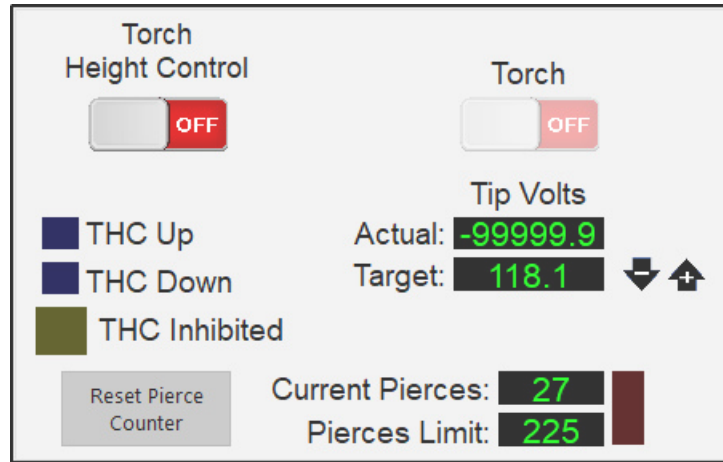




Mach4 Plasma Users Guide

Version 2020Q3.1

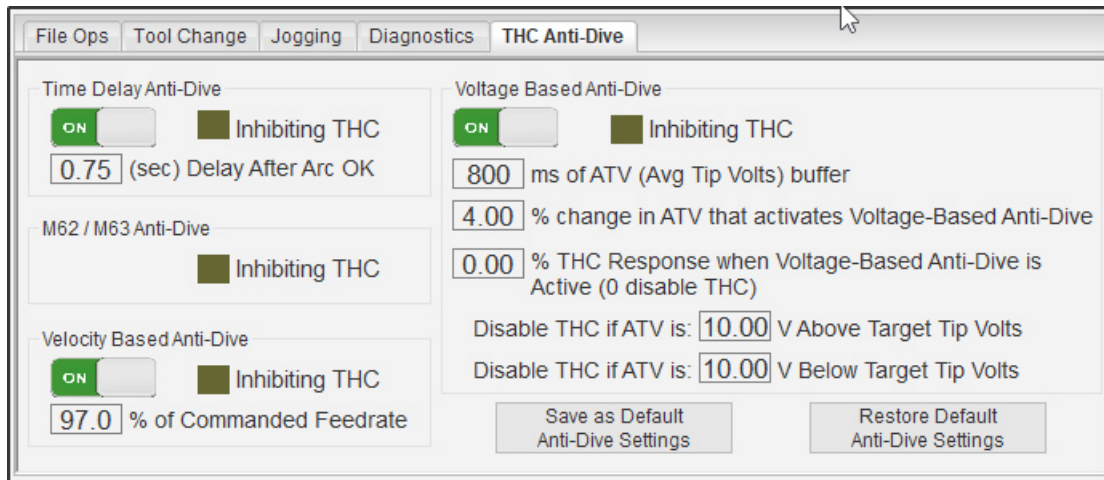
1. Main Screen Plasma Functions



- **Torch Height Control Toggle** - This switch will turn on or off all THC functionality (Z-axis height will be modulated by the Torch Height Controller to achieve the Target Voltage when toggle is "On").
- **Torch Toggle** - This switch will turn the torch on or off.
- **THC Up Indicator Light** - This indicator will be illuminated when the Torch Height Controller is commanding positive Z-axis motion.
- **THC Down Indicator Light** - This indicator will be illuminated when the Torch Height Controller is commanding negative Z-axis motion.
- **THC Inhibited Indicator Light** - This indicator will be illuminated when THC motion is currently being inhibited by one or more anti-dive settings.
- **Actual Tip Voltage** - This read out will display the current arc voltage during plasma cutting.
- **Target Tip Voltage** - This read out will display the target tip voltage manually set by the user or set by the G-Code program. This is the voltage THC motion will modulate Z-axis height to achieve. New target values may be typed into this box or adjusted with the "+" or "-" arrow.
- **Current Pierces** - This readout will display the number of "torch on" events that have been initiated since the count was last reset.
- **Pierces Limit** - This readout will display the desired pierce limit. When "Current Pierces" is equal to the "Pierces Limit" value the indicator light will be illuminated. New values may be typed into this box. The primary function of this limit is for consumable life tracking.
- **Reset Pierce Counter** - This button resets the Current Pierce count. When used for consumable life tracking this button should be pressed after a consumable change.



