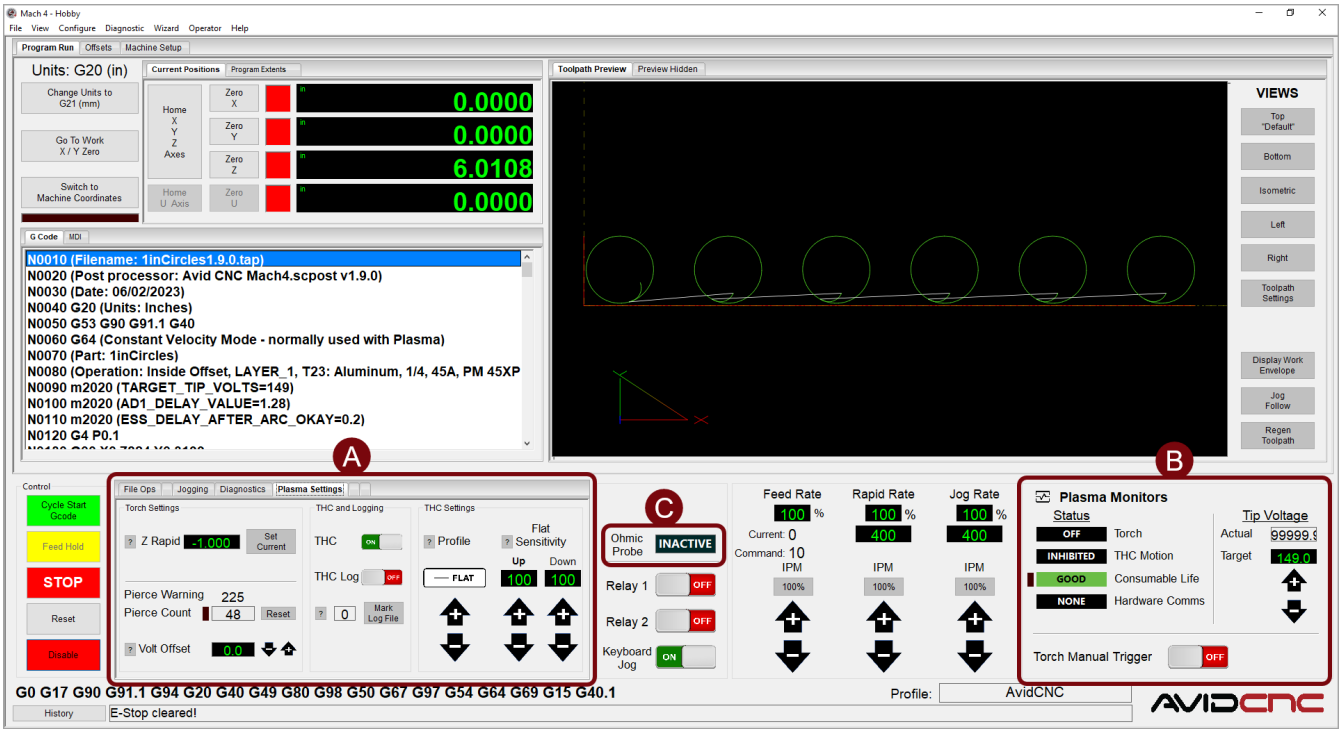
Mach4 Plasma Users Guide

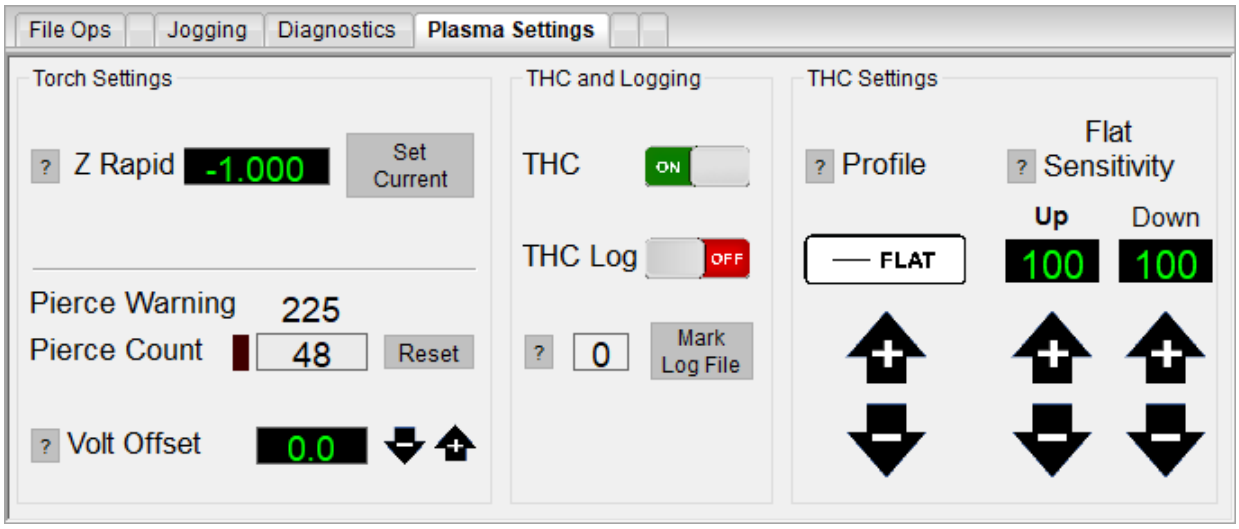
v2023Q1.1

Mach4 Plasma Users Guide

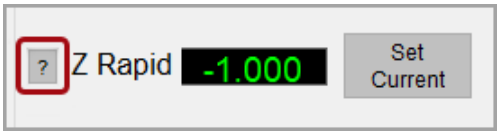
Main Screen Plasma Functions



A. Plasma Settings Group

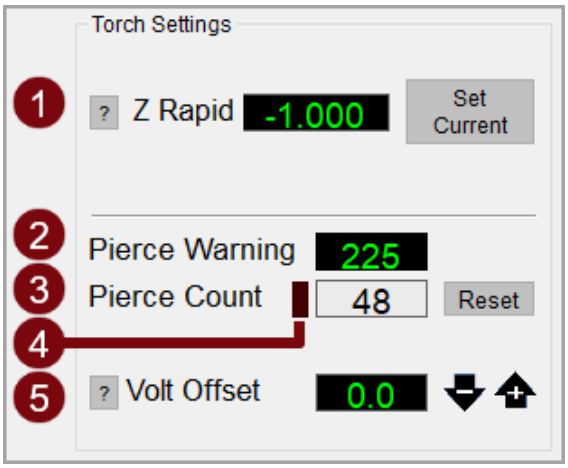


Tooltip Popups



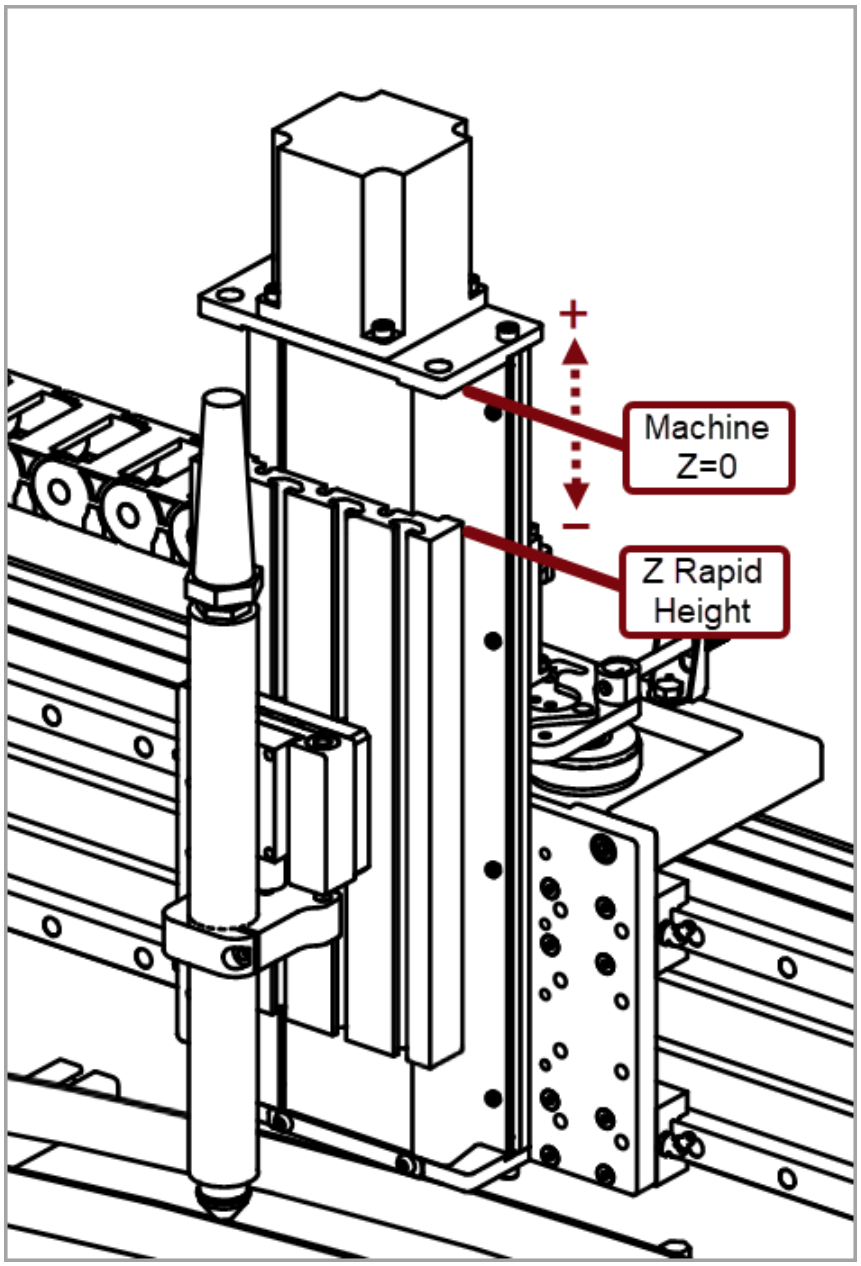
Next to many elements of the Mach4 Screenset, you will see a '**?**' icon. Clicking on icons will bring up help windows breifly describing screen functions.

Torch Settings



1. **Z Rapid Height**

   The Z Rapid DRO sets the height **IN MACHINE COORDINATES** that the torch will retract to in between cuts. The default setting of -1.000in (-25.4mm) means the torch will retract to 1 below the Z home proximity sensor.



The **Set Current** button will set the Z Rapid position to the current position. This height should be set for each new program or material. The rapid position should be above the highest point of the material and above any likely tip-ups.

> **Note**
>
> The Z Rapid setting should always be negative(-).

2. **Pierce Warning**

   The Pierce Warning DRO sets the number of pierces(cuts) allowed before triggering a warning to replace consumables. This DRO is editable when Mach4 is Disabled.

3. **Pierce Count**

   The Pierce Count DRO shows the number of times the torch has fired since the last pierce count reset.

   This DRO cannot be adjusted but should be reset using the **Reset** button each time consumables are replaced.

4. **Pierce Count Warning LED**

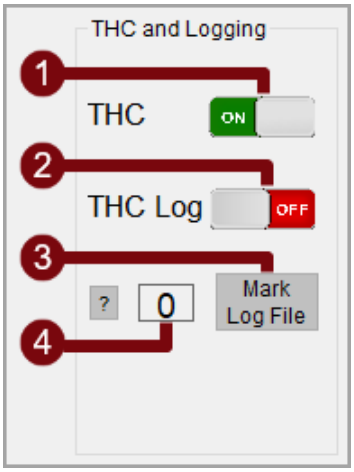
   The Pierce Count Warning LED turns red when Pierce Warning limit is exceeded.

5. **Volt Offset**

   The Volt Offset DRO sets the tip volt zero point and can be used to trim the voltage for consumable wear or a known offset. It can be edited directly, or with the incremental buttons.

   - A **negative** volt offset will cause the torch to cut higher. This can be helpful when cutting with worn consumables as they may cut lower than desired.
   - A **positive** Volt Offset will cause the torch to cut lower.
   - As a rule of thumb: 1V = ~0.003 of electrode wear.

THC & Logging



1. **THC toggle**

   Toggles the Torch Height Control (THC) ON/OF. By default, torch height control is turned on and is reccomended for most cutting operations.

2. **THC Log toggle**

   Toggles THC log creation on and off. When ON, THC logs are saved in the C:\Mach4Hobby\W9_HC folder

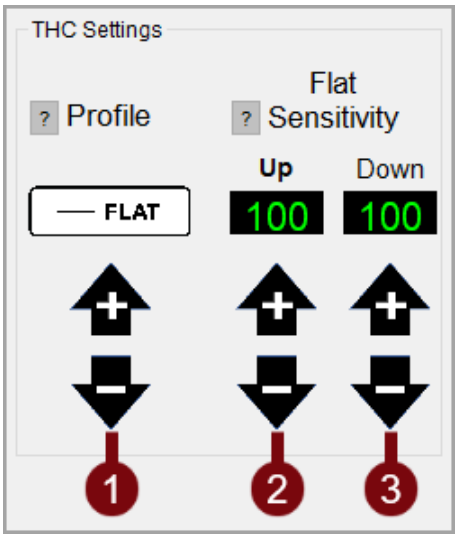
3. **Mark Log File**

   This button adds a numbered mark in the THC log file at the current timestamp. This can be useful in diagnosing consistent cut issues at a specific point in a program.

4. **Log file mark number**

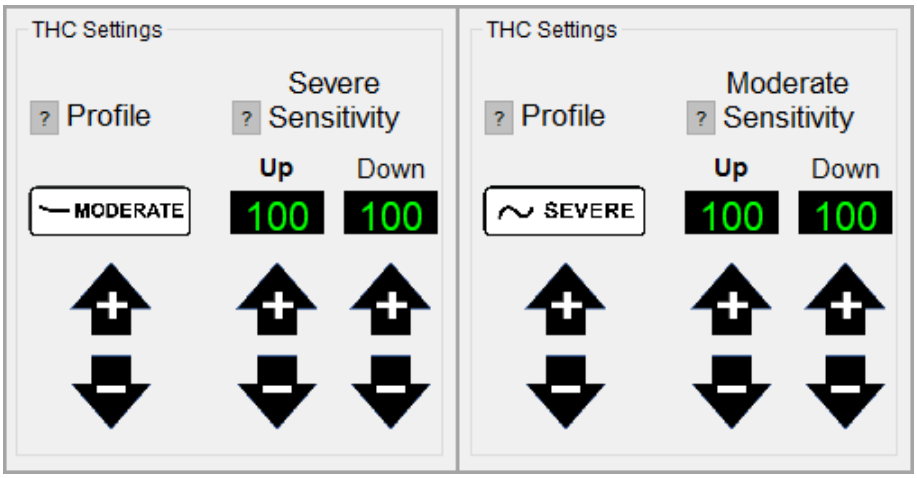
   This button allows the user to mark the log file at a point of interest. Clicking the button marks the log at the current time with the current number. The mark number will automatically increase with each mark. The DRO cannot be edited.

THC Settings



1. **Material Profile**

   The material profile is used to set THC speed and Anti-Dive settings. Use the arrows to choose the profile that best matches the profile of the material being cut.



   The **FLAT** setting is recommended unless there is significant variation in material height.

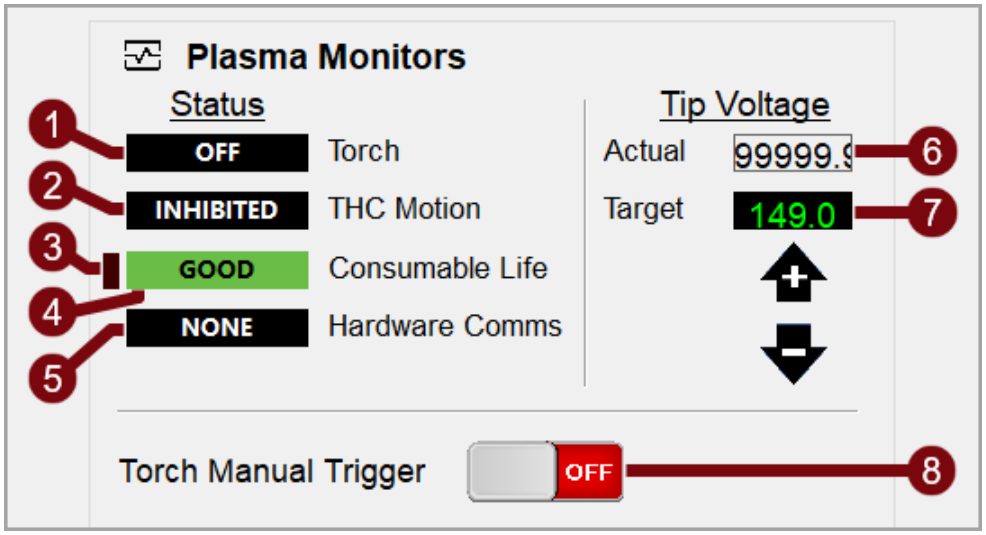
2. **Up Sensitivity**

   Default of 100 uses the recommended precalculated THC settings. Increasing will increase the Z axis response speed in the UP direction. Decreasing will slow Z speed in the UP direction. This override setting is specific to a Material Profile and will be saved for FLAT, MODERATE, SEVERE.

3. **Down Sensitivity**

   Default of 100 uses the recommended precalculated THC settings. Increasing will increase the Z axis response speed in the DOWN direction. Decreasing will slow Z speed in the DOWN direction. This override setting is specific to a Material Profile and will be saved for FLAT, MODERATE, SEVERE.

B. Plasma Monitors Group



1. **Torch**

   The torch indicator shows the status of the torch in Mach4, **ON** or **OFF**

2. **THC Motion**

   The THC Motion indicator displays the current status of THC motion - **UP**, **DOWN**, or **INHIBITED**.

