Texas MicroCircuits (Sound Logic) Plasma Torch Height Controller

THC301 digital

Figure 1 - THC301d aktuális modell

Figure 2 - THC301d Front Panel az új Multi-Turn (10 fordulat) gombbal és az új szikrának ellenálló előlappal – rövidesen

Torch Height Control (Fej magasság szabályozás)

A plazmavágó gépek állandó áramú tápegységet használnak a vágáshoz. A tápegység áram tartománya 30 - 200 Amper (vagy több) lehet, melyet a plazmavágó vezérlőpanelén választunk ki. Egy állandó áramú táp az áramot a beállított értéken tartja a vágó feszültség változtatásával, ahogy a terhelés változik. A terhelés változik, ahogy a távolság a vágófej és a vágás alatt lévő fém között változik. A THC301d magasság szabályozó monitorozza ezt a feszültséget és változtatja a fej magasságát, hogy a vágó feszültség +/- 0.5V-on belül maradjon a beállított feszültséghez képest.

Cut Height (Vágó magasság)

A Vágó magasság a fej csúcsa és a vágás alatt lévő fém teteje közti távolság.

Pierce Height (Szúró magasság)

A szúró magasság körülbelül kétszerese a Vágó magaságnak. Ez segít megakadályozni a visszafújást, ami károsítaná a fúvókát a fém "átszúrása" közben.

Tip Volts or Arc Volts (Csúcs feszültség vagy Ív feszültség)

A Csúcs feszültség vagy Ív feszültség az a feszültség amit a fej csúcsa és a vágott fém között mérünk. Ez a feszültség 0 - 255 V DC tartományban lehet. Speciális esetben a THC301d kalibrálható egészen 512V DC-ig.

Set Volts (Beállított feszültség)

A Beállított feszültség a "cél" feszültség, amit szeretnénk, hogy a THC tartson vágás közben és értéke változtatható a THC301d előlapján.

Resolution (Felbontás)
A THC301d + / - 0,5V-on belül fogja tartani az Ív feszültséget a beállított érték körül (target).

Anti-Dive (Bemerülés védelem)
Az automatikus bemerülés védelemmel a THC301d megakadályozza, hogy a fej a vágás alatt lévő fémhez közelítsen amikor korábban vágott területeket keresztez, vagy körök és ívek vágása végén.

Control Program (Vezérlő program)
A THC301d a Mach3 vezérlő programhoz készült. A vezérelt tengelyek az X,Y,Z, és A az LPT1-ről kapják a vezérlést, a THC301 az LPT2-ről.

