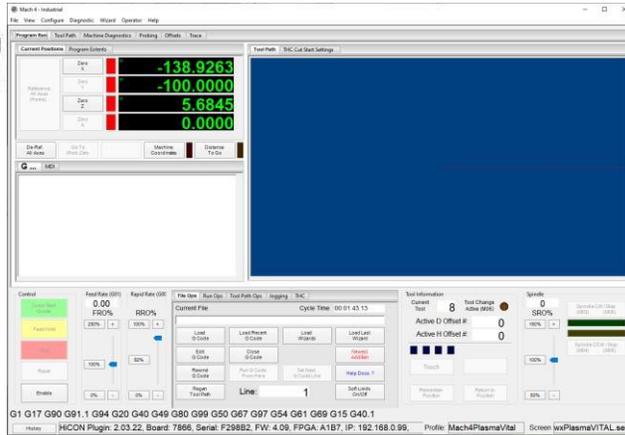


# ArcPro Plasma User Guide



Document Revision 3.0

(Updated July 23, 2020)

© 2020 Vital Systems Inc  
Atlanta, GA USA

For more information please visit the product  
web page: [www.vitalsystem.com](http://www.vitalsystem.com)

# Contents

License Agreement .....	3
Introduction .....	4
Wiring Diagrams .....	5
Plasma Electrical Noise Filter for Digitize Sensor.....	5
Importing Mach4 Profile.....	7
Mach4 I/O Configuration .....	8
Plasma Cut Sequence.....	9
Plasma Tip Voltage Adapter 77ISO .....	11
HiCON Integra 7866 Setup .....	12
MACH4 Plasma Screen Setup.....	13
1. USE ANALOG VOLTAGE FOR ARCOK .....	13
USE EXTERNAL ARC OK .....	14
Screen Settings .....	15
Characteristics .....	16
Screen Definitions.....	17
THC TAB.....	17
THC CUT START SETTINGS .....	18
Troubleshooting.....	20
The system disarms when calling the M3 command.....	20
The system hangs up during the M3 sequence .....	21
The Torch does not move toward the designated probe limit position.....	21
The Torch completes the M3 setup sequence, but does not move up or down afterwards.....	22
The Z axis moves too fast while cutting .....	22

# 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:

- *Mach4 HiCON Integration Manual*
- *User Manual for HiCON Integra or Mini Motion Controller*

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.

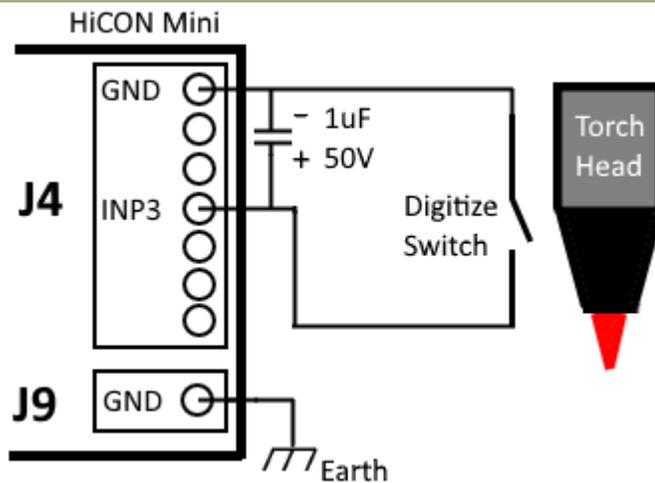
This document only serves as a supplemental user guide for the additional setup of integrating Torch Height Control with the HiCON and Mach4.