2. THC Anti-Dive Functions



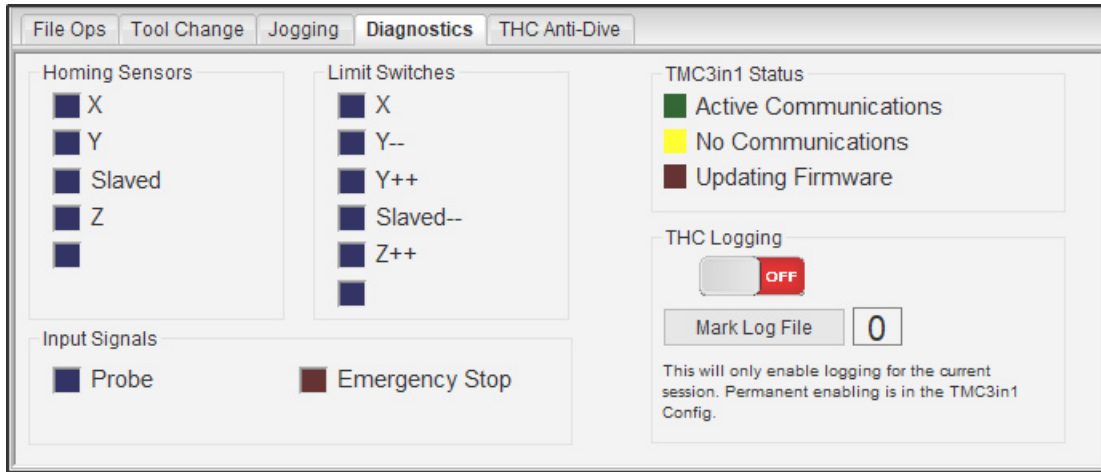
This menu can be accessed by selecting the "THC Anti-Dive" tab (bottom left of Mach4 interface). Anti-dive settings are used to handle exception cases during THC movement, i.e. cutting over voids, cutting into corners, leading out of interior profiles etc.

- **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 AvidCNC 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 actual voltage and target 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 volt rolling average calculation. 800 milliseconds is the maximum value. As this value is increased the number of recorded tip volt values which will be used for the rolling average is increased, which will make the average slower to respond to tip volt variation. 800 is the recommended setting. New values may be typed directly into this box.
- **% change in ATV that activates Voltage-Based Anti-Dive** - This value specifies the percent difference between the rolling average (ATV) voltage and the most recent actual tip voltage which will engage Voltage Based anti-dive. New values may be typed directly into this box.
- **% THC Response when Voltage-Based Anti-Dive is Active** - This value specifies the percent of full THC motion velocity allowed when Velocity Based anti-dive is inhibiting THC motion. Setting this value to 0 will disable THC motion when Voltage-Based anti-dive is active. The recommended setting is 0. New values may be typed directly into this box.
- **Disable THC if ATV is XXXX V Above Target Tip Volts** - This value specifies an upper limit for the difference between ATV and target tip voltage. If the rolling average voltage is greater than this value plus the target tip voltage the THC motion will be inhibited. New values may be typed directly into this box.
- **Disable THC if ATV is XXXX V Below Target Tip Volts** - This value specifies an lower limit for the difference between ATV and target tip voltage. If the rolling average voltage is less than the target tip voltage minus this value the THC motion will be inhibited. New values may be typed directly into this box.
- **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.