> **THC Note**
>
> **INHIBITED** does not mean that THC is turned off or is not working. It means that for some reason THC motion is currently inhibited which could be because of an inhibit in the gcode or an Anti Dive rule.

3. **Consumable LED**

   The Consumable LED warns the operator that the Pierce Warning limit is exceeded.

4. **Consumable Life**

   The Consumable Life indicator shows whether the number of pierces since last reset is under the pierce count warning, GOOD, or the consumables should be changed, REPLACE.

5. **Hardware Comms**

   The Hardware Comms indicator shows the status of Mach4 communication with the WarpRunner/TMC3in1 THC controller - **NONE**, **ACTIVE**, or **UPDATING**.

> **Operation Note**
>
> **ACTIVE** status is required to start G-Code.

> **Software Update Note**
>
> **UPDATING** indicates that the WarpRunner/TMC3in1 firmware is being updated. This is common after updating Mach4 to a new plugin version. The status should return to **ACTIVE** once the update is complete.

6. **Actual**

   The Actual indicator displays the current Tip Volts as measured by the plasma power supply and WarpRunner/TMC3in1 (After applying the Volt Offset).

7. **Target**

   The Target Tip Volts indicator displays the target voltage read from the G-Code once the program is started. The target can be adjusted up and down during a program using the arrows.

> **Post Processor Note**
>
> The Avid CNC post processor is required to properly format the G-Code so that the target voltage is included.

8. **Torch Manual Trigger**

   The Torch Manual Trigger switch turns the torch **ON** or **OFF**.

> **Warning**
>
> This switch will fire the torch with no additional warning. Use caution and proper PPE whenever using the torch.

C. Ohmic Probe

The Ohmin Probe indicator displays the state of the Ohmic Probe signal - **ACTIVE** or **INACTIVE**.

ACTIVE means that there is conductivity between the torch tip and the material clamp, generally from the torch tip touching material properly connected to the material clamp.

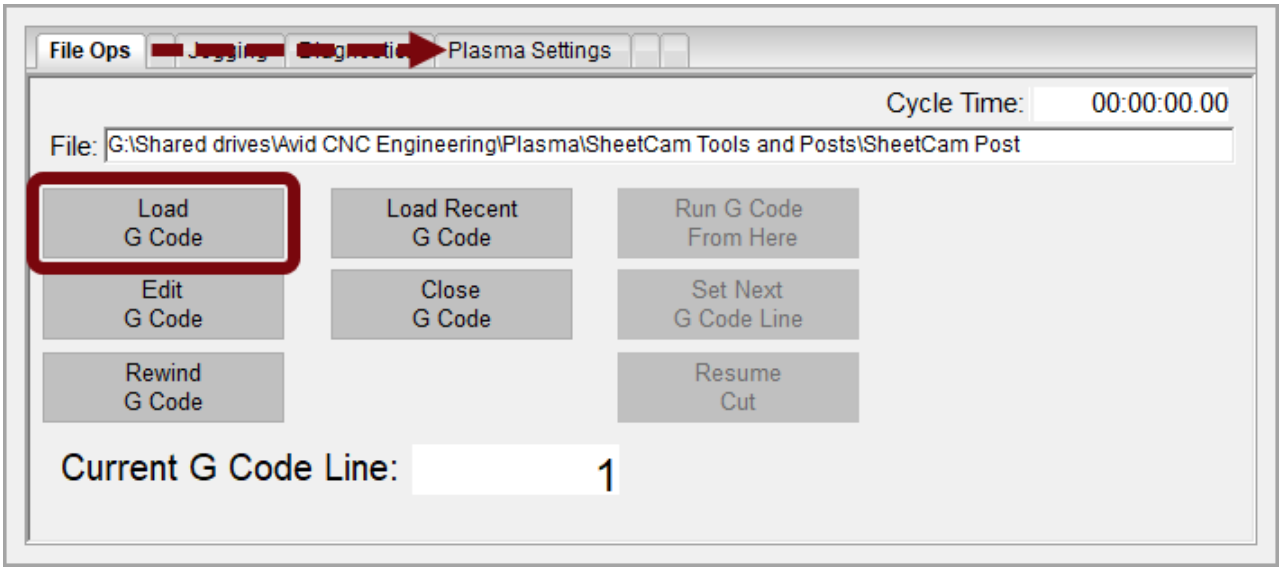
Plasma Workflow

Workflow Overview

The list below shows the typical order of operations for a plasma cutting operation.

1. Home the machine and set work XY zero
2. Load G-Code
3. Set Z Rapid Height
4. Check consumable state
5. Check THC state
6. Verify THC settings
7. Cycle Start

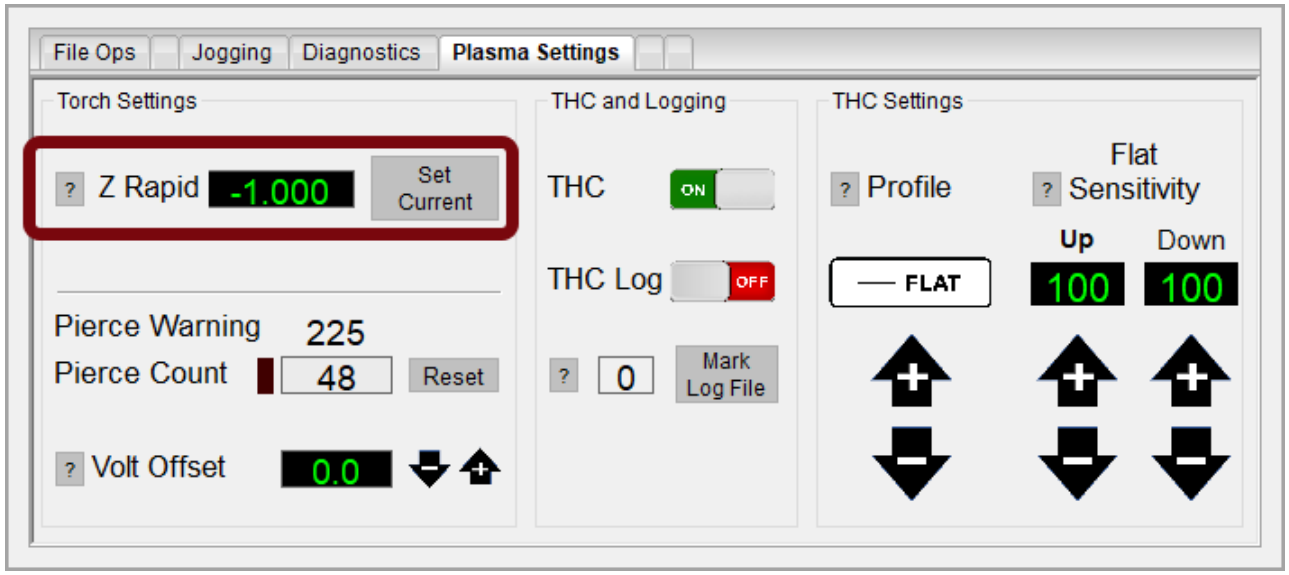
> **Operation Note**
>
> For more detailed instructions of the plasma cutting workflow, check out our **Plasma First Cut Instrucions**



First, load a program by clicking the **Load G-Code** button in the **File Ops** tab.

After loading a new program, Mach4 will automatically switch to the **Plasma Settings** tab to continue setup of the program.

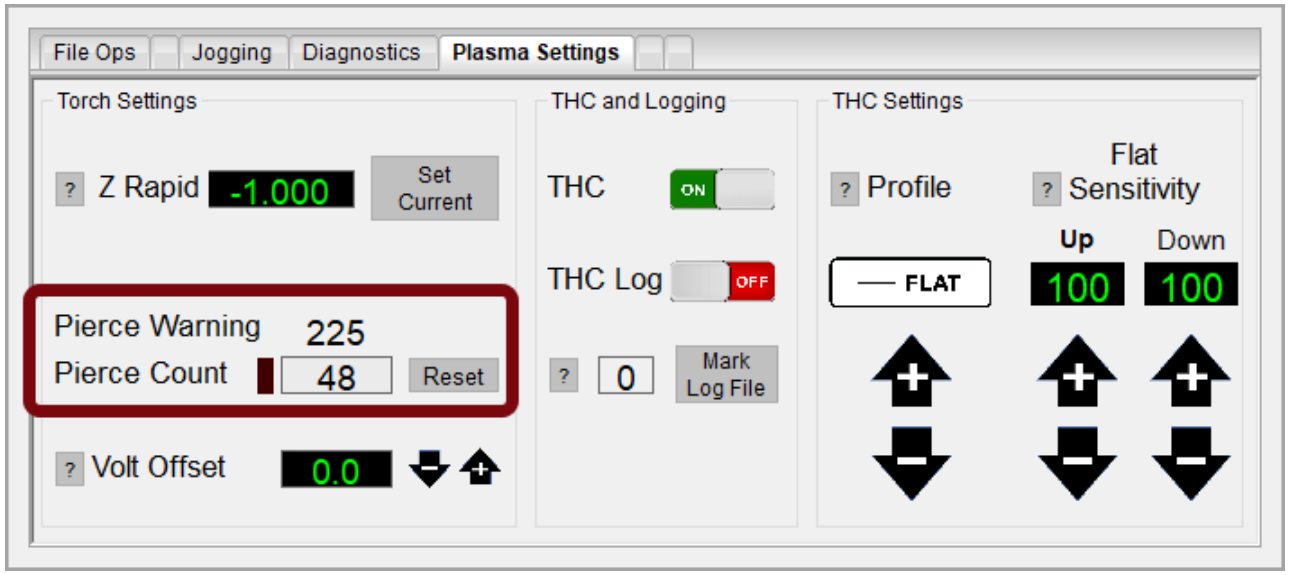
Set Z Rapid Height



Next, jog the torch to a safe Z height for the material. Then, set the Z Rapid Height by clicking the **Set Current** button.

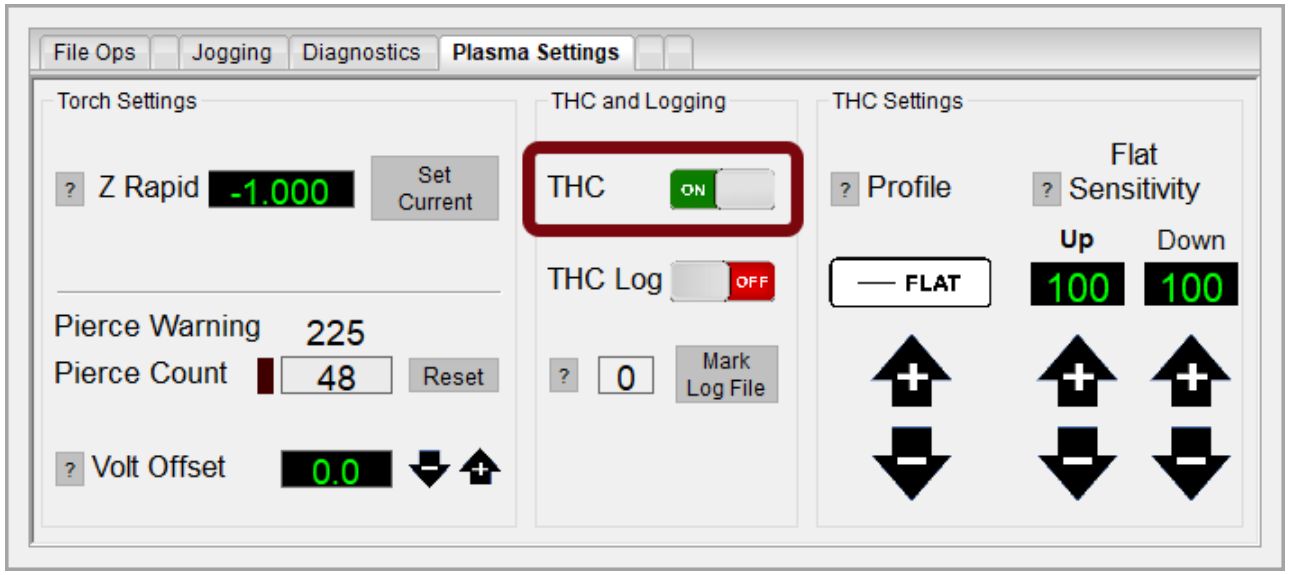
Operation Note

This height should be above the highest point of the material and potential tip ups of small parts being cut.

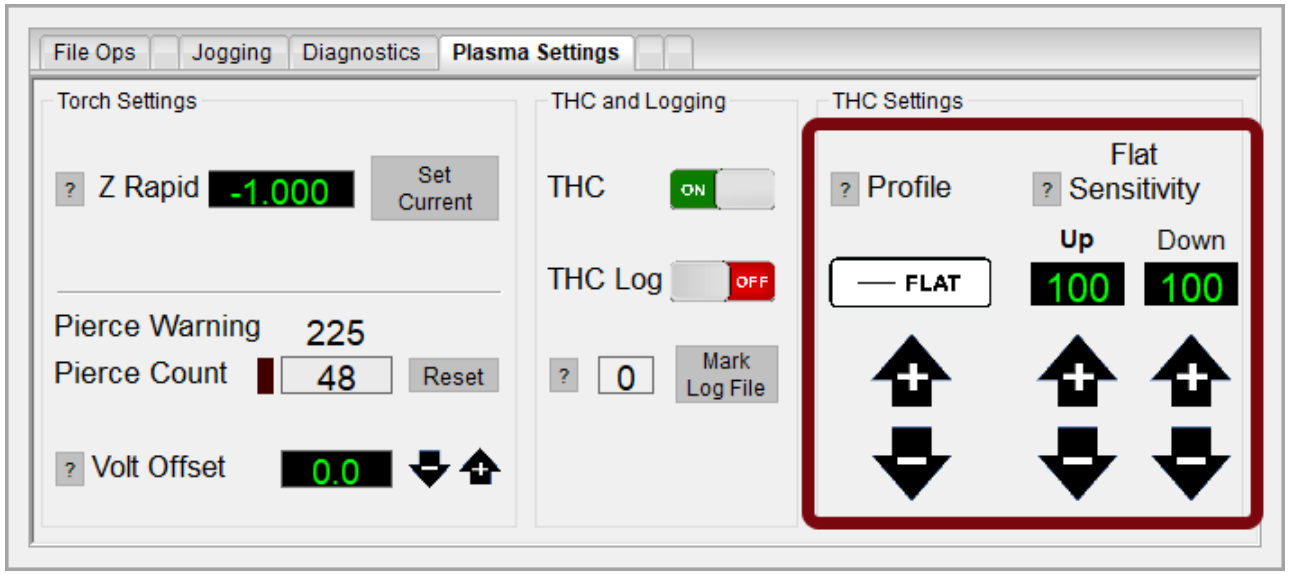


Next, check that the current consumables are within their useful life - that the pierce count is below the pierce warning.

Check THC State



After check the consumables, ensure that the torch height control setting is correct. In most cases, THC should be **ON**.



Finally, make sure the material profile and sensitivity settings are appropriate for the program.

Torch Height Control

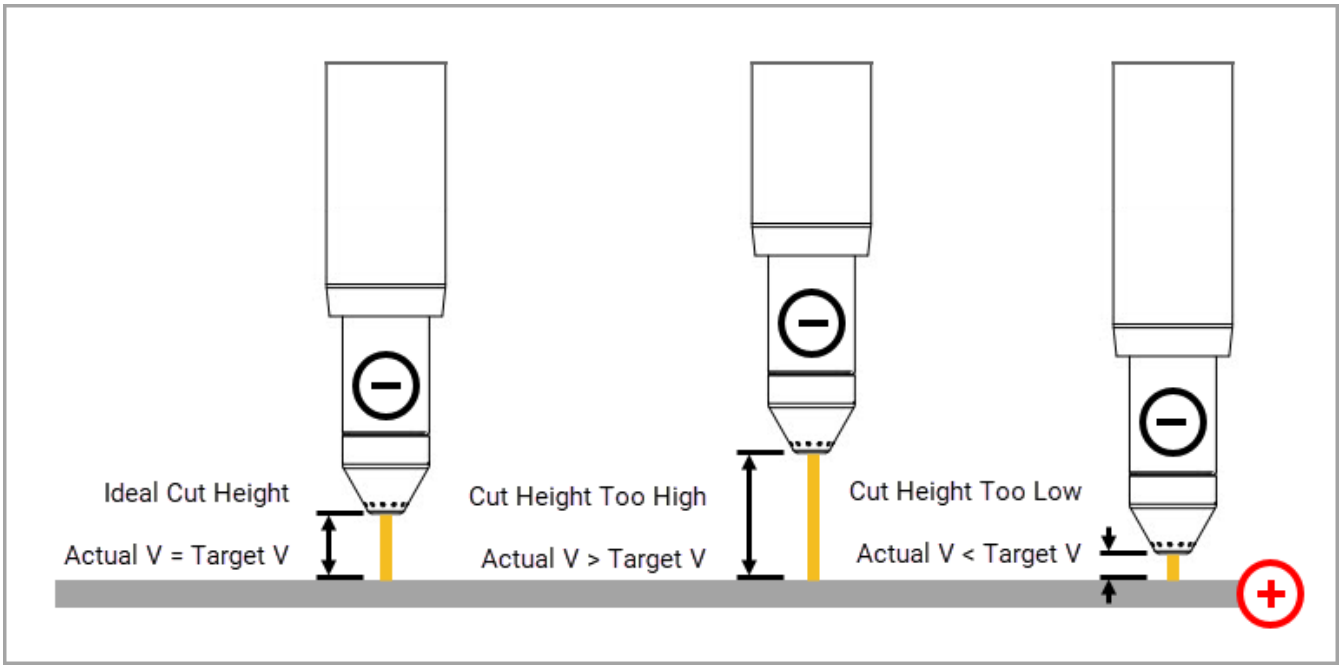
Operating Theory

The purpose of a THC system is to maintain a consistent torch-to-material offset across a workpiece. This allows for the best cut quality on materials that vary in height due to warping or inherent waviness.

