DTHC II - SETUP/INSTALL MANUAL

REV1
May 2011

For use with the following CandCNC products:

UBOB III Builders Kit + DTHC II
MP3000E-DTHCII or later
BladeRunner (all versions) with DTHC II option
BladeRunner AIO Dragon-Cut (shipped after 4/15/11
DCP-01 Digital Current Probe (11/02/2010)
Smart-Kut Software Upgrade (10/15/2010)
Addendum for THCSensorPWM Rev18 MOD A & REV19

Use this manual to install and setup a DTHC II
Expansion Module in the field for any of the above
listed CandCNC products OR to setup and test the
DTHC II functions in a a CandCNC Product that already
has the DTHC II Module installed.

Includes complete setup and testing of the new CandNC
DIGITAL CURRENT PROBE

May 1st 2011
Some torches will have more than one set of small wires for other sensors in the head. Confirm switch pair with an ohmmeter while operating the switch (Plasma Unit power OFF).

Good connection to the workpiece with clamp is essential for proper operation of the THC.

HOW DTHC (THC/AVC/DTHC) WORKS

Automatic Torch Height Control (often called just THC) works by reading the Arc Gap Voltage while cutting. Plasma uses constant current cutting. If the Current stays constant and you vary the gap (either by moving the torch or moving the material UP or DOWN) then the voltage will change in proportion to the change in arc gap. Much like the altimeter on a plane (that measures barometric pressure to determine altitude) the Arc voltage indicates the RELATIVE distance from the end (tip) of the nozzle to the top of the material. The change in voltage for a change in height is a small percentage of the overall cutting voltage. A 1% change in voltage (100 to 101 volts) is equal to several thousands (typically .025 or more) of arc gap change so the THC must be able to see and act on a small change in a large number. The THC control must take the actual cut voltage and compare it to a preset “target” and move the Torch Up or Down to try and correct the height based on it’s arc voltage. The process forms a “servo loop” where an “error” voltage from a preset is used to physically move the torch Up or Down to “correct” the error. Under normal cutting conditions the voltage stays constant but certain conditions that effect the arc gap voltage can skew the gap volts and case the THC circuit to overreact. The feedrate (how fast the tip is moving across the material) determines the current density and the Gap Volts. A slower feedrate will cause an increase in Torch Volts (if no THC servo is there to correct). With THC engaged the circuit will sense the higher voltage and based on the error created lower the torch to try and

- Arc Gap = Arc volts=Torch Volts
- 1 volt (change) = approx .025”(change)
- >Arc volts = > Arc Gap. (greater the Arc Gap the greater the Arc Volts)
- Control has “window” (Span Volts) where no UP or DOWN occurs. (prefect cut height) Anything inside the Span (+ or -) from the Preset generates NO change. SPAN VOLTS is set in 1/4V increments in the Cut Profile.
The following pages will cover the identification, hookup, setup and testing of the DTHCII Digital Torch Hsight Control System. Each card/mosule has a specific function and set of tests. A minimum system will consists of a DTHC II Expansion Module (interfaced to a CandCNC UBOB III Universal Breakout Board) and the THC Sensor PWM Module.

The DTHC II is a later version of our popular DTHC that was introduced in late 2008. The DTHC has always been a feature rich product with advanced technology based on powerful embedded processor chips and modern surface mount components. From the innovative Total isolation (including the analog Arc Volts readings) to the Self-test and built in “Tip Saver” anti-dive the DTHC has earned a reputation for being solid, reliable and user-friendly, while offering the operator a wide range of options for precise cutting with plasma and all at a very effective price.

The DTHC II builds on that success by making the product even more plug-n-run with several Plasma Manufacturer’s models that will offer standard external connector interface for access Automation control signals in the plasma. The new THC Sensor PWM takes a divided Arc Volts signal (available as an option on several plasma models or from our Optional RAV-01 card) and changes the small analog signal to a constant level PWM signal that is many times more immune to external noise and EMF problems. Designed to work with your existing equipment including HF and CD start units or the most modern plasma units in built-in Automation Interfaces, it set a new standrad for Torch Height Control. You can pay MORE for a THC but cannot get more features or accuracy than the DTHC II offers.
Block diagram of a typical DTHC II Hookup for a system with NO Automation Interface

- **DCP-01 (option)**
- **Located in the control box with the UBOB III card**
- **DTHC II Module**
- **Cat5 UTP cable UP to 25 ft**
- **THC SENSOR PWM Plasma Pickup Module Located external and close to the Plasma cutter**
- **Torch Switch and Arc OK local connections**
- **RAW ARC VOLTS**
- **RAW ARC VOLTS (voltage Divider)**
  - **RAV-01 Card OPTIONAL**
  - RAW ARC VOLTS is mounted internally and used on units that do not have a voltage divider. It is now an option.
Block diagram of a typical DTHC II Hookup for a system with full Automation Interface including Divided Arc Volts)

