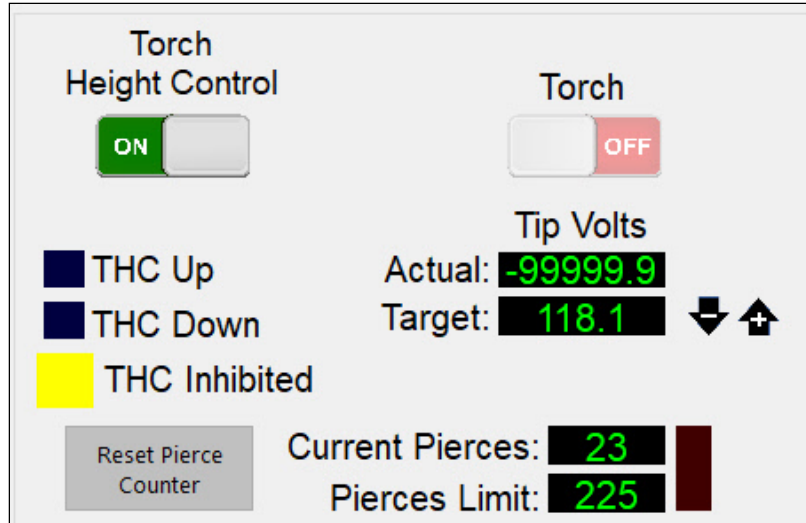# Mach4 Plasma Users Guide

v2020Q4.1

Mach4 Plasma Users Guide

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.

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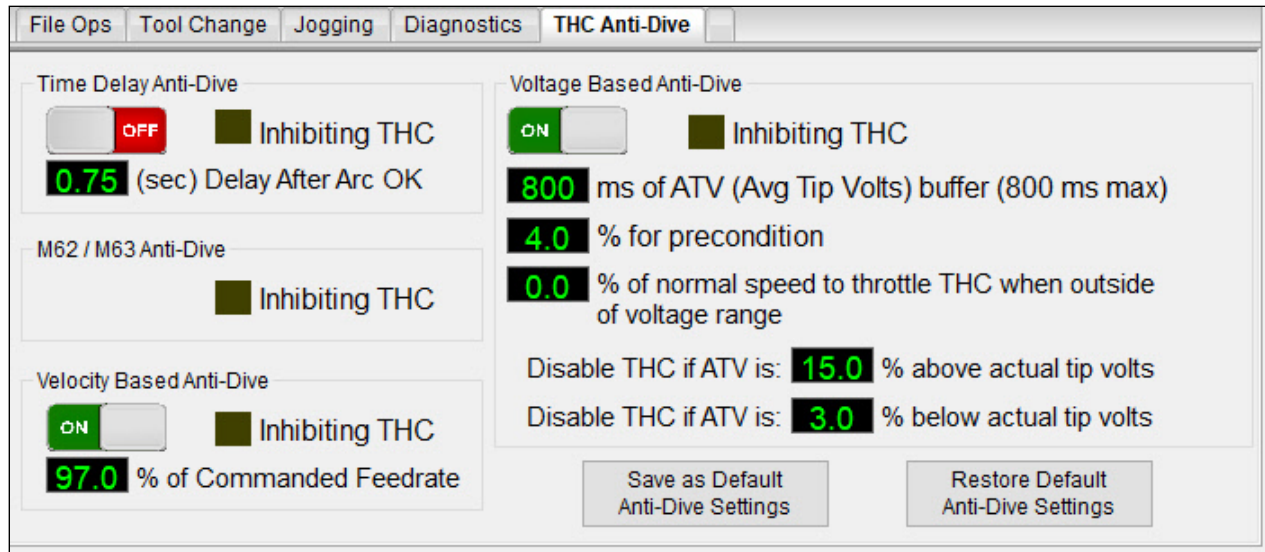
This menu can be accessed by selecting the **"THC Anti-Dive"** tab (bottom left of Mach4 interface). Anti-dive settings are used to handle exception cases during THC movement, i.e. cutting over voids, cutting into corners, leading out of interior profiles etc.

- **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 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.