Most THC systems use Arc Voltage (Tip Volts) as an indirect measurement of height. The arc voltage is measured between the Electrode (in the consumable stack) and the workpiece. The plasma arc voltage between the electrode (-) and workpiece (+) is governed by the equation below:

V = I x R or **Voltage = Current x Resistance**

The arc current is constant but the resistance increases with increasing arc length. This means the required arc voltage increases as the arc lengthens and can be used as an indirect measurement of torch-to-material offset.



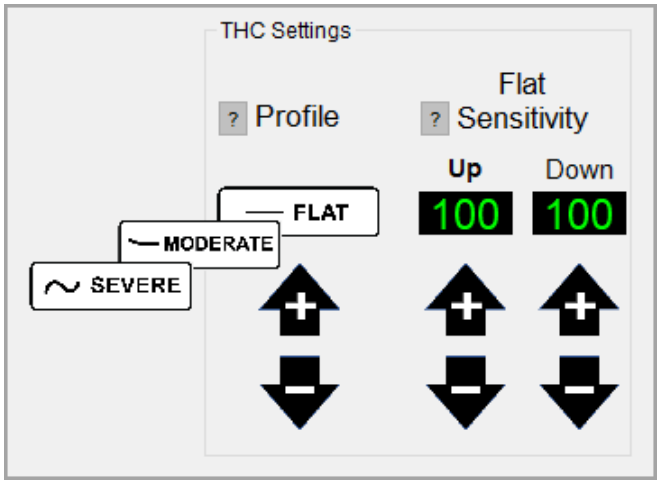
The THC system attempts to bring the **Actual Tip Volts** closer to the **Target Tip Volts** by moving the Z axis (torch) up/down.

Because the measurement is indirect, **Actual Tip Volts** and torch height will not always directly correlate. Some common situations that can cause fluctuation in tip voltage include:

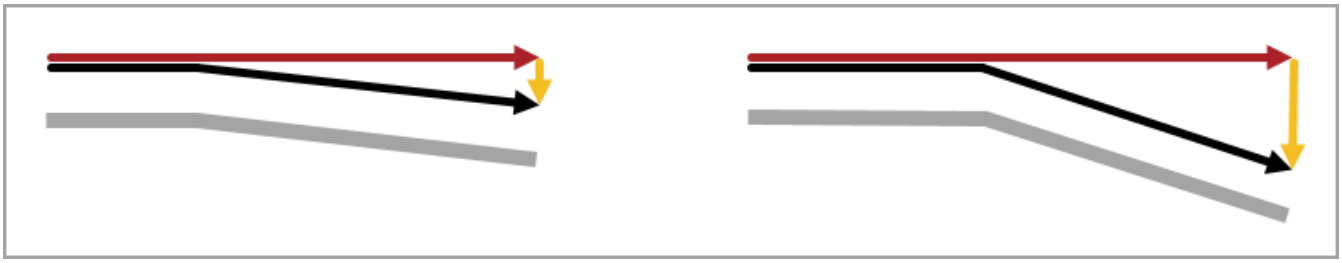
- Leadin/leadout - the voltage is unstable when the XY velocity changes significantly.
- Tight corners - the voltage typically increases as the XY motion slows around a corner.
- Small holes/shapes - the voltage will increase as XY motion slows
- Pre-cut material (voids) - the voltage will increase rapidly as the torch-material distance gets very large because there is no material directly under the torch.

These situations can lead to unwanted THC motion. In most cases, this motion will be toward the material. In many cases, this unwanted motion can be prevented with Anti Dive settings. If the unwanted motion cannot be eliminated with the Anti Dive settings, they can typically be correct tuning the THC to suit the material.

Material Profile Settings



The Z axis speed necessary for the torch to maintain a consistent height above the material is dependent on the severity of the slope and the XY feedrate (set in SheetCam). In the two illustrations below, the torch needs to follow the black path to maintain this consistent cut height. Because the XY feedrate is the same between both examples, the Z axis will need to move more quickly to follow the material slope on the right than on the left.

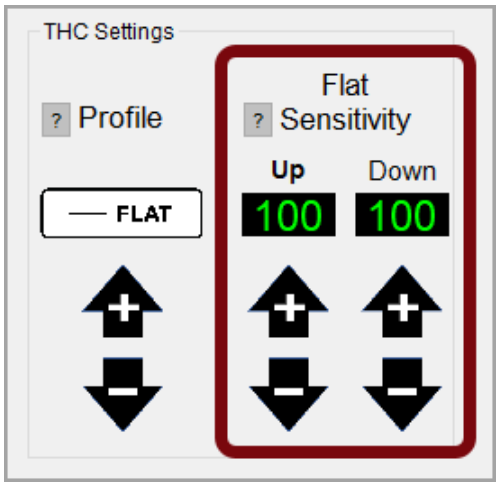


Most disruptive events (corners, holes, etc) during a cut lead to an increase in tip voltage which will cause the torch to dive. To avoid this, it is useful to limit the Z axis speed to follow the likely material curve while correcting for delayed response. The Profile Settings of **FLAT**, **MODERATE**, and **SEVERE** allow increasingly faster Z motion to correct for voltage fluctuation. These settings also adjust Anti Dive settings in an attempt to maximize cut quality.

The **FLAT** material profile is intended for material that is nominally flat and should be used in most cases. Thin materials are prone to warping during cutting but the warpage is typically not significant enough to warrant a more drastic material profile setting. For reference, a 5% slope (0.6in/12in) can easily be handled by the **FLAT** profile setting.

The **MODERATE** and **SEVERE** settings should only be used for material with significant variation or severely warped thin material. Using either of these profiles on flat material can lead to excessive torch movement and crashes due to the torch diving into the material.

Fine Tuning



Each Profile Setting allows for independent adjustment of the Up/Down Z-axis response speed. The number displayed is the percentage of the default setting. By defualt, it is set to 100%, but can be adjusted as needed from 10-200%.

If the torch fails to follow the material closely, use the **plus** arrows to increase the Up or Down setting(s) accordingly.

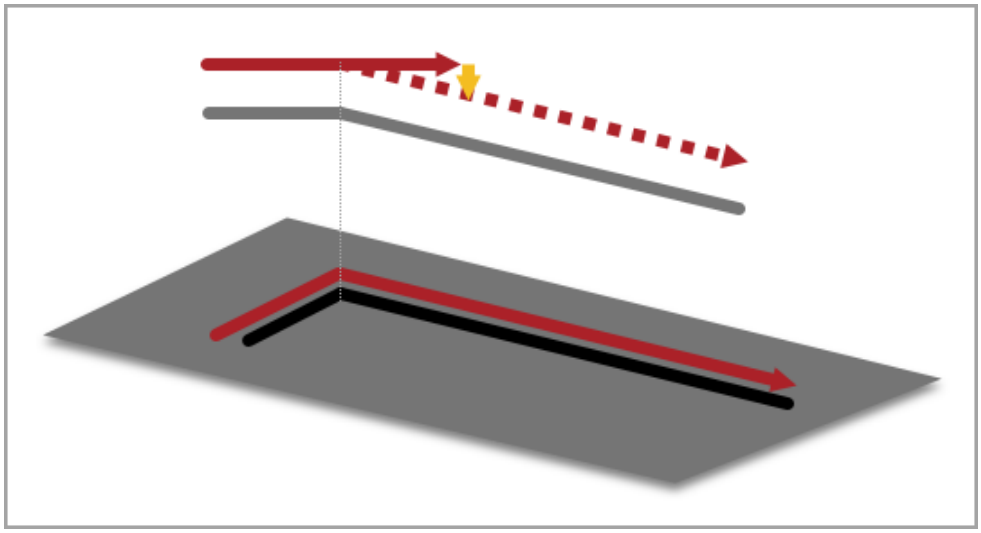
If the torch moves up or down too much, dives/crashes or cuts excessively high, use the **minus** arrows to decrease the Up or Down setting(s) accordingly.

These settings are linked to each Material Profile and can be adjusted on-the-fly during a cut.

Additional Torch Height Control Settings

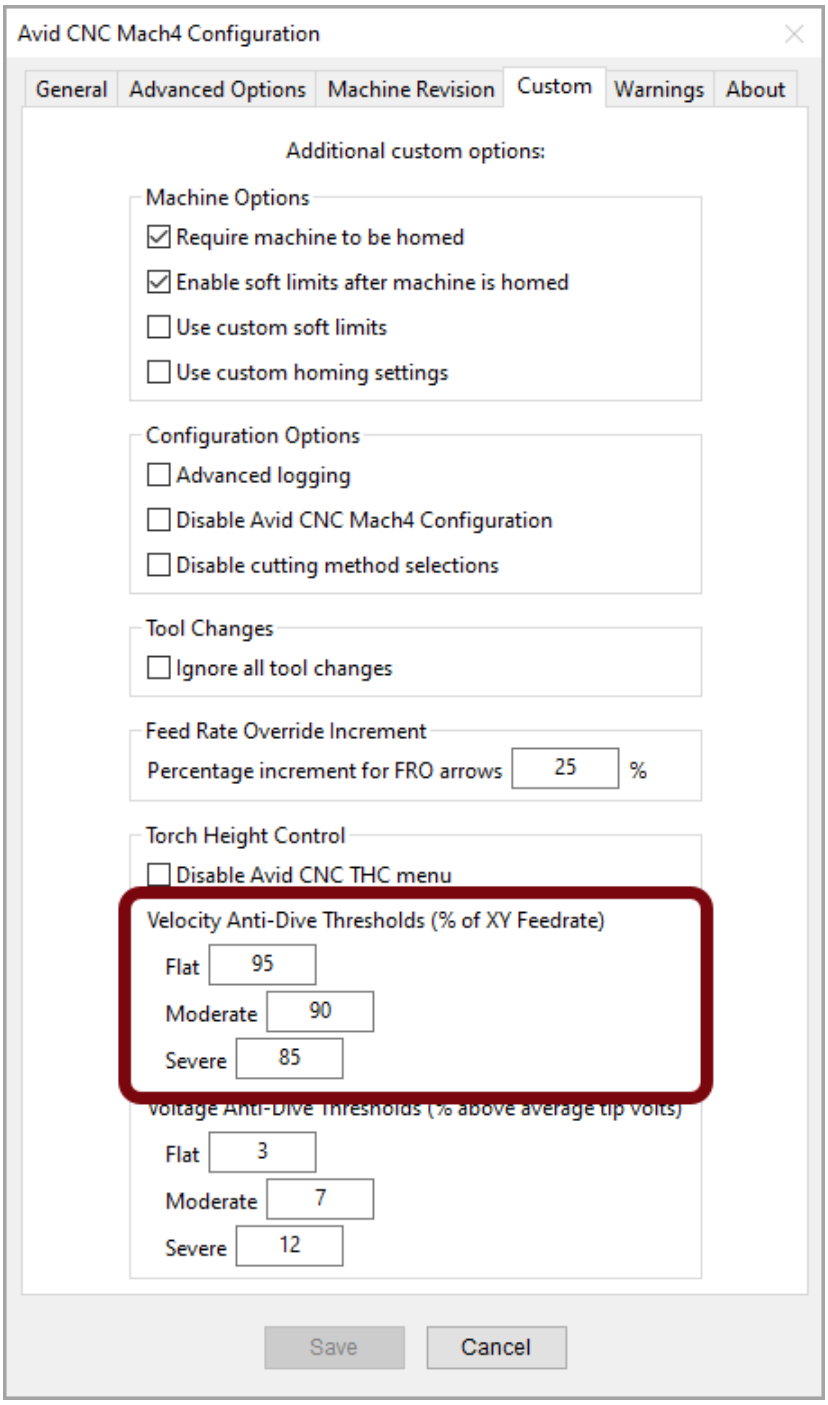
There are several other torch height control settings that are available but rarely needed.

Each material Profile has default Anti Dive settings that are intended to only allow the Z motion necessary to track the material. In general steeper material slopes require Anti Dive settings that allow motion more often.



The example above is a corner on sloped material. The torch path is shown in red, following the black cut profile. As the torch moves around the corner, tip volts are likely to spike. As the voltage spikes, THC would move the torch downward. The profile shown in the upper portion of the image illustrates Velocity Anti-Dive briefly inhibiting Z-axis motion leading to a higher cut height as the material drops away. Depending on the Anti Dive settings, this could result in poor cut quality or a failed cut.

Velocity Anti-Dive Threshold



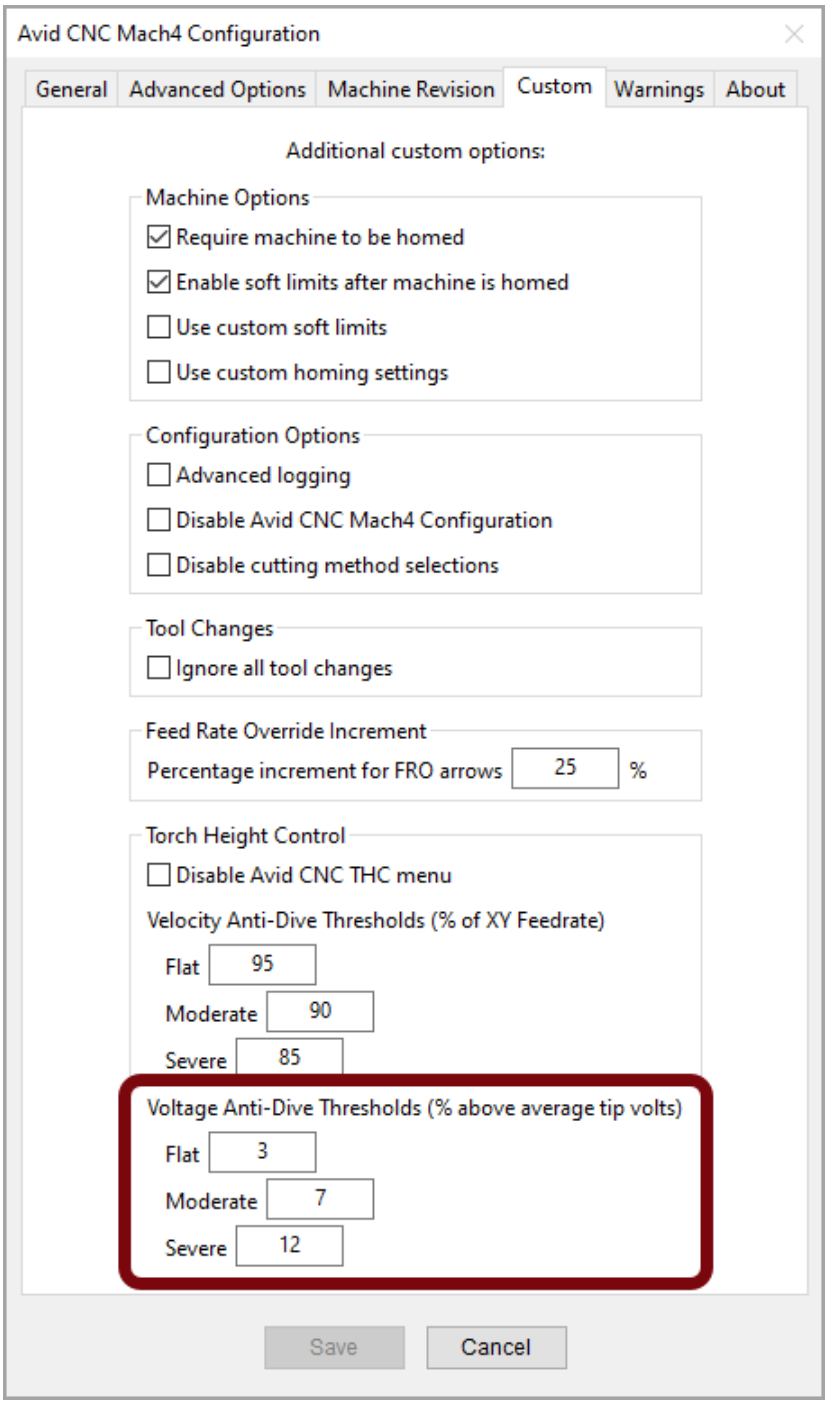
The **Velocity Anti-Dive Threshold** sets the percentage of programmed XY feedrate that will momentarily inihibit THC. For example, if the actual feedrate drops below the threshold due to acceleration limits in corners and small arcs, THC motion is inhibited until the feedrate recovers.

To access this setting, select **Configure** -> **Avid CNC Mach4 Configuration** from the top menu in Mach4.

If the torch is frequently diving in low speed situations but otherwise tracking the material properly, increasing the Velocity Anti-Dive Threshold could help prevent the dives.

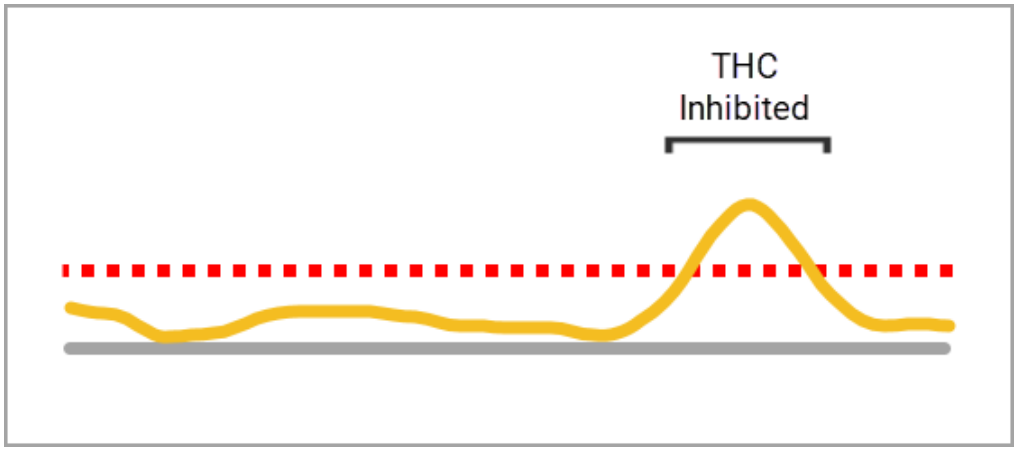
If the torch is failing to track the material during or after low speed situations, decreasing the Velocity Anti-Dive Threshold could help to allow more motion.