- **DCP-01** (option)
  - used for ARC Current Readout; NOT Required

**DTHC II Module**
- Located in the control box with the UBOB III card
- Cat5 UTP cable up to 25 ft

**THC SENSOR PWM**
- Plasma Pickup Module
- Located external and close to the Plasma cutter

**MIC-01 Custom Cable**

**CPC Plug on Plasma Unit**
- Single cable Hookup to Plasma Unit

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CandCNC
BASIC DTHC II Module Kit includes:

THC SENSOR PWM

DTHC II Expansion Module

16 Pin IDC ribbon cable to UBOB III

CAT5 UTP Cable

25 ft
MODULES SETUP

DTHCII MODULE

THC SENSOR PWM MODULE

RAV-01 VOLTAGE DIVIDER (OPTION)
DTHC II EXPANION MODULE. Located above the UBOB III card in most CandCNC products. Ribbon cable connecting DTHC down to UBOB card may cover adjustment pots. If so, gently move it out of the way. Do not unplug the ribbon cable or the card will be disabled.

2. Using the diagram below and with the THC SENSOR PWM module in the TEST/CAL mode (LED flashing) adjust the Torch Volts calibration pot while watching the TORCH VOLTS DRO in the MACH screen. Adjust the pot until the value displayed is 126 Volts. Note: only adjust the setting if it is not displaying 126 to 127 volts.

DCP Calibration POT ADJUST per the instructions

TORCH VOLTS Calibration SET FOR 126VDC INDICATED [TORCH VOLTS]
Unit is calibrated at the factory.
The photo shows a top view of the DTHC module card. There are two connections to make. The first is the 16 pin IDC cable between the DTHC and the UBOB Feature Connector. It’s the only 16 pin header on the UBOB. Both headers are keyed so the cable only fits one way. The other connection is to the DB9 socket from the THC Sensor Card.

Actual card layout may vary from the photo.

Skip this section for products that have the DTHC II installed at the Factory

INSTALLING THE DTHC INTO AN EXISTING MP3000 or BladeRunner PRODUCT

1. Locate the UBOB III card in the unit. It is the card with the PORT1 and Serial Port inputs. There is a 16 pin FEATURE CONNECTOR. Use the short 16 pin IDC cable included with the DTHC II and plug one end into the FEATURE CONNECTOR.

2. Mount the DTHC II to the Front Panel using the 4-40 screws and L brackets on the PCB. Line up the holes for the TEST LED and the TEST BUTTON. Replace the 4-40 screws through the front into the L Brackets and tighten until the board is snug against the inside of the panel.

3. Hold the back of the DTHC II Module and insert the other end of the 16 pin IDC cable from the UBOB card FEATURE CONNECTOR Header.

4. Proceed to DTHC preliminary testing.
PRELIMINARY TESTING THE DTHC MODULE:

If you have an MP3000 with the DTHC II already installed, power up the MP3000-DTHCII and using a small probe (stiff wire, paperclip, etc push the TEST Button that is recessed behind the front panel. Press and release one time. The yellow LED should start to flash. If it does not check the AC cord (main power) and the 16 pin ribbon cable to the UBOB III card and plug and try again. There is a green LED on the DTHC II module that will light when the DC to DC converter is on. There are also three power LED’s on the UBOB card itself that should be on. If the Test LED lights and flashes it indicates that the DTHC II has power and the on-board processor is working. IT DOES NOT TEST ANY OTHER FUNCTION AT THIS POINT.

Further testing requires you have MACH3 installed, the serial cable attached and the MP3000-DHTC profile and screen set loaded. See the section on Loading DTHC DRIVERS

LOADING DTHC DRIVERS/PLUG-INS

The Following assumes that MACH3 has been installed and that you can start MACH and get a default screen. While the MACH license does not need to be installed to load the CandCNC drivers, you cannot use the THC functions in MACH with a DEMO license. Refer to the MP3000 or BladeRunner manual to install a license. If you are building up a unit (UBOB or UBOB Builders Kit) you need to refer to those manuals for the base setup. If you have already loaded the CandCNC support files (auto installer from the CD) then you can skip step 1 below. The communication drivers need to be configured for DTHC II interface. The following steps will take you through setting up the system to use with the DTHC II module.