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

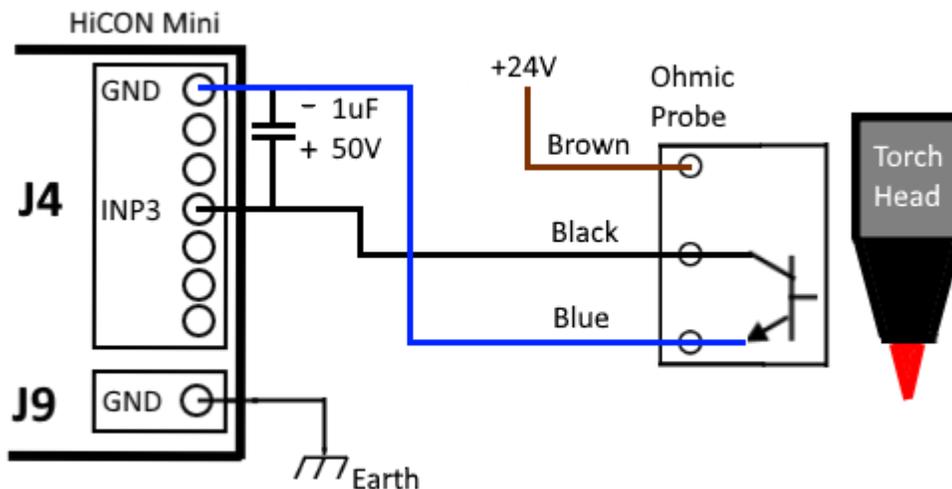
# Wiring Diagrams

## Plasma Electrical Noise Filter for Digitize Sensor (Mini)

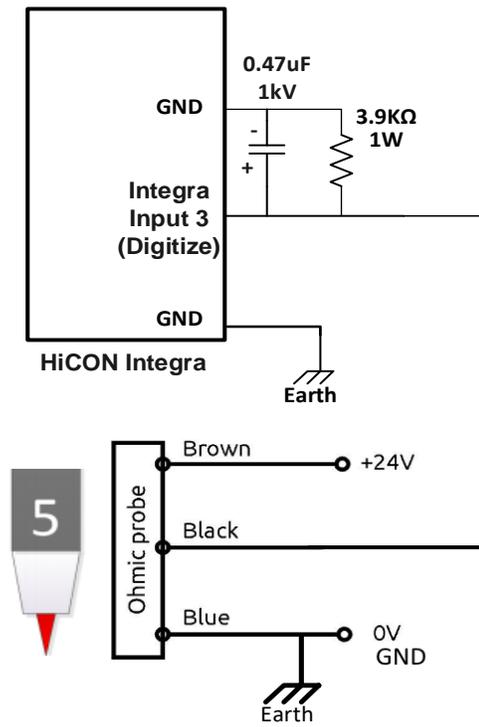
**NOTE:** It is highly recommended to follow the circuit diagram below when using a Digitize sensor on the torch head. Because a Plasma Torch uses high-voltage for cutting, voltage spikes and electrical noise must be properly filtered in order to safely connect the sensor to a digitize input on the HiCON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



## Connecting NPN Digitize Sensor (Ohmic Probe)



## Connecting NPN Digitize Sensor (Ohmic Probe) (Integra 7866)

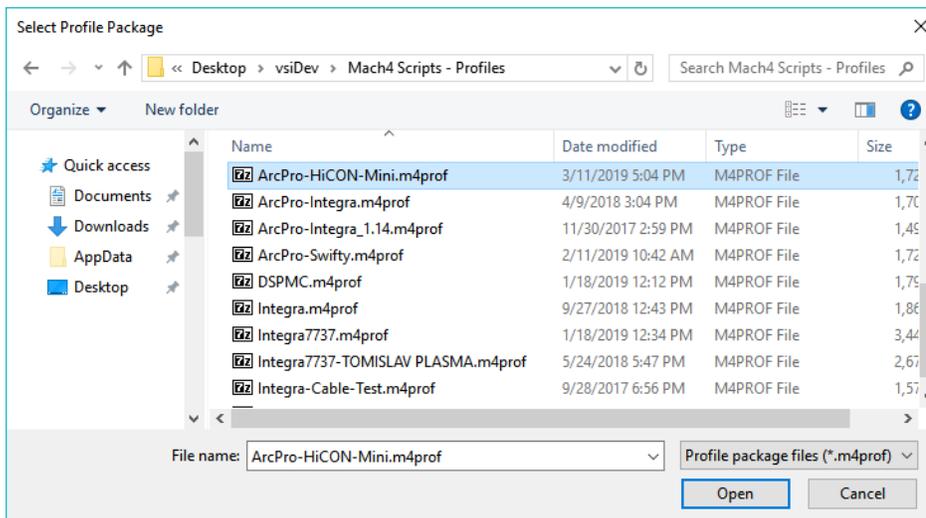
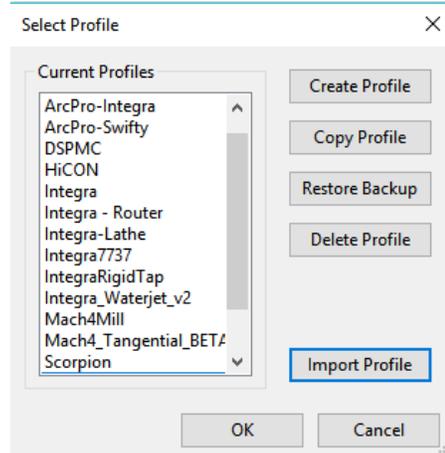