Voltage Anti-Dive Threshold



The **Voltage Anti-Dive Threshold** sets the percentage above the Average Tip Volts that will momentarily inihibit THC. If the Actual (or ﷺinstantaneousﷺ) tip voltage exceeds the threshold, THC motion is inhibited until the actual voltage returns to the expected range.

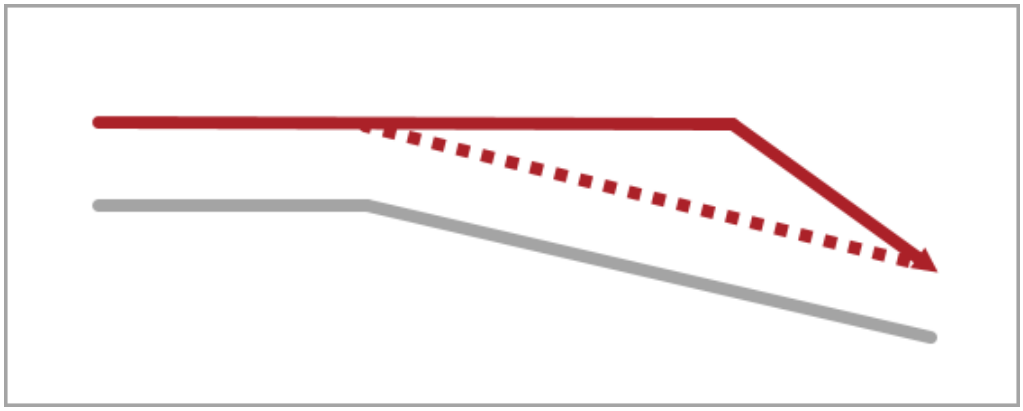
To access this setting, select **Configure** -> **Avid CNC Mach4 Configuration** from the top menu in Mach4.



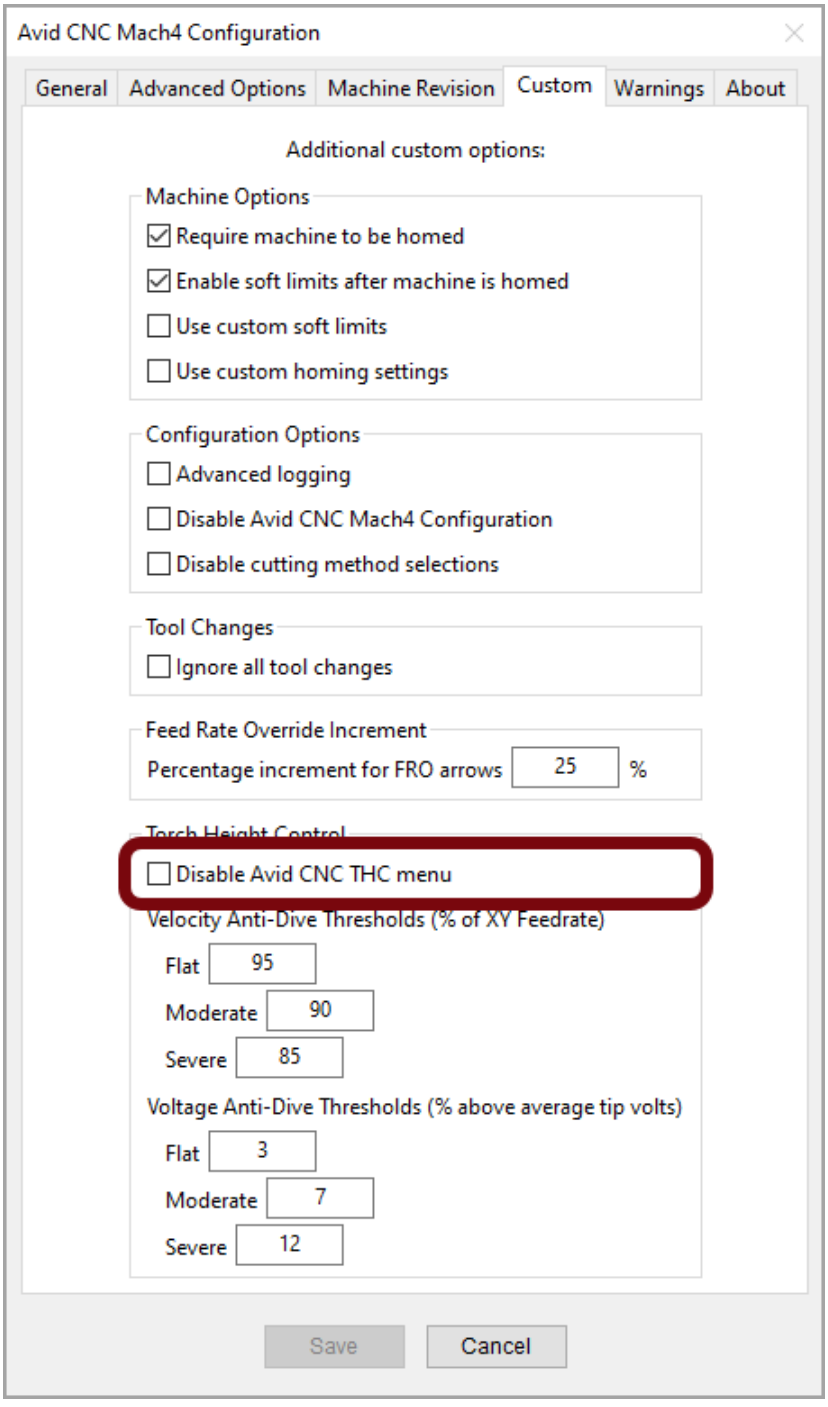
The image above shows the Actual Voltage (yellow), Average Voltage (grey) and Voltage Anti-Dive Threshold (red). When the Actual Voltage spikes above the threshold, THC motion would be inhibited during the spike.

If the torch is frequently diving when crossing voids or other irregularities, decreasing the Voltage Anti-Dive Threshold could help prevent the motion.

If the torch fails to begin following changes in material slope, increasing the Voltage Anti-Dive Threshold could help allow motion sooner. This would look like the image below where the torch path (red) does not follow the intended path (dashed red) and has to quickly recover.

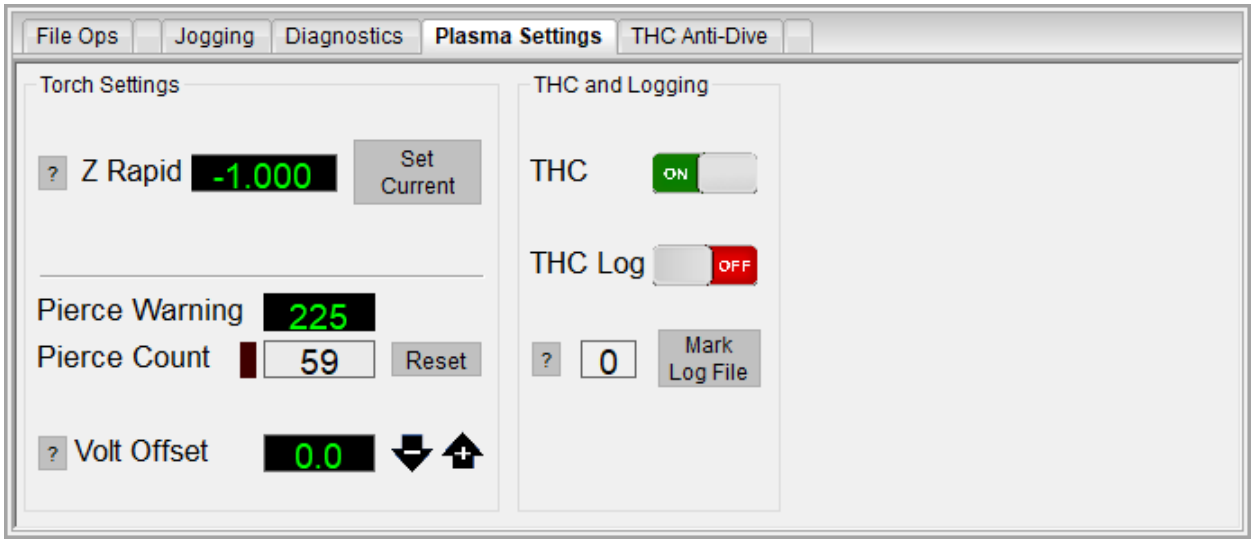


Disabling THC

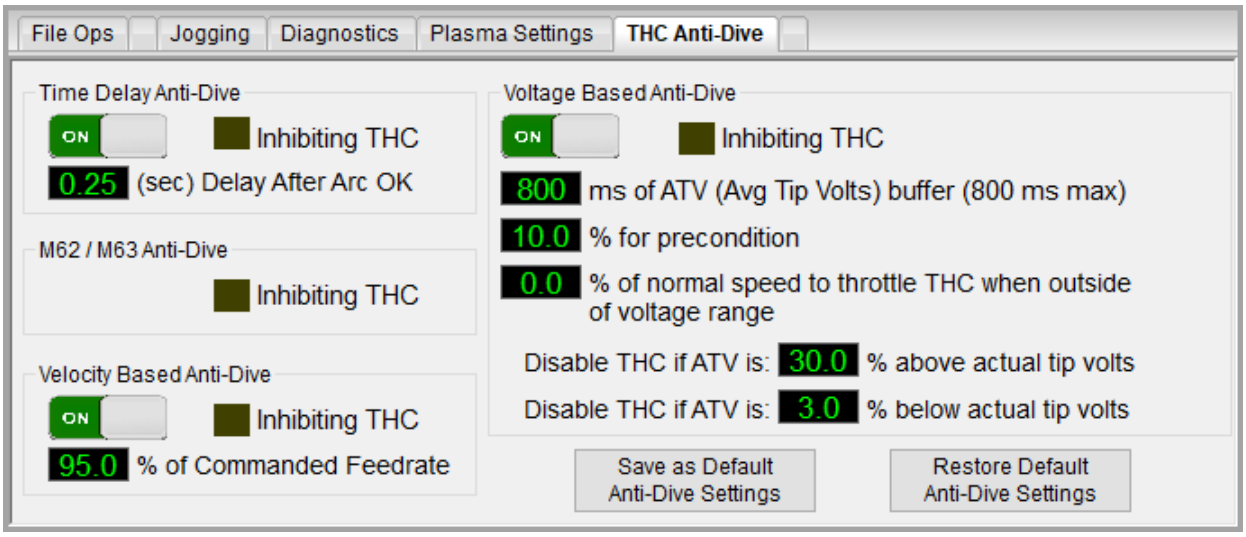


If necessary or desired, the Avid CNC THC parameter calculations can be disabled. Doing so will disable all feedrate and profile based Z axis response calculations. This should only be done by users that have an understanding of each Anti-Dive setting, including the Linear Response Band.

This will hide the Profile and Sensitivity settings and expose the THC Anti-Dive tab



THC Anti-Dive Functions



Anti-dive settings are used to handle exception cases during THC movement, i.e. cutting over voids, cutting into corners, leading out of interior profiles etc.

Time Delay Anti-Dive

Time delay anti-dive will pause THC motion for a specified amount of time after a plasma arc is initiated.

- **Time Delay Anti-Dive Toggle** - This switch will enable or disable time delay anti-dive functionality. When disabled there will be no delay in THC response after arc initiation.
- **Delay After Arc OK Time Setting** - This value specifies the amount of time (in seconds) to delay THC functionality after the Arc OK signal is received from the plasma supply. New values may be typed directly into this box.
- **Time Delay Anti-Dive Inhibiting THC Indicator Light** - This indicator will be illuminated if time delay anti-dive is currently inhibiting THC motion.

M62/M63 Anti-Dive

M62/M63 anti-dive turns THC functionality on when a M62P4 is executed and off when a M63P4 is executed. These M codes can be generated by your CAM software. (Using SheetCam with the Avid CNC post processor is recommended)

- **M62/M63 Anti-Dive Inhibiting TCH Indicator Light** - This indicator will be illuminated if M62/M63 anti-dive is currently inhibiting THC motion.

Velocity Based Anti-Dive

Velocity based anti-dive will prevent THC motion when the actual X-Y velocity of the machine is less than the specified percentage of the current commanded feedrate.

- **Velocity Based Anti-Dive Toggle** - This switch will enable or disable velocity based anti-dive functionality. When disabled THC motion will be allowed at any machine velocity.
- **% of Commanded Feedrate Setting** - This value specifies the percentage of the commanded feedrate the machine must achieve to enable THC motion. New values may be typed directly into this box.
- **Velocity Based Anti-Dive Inhibiting THC Indicated Light** - This indicated will be illuminated if velocity based anti-dive is currently inhibiting THC motion.

Voltage Based Anti-Dive

Voltage based anti-dive will prevent THC motion when the current tip voltage and average tip voltage are too dissimilar.

- **Voltage Based Anti-Dive Toggle** - This switch will enable or disable voltage based anti-dive functionality.
- **ms of ATV (Avg Tip Volts) buffer** - This value specifies the number of milliseconds which will be used for the tip voltage rolling average calculation. 800 milliseconds (ms) is the maximum value. As this value is increased, the number of recorded tip voltage values which will be used for the rolling average is increased, making the average slower to respond to tip voltage variation. 800 ms is the recommended setting. New values may be typed directly into this box.
- **% for precondition** - Voltage based anti-dive is not allowed when the torch is first lit. Once the average tip volts are within the precondition percentage of target tip volts, voltage based anti-dive will be allowed for the rest of the cut.
- **% of normal speed to throttle THC when outside of voltage range** - When THC is throttled due to voltage based anti-dive, this percentage determines the response rate of changes in Z height. Setting this value to 0 will disable THC response and is the default setting.
- **Disable THC if ATV is XX % above actual tip volts** - This prevents rising when the material warps up towards the torch or if surface contamination is present, causing the actual tip volts to rapidly drop below the average tip volts. Decreasing this percentage will disable THC response at a lower difference and stop the torch from rising sooner.
- **Disable THC if ATV is XX % below actual tip volts** - This prevents diving when crossing a pre-cut line or if surface contamination is present, causing the actual tip volts to rapidly rise above the average tip volts. Decreasing this percentage will disable THC response at a lower difference and stop the torch from diving sooner.

Save as Default Anti-Dive Settings Button

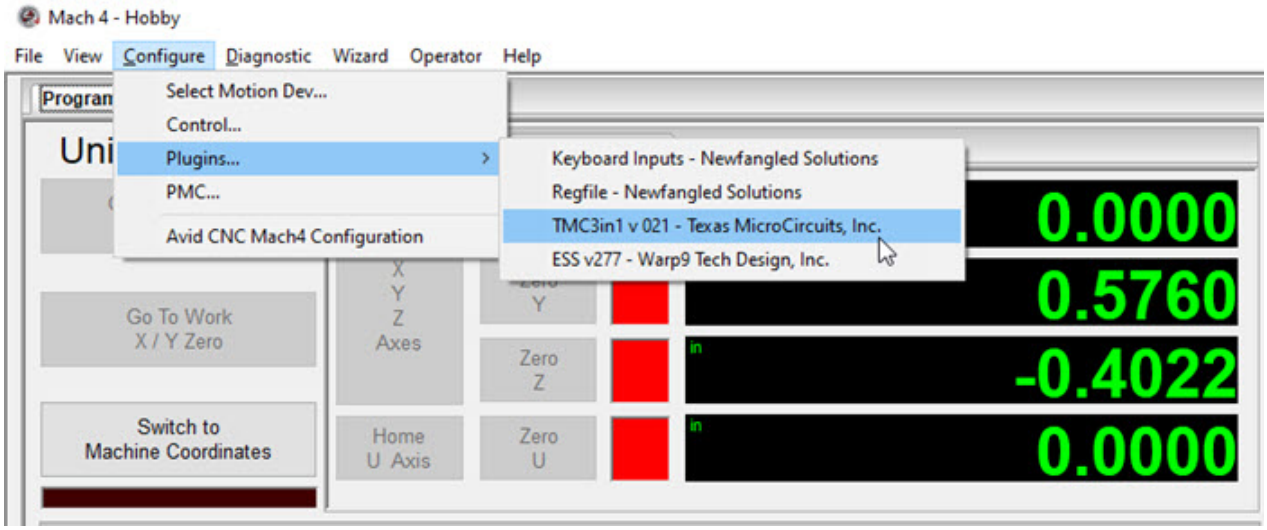
This button will save the current THC anti-dive settings as set in the Mach4 main screen interface as the default THC settings. When Mach4 is closed and reopened these default THC anti-dive settings will be loaded. If you adjust the THC settings and do not save them as the default, they will return to the saved defaults on restart.

Restore Default Anti-Dive Settings Button

This button will change the current THC anti-dive settings to the saved default settings.