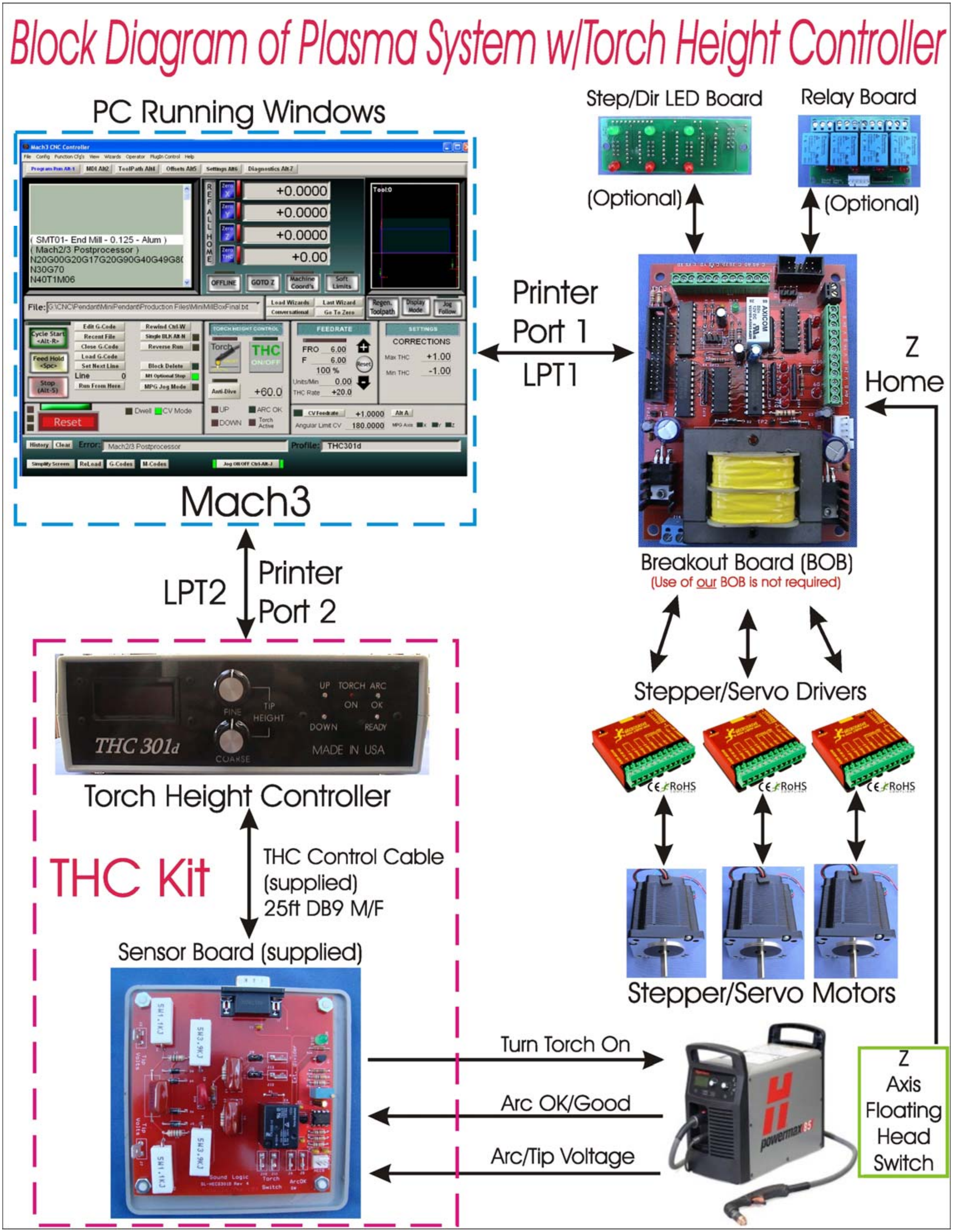

Figure 3 - THC System Block Diagram

THC301d System Requirements and Preferences

Mach3 - Required

The THC301d **is not a standalone** Torch Height Controller.
At the present, it requires Mach3 as the control program.
A special Plasma screen set is supplied as an **install program** from the Texas MicroCircuits website.

Second Parallel Port - Required

The THC301d is connected to a second parallel port on the PC. If your PC does not have a second parallel (printer) port, they can be purchased from many places (including eBay) for less than US20.00. Mach3 supports the second parallel port and uses it to control the THC301d.

Floating Head Z Axis Switch for Touch-Off – Preferred

At the present, most THC301d users have what is called a "floating head" on their Z axis that holds the torch. This Floating Head mechanism provides slide movement of 1 inch or less between the Z axis and the Torch. A switch is connected such that it activates at the top end of the floating head movement. This switch is configured in Mach and is used to automatically "touch-off" the torch and set it at the preferred height for piercing and cutting the metal.

Though not required, as the torch can be manually set above the metal for piercing and when the arc is established, the THC will take over operations, it is very much a time saver and automates the piercing especially when the metal is not perfectly flat and piercing distance in different areas is not consistent.

Most users build their own floating heads and there are many references to this on cnc plasma forums on the web. Texas MicroCircuits may sell a floating head unit kit in the near future.

Another type of "touch-off" mechanism that is being tested is a "harsh environment" contact touch-off device. The current design we are testing has proven to work well and even works when the metal is under water to prevent plasma dust and smoke. Check with our website for progress and availability of this device.

Misconceptions of Requirements for use of the THC301d

Use of the THC301d is **not** dependant on:

- Use of our THC Breakout Board (THCBOB). We provide this breakout board as a convenience for those that are converting or upgrading the electronics on their plasma gantry.

- Use of any special electronics or motors to drive you gantry as long as they can be controlled by the Mach3 control program.

- An "Arc OK" or "Arc Good" signal from your plasma cutter. If your plasma cutter does not provide this signal (many "hand torch only" systems do not), we provide a Hall Effect Current Sensor module that clamps around the ground or "work cable" and then plugs into our Sensor Board to provide this signal.

- If you plasma machine provides a "divider circuit" that reduces the arc voltage by some ratio, the THC301d can be calibrated to accept this divided ratio for Tip Voltage. See our User Guide on the Texas MicroCircuits website for more information.

Block Diagram and Overview of the THC Sensor Board

The supplied THC301d Sensor Board is the main connection interface between the THC301d and the plasma cutter. It basically provides communication interface for the following signals:

- Conditioning the Tip Volts and relaying that information to the THC301d during operation

- Conditioning either the Arc OK or Arc Good signal from the plasma cutter or detecting and conditioning the “Arc OK” from sensing the cutting current via the HECS sensor.

- Providing the conditioned signal to turn the torch ON.

- Physical mounting of the THC301d Sensor Board is usually close (or inside) the plasma cutter. A 25ft male-female 9 pin “serial” cable is provided for communication between the THC301d and the Sensor Board.