3. Logging and Diagnostics



This menu can be accessed by selecting the "Diagnostics" tab (bottom left of Mach4 interface). The indicator lights on the left are generic to the Mach4 Avid CNC screenset and are described in more detail in the Mach4 Users Guide.

TMC3in1 Status - The TMC3in1 is the hardware responsible for all Torch Height Control functionality. The indicator lights in this section will display the current status of the TMC3in1 hardware.

- **Active Communications** - This indicator will be illuminated when the TMC3in1 hardware and the TMC3in1 Mach4 plugin are communicating correctly.
- **No Communications** - This indicator will be illuminated when the TMC3in1 hardware is not currently communicating with the TMC3in1 Mach4 plugin. This will be the case when mach4 is in a Disabled state.
- **Updating Firmware** - This indicator will be illuminated when the TMC3in1 is going through a firmware update. While this indicator is on, the TMC3in1 cannot output THC movement commands and programs should not be executed.

THC Logging - The TMC3in1 plugin is capable of creating a CSV format log file which will record the status of the TMC3in1 hardware during cutting operations. This can be useful for diagnostics purposes if any issues arise. It can be challenging to interpret all variables present during cutting operations as the duration of the various anti-dive states and THC motion commands may be very short. This allows for analysis post operation, either with Excel type software or with the THC Log Analyzer software.

- **THC Logging Toggle** - This switch enables or disables logging functionality. When the logging is enabled, a new log file will be created when Mach4 is put into an "enabled" state. The file is completed and saved to the TMC3in1 folder (C:\Mach4Hobby\TMC3in1) when Mach4 is then put into the "disabled" state. In order to log a plasma operation it is recommended you turn THC Logging on, mark the log file, enable Mach4, and press cycle start. Then upon completion of the GCode program, mark the log file again and disable to save the log file.
- **Mark Log File Button** - This button creates a marker at the current time in the active log file (Mach4 must be in the "enabled state") which can help to locate the current cut or moment during a cut in an otherwise large log file.



4. 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 common scenarios that may require a plasma program to be resumed.

Scenario 1: 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). If an E-Stop caused lost position the restarted cut will not be correct.

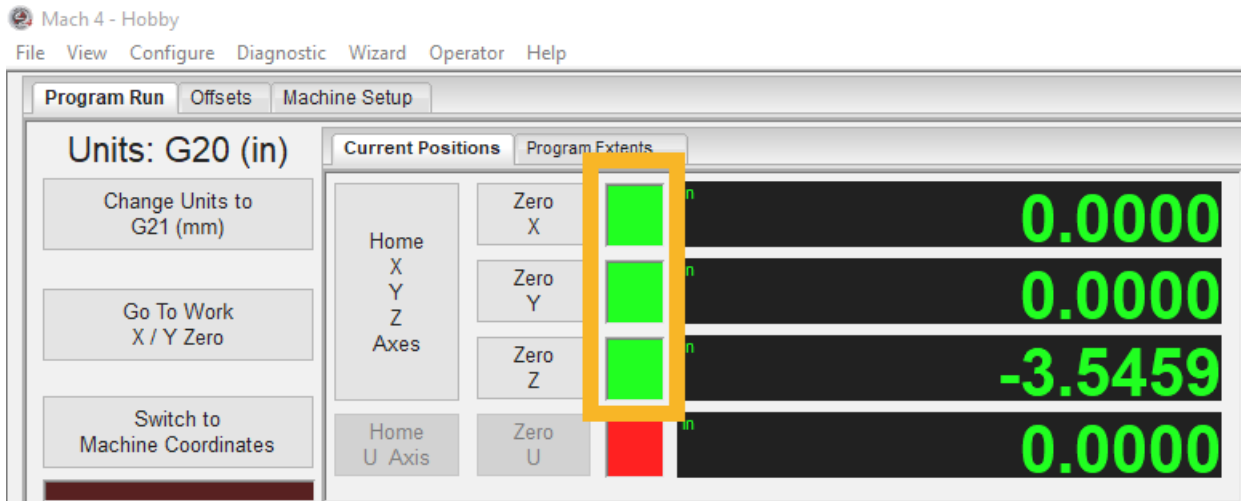
“Resume Cut” works well if there is enough metal at the restart location for the torch to establish an arc. If it stopped due to a void or re-cut line this may not work, and the most reliable way to continue will be at the next pierce location (see **Scenario 2**).