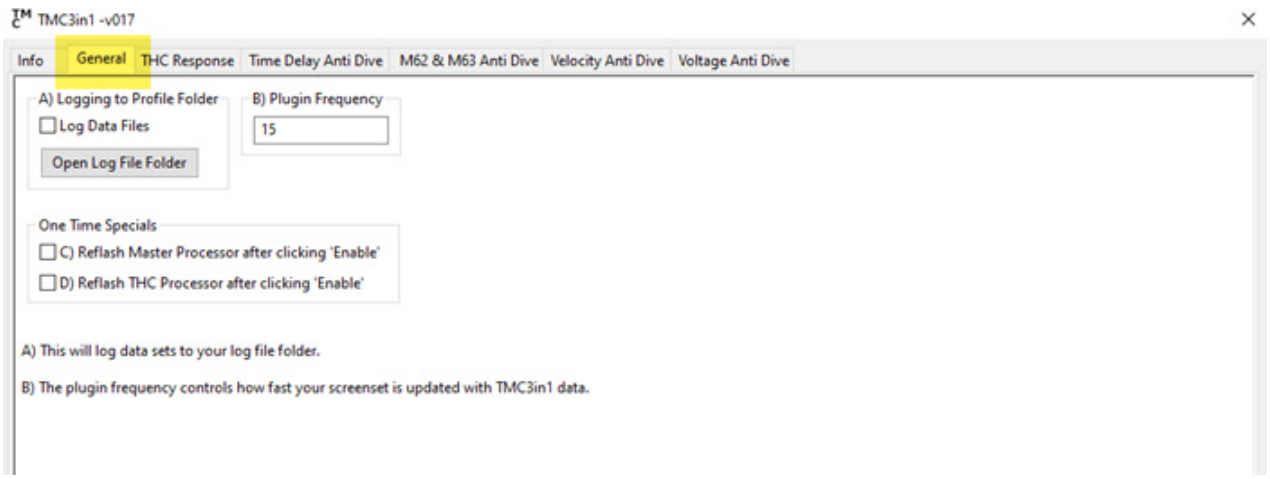
TMC3in1 Plugin Configuration

There are additional TMC3in1 settings that can be accessed in the TMC3in1 plugin configuration menu shown below. Settings that will be used routinely in the operation of your PRO CNC Plasma system can be accessed directly in the Mach4 screen.

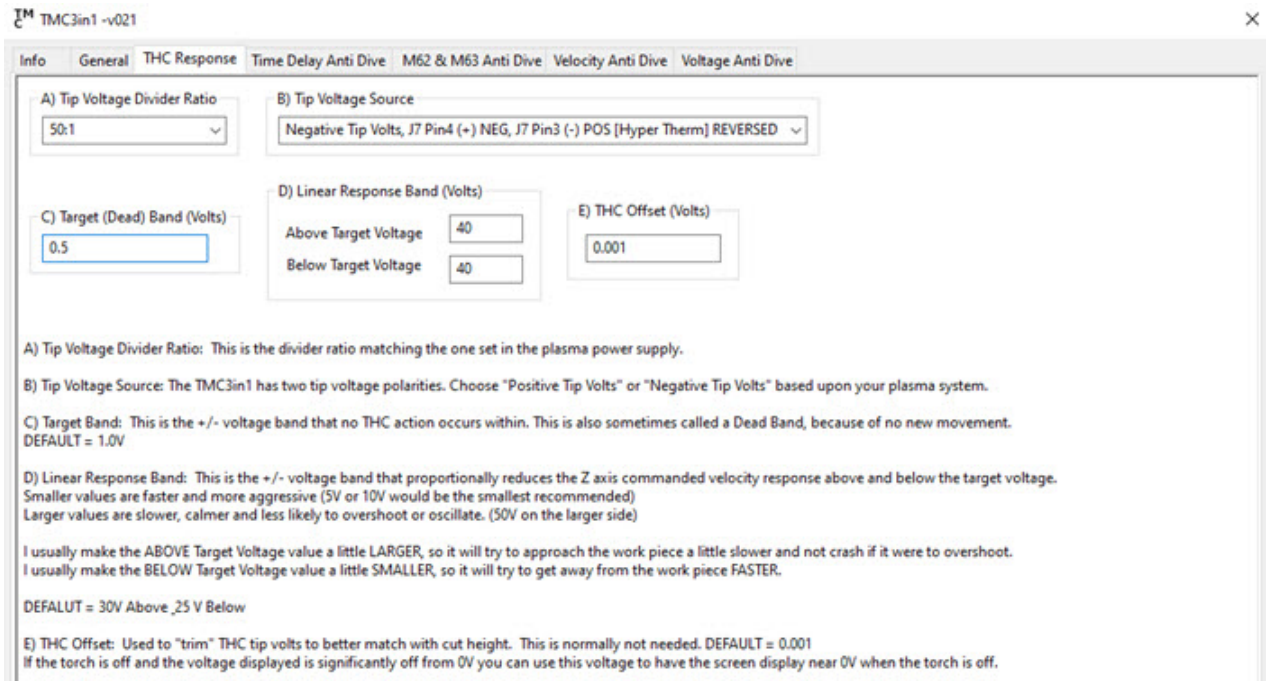


To access the TMC3in1 Plugin configuration navigate to TMC3in1 in the Plugins menu under the Configure pull down menu. ***Any settings changes made from the TMC3in1 Plugin menu will be saved as defaults.***

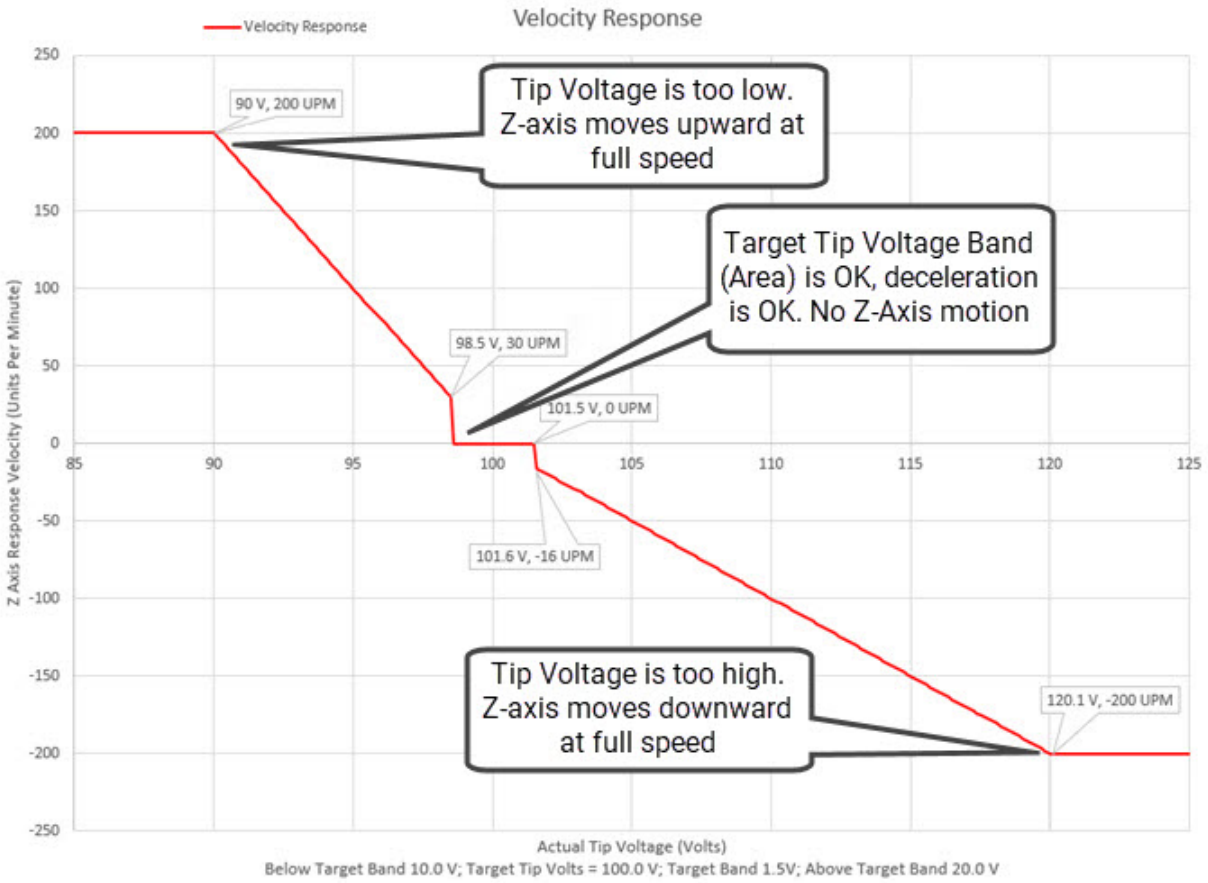
> **Info**
>
> Mach4 must be disabled to access the TMC3in1 Plugin Configuration menu.



- **(A) Logging to Profile Folder** - This checkbox is the same as the toggle on the mainscreen diagnostics tab. The button will open the default logging file location (C:\Mach4Hobby\W9_HC).
- **(B) Plugin Frequency** - This setting should not be changed without consulting Avid CNC support or Warp9 Tech Design support.
- **One Time Specials** - These settings should not be used without consulting Avid CNC support or Warp9 Tech Design support.

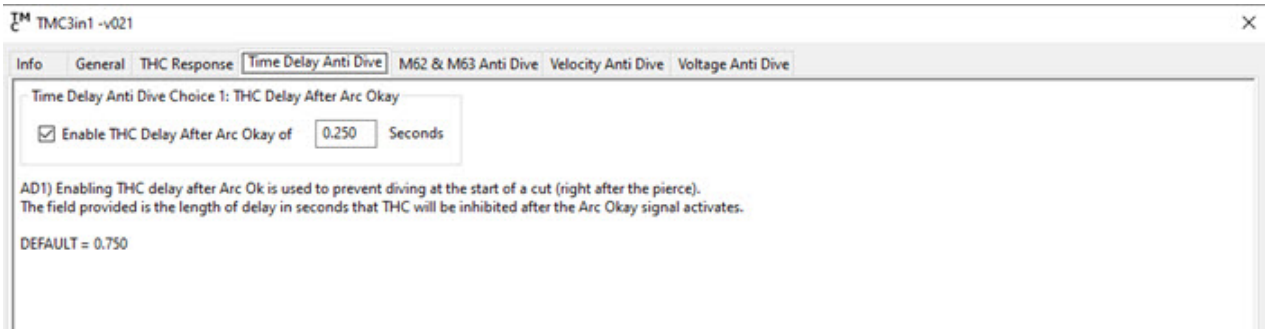


- **(A) Tip Voltage Divider Ratio** - This setting is based on the brand of plasma torch in use. Hypertherm torches always output a 50:1 divided arc voltage.
- **(B) Tip Voltage Source** - This setting is based on the brand of plasma torch in use. Hypertherm torches always output "Negative Tip Volts."
- **(C) Target Band** - This setting changes the "width" of the target voltage band. When the actual voltage is within this target band there will be no THC motion. (See next section).
- **(D) Linear Response Band** - This setting controls the +/- distance from the target tip volts which will produce a linearly proportional THC motion response. Above or below these set limits the THC motion will be commanded at maximum speed.
- **(D) THC Offset** - This setting is only useful in specific applications as a 'trim' adjustment and should not be used without consulting Avid CNC support or Warp9 Tech Design support.

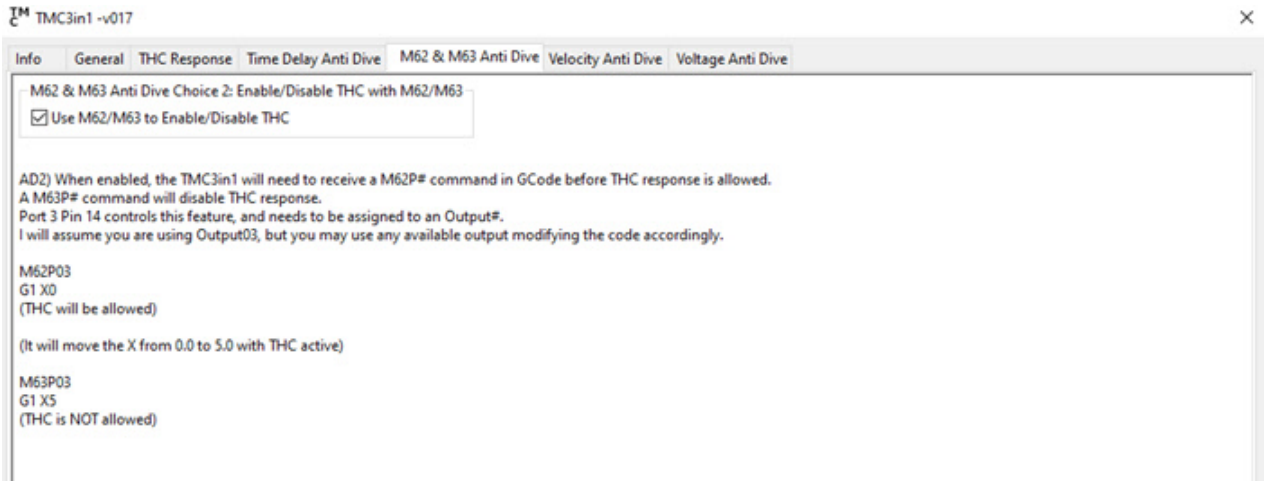


The above is a graphical representation of the THC motion (Z Axis Response Velocity - Y axis of graph) produced as a result of the incoming tip voltage signal from your plasma torch (Actual Tip Voltage - X Axis of graph). Reading the graph left to right, the data represents the following scenarios:

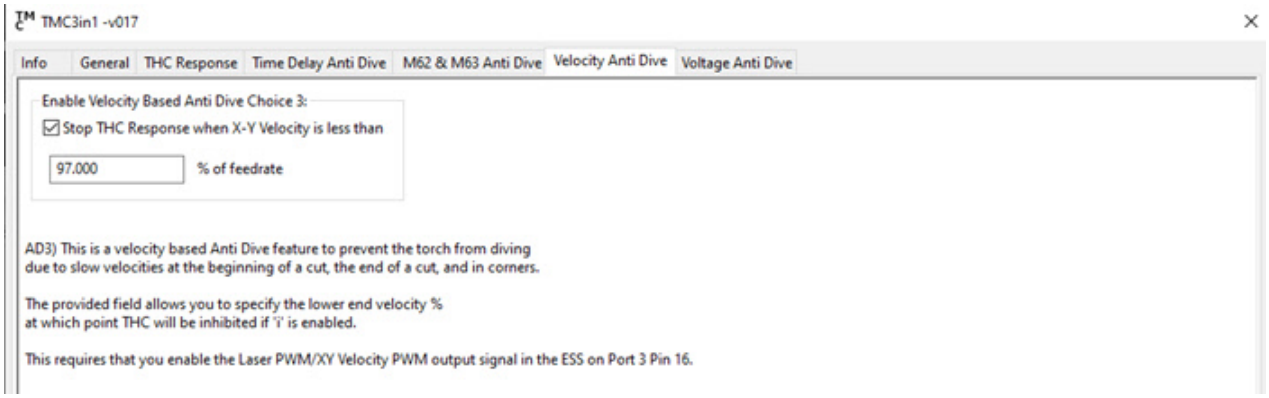
- **Z Axis Response Full Positive** - From 85 to 90 tip volts the actual voltage is below the target tip voltage by more than the negative linear response band setting. THC commanded Z-axis motion is positive at maximum velocity (in this example 200 units per minute).
- **Z Axis Response Linearly Positive** - From 90 to 98.5 tip volts the THC motion is commanded in the positive direction at a speed which is linearly proportional to the difference between the actual and target tip voltage.
- **Target Tip Voltage** - The target tip voltage is set to 100 volts in this example and the target tip voltage band is 3. From 98.5 to 101.5 (3 volt band) there is no commanded THC velocity as the actual voltage is within the target tip voltage band.
- **Z axis Response Linearly Negative** - From 101.5 to 120 tip volts the THC motion is commanded in the negative direction at a speed which is linearly proportional to the difference between the actual and target tip voltage.
- **Z Axis Response Full Negative** - From 120 to 125 tip volts the actual voltage is above the target tip voltage by more than the positive linear response band setting. THC commanded Z-axis motion is negative at maximum velocity (in this example 200 units per minute).



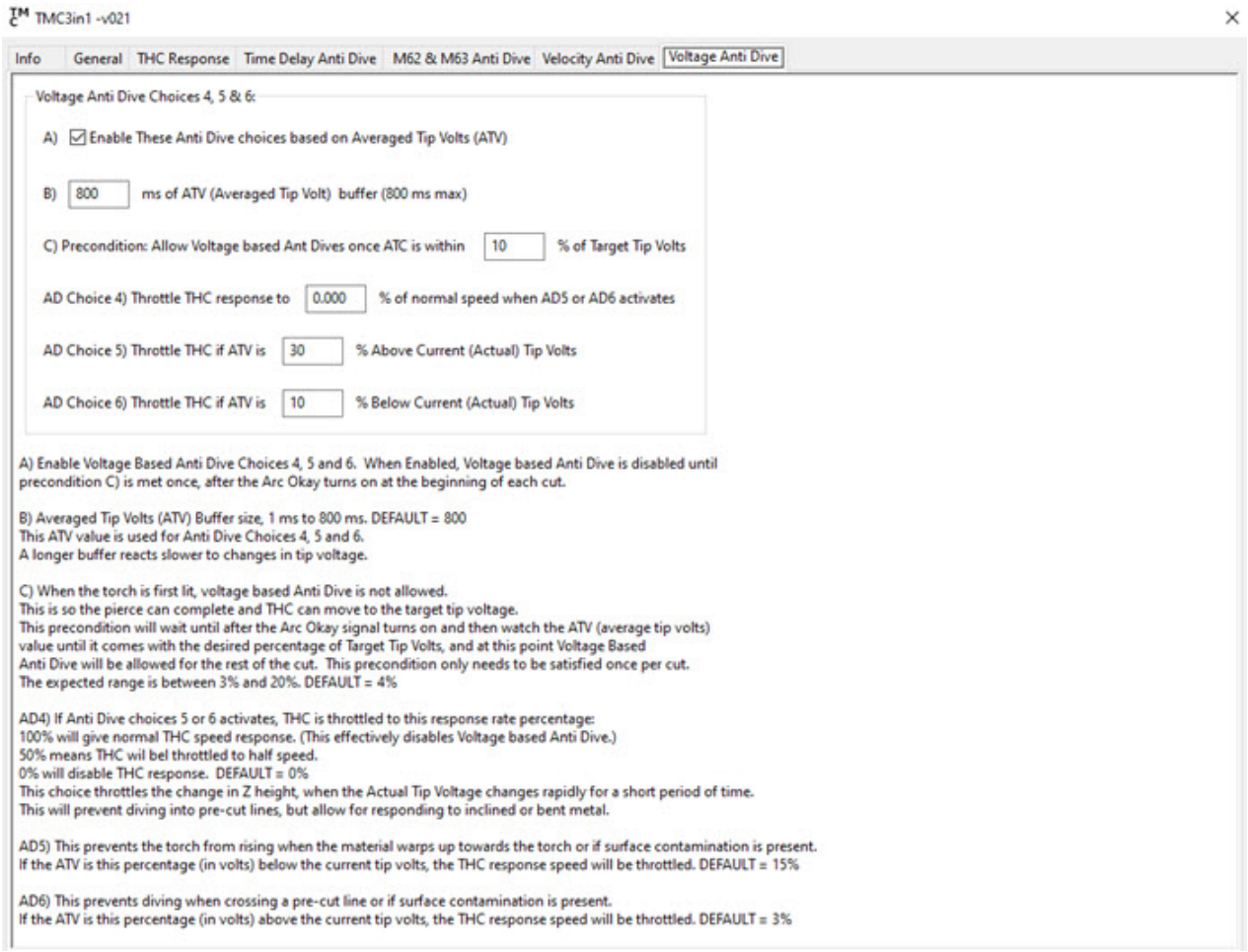
These anti-dive settings are the same as the THC main screen THC Anti-Dive tab. Changes made in the TMC3in1 plugin menu will be saved as default and overwrite defaults set by the THC main screen "Save as Default Anti-Dive Settings" button.