1. From the Support CD (or a web download locate the MP3000E-DTHC-UBOBIlll_INSTALL file. Run it in Windows with MACH3 NOT RUNNING. It will place two MP3000-DTHC (or BladeRunner) icons on the desktop that will Start MACH with the correct profile instead of having to use MACH Loader each time. All of the plug-ins, MACH profiles and Icons to use with the DTHC II will be loaded during the install. The MP3000-DTHC profile in MACH will be added along with the matching screen sets and macros.

2. After the MP3000-DTHC Install, open MACH3 using either the MP3000-DTHC Icon OR BladeRunner AIO icon from the matching named profile in the MACH Loader.

3. If you re-install MACH or upgrade, you may need to run the Install again.

4. Open MACH using the MP3000-DTHC-UBOBIII or BladeRunner AIO profile (for the product you have) and select CONFIG PLUGINS from the CONFIG menu in the top row. You will see a list of plugins that are available. At the top of the list are the two CandCNC plug-ins. Each one starts with "ccc_"

5. Confirm that they are all ENABLED. If you make any changes make sure you close and restart MACH.
Use the screen to select the hardware you are using. The Ubob THC Plugin should be selected. If you have a ESPII Power supply (part of all BladeRunner, RouterPak and PlazPak products) then be sure to check UACM Modular Power Supply as well. Note the

DYNAMIC SELF-TEST of DTHC MODULE

★ Activate the recessed TEST Button on the front panel of the MP3000-DTHC or your unit with the DTHC module installed and connected. The TEST LED should start flashing. The unit goes into a test sequence where the TIP VOLTS DRO is set to 100 and the UP screen LED flashes 5 times. Then the TIP VOLTS DRO is set to 150 and the DOWN LED flashes 5 times. This test sequence repeats until you hit the Test Button again and the TEST LED stops flashing.

★ If the test does not show the above results the most probable cause is the serial communications is not working between the PC and the MP3000/BladeRunner. Make sure you have the right port selected. All Standard cables supplied from CandCNC are straight through with all pins connected (sometimes called "extension cables")
THC SENSOR PWM SETUP AND TESTING

RJ45 (Cat5) cable to DTHCII Module

ARC OK signal FROM Plasma

TO Plasma TORCH SWITCH or Start circuit

Divided volts from CandCNC Raw Arc Volts card

CandCNC THC SENSOR PWM Card
(Inside Plasma Pickup Module)
## THC SENSOR PWM FRONT PANEL LEDS

<table>
<thead>
<tr>
<th>TORCH</th>
<th>ARC OK</th>
<th>TEST</th>
<th>+5</th>
<th>+12</th>
</tr>
</thead>
<tbody>
<tr>
<td>THC SENSOR Unplugged or DTHC II power is off</td>
<td></td>
<td></td>
<td></td>
<td>Show condition of power. Both must be ON when plugged to DTHC II and power is on</td>
</tr>
<tr>
<td>NO ACTIVITY Standby state</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEST/CAL MODE. TEST button is pushed and released</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TORCH FIRED from code or screen button</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc OK is Active</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc OK is Active, Torch is fired</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes
- **TEST LED FLASHES.** Sends PWM signal to DTHC II. Calibrate DTHC II to read 126 VDC
- **Readout on TORCH VOLTS (screen DRO) confirms proper operation of THC SENSOR PWM and DTHC LL input.
- **Steady RED LED shows anytime Torch RELAY is active on THC SENSOR.
- **Confirms Torch Relay on THC SENSOR Card is active. Tests signal from DTHC II to fire Torch.
- **STEADY YEL LED. Turns on if ARC OK from ARC OK TEST button is active
- **Also Used to set sensitivity (trip point of ARC OK from DCP, for hardware ARC OK from DCP (see Manual)
- **Torch fire is active; ARC OK signal from Plasma is active
- **Shows proper operation of the ARC OK from the plasma (or using the DCP as the ARC OK)
NOTE: See next page for units shipped after May 1st 2011.

If you have a THC SENSOR PWM shipped BEFORE MAY 1st 2011 and you need to use the internal divider on your plasma unit you will need to return your THC SENSOR PWM module to get the MOD A upgrade. YOU ONLY NEED THIS IF YOU ARE NOT USING THE RAV-01 CARD Units using the RAV-01 (7:1 divider ratio) will work WITHOUT THE MOD A. Just use the above.

To set THC SENSOR PWM ratio divider option:
1. Remove rear cover of THC SENSOR PWM Case
2. Determine the proper setting for the type setup you have.
3. Set the small option jumper to match.
ADDENDUM for REV 18 cards with MOD A tag and REV 19 Cards.