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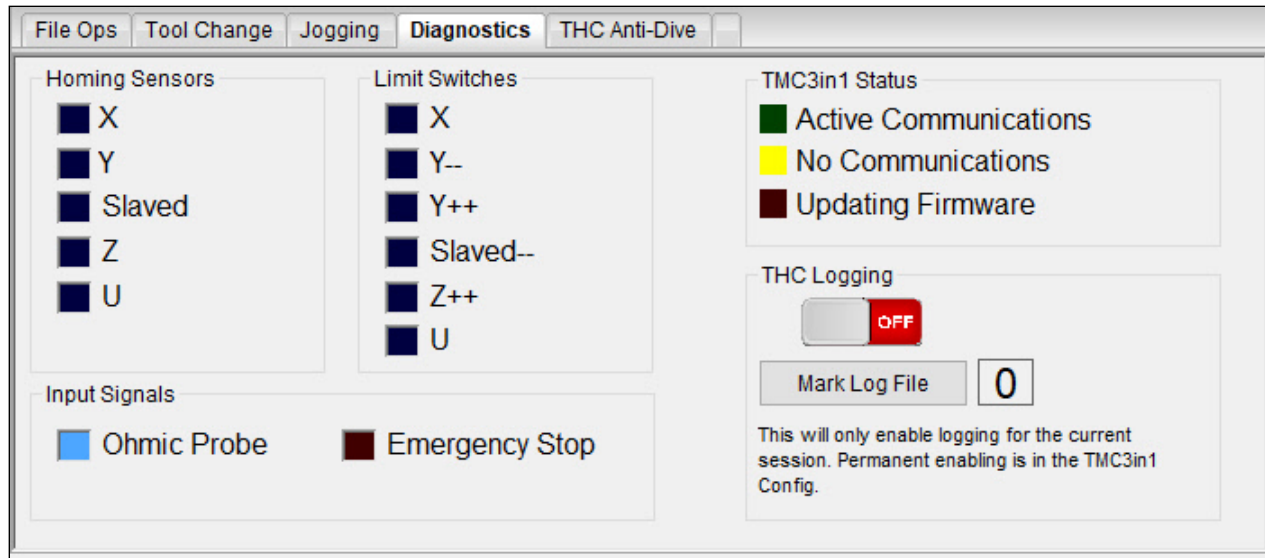
This menu can be accessed by selecting the **Diagnostics** tab (bottom left of Mach4 interface). The indicator lights on the left are generic to the Mach4 Avid CNC screenset and are described in more detail in the Mach4 Users Guide.

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 a G-Code program is run. In order to log a plasma operation, it is recommended to turn THC Logging on before pressing Cycle Start. When the program finishes, the log file is saved to the TMC3in1 folder (C:\Mach4Hobby\TMC3in1).

- **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.

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).
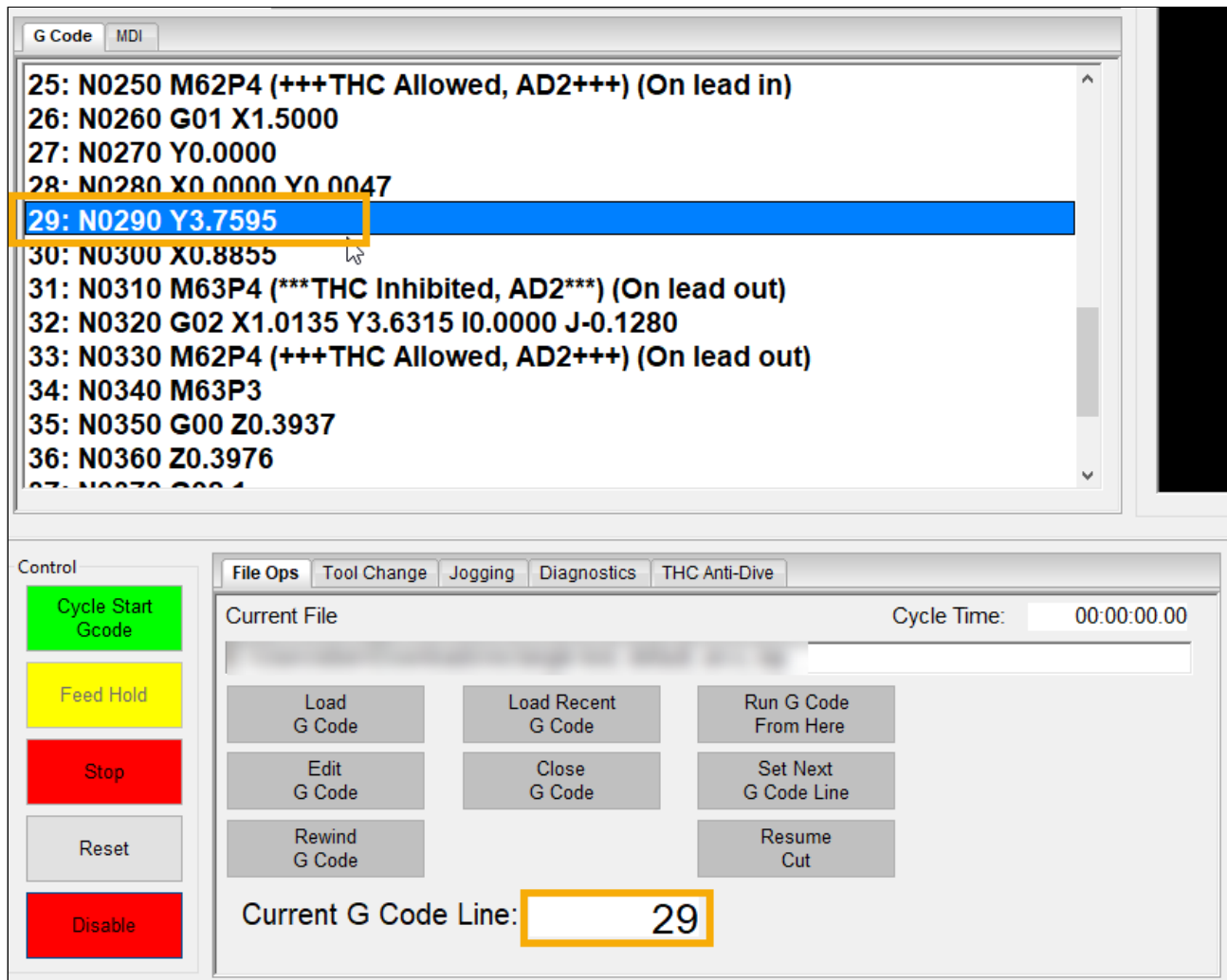
Scenario 1 Instructions