# Importing Mach4 Profile

Download the latest ArcPro Plasma profile available on the sidebar 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

The screenshot displays the Mach4 Industrial software interface. The top section shows the 'THC Cut Start Settings' with a diagram of the torch cutting process. The diagram includes steps: 1. Cool Torch, 2. Max Find Distance (20.0000), 3. Torch On Height (0.1000), 4. Pierce Height (0.1000), 5. Max Cut Height (5.0000), and 6,7. A timeline below the diagram shows the sequence of events: Probe Offset Z (-0.0400), Move - Material Ref Touch Speed (50.0000), Move - Ignition Height, Wait - Arc OK Delay (ms) (1000), Move - Pierce Height, Wait - Pierce Delay (ms) (100), Wait - THC Delay, and Move - Cut Height, THC On. The bottom section shows control parameters: Feed Rate (0.00 FRO%), Rapid Rate (RRO%), THC Mode (Analog), THC Enabled, Target Voltage (165.00), Analog Voltage Multiplier (35), Tip Voltage (0.00), Adjust Rate (100.00), XY Blend Velocity (0.00), Anti Dive Rate (5.00), Spindle SRO% (0), Spindle CW (0), and Spindle CCW (0).

The screenshot shows the 'Mach Configuration' dialog box, specifically the 'Output Signals' tab. The table below lists various output signals and their configurations:

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

A red box highlights the 'Spindle On' row, and a red arrow points to it with the text: 'Map the SpindleON output signal to the digital output that will turn on the Plasma Torch.'

# Plasma Cut Sequence

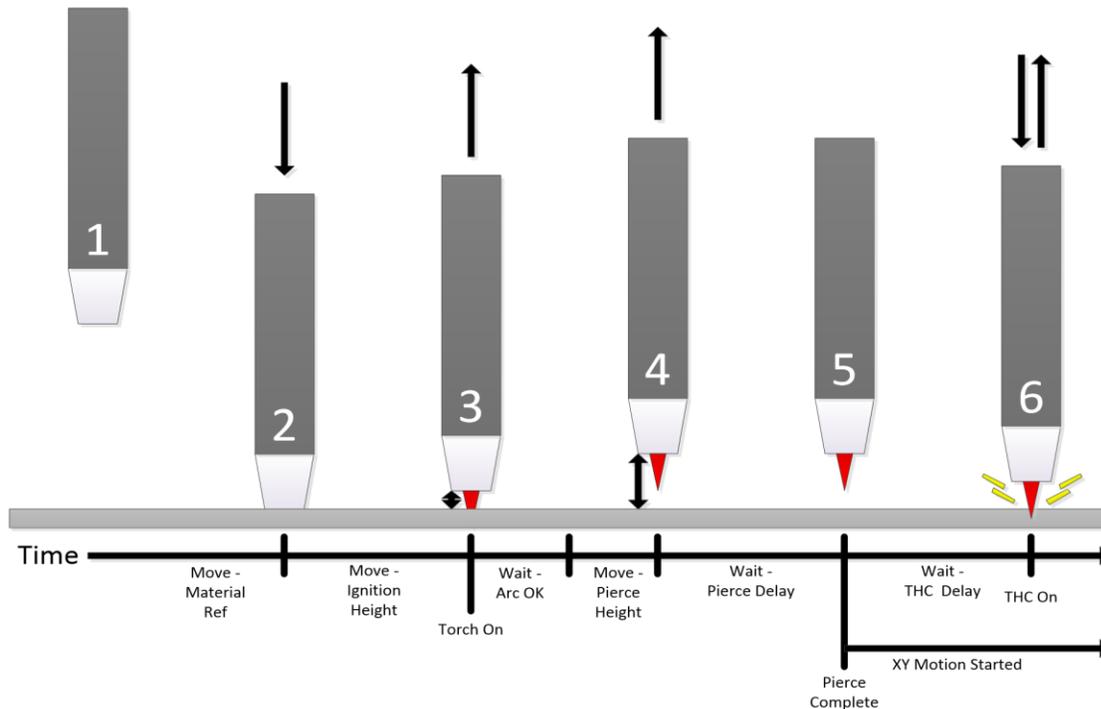
The typical plasma cut sequence starts with a probe to locate the material. After the probe is complete, the torch is raised to ignition height and torch is turned on and wait until the Arc OK (Ok to move) signal is detected. Once the Arc OK signal is found, the Z axis moves to the pierce height and the pierce delay starts. Immediately following the pierce delay, the XY motion starts and the torch height control begins once the THC delay expires.