Below is a block diagram of the THC301d Sensor Board

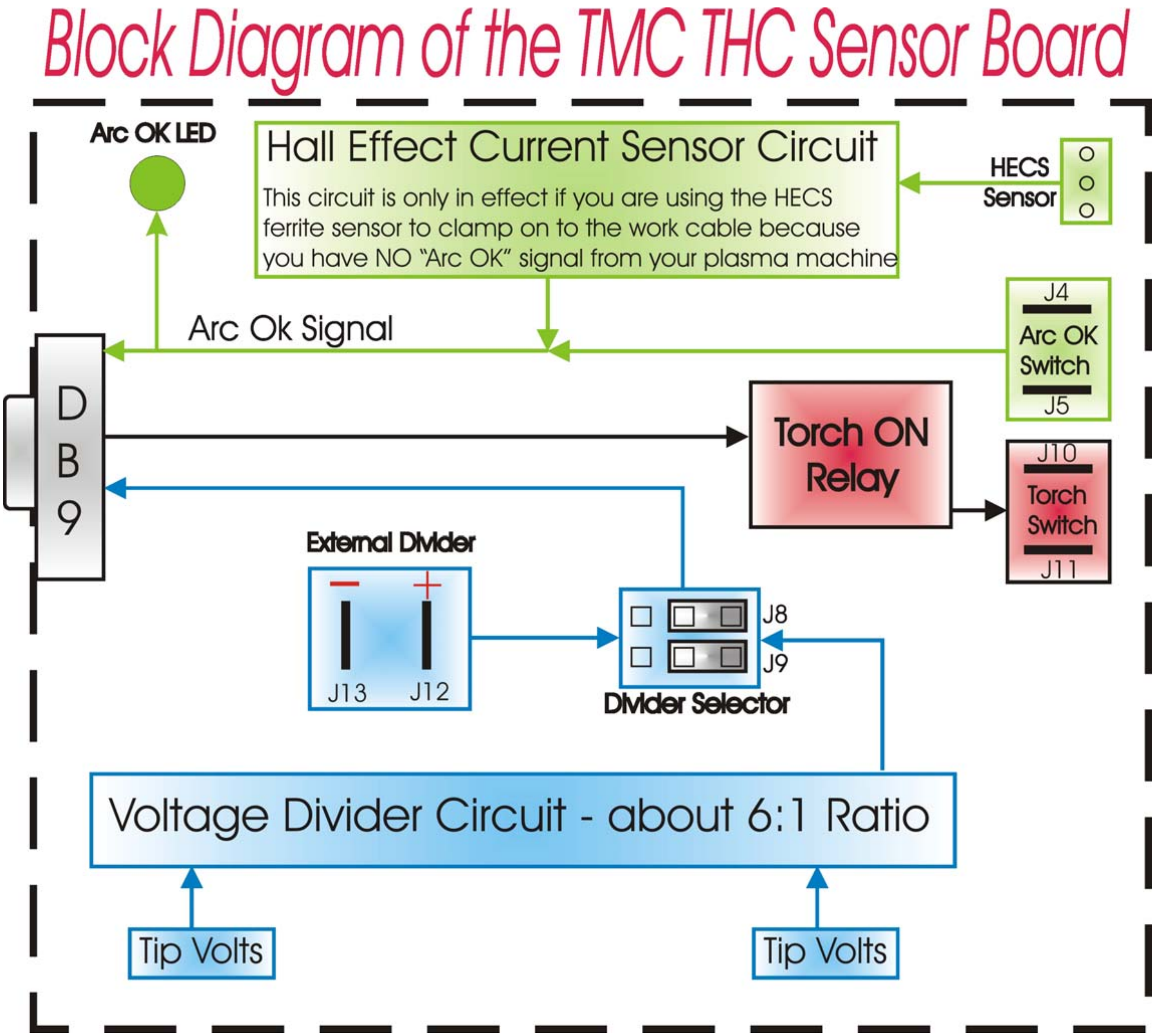

Figure 4 - Block Diagram THC Sensor Board

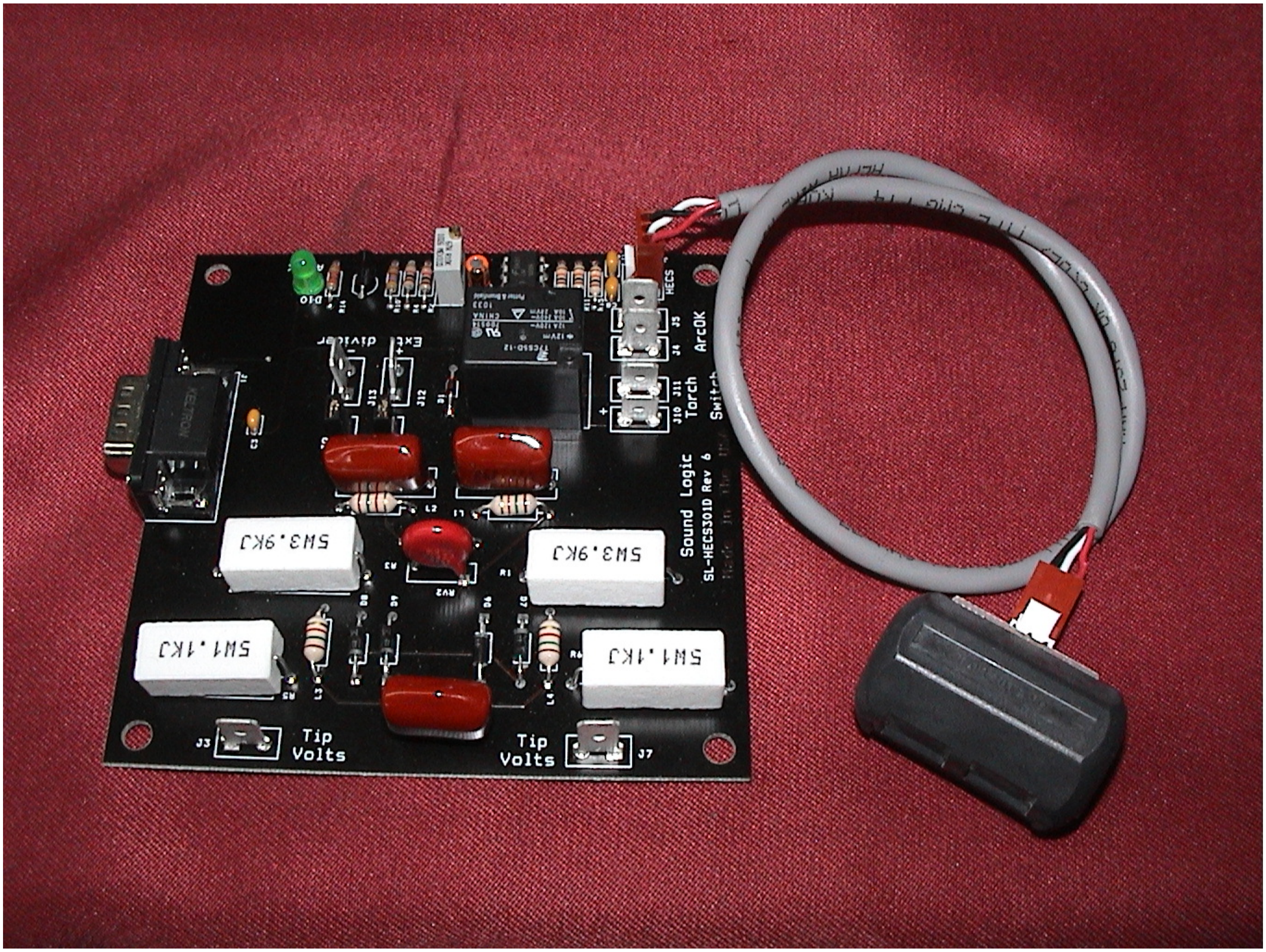

Figure 5 - THC Sensor Board with HECS Sensor

The photo above shows the THC Sensor board with the (optional) Hall Effect Current Sensor (HECS) attached. The sensor is a ferrite “clamshell” device that clamps over the work (ground) cable of the plasma machine to sense when current is flowing and “Arc OK” is generated using this device. Where the plasma machine presents an “Arc OK” signal, this HECS is not required. It is preferable to use the plasma generated “Arc OK” where possible.