When enabled, the TMC3in1 will need to receive M62P4 commands in your GCode before THC response will be allowed. M63P4 commands can then be used to disable THC response. This type of anti-dive should not be disabled without consulting Avid CNC support.



These anti-dive settings are the same as the main screen THC Anti-Dive tab. Changes made in the TMC3in1 plugin menu will be saved as default and overwrite defaults set by the THC main screen "Save as Default Anti-Dive Settings" button.



These anti-dive settings are the same as the main screen THC Anti-Dive tab. Changes made in the TMC3in1 plugin menu will be saved as default and overwrite defaults set by the THC main screen "Save as Default Anti-Dive Settings" button.

Restart/Resume a Plasma Cut

Because a plasma torch cannot simply re-cut parts of a program that are already complete, there are specific steps required to resume a cut correctly. There are two methods for resuming a plasma cut.

The Resume Cut button can be used if the program stopped in the middle of a cut, after a successful pierce sequence, and did not lose position. This could be due to a Feed Hold or the torch losing arc. This method only works properly if the machine has NOT lost position (still referenced and next to the DROs are green) and is NOT in a stopped state.

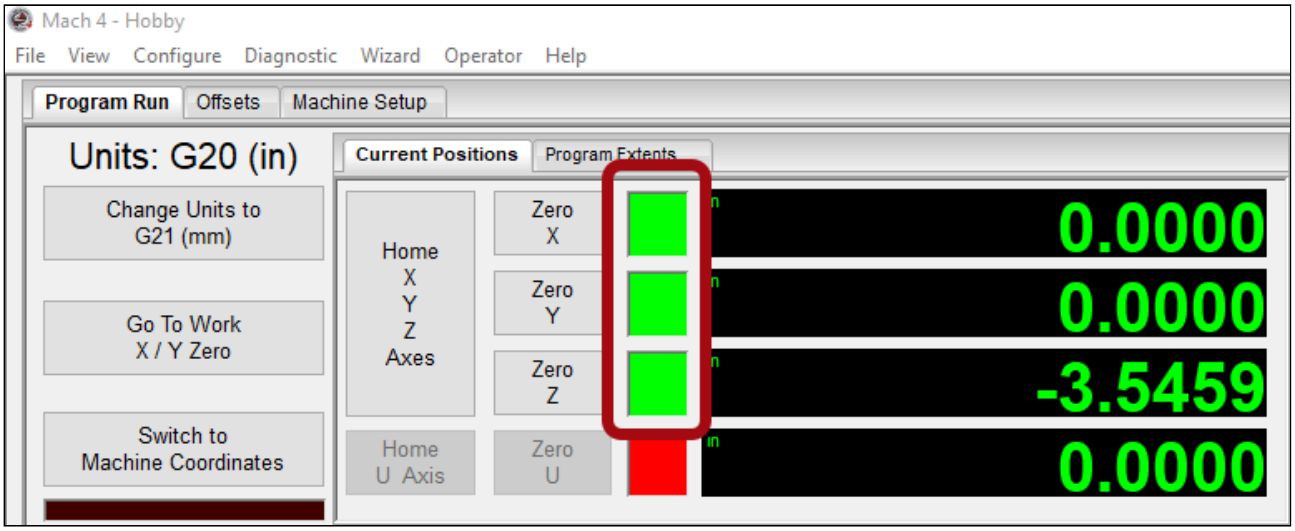
If the torch stopped due to a void or re-cut line this may not work, and the most reliable way to continue will be at the next pierce location (see ***Restart Point***).

If the machine axes are de-referenced (due to a Stop or E-stop) or the cut failed in a location without enough material to use the Resume Cut button, the cut must be restarted at a probe location. These are noted in the G-Code with a <<<<<<RESTART POINT>>>>>> tag.

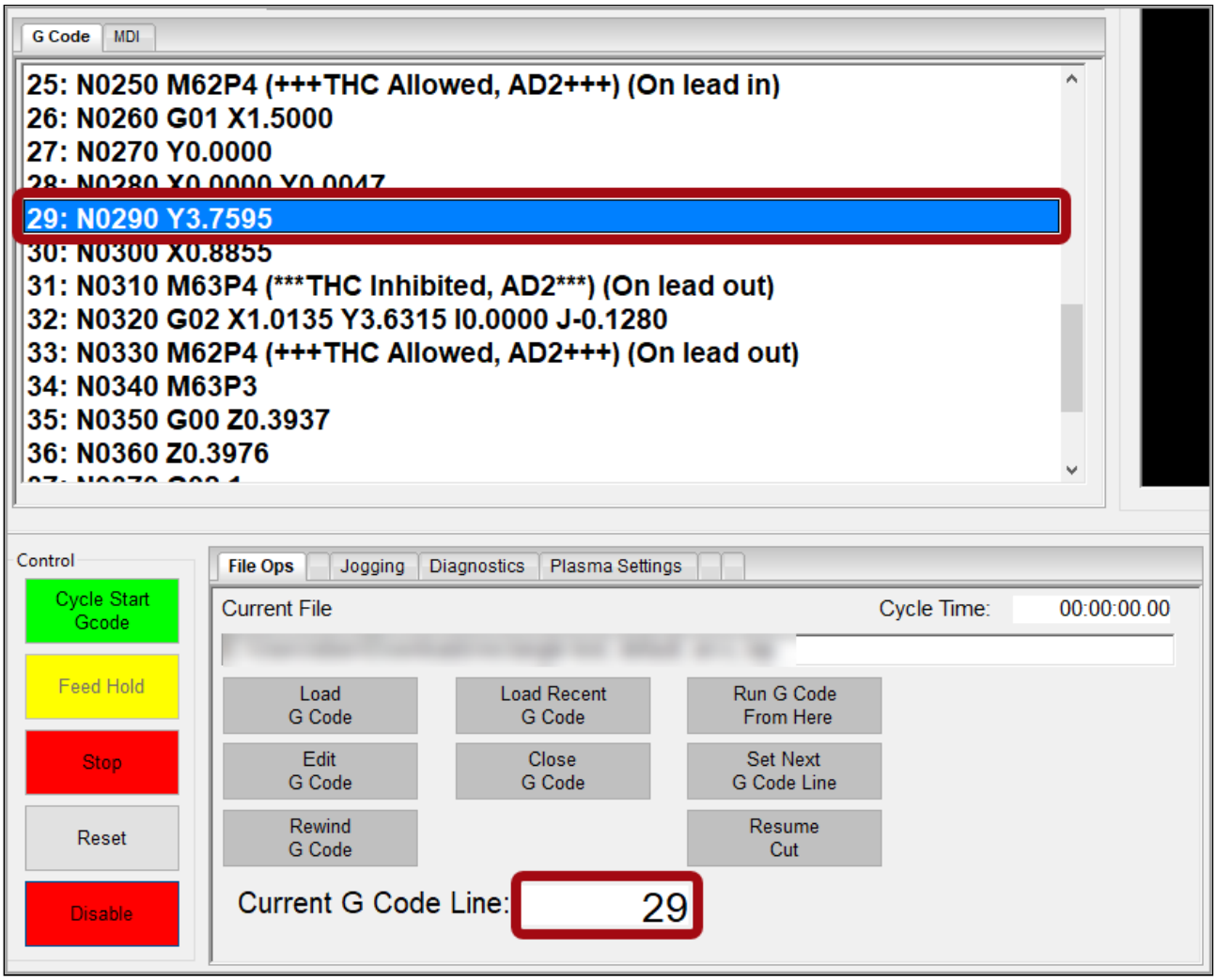
Resume Cut Button

For this method to work, the torch must still be in the correct XYZ location and the machine can't have lost position due to an Emergency Stop.

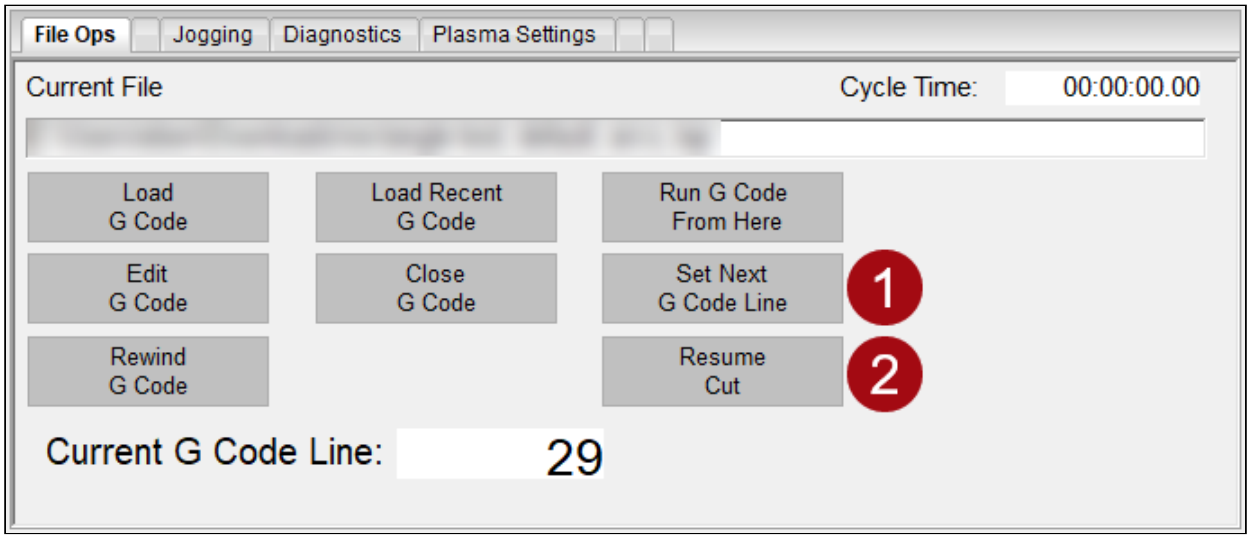
1. Check that the Axis Referenced LEDs next to the DRO are still green, indicating the machine is still referenced properly.



2. Re-enable the machine if necessary.
3. Make sure the G-Code and "Current G Code Line" is on the same G-Code line it stopped at (double click in the G-Code window to toggle line numbers). Click on the correct line if needed.



4. On the main File Ops tab, click the Set Next G Code Line button (1).



5. Click the Resume Cut button (2). This will issue a new cycle start command, turn on the torch, and resume movement once the controller receives an Arc OK signal from the torch.

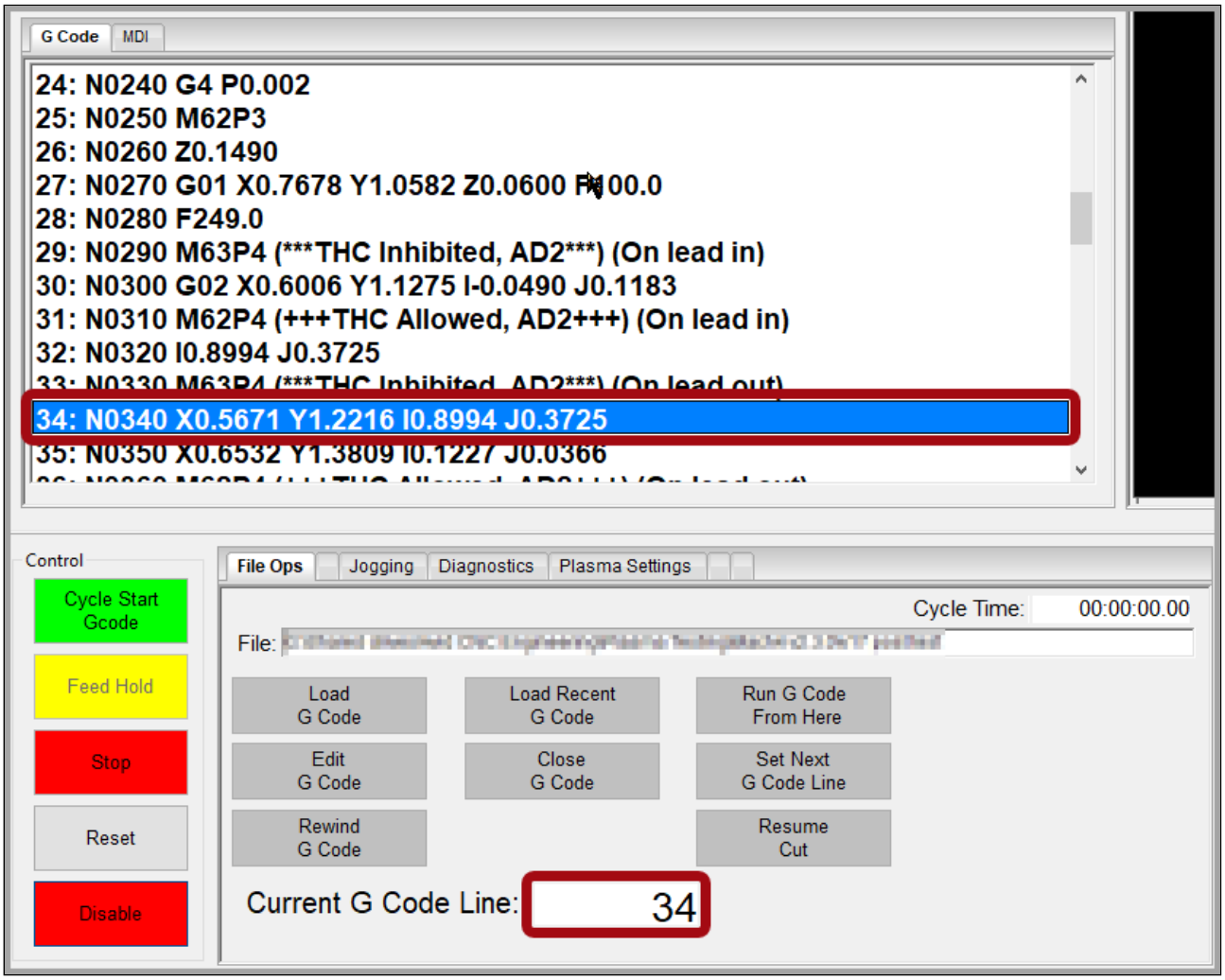
Restart Point

Note

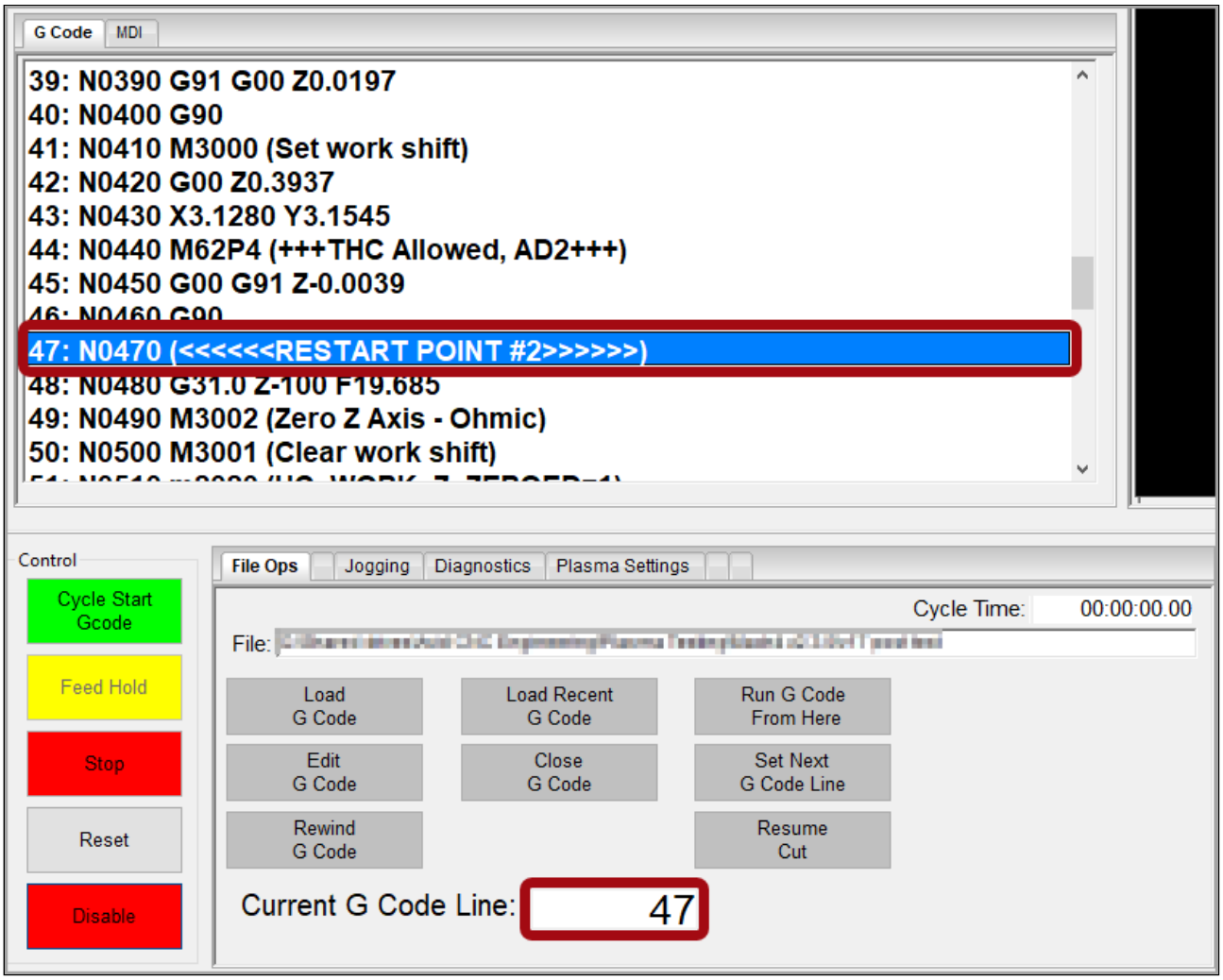
This method is only available with Mach4 for Avid CNC Machines v2.3.2+ and Avid CNC SheetCam post processor v1.7+ (released 9/14/2021). You can check your Mach4 version on the About tab (https://www.avidcnc.com/support/instructions/software/mach4Configuration/#7-about). If an upgrade is needed, go to the Mach4 for Avid CNC Machines (https://www.avidcnc.com/support/instructions/software/downloads/mach4) downloads page for the latest installer.