All these steps are done by the M3 Macro script provided in the Mach4 Plasma Screen.

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

```
M3      (Probe the material, move to ignition height, turn torch on, wait for Arc Ok, move to pierce height, wait for pierce delay)
GO X5Y5 (Begin XY motion, at the same time wait for THC delay then Z- axis starts to follow the material height)
GO X10Y10
M5      (end torch height control sequence)
```

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 (probe).
- Step 3:** The torch head lifts to ignition height and turns on.
- Step 4:** The Arc Ok signal is detected and the torch moves to pierce height.
- Step 5:** Torch waits for pierce delay to complete and XY motion begins. THC delay timer is started.
- Step 6:** THC delay is complete and the THC takes over Z-Axis control

# Plasma Tip Voltage Adapter 77ISO

The 77iso boards works with 7866 Integra motion controller to read the plasma tip voltage.



This adapter accepts 0 to 10volts from the Plasma unit. You must select the proper divider to reduce the tip voltage (which are usually in the 300 volts range) down to 0-10 volts range.

**If you connect the Tip voltage directly to this unit without a divider, the adapter and the motion controller will be damaged instantly.**

# HiCON Integra 7866 Setup

- Connect the 7866 to the network and launch the VSI Device Manager
- Select the controller and go to the 'HiCON' tab

VSI Device Manager (v5.32) -DEBUG-

Network Devices

IP Address	Firmware	Serial Number	FPGA	Boot Loader	Hardware	Adapter IP
192.168.0.99	4.09	5410ECF298B2	A1B7	1.45	7866	192.168.0.204

Scan Network

Boot Loader Activation HiCON

Firmware Pins

- IN\_EStop1
- IN\_EStop2
- IN\_KeyLock
- OUT\_AuxCPULED
- OUT\_AuxErrorLED

Pin:

Active Low

Firmware Variables

Name	Description
Enable J7 Step/Dir Channels	Switches J7 from Digital I/O to Step/Dir Channels
Enable J8 Step/Dir Channels	Switches J8 from Digital I/O to Step/Dir Channels
Enable J7 THC Adapter	Allows Reading Tip Voltage via 77ISO THC Adapter on J7

Value:  Enabled

Download

Close

1. SET 'J7' TO ENABLE 77ISO TO READ TIP VOLTAGE

2. CHECK ENABLED. UNCHECK OTHER 2 IF THEY'RE CHECKED

3. HIT DOWNLOAD

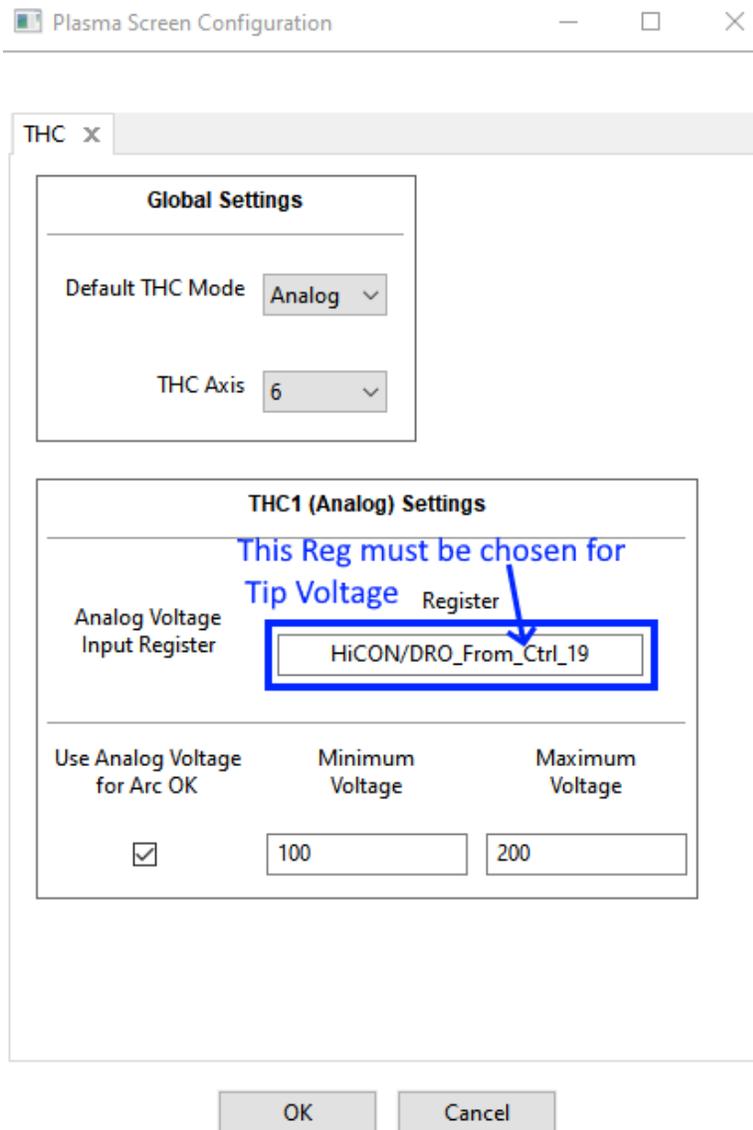
- Make sure to uncheck J7, J8 for switching to Step/Dir channel and just select the 'Enable J7 THC Adapter'
- Check enabled
- Hit Download to save this setting on the 7866 board