The HECS current sensor located at the bottom right of the photo; is used to generate the Arc OK signal. To adjust it plug the HECS cable into J14, plug the DB9 cable into the THC301d and the sensor board; turn the power on to the THC301d, adjust the trim pot CW until the green LED lights then adjust it back CCW until it just goes out.

Torch Height Control Operation Sequence for THC301d

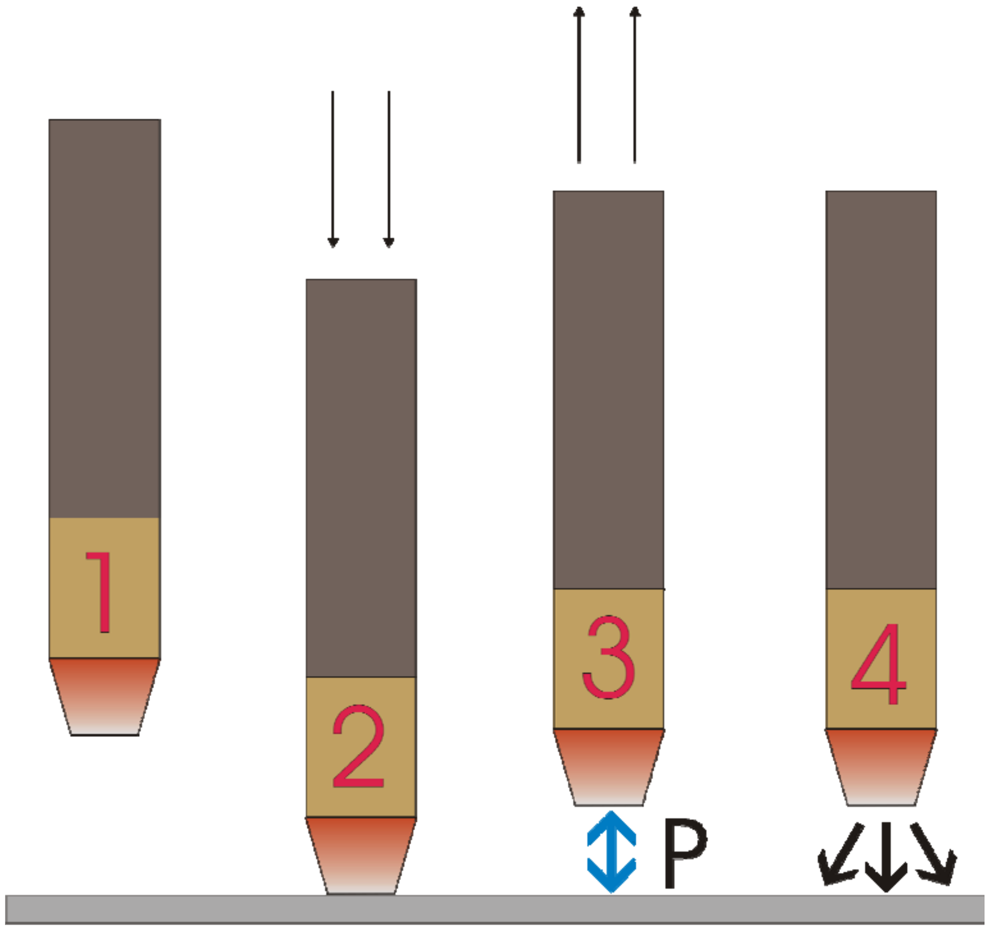

Figure 6 - THC Plasma Sequence 1 of 2

Both the Mach3 and Sheetcam settings overview will be discussed after this section. The below explanation is a simplified sequence of events. There is much more to consider and the THC301d does this internally in its firmware. These will be explained later.