Scenario 2: The program stopped after a failed pierce or needs to be restarted at the next pierce. This typically means Mach4 never got an Arc OK signal and failed to start moving. It can also be used to resume a program after re-referencing the machine (due to an Estop).

Scenario 1 Instructions

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 next to the DRO are still green, indicating the machine is still referenced properly.

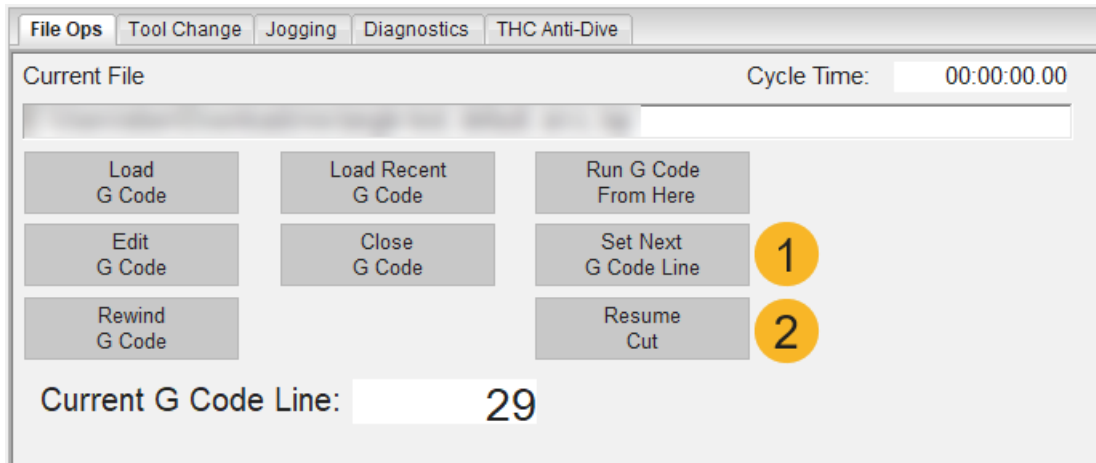


2. Re-enable the machine if necessary

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

The screenshot displays the Mach4 Plasma software interface. The top window, titled "G Code MDI", shows a list of G-code lines. Line 29, "N0290 Y3.7595", is highlighted in blue and has a yellow box around it. Below this window is the "Control" panel. On the left side of the control panel are five buttons: "Cycle Start Gcode" (green), "Feed Hold" (yellow), "Stop" (red), "Reset" (grey), and "Disable" (red). The main control area has tabs for "File Ops", "Tool Change", "Jogging", "Diagnostics", and "THC Anti-Dive". Below these tabs, there is a "Current File" field and a "Cycle Time" display showing "00:00:00.00". A grid of buttons includes "Load G Code", "Load Recent G Code", "Run G Code From Here", "Edit G Code", "Close G Code", "Set Next G Code Line", "Rewind G Code", and "Resume Cut". At the bottom of the control panel, the "Current G Code Line:" is displayed with a yellow box around the number "29".

- On the main File Ops tab, click the Set Next G Code Line.
- Click the Resume Cut button. 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.