# MACH4 Plasma Screen Setup

For ArcOK may be chosen within the Mach4 without any external ArcOK by using Analog Voltage or an external ArcOK signal can be used as an input to the HiCON 7866 Motion Controller. Both the cases are described as follows,

## 1. USE ANALOG VOLTAGE FOR ARCOK

- Use Mach4 to load the profile “Mach4PlasmaVITAL.m4prof”
- Select Configure >> Plasma Screen Setting

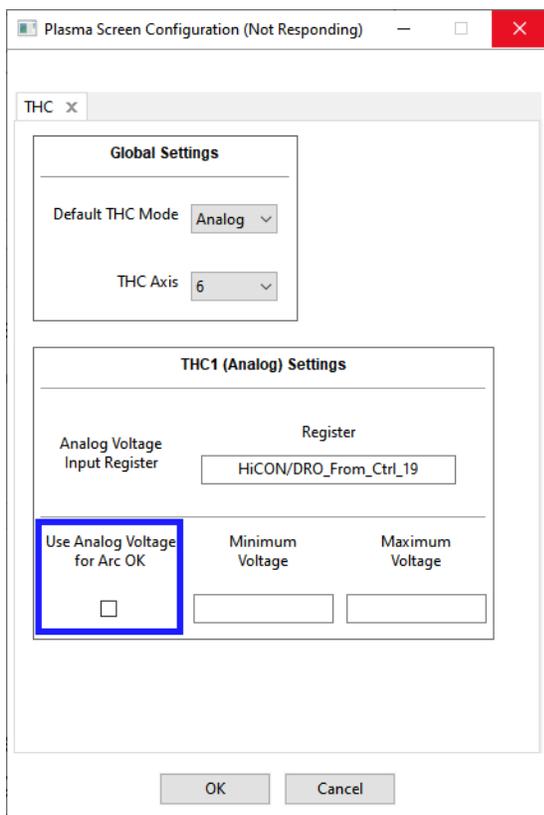


- In the Global settings, choose Default THC Mode to ‘Analog’

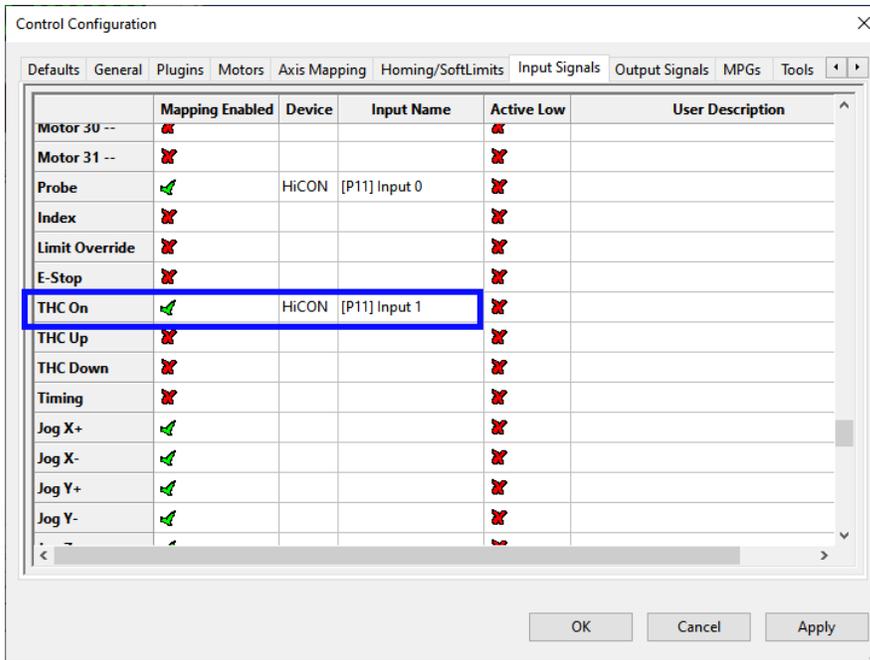
- In the THC1(Analog) Settings, chose the register “HiCON/DRO\_From\_Ctrl\_19” as the Analog Voltage Input Register
- Set the Analog Voltage for ArcOK with a desired range (Min and Max Voltage). Arc Ok and THC sequence will only continue if it sees the Tip Voltage value is within this range and the THC On led is lit.