Assuming Mach3 is set up properly for THC Plasma operation and a G-Code "cut file" has been properly generated from SheetCam, the sequence of events follows when plasma cutting:

1. The Plasma Torch is at some "retract" height above the work metal.

2. Pressing Start on Mach3 (with the THC On/Off button activated on the Mach3 screen under Torch Height Control) causes the torch to move to the requested X/Y position. The Z axis moves down and the "floating head switch" or Ohmic sensor detects the work piece with the tip of the torch.

3. Mach3 then raises the torch to the Pierce Height (determined by settings in SheetCam) – P=Pierce Height

4. Mach3 then turns on the TORCH light under Torch Height Control and tells the THC to fire the torch (Torch On signal). The THC turns on the TORCH ON LED on the front panel then sends the signal to the THC Sensor board where the relay activates and sends the "torch on" signal to the plasma cutter. Gas flow (shop air in most cases) begins.

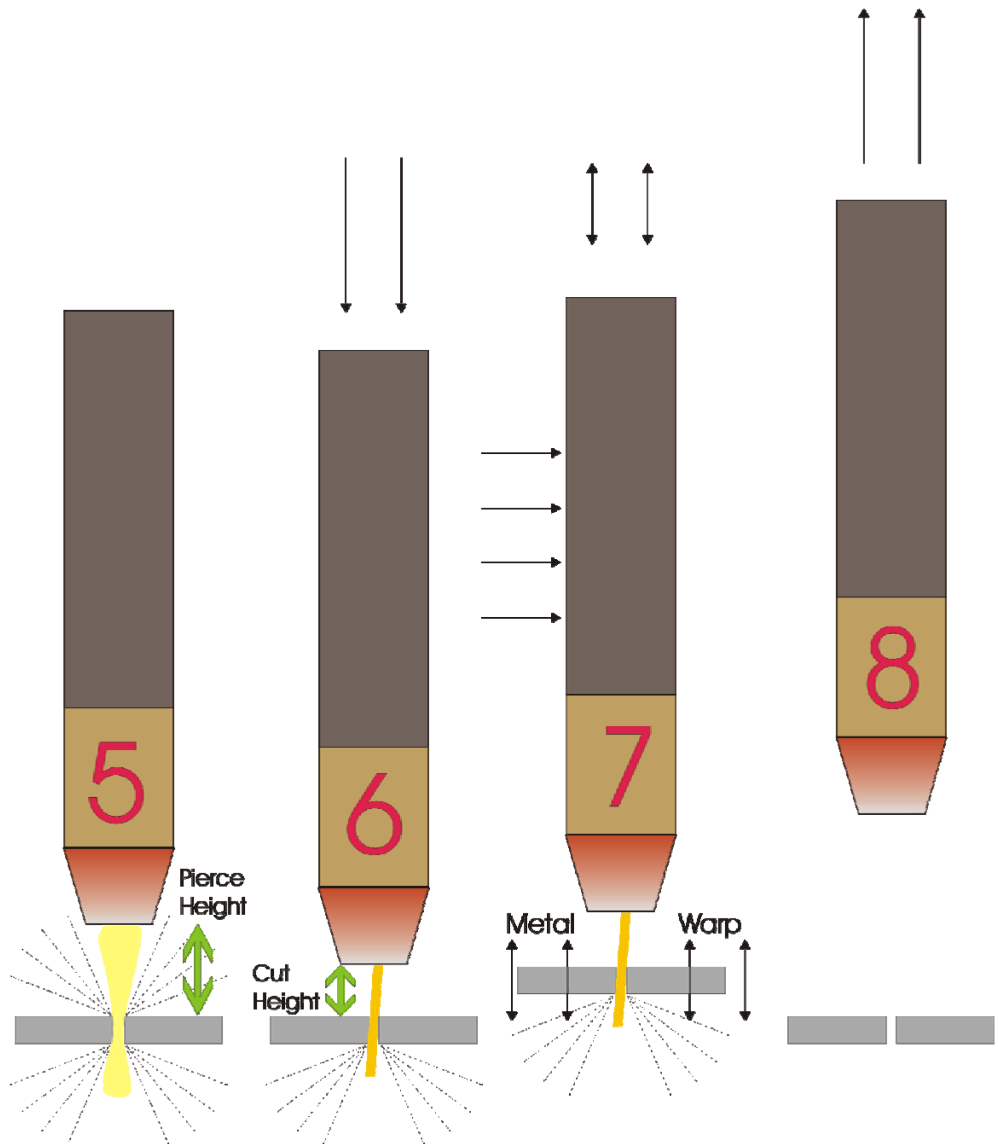

Figure 7 - THC Plasma Sequence 2 of 2

5. The plasma pilot arc initiates via the plasma machine. The pilot arc transfers to the cutting arc and cutting arc connects with the work piece. Arc OK signal is sent to the THC Sensor board via either an on-board "Arc OK or "Arc Good" signal from the plasma cutter or the Hall Effect Current Sensor detects a current spike (when the transfer from pilot arc to cutting arc is executed) and the Green LED on the THC Sensor board lights. The "Arc OK" signal is then transferred to the THC where it turns on the ARC OK LED on the THC front panel and then sends it to Mach3 via the parallel port cable. Mach3 then turns on the ARC OK square "LED" on the screen in the Torch Height Control section. If there is a Pierce Time Delay that was set in SheetCam for this operation, then the Mach3 delays moving the torch until the delay has ended.