Scenario 2 Instructions

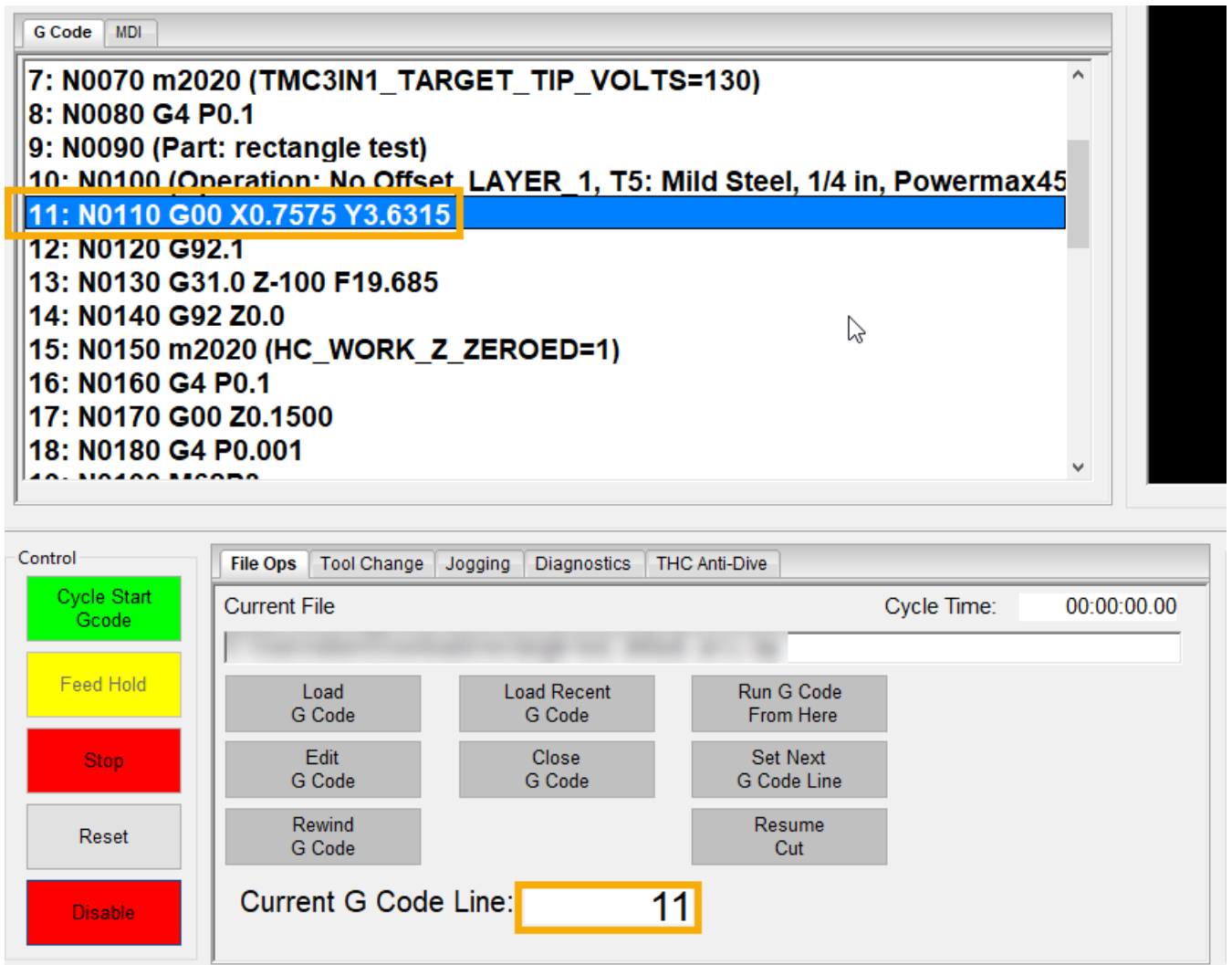
This method is necessary if the program stops during a pierce sequence, or pierces but fails to continue. It can also be used at the next pierce location if the torch went out and "Resume Cut" didn't work.