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.
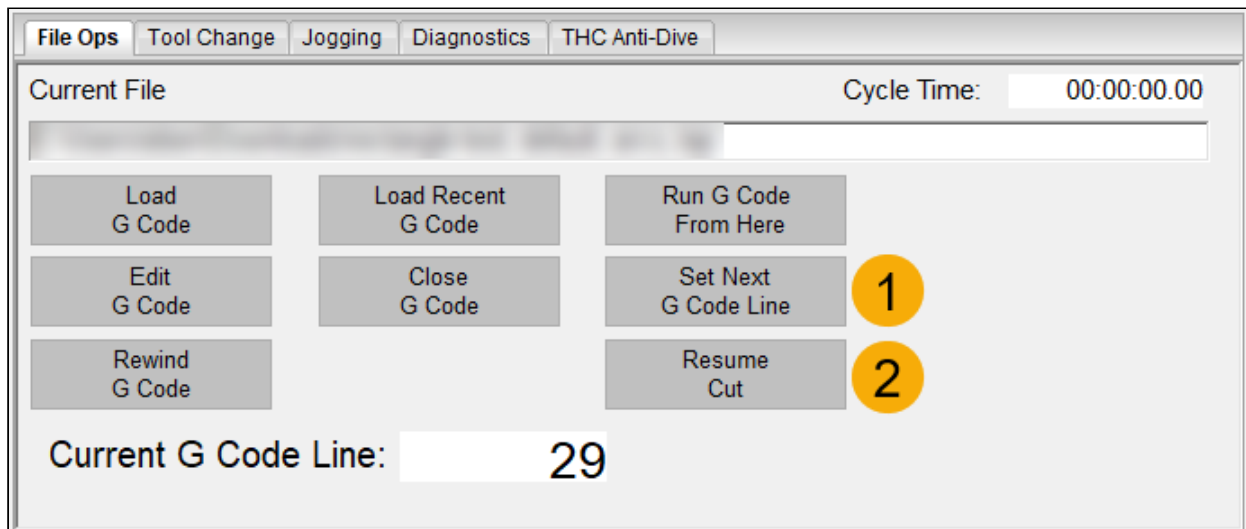
1. Check that the Axis Referenced LEDs next to the DRO are still green, indicating the machine is still referenced properly.
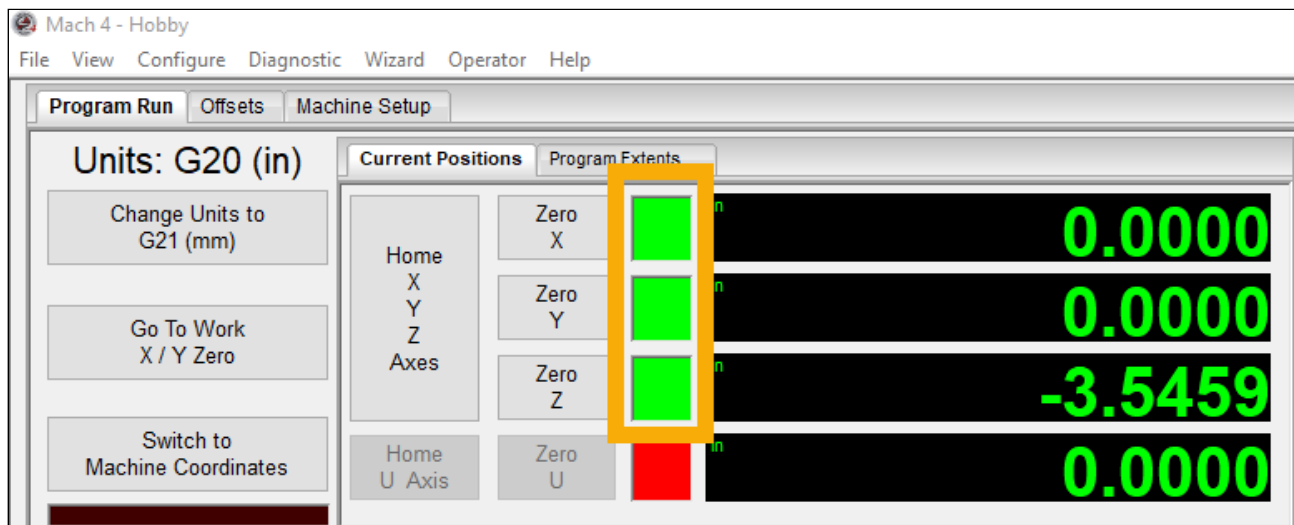
2. Re-enable the machine if necessary