### USE EXTERNAL ARC OK

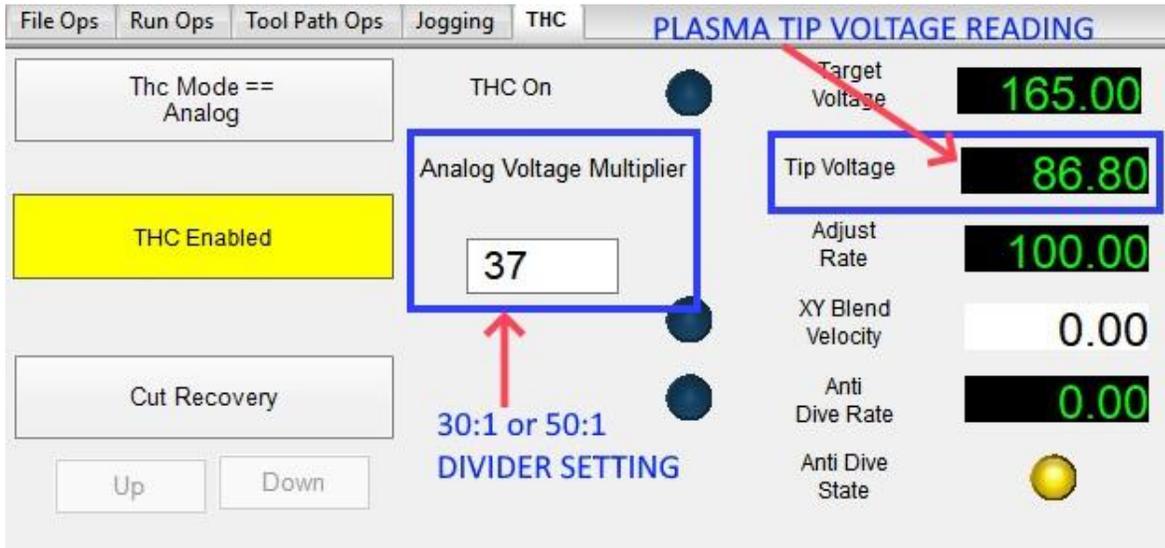
- All the settings remain same as above except for the ‘Use Analog voltage for Arc OK on the Plasma screen configuration is unchecked, as shown below.



- When using an external ArcOK signal from the Plasma machine, given as input to the 7866 motion controller, from the input mapping of ‘THC ON’ signal to an input pin.