1. Note the line of g-code that the program stopped at.

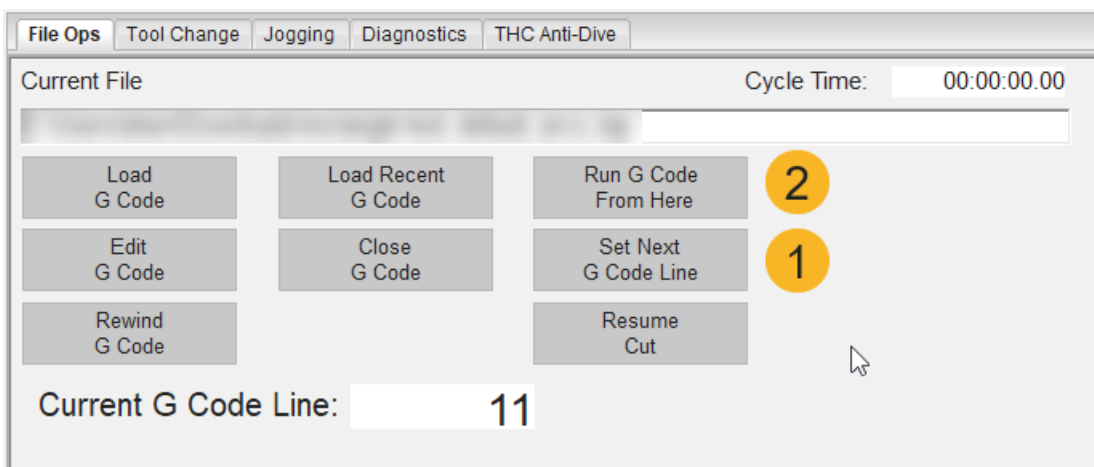
The screenshot displays the Mach4 CNC control software interface. The top window, titled "G Code", shows a list of G-code lines. Line 29, "N0290 Y3.7595", is highlighted in blue and has a yellow box around it. Below the G-code window is the "Control" panel, which includes several buttons: "Cycle Start Gcode" (green), "Feed Hold" (yellow), "Stop" (red), "Reset" (grey), and "Disable" (red). The "File Ops" tab is selected, showing a "Current File" field and a "Cycle Time" of 00:00:00.00. Below these are buttons for "Load G Code", "Load Recent G Code", "Run G Code From Here", "Edit G Code", "Close G Code", "Set Next G Code Line", "Rewind G Code", and "Resume Cut". At the bottom of the "File Ops" panel, the "Current G Code Line:" is displayed as 29, with a yellow box around the number.

2. Look back through the gcode to find the most recent pierce location (or the next pierce if "Resume Cut" failed). A sample of g-code output from SheetCam with the Avid CNC Mach4 post processor is below; the highlighted line moves the torch to that pierce location