6. Now Mach3 working with the THC moves the torch down to the Cut Height as determined by the Arc Voltage. The Arc Voltage or Tip Voltage is sensed by the Voltage Divider Circuit on the THC Sensor board and sent to the THC. The THC compares it to the Set Voltage (Set Voltage is the number the user set in the THC by adjusting the TIP HEIGHT knob(s) on the THC front panel and reflected in the THC display) and tells Mach3 to adjust the Z axis to compensate. Mach3 now tells the torch to move and start cutting.

7. As the torch moves and cuts the work piece the Tip Voltage may change if the metal warps or is not perfectly flat. This necessitates movement of the Z axis to maintain the proper cut height. The THC tells

Mach3 to move the Z axis up if the Set Voltage is higher than the Tip Voltage or down if the Set Voltage is higher than the Tip Voltage. If they are equal, then no Z axis motion is performed. These actions are reflected in both the UP and DOWN lights on the Mach3 screen and on the THC.

8. When the cut is finished, Mach3 stops X/Y movement, tells the THC to turn the torch off, whereas the THC loses Arc OK, and Mach3 raises the Z axis to the "retract" height. If there is more to cut, then Mach3 will move the torch to the next X/Y position and the process will start over.

NOTE: Sheetcam can be programmed to perform a Z axis touch-off on every cut, or when the distance from the last touch-off is over 500mm. <u>These options will be discussed later.</u>

Constant Velocity Cutting

To Be Explained Later

Anti-Dive Operation

To Be Explained Later

Mach Screens for the THC300 & THC301 Torch Height Controllers

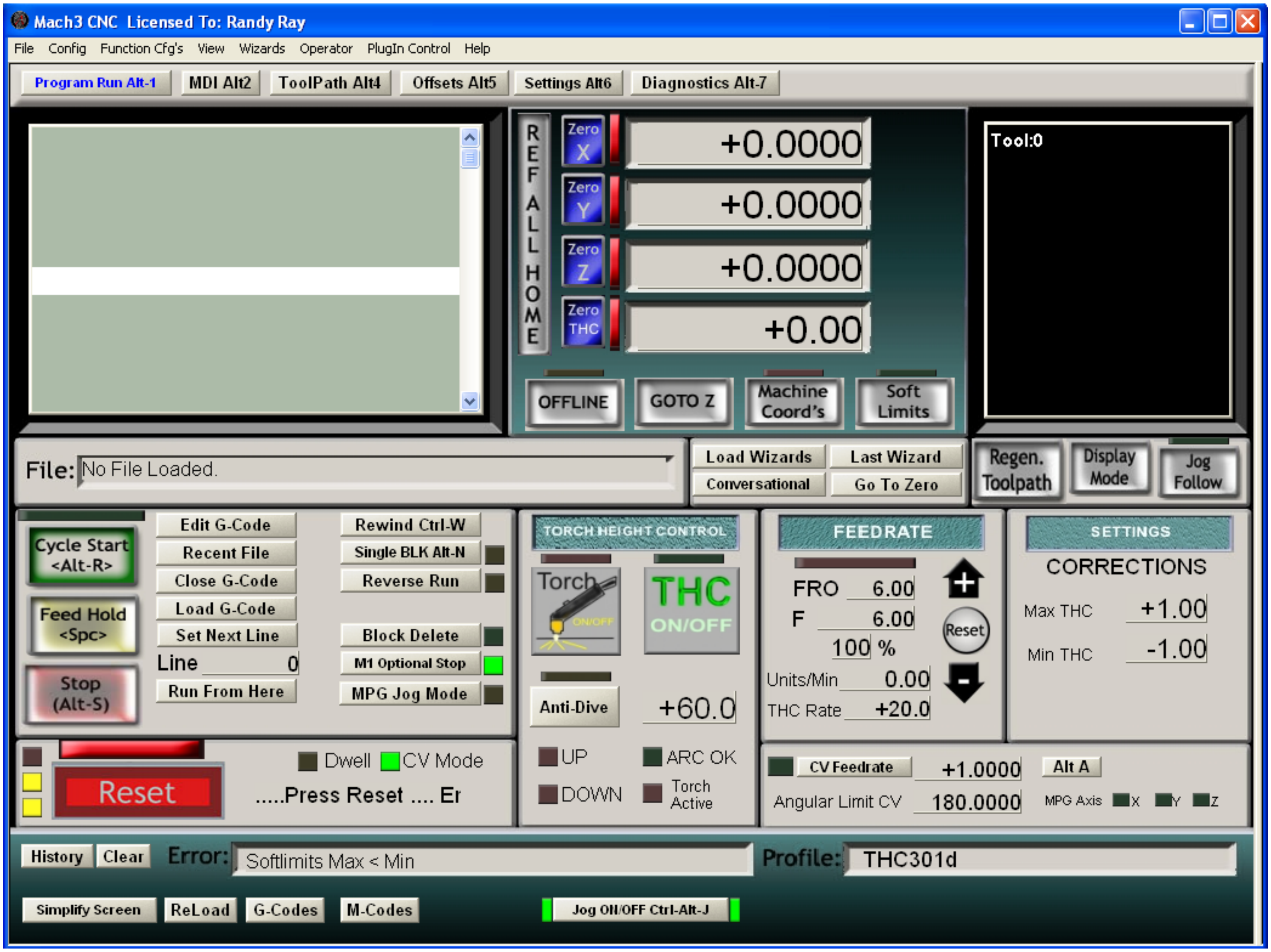

Figure 8 - Mach3 Screen for THC300 & THC301

Mach Screen THC Function Definitions

Torch Height Control Area (Center Bottom)

Torch On/Off – This both a "pushbutton" and indicator. It allows manually firing the torch by clicking on the Torch button and the red bar above the button will light. When Mach3 send the Torch On signal to the THC, the red bar also lights.