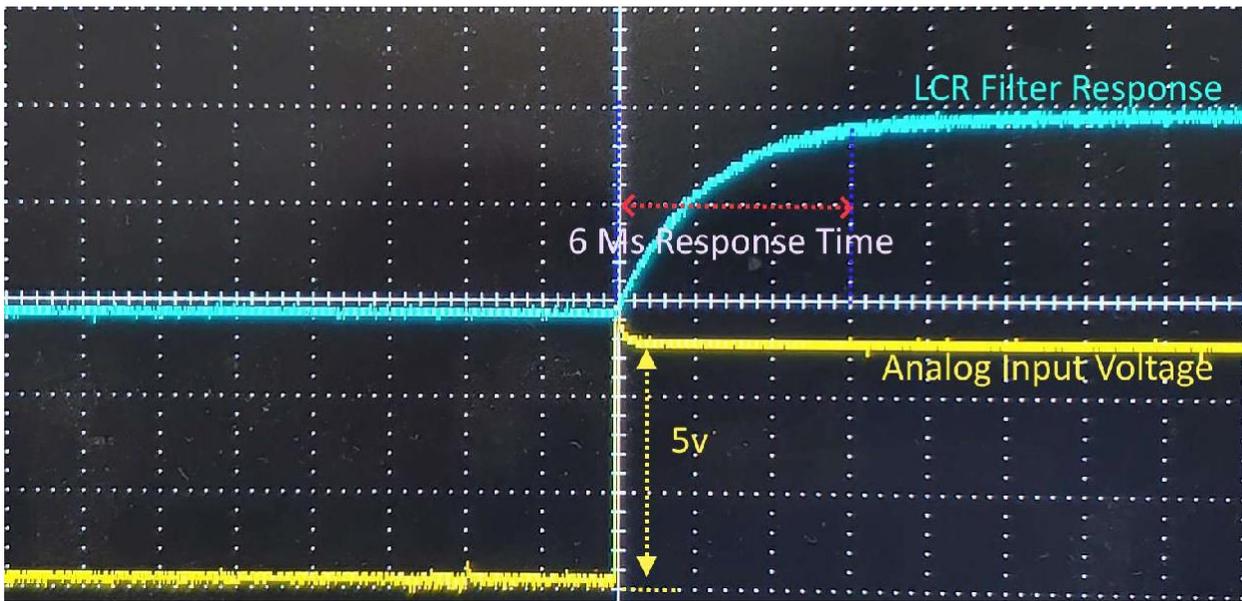
### Screen Settings



- The THC section of this screen has Tip Voltage Reading and Analog Voltage Multiplier
- The Tip Voltage displays the value of the analog reading multiplied by the value given in the Analog voltage multiplier
- The value of the Analog Voltage multiplier can be derived based on the Plasma Machine's 30:1 or 50:1 divider.

## Characteristics

- The Response delay of the 77ISO board is hardly noticeable due to its fast response time as short as 6Ms.
- This ensures that the THC operation takes place with fast Tip voltage input to the 7866-motion controller.



# Screen Definitions

## THC TAB



This tab contains run time info as well as DROs that will be used to set optimal cutting conditions.

**THC Mode:** a toggle button that will select either manual, digital, or analog mode for THC.

**THC Enable:** a toggle button that forces THC on. It should only be used in this way when turning the torch on manually and cutting manually. Under normal conditions, THC is enabled when the torch is on and it is turned off when the torch is off.

**THC On:** Arc OK and is associated with an LED.

**Up/Down:** buttons that control THC when in manual mode.

**Target Voltage:** the voltage Mach4 will maintain during digital or analog plasma operation.  
*\*This will depend on the plasma unit. Refer to the plasma user manual pertaining to material type and thickness.\**

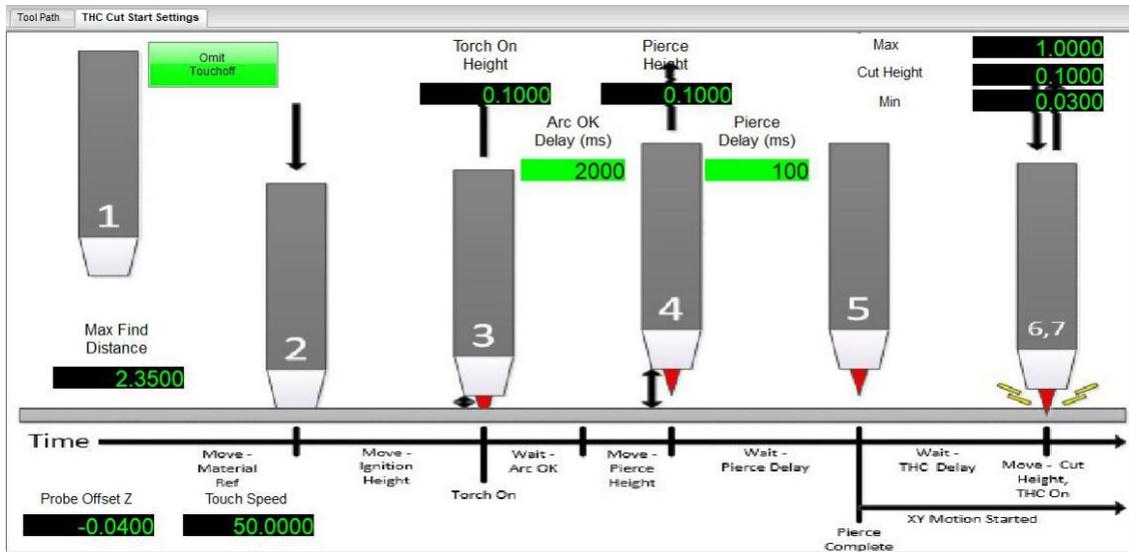
**Adjust Rate:** the speed at which THC will move to achieve Target Voltage.