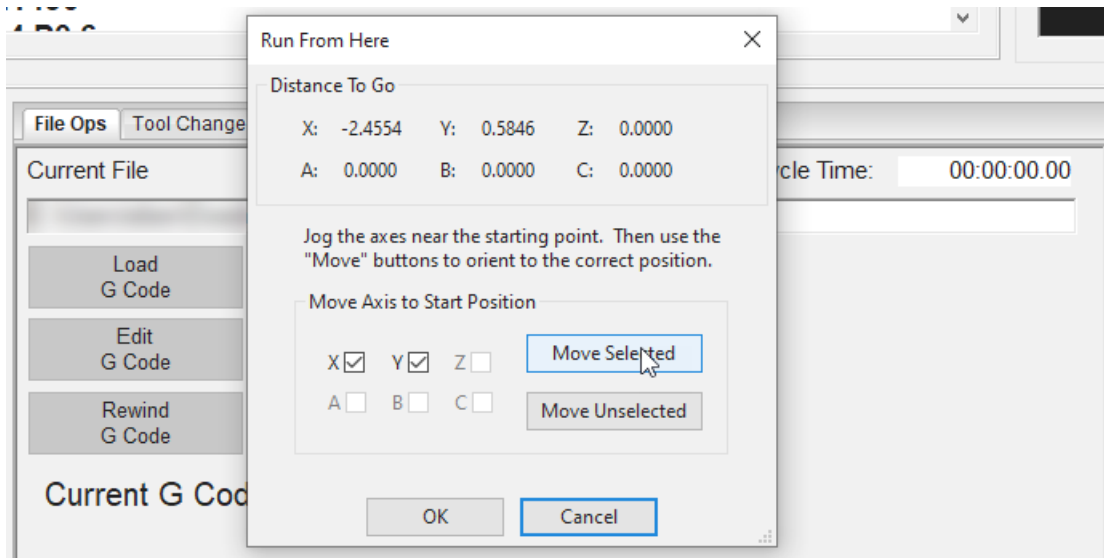
N0110 G00 X0.7575 Y3.6315	<i>-move to pierce location</i>
N0120 G92.1	<i>-clears existing G92 offsets</i>
N0130 G31.0 Z-100 F19.685	<i>-G31 is the probe move</i>
N0140 G92 Z0.0	<i>-the G92 Z offset value is set to 0</i>
N0150 m2020 (HC_WORK_Z_ZEROED=1)	
N0160 G4 P0.1	<i>-pause</i>
N0170 G00 Z0.1500	<i>-move to pierce height</i>
N0180 G4 P0.001	<i>-pause</i>
N0190 M62P3	<i>-torch ON command, to be executed after the next move</i>
N0200 Z0.1490	<i>-small move to execute the torch ON command</i>
N0210 G04 P0.6	<i>-pierce delay</i>
N0220 G01 Z0.0600 F100.0	<i>-move to cut height</i>
N0230 M63P4 (**THC Inhibited, AD2**)	<i>-THC inhibited for leadin</i>
N0240 G02 X0.8855 Y3.7595 I0.1280 J0.0000 F48.0	<i>-leadin move</i>
N0250 M62P4 (+++THC Allowed, AD2+++)	<i>-THC allowed after leadin</i>
N0260 G01 X1.5000	<i>-the actual cut proceeds from here</i>



3. Select that line in the G Code window in Mach4 and choose the Set Next G Code Line and then Run G Code From Here button in the File Ops tab



4. Follow the instructions that pop up to restart the g-code. The code should move the machine to the correct position and use Cycle Start to restart that pierce sequence and cut.



5. If the original cut pierced through but did not move, this 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, select the next line of code containing G92.1 and use Set Next G Code Line and Cycle Start. This will pierce in the new location and then complete the leadin and cut as intended.

The screenshot displays the Mach4 Plasma software interface. The top panel, titled "G Code", shows a list of G code lines. Line 12, "N0120 G92.1", is highlighted in blue and has a yellow box around it. The bottom panel, titled "Control", contains several buttons and a "Current G Code Line" field. The "Cycle Start Gcode" button is highlighted in green and has a yellow circle with the number "2" next to it. The "Set Next G Code Line" button is highlighted in yellow and has a yellow circle with the number "1" next to it. The "Current G Code Line" field is highlighted in yellow and contains the number "12".

G Code MDI

9: N0090 (Part: rectangle test)
10: N0100 (Operation: No Offset, LAYER_1, T5: Mild Steel, 1/4 in, Powermax45
11: N0110 G00 X0.7575 Y3.6315
12: N0120 G92.1
13: N0130 G31.0 Z-100 F19.685
14: N0140 G92 Z0.0
15: N0150 m2020 (HC_WORK_Z_ZEROED=1)
16: N0160 G4 P0.1
17: N0170 G00 Z0.1500
18: N0180 G4 P0.001
19: N0190 M62P3
20: N0200 Z0.1490
21: N0210 G00 Z0.0

Control

File Ops Tool Change Jogging Diagnostics THC Anti-Dive

Cycle Start Gcode 2

Feed Hold

Stop

Reset

Disable

Current File

Cycle Time: 00:00:00.00

Load G Code Load Recent G Code Run G Code From Here

Edit G Code Close G Code Set Next G Code Line 1

Rewind G Code Resume Cut

Current G Code Line: 12