3. Make sure the 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.

```
G Code   MDI

25: N0250 M62P4 (+++THC Allowed, AD2+++) (On lead in)
26: N0260 G01 X1.5000
27: N0270 Y0.0000
28: N0280 X0.0000 Y0.0047
29: N0290 Y3.7595
30: N0300 X0.8855
31: N0310 M63P4 (***THC Inhibited, AD2***) (On lead out)
32: N0320 G02 X1.0135 Y3.6315 I0.0000 J-0.1280
33: N0330 M62P4 (+++THC Allowed, AD2+++) (On lead out)
34: N0340 M63P3
35: N0350 G00 Z0.3937
36: N0360 Z0.3976
```

Control

| Cycle Start Gcode |
| Feed Hold |
| Stop |
| Reset |
| Disable |

File Ops | Tool Change | Jogging | Diagnostics | THC Anti-Dive

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
Rewind G Code | | Resume Cut

Current G Code Line: 29

4. On the main File Ops tab, click the Set Next G Code Line.

5. 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.

File Ops | Tool Change | Jogging | Diagnostics | THC Anti-Dive

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 (2)

Current G Code Line: 29

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.

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                          -move to pierce location

N0120 G92.1                                        -clears existing G92
                                                    offsets

N0130 G31.0 Z-100 F19.685                          -G31 is the probe move

N0140 G92 Z0.0                                     -the G92 Z offset value
                                                    is set to 0

N0150 m2020 (HC_WORK_Z_ZEROED=1)

N0160 G4 P0.1                                      -pause

N0170 G00 Z0.1500                                  -move to pierce height

N0180 G4 P0.001                                    -pause

N0190 M62P3                                        -torch ON command, to be
                                                    executed after the next
                                                    move

N0200 Z0.1490                                      -small move to execute
                                                    the torch ON command