**XY Blend Velocity:** equals the current blended velocity of X and Y; used for AntiDive.

**AntiDive Rate:** the rate at which XYBlendedVel will disable AntiDive.

**AntiDive State:** 1 is on, and 0 is off.

All of these values will be registers in Mach4. To see these registers, go to Diagnostics>iRegs0>nf>thc. This is the location the THC module will access these values during operation.



## THC CUT START SETTINGS

THC Cut Start Settings are settings for optimal torch firing sequence through final cut height where THC will enable and maintain target voltage.

**Omit Touch Off:** For machines that do not have a probe input, there is a button on the THC Cut Start to omit the material touch off as part of the M3 sequence. Special attention must be taken when the touch off has been omitted. The top of the material (“Z”) must be set manually in the current work coordinate system prior to cutting.

**Max Find Distance:** distance the torch will travel to find the material top while looking for a probe strike.

**Touch Speed:** units per minute Z axis will travel during the Max Find Move.

**Probe Offset Z:** A DRO that can be used to enter a compensating value for a plunger style probe. If the probe is a solid strike style, 0 can be entered. If the torch tip hits the material top but continues to travel -.04 to complete the probe strike, -.04 will be entered.

**Torch On Height:** Position the Z axis will be at when the plasma is told to fire (turn on); used in M3.

**Pierce Height:** Position the Z axis will be at when a pierce begins; used in M3.

**THC On Delay(ms):** Time in milliseconds the THC waits to start controlling height; used in M3.

**\*2000 = 2 Seconds**

**Pierce Delay:** Time in milliseconds allowed to complete piercing material; used in M3.

***\*This value can be found in user manuals for Plasma units.***

**Max:** Maximum height THC will move the torch up to while trying to get to the target voltage.

**Cut Height:** Optimal position to run THC at; used in M3.

***\*This value can be found in user manuals for plasma units***

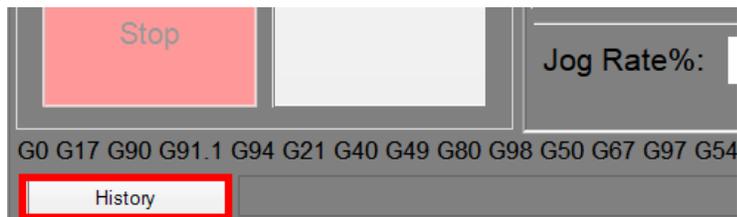
**Min:** Minimum height THC will move the torch down to while trying to get to the target voltage.

There are many variables involved in plasma Configuration, most of which have been create directly in the screen for immediate use.

# 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



## 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 <b>[THC On]</b> is enabled and mapped to a digital input on the motion controller.
The <b>[ArcOK]</b> or <b>[DIGITIZE]</b> 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 <b>[Digitize]</b> signal in Mach4 is mapped to the correct digital input, and that the <b>[Digitize]</b> signal toggles correctly by checking the signal state in the diagnostic tab on the Mach4 screen.  <b>NOTE:</b> It is also recommended to go through the <a href="#">wiring diagram</a> for safely connecting the digitize sensor to the
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 <b>[ArcOK]</b> 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.

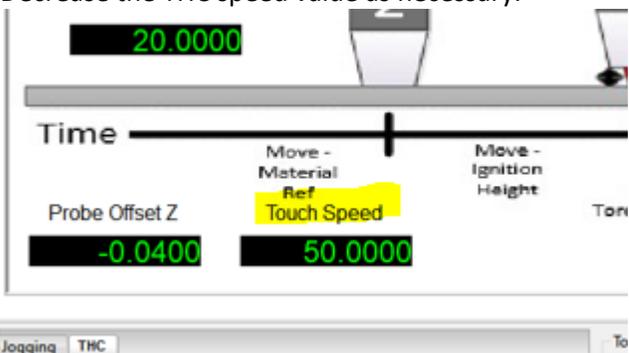
## The Torch does not move toward the designated probe limit position

Cause	Solution
The displayed coordinates have a "Work Offset" applied.	<p>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.</p> <p>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-&gt;Fixture Offsets" window.</p>
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 Z axis moves too fast while cutting

Cause	Solution
The THC Touch Speed in is set to a large value	<p>Decrease the THC speed value as necessary.</p>  <p>The screenshot shows a timeline with the following values:</p> <ul style="list-style-type: none"> <li>Move - Ignition Height: 20.0000</li> <li>Probe Offset Z: -0.0400</li> <li>Move - Material Ref Touch Speed: 50.0000</li> </ul>