THC On/Off – This is the control activating the THC. When it is off, Mach3 ignores any commands from the THC. When it is on, Mach3 will depend on the THC for communication to maintain proper tip height of the torch.

Anti-Dive – This button/indicator turns on/off the Mach3 **internal** Anti-Dive mechanism that keeps the THC from diving (moving the torch down when falsely detecting a higher Tip Voltage) when crossing a gap (previously cut line) or rounding corners. Though a few users have played with this, most don't think it provides any added benefit and rely entirely on the THC internal anti-dive mechanism.
Recommendation is to leave this feature turned OFF.

Anti-Dive DRO – This number is actually a **percentage** of the running velocity (XY combined) and is set in the Anti-dive DRO (to the right of the Anti-dive button). If activated and the average velocity of XY drops below the percentage set in the Anti-dive DRO, the Z axis will not move further down.
Once again, the THC301d internal Anti-Dive firmware will work better than this Mach3 version.
Recommendation is to leave this feature turned OFF.

Up – Down – These indicators show when the Z axis is moving Up or Down.

ARC OK – This indicator shows when the THC reports to Mach3 that the Arc has transferred and Arc OK is valid.

Torch Active – I have no idea what this indicator does other than, possibly, the obvious.

Feedrate Area (Right of Torch Height Control)

THC Rate – This number is a **percentage** of the set cutting feedrate and is used to throttle the Z axis movement and make it proportional to the feedrate. If the THC Rate is set to low, the Z axis will not keep up with sudden Arc Voltage changes such as when cutting corrugated material. If the THC Rate is set too high the Z axis becomes overly sensitive to Arc Voltage changes and the Z axis will oscillate up and down trying to the axis perfectly “in the zone”.

Settings Area (Right Bottom)

Max THC – This is the maximum limit the Z axis will be allowed to travel under THC control

Min THC – This is the minimum limit the Z axis will be allowed to travel under THC control.