N0210 G04 P0.6                                     -pierce delay

N0220 G01 Z0.0600 F100.0                           -move to cut height

N0230 M63P4 (***THC Inhibited, AD2***)             -THC inhibited for leadin

N0240 G02 X0.8855 Y3.7595 I0.1280 J0.0000 F48.0    -leadin move

N0250 M62P4 (+++THC Allowed, AD2+++)               -THC allowed after leadin

N0260 G01 X1.5000                                  -the actual cut proceeds
                                                    from here
```
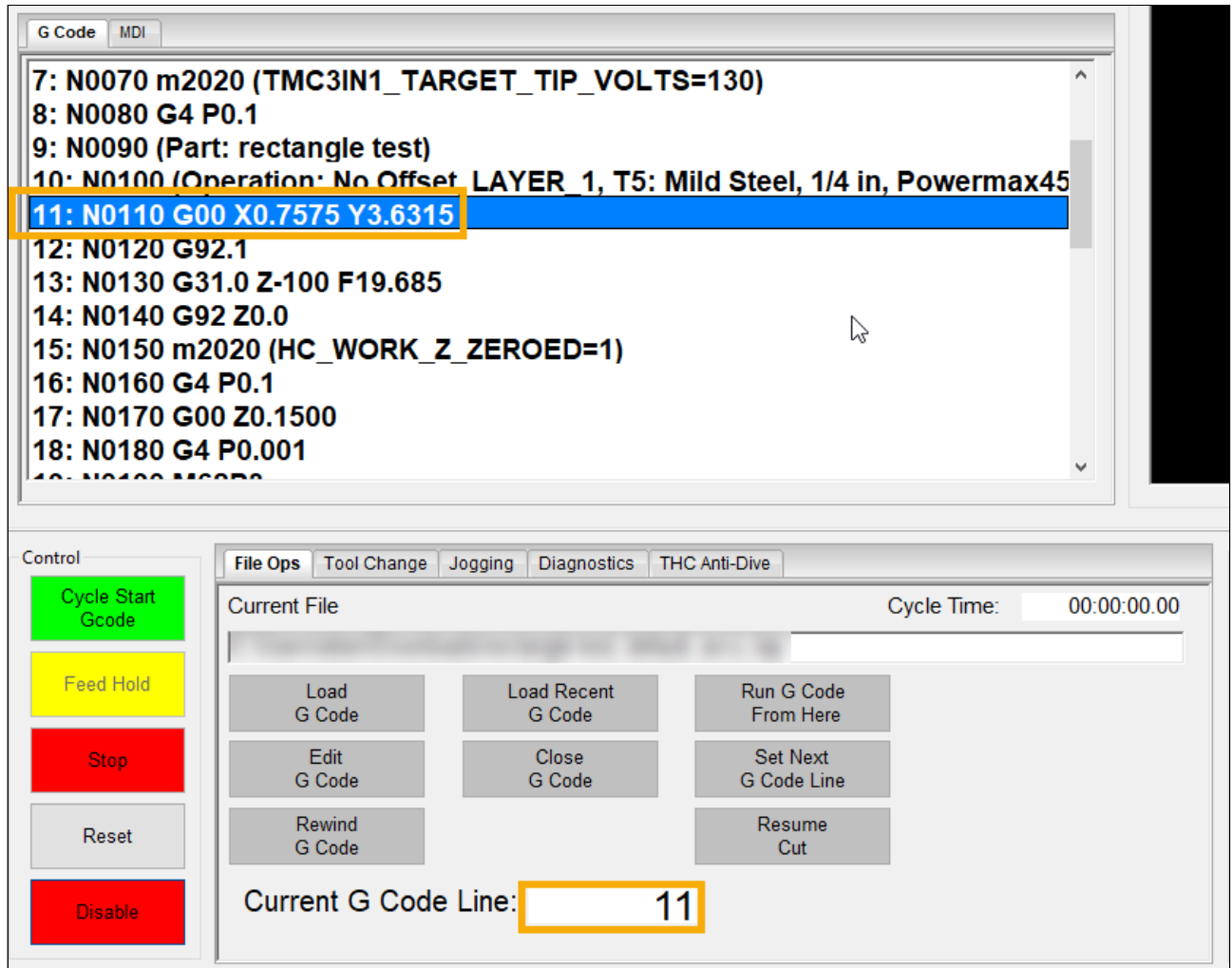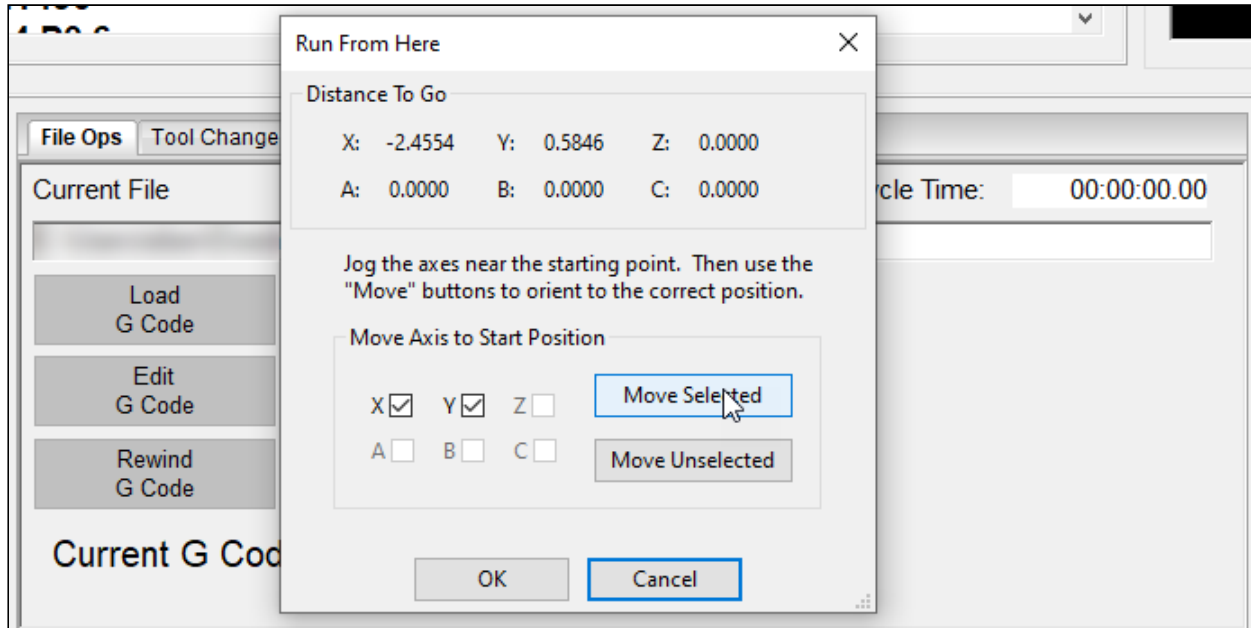
3. Select that line in the G Code window in Mach4 and choose the Set Next G Code Line and then Run G Code From Here button in the File Ops tab
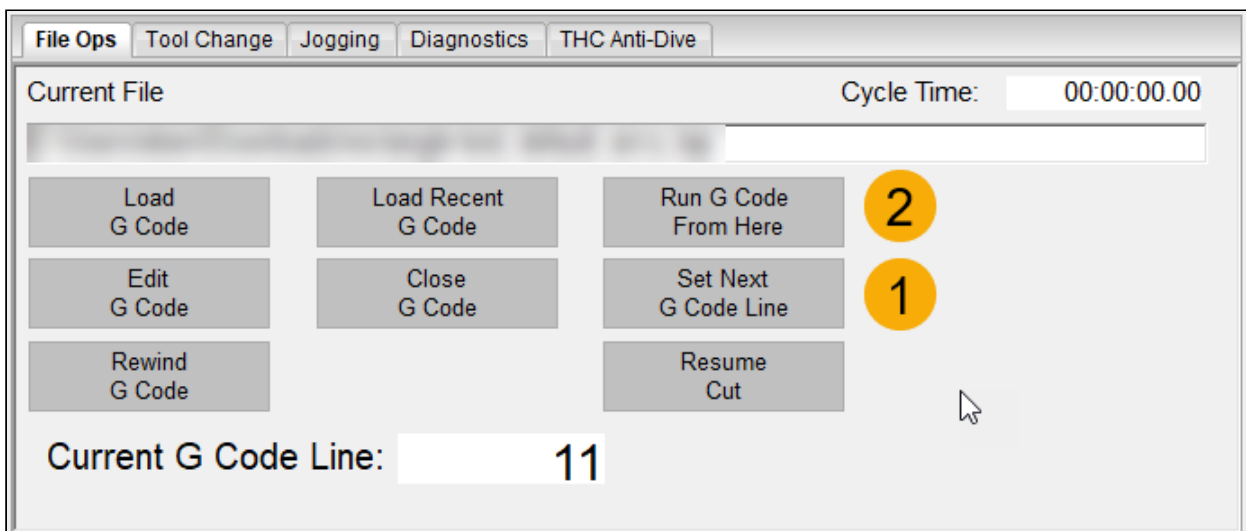
4. Follow the instructions that pop up to restart the g-code. The code should move the machine to the correct position and use Cycle Start to restart that pierce sequence and cut.

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.