These steps are necessary if the program stops during a pierce sequence, or pierces but fails to continue. It can also be used at the next pierce location if the torch went out and Resume Cut didn't work.

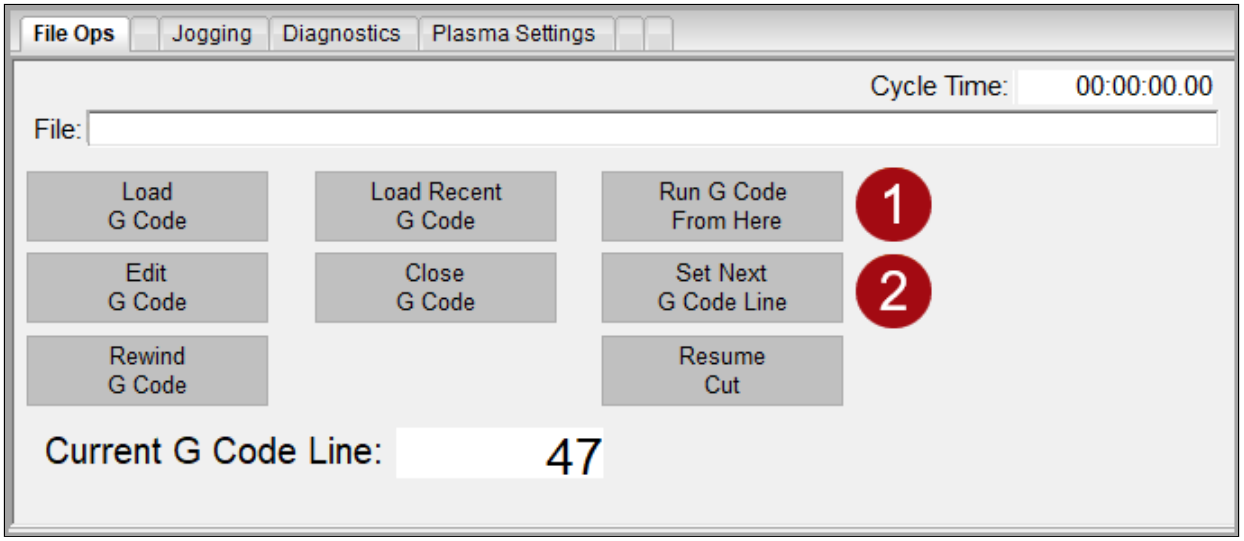
1. Note the line of G-Code that the program stopped at.



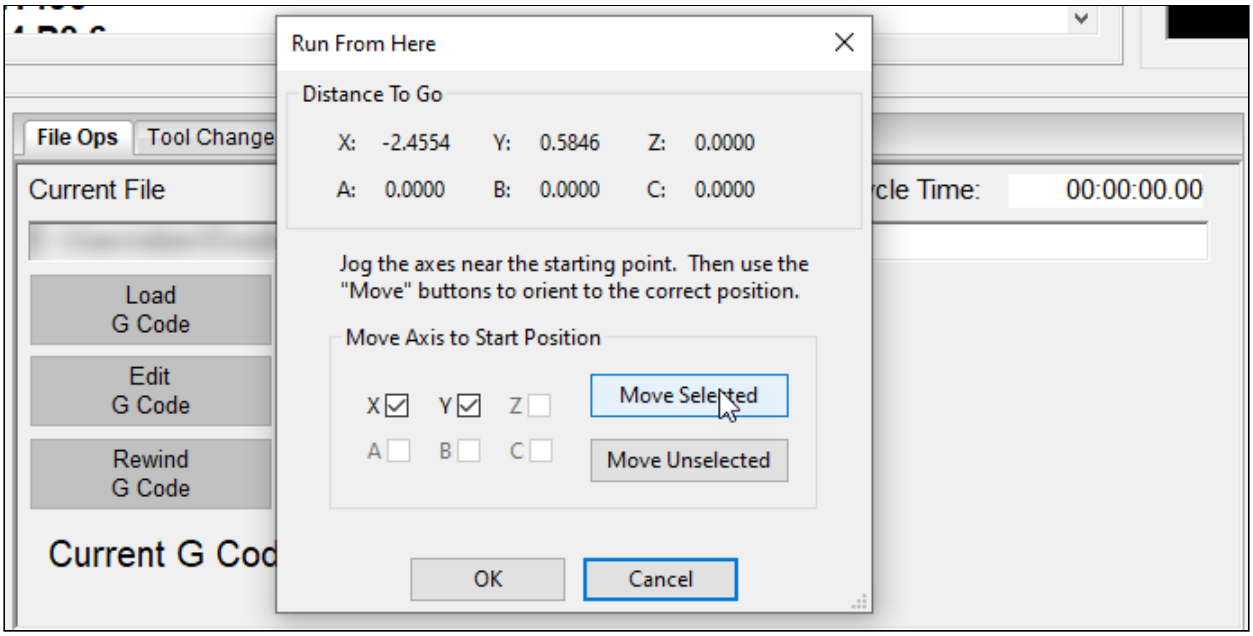
2. Look back through the G-Code to find the most recent <<<<<<RESTART POINT>>>>>> tag (or the next tag if Resume Cut failed and you need to skip a profile). A sample of G-Code output from SheetCam with the Avid CNC Mach4 post processor is below; the highlighted line is the proper place to restart a cut.



3. Select that line in the G-Code window in Mach4. Click the Set Next G Code Line button (1) and then the Run G-Code From Here button (2) in the File Ops tab.



4. Follow the instructions on the window shown to restart the G-Code. The G-Code should move the machine to the correct position and then use the Cycle Start button to restart that pierce sequence and cut.



5. If the original cut pierced through but did not move, restarting at the previous pierce may not work. In this case you can move the torch close to, but not exactly on (.050 off should be enough), the intended pierce position. This will give the torch fresh material to pierce.
6. In this case don't use the Run G Code From Here feature, only use the Set Next G-Code Line and Cycle Start buttons. This will pierce in the new location, completing the leadin and cut as intended.

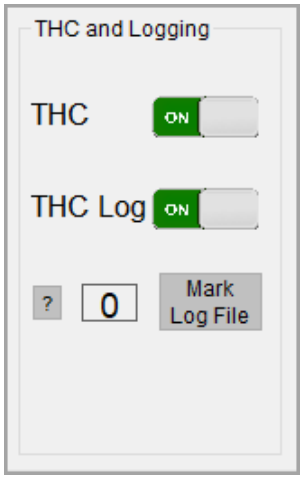
Logging and Diagnostics

Files for troubleshooting

If you have performance issues that cannot be resolved with the available settings, the following files can help with further troubleshooting:

1. SheetCam project file (.job extension)
2. G-code file (.tap or other text file equivalent)
3. THC log file (.thc extension). These will be saved by default in C:\Mach4Hobby\W9_HC
4. Mach4 log file (.log extension), saved wherever you choose.

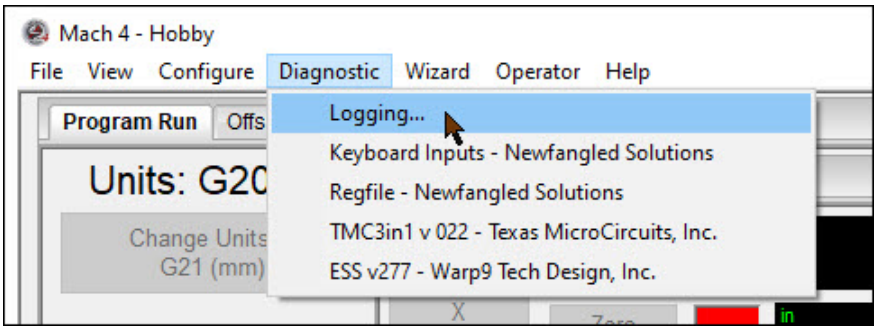
Recording a THC Log



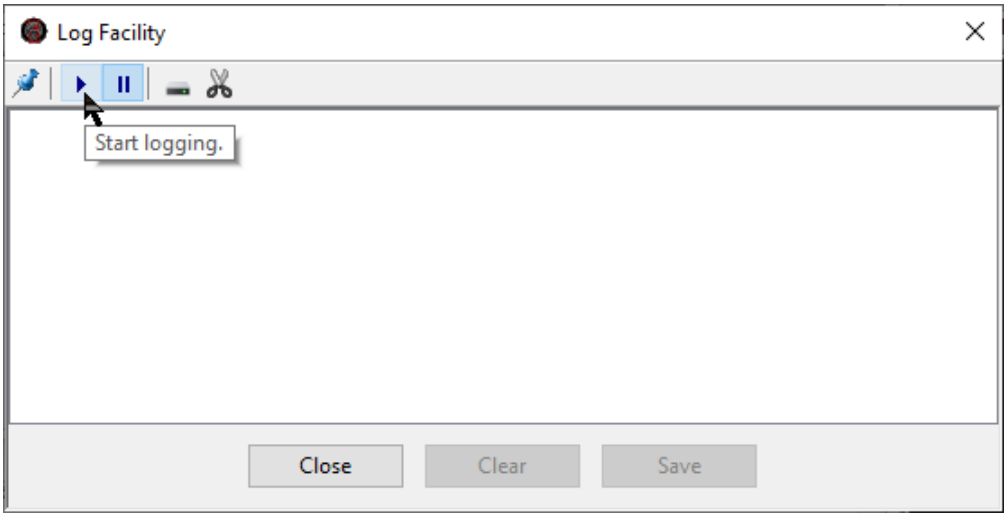
1. Make sure the THC Log toggle is ON.
2. Run the program that is experiencing issues.
3. Copy the log file. Log files are saved in C:\Mach4Hobby\W9_HC with a timestamp filename and a ﷽.thc﷽ extension.

Record Mach4 Diagnostic Log

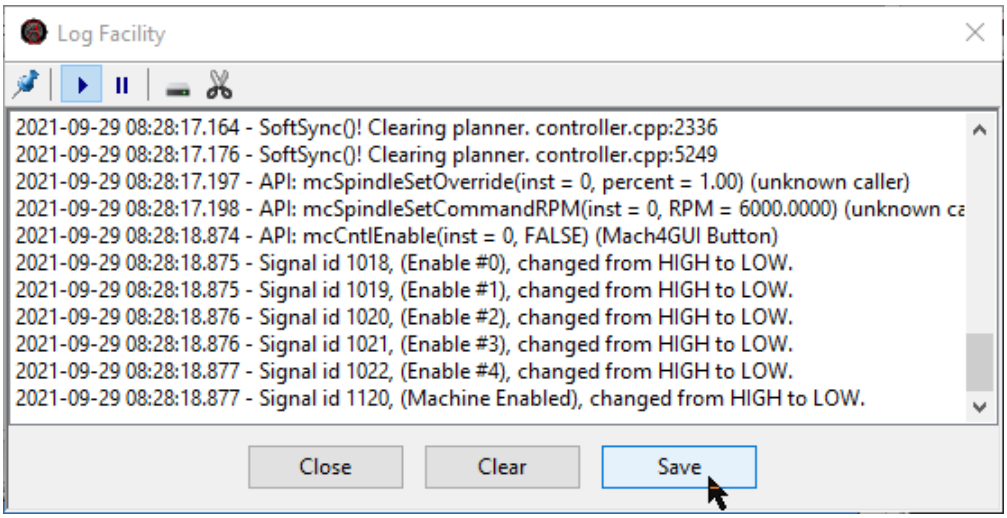
1. In Mach4 go to the **Diagnostic -> Logging** menu.



2. Click the Play button to start logging.



3. Click Save after capturing the relevant events to save the log as a text file. **Note:** Mach4 logs capture many events and can be very long. Try to focus the log on a specific event for easier diagnostics.



THC Log Analyser

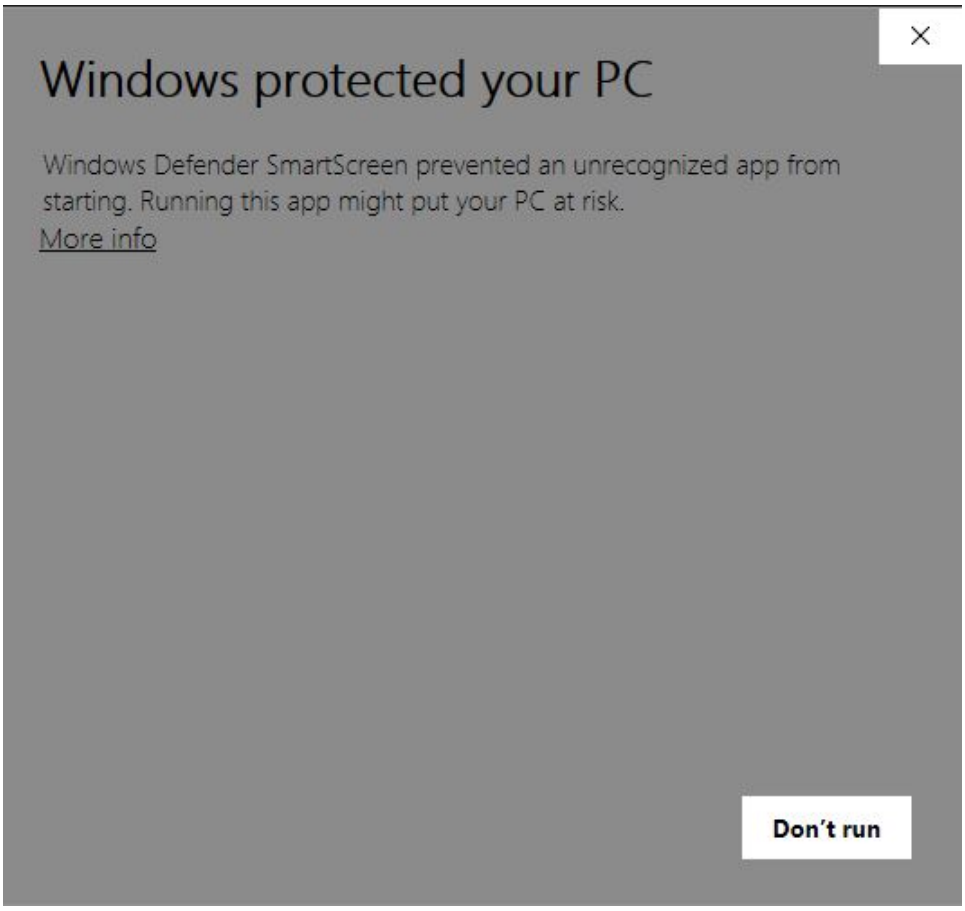
1. Log Analyser Installation

DOWNLOAD AND INSTALL .NET FRAMEWORK

- **.NET Framework** - Microsoft .NET Framework 2.0 is required for the THC Log Analyser to install properly. Please confirm you have .NET Framework 2.0 installed, or download and install .NET Framework 3.5 (which includes 2.0) from Microsoft: **https://www.microsoft.com/en-us/download/details.aspx?id=21**.