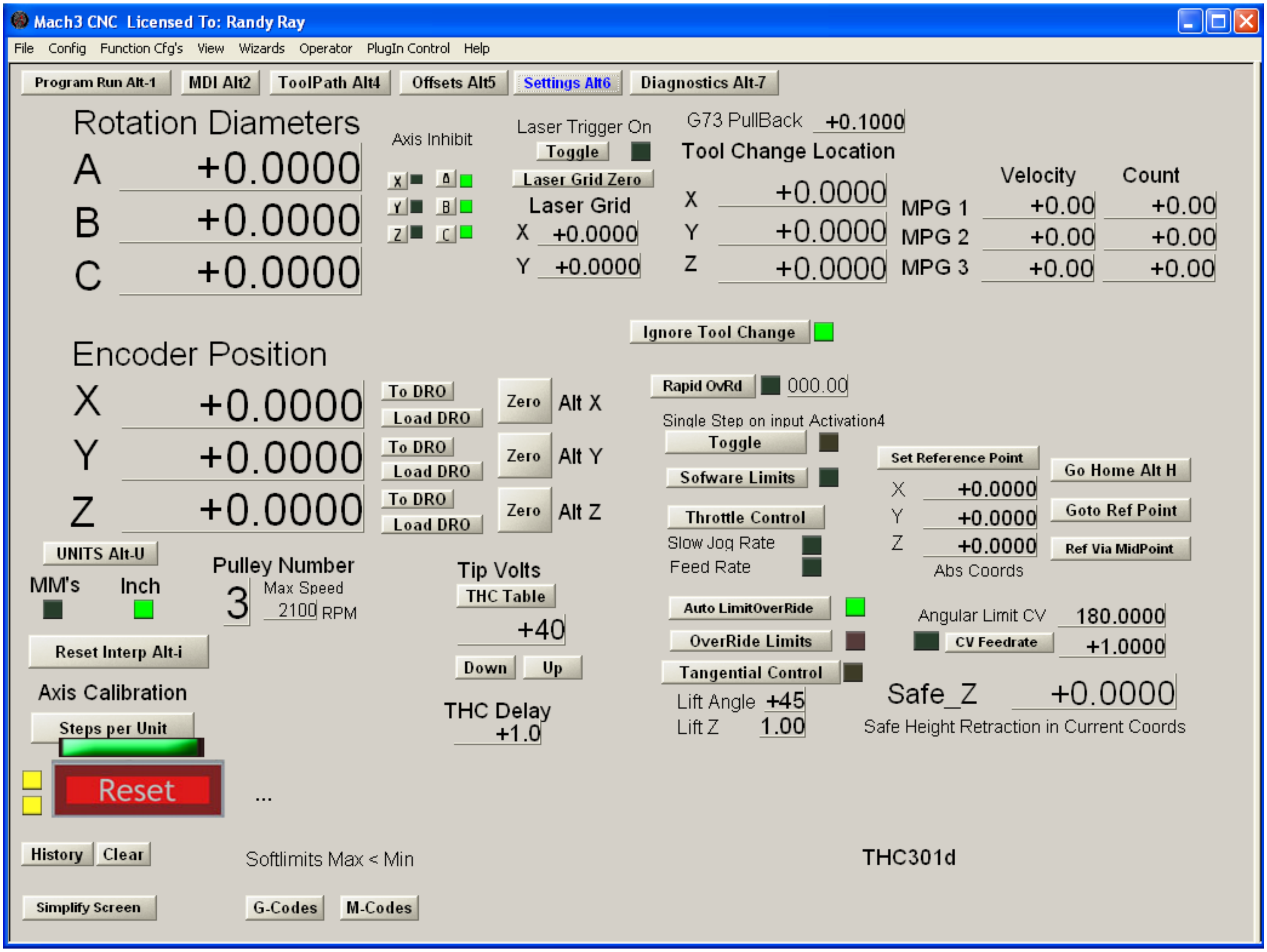

Figure 9 - Mach3 Settings Screen Features No Longer Used

TIP Volts – Not used with the THC301d

THC Delay – Not used with the THC301d

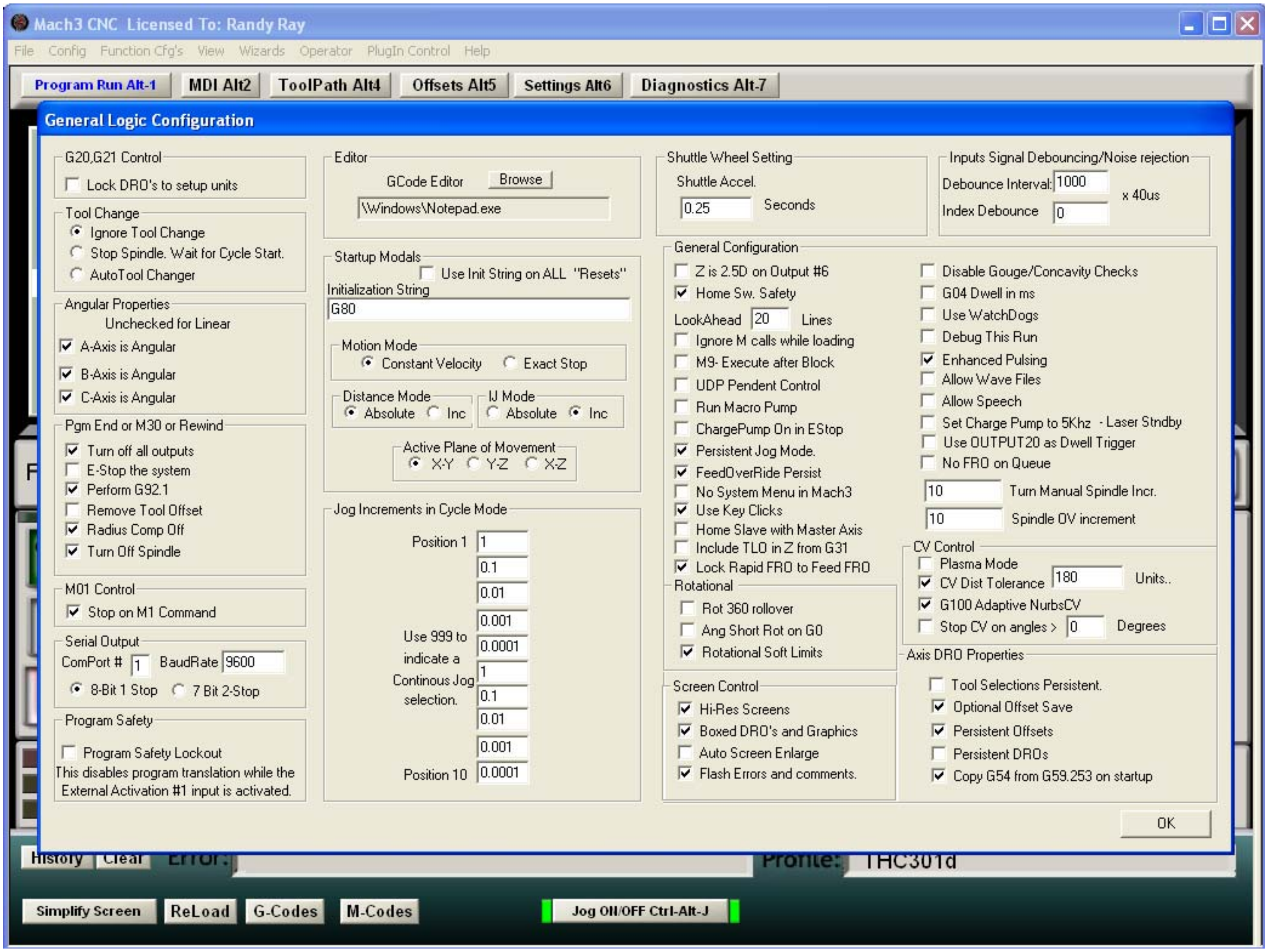

Figure 10 - Mach General Configuration Screen

Plasma Mode under CV Control (right side of screen near bottom) – **Do Not check**

More Later. This is an early draft and will be expanded.