DOWNLOAD AND INSTALL THE THC LOG ANALYSER

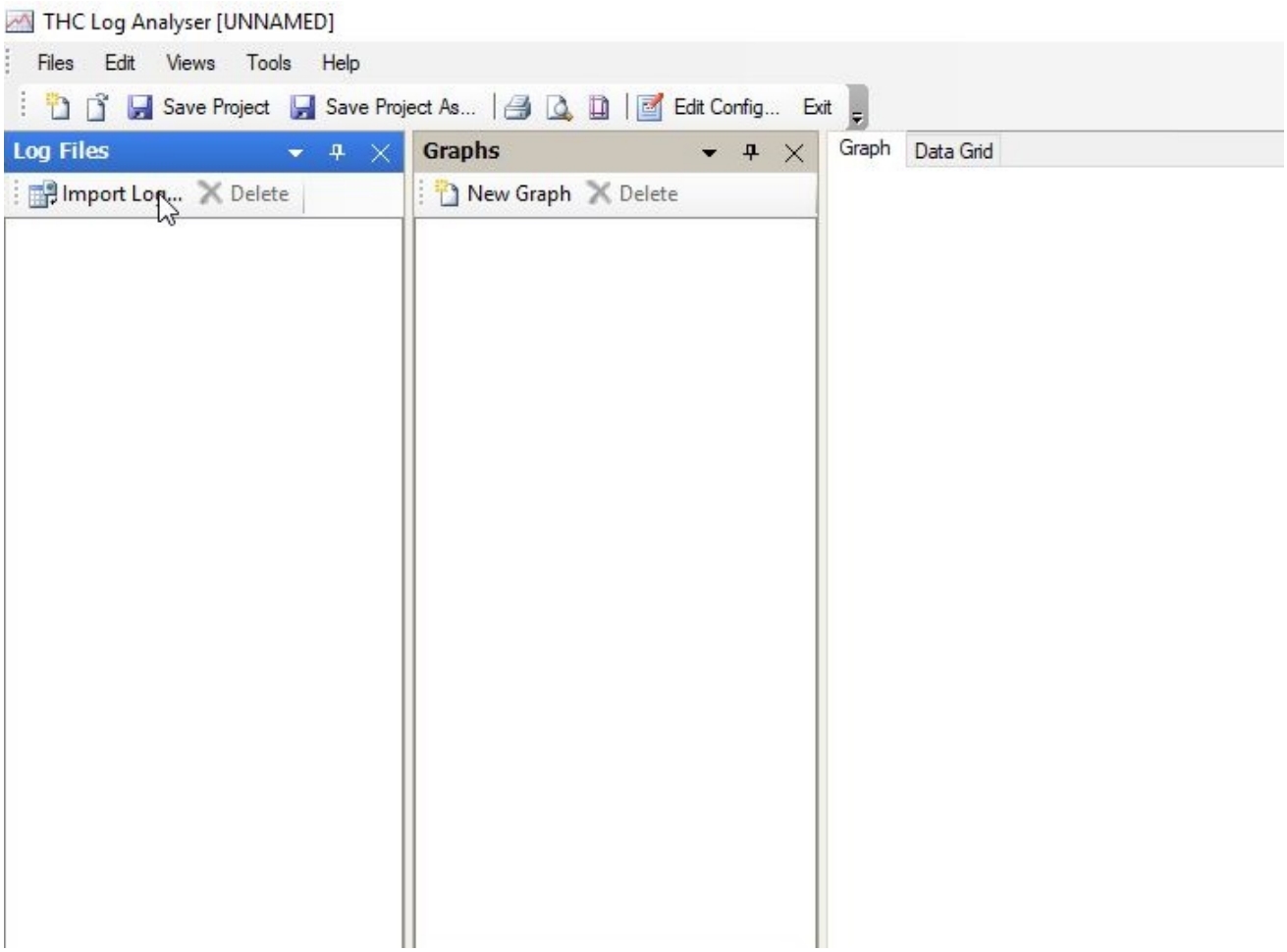
- **Download THC Log Analyser** - **Download the Log Analyser** from Avid CNC. (https://www.avidcnc.com/cdata/cad/2018Q2/THCLogAnalyser.msi)
- **Install THC Log Analyser** - Run the "THCLogAnalyzer.msi" you downloaded from the above link.



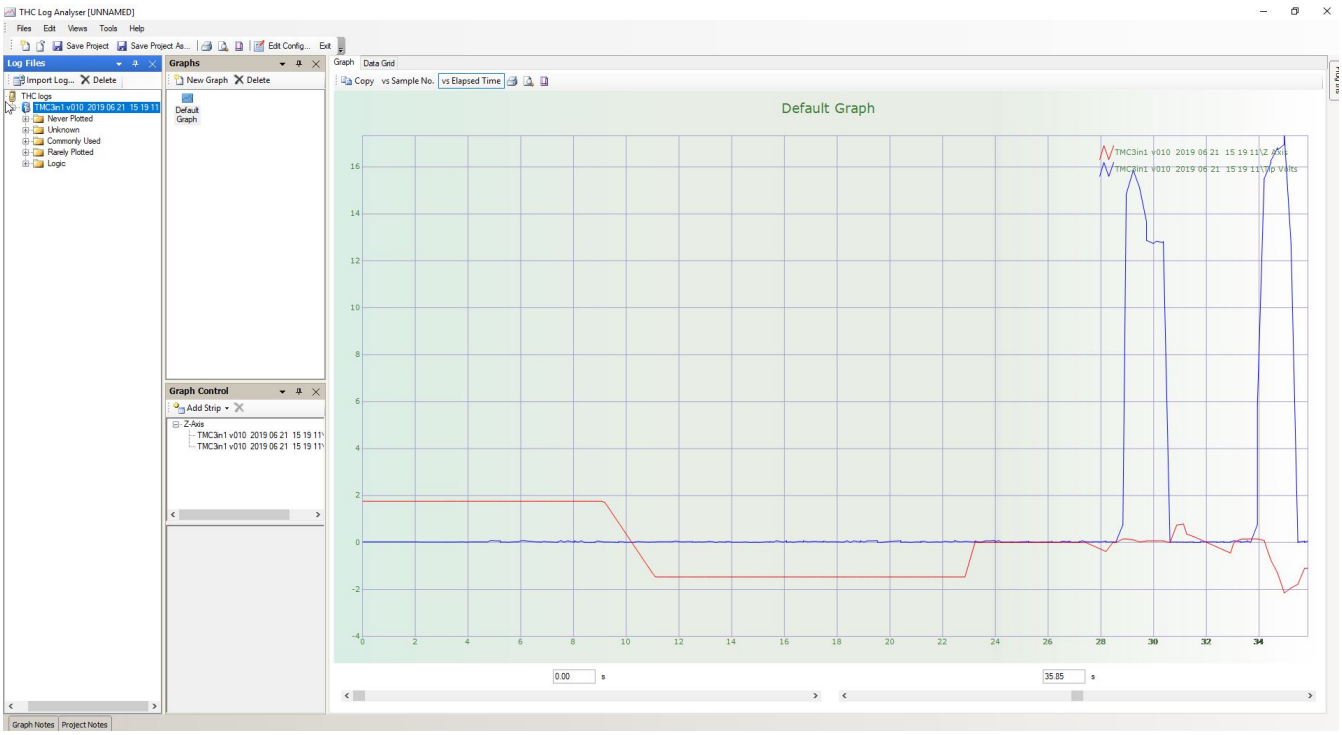
- You may see a Windows Defender alert display in some versions of Windows. Press "More Info" and then "Run Anyway" to run the Log Analyser Installer. Follow the on screen prompts to complete the installation.

2. Import Data into Log Analyser

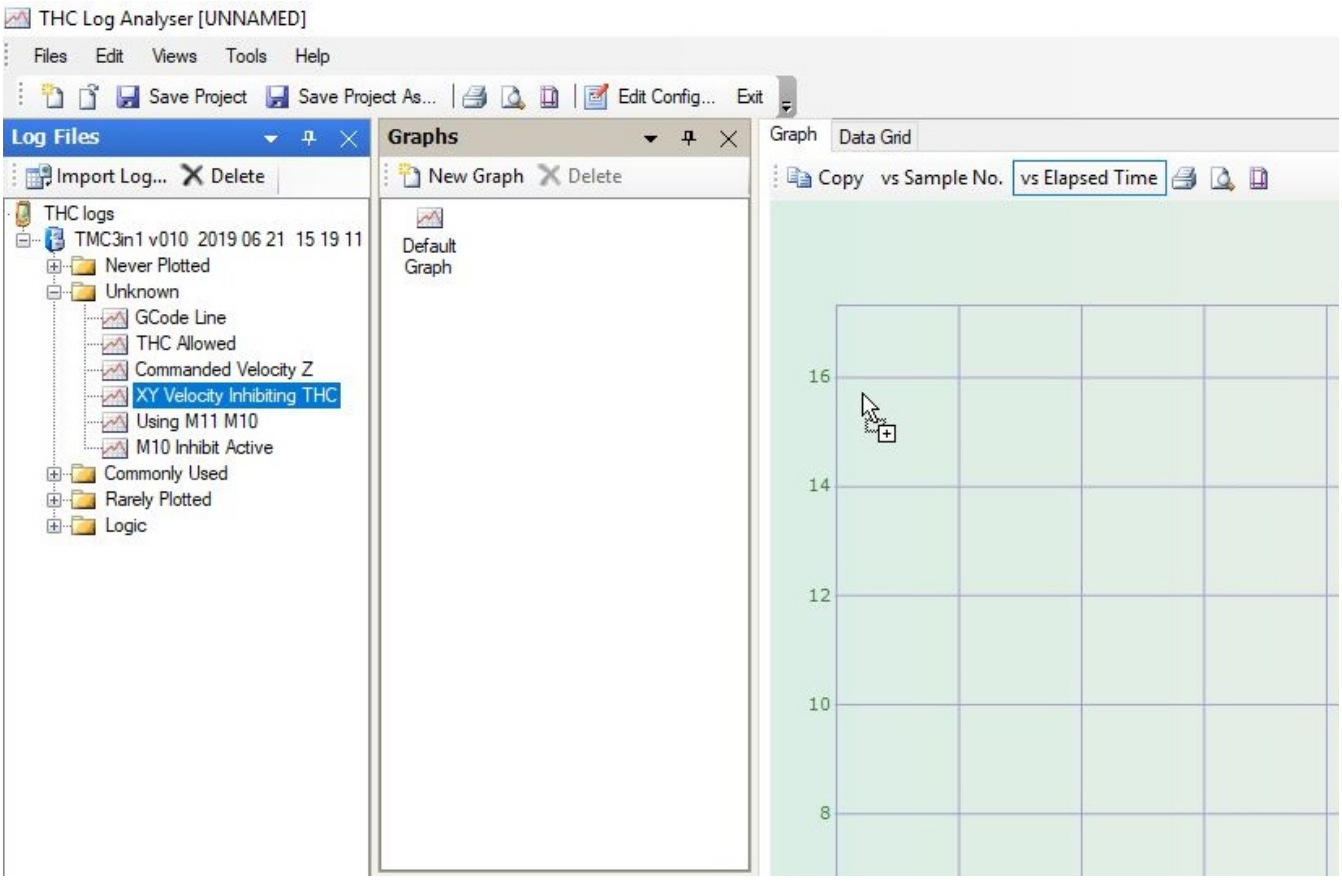
- **Open Log Analyser** - Open the windows start menu, search for "THC Log Analyser" and open the application.



- **Import Data** - Click the "Import Log" button and navigate to the log file which you collected earlier. The default location of the THC log files is C:\Mach4Hobby\W9_HC.

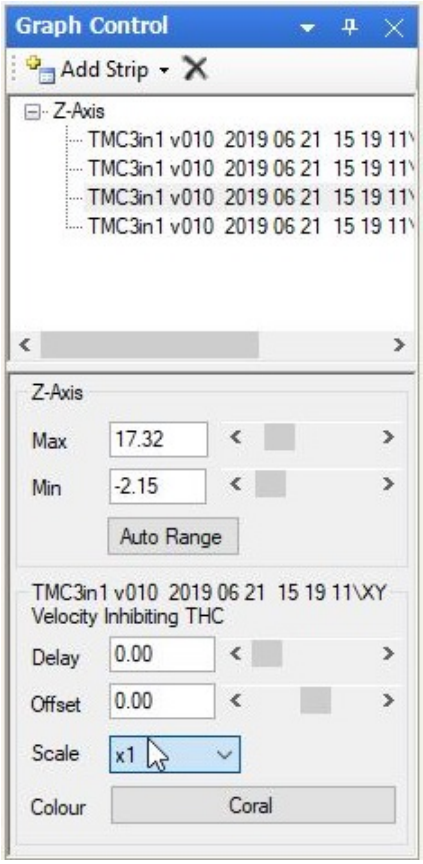


- **Default Graph** - By default the Tip Volts and Z Axis motion of the imported log file will be graphed on the right side of the application window.



- **Adding Log Data to the Graph** - Expanding the THC log menu on the left of the screen will display the different data which can plotted and compared. To plot specific data, select it on the left of the screen then click, drag, and drop the data onto the graph (right side of the screen).

- **Changing the Graph Scale** - The sliders at the bottom of the graph will change the time scale of the graph and the position of the graph along said time scale. Shorten the timescale (right slider) and scroll across the graph (left slider) to the point during the cut you wish to analyze.

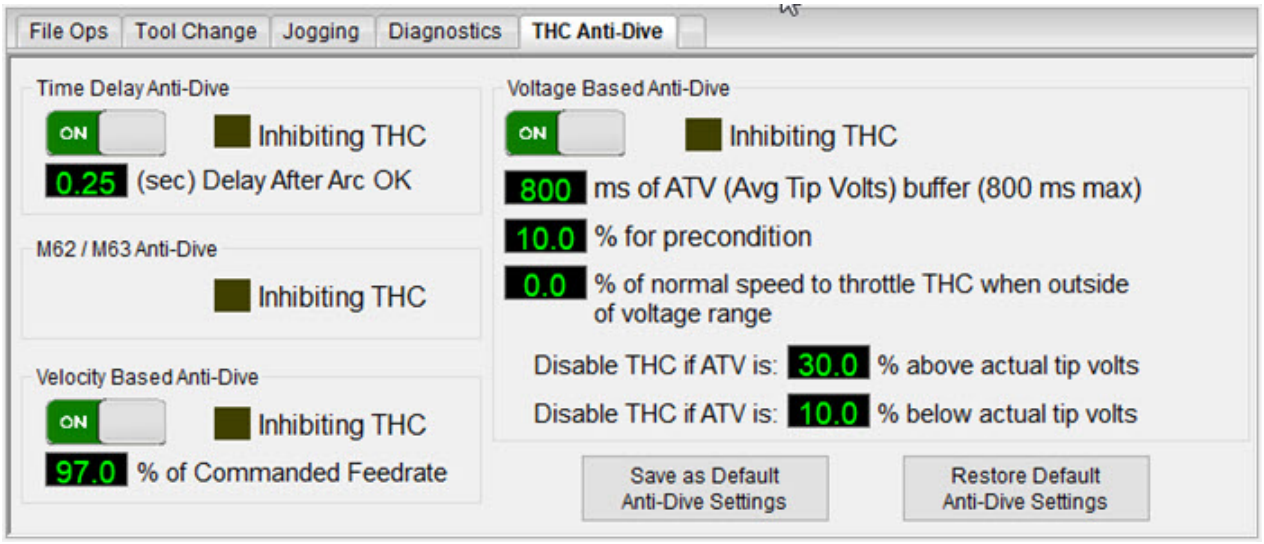


- **Scaling Log Data** - The Graph Control menu allows you to change the scale of individual data. The original scale of different data (Z axis height 0-8in, Tip volts 100-200V) can be altered (scale x10 or scale /10) to make them more easily comparable.

3. Example Data Analysis

Analyzing the Plotted Data - This data represents a single pierce and small circular cut.

- **M Code Anti-Dive** - The green line represents M-code based anti-dive and is shown inhibiting THC movement (green line goes up to 13 at 28.6 seconds) until 29.6 seconds (when the green line returns to 0). This represents the M62P3 and M63P3 lines in the g-code file which occur before the pierce movement and ends after the descend to cut height from pierce height.
- **Tip Volts** - The blue line represents the tip voltage. The tip voltage is very high during the pierce operation, this is normal. The tip voltage stabilizes near the target after the torch descends to cut height, torch height control then takes over and modulates Z-axis height to bring actual voltage in line with target voltage. The tip voltage then goes to 0 when the cut finishes.
- **XY Velocity Anti-Dive** - The yellow line represents XY velocity based anti-dive and is shown inhibiting THC movement after the torch descends to cut height but before the machine XY motion is up to speed during the cut feed. XY velocity anti-dive prevents THC motion directly after M Code based anti-dive goes to zero (yellow line spike at 29.8 seconds). Once the machine accelerates and achieves 97% cut feed velocity THC motion is allowed. At 30.4 seconds when the cut ends the machine decelerates and velocity drops below 97% commanded feed, THC motion is once again inhibited.
- **Z Axis Position** - The red line represents the Z axis position. At 28.8 seconds the Torch jumps to pierce height and then descends to cut height at 29.5 seconds. From 29.5 to 30.4 seconds the Z axis slowly increases in height, this mirrors the tip voltage (blue line) which increases steadily to achieve target voltage.



Adjusting the THC settings - The cut analyzed in the above example was successful, so the settings may not need adjustment. However, if an unsuccessful cut (crashed torch, low cut quality) is analyzed it may identify the fault with the THC settings causing the issue.

- **Torch Crash** - The cut may have ended with a torch crash due to a THC diving response, this can generally be avoided by increasing the sensitivity of the anti-dive settings. The anti-dive settings will be shown by the graph to not have inhibited THC motion during the crash. In Mach4 the anti-dive settings may be adjusted on the main screen under the THC Settings operations tab. Increasing the Time Delay after Arc OK, the % of commanded feedrate or decreasing the % change in ATV that activates voltage-based anti-dive may be appropriate depending on the situation. For more information on these anti-dive settings please see Mach4 Plasma Users Guide.
- **Poor Cut Quality** - The cut may have completed but failed to follow the material and achieve target voltage during the bulk of the operation, this can potentially cause a poor cut. The graph will show the anti-dive settings as inhibiting THC motion during most of or the entire cut. The solution to this issue is to decrease the sensitivity of the anti-dive settings. Decreasing the Time Delay after Arc OK, the % of commanded feedrate or increasing the % change in ATV that activates voltage-based anti-dive may be appropriate depending on the situation. For more information on these anti-dive settings please see Mach4 Plasma Users Guide.
- **Path Rules** - Another way cut issues may be addressed is to identify which part of the cut is causing the problem (using the log analyzer) and then create a "Cut Rule" in sheetcam which will inhibit or allow THC motion during this feature of the program using M code based anti-dive. For more information on SheetCam cut rules please see SheetCam Software Setup Guide.