NOTE: the number of options has increased and the order of the jumper positions has reversed. If you have a unit tagged with "MOD A" or any unit shipped after 5/1/2011 Then use this sheet to set your divider jumpers.

To set THC SENSOR PWM ratio divider option:
1. Remove rear cover of THC SENSOR PWM Case
2. Determine the proper setting for the type setup you have.
3. Set the small option jumper to match.

20:1 Scale (Hypertherm and some others) recommend setting
16:1 Standard on Thermal Dynamics, others
7:1 Divider (from CandCNC RAV-01 Card)
50:1 Standard on Hypertherm, Thermal Dynamics, others
THC SENSOR PWM (Plasma Pickup Module) can be put in TEST/CAL mode without removing the card from the case. Turn the case over and remove the 4 corner screw holding the back on and carefully pry off the back panel. It will expose the back of the PC board and there are two small momentary pushbuttons and a dual row of option jumpers. The switches are small tactile switch that requires light pressure. One push puts the unit in test/cal mode. The Test LED will flash. The voltage will display on the TORCH VOLTS DRO. A second push will take the unit out of test/cal mode and the LED will stop flashing and the TORCH VOLTS reading will return to Zero. Once in TEST mode you can calibrate the DTHC II module to display the correct TORCH VOLTS on the screen. The calibration is based on a simulated PWM from the circuit so if the prescale divider setting is wrong the calibration will show correct but when the torch is fired the voltage will be wrong. Make sure you match up the prescale option jumper setting with the divide ratio of the divider ratio your plasma is using.
CHECKING ARC OK SIGNAL BACK TO DTHC II Card:

1. Remove case bottom.
2. With RJ45 (UTP cable) connected to DTHC II and unit powered up, depress the ARC OK TEST BUTTON on the card. The ARC OK LED on the MACH screen should light. The ARC OK test LED on the front of the case will light.

Depress and release TEST button to test PWM circuit back to DTHC II. Test LED on front) will flash and DTHC screen in MACH should display a voltage. Calibrated units (see calibration section) should display 126 to 128 volts during test.
THC SENSOR PWM MODULE TESTING

Before you make connections to the plasma unit you may want to do some testing to confirm proper operation of the THC SENSOR PWM with the DTHC II Module.

- Set the THC SENSOR PWM Module to the DTHC II module
- Connect the THC SENSOR PWM to the RJ45 (CAT5) connector on the DTHC II Module
- Load MACH3 and do the auto-install from the CD for your product (MP3000-DTHC-UBOB III). Start MACH3 using the Desktop Icon for DTHC Profile and make sure you can come out of RESET and that the CP (Charge Pump) LED on the front of the UBOB/MP3000/BladeRunner is ON.

- On some products you may have to have the Motor DC on to come out of RESET
- Click on the TORCH icon on the screen. You should see the LED above the TORCH button on MACH turn on and there will be a click in the THC Sensor PWM card and the small LED on the front labeled TORCH ON will light. That indicates the TORCH ON relay is working.

- The next check is to confirm the ARC OK circuit is working. Follow the instructions for the THC SENSOR PWM section and open the back and use the ARC OK Test button. The ARC OK LED on the MACH3 Screen should light. If it does you can proceed to the actual hookup of the THC SENSOR PWM Module to your plasma unit.

- If any of the tests fail make sure you have the cables firmly attached and that they are the correct type.

All cards are checked at least twice and most three times before they leave the factory. It’s unusual for a THC SENSOR PWM to be bad or fail in no load testing. If you have checked all of the connections, cables and MACH setup and you still cannot get the THC SENSOR to work contact us at 903-364-2740 or via e-mail at Tom @CandCNC.com

NOTE: Some Larger (>100A) plasma units or older smaller models use various methods to start the initial ARC. Most common is HF (High Frequency) start. HF Start presents several challenges. It uses the concept that higher frequency waves travel through air (and arc) easier than DC voltage. The HF is normally combined with a higher voltage and it starts an ARC that the plasma uses to ignite the air. Once the arc fires, if a conductive part is close, the arc will transfer to the material. The HF start causes a lot of noise and current spikes. The other form of High voltage start is the CD (Capacitor discharge) method. It is basically a high current version of an Automotive ignition system. Up to 30,000 volts can be generated. If the THC Sensor is not protected, the high voltage and high frequency can cause component failure on the card or (worse) in the THC unit and even burn the board. The THC Sensor PWM (REV18 and up) is protected from HF and most High Voltage start circuits.
The smaller Hypertherm and other modern brand units use a low noise method called "blowback arc start". The electrode is mounted against a spring that keeps it pushed against the inside of the nozzle as long as air is not flowing. When the unit is triggered the starts a few milliseconds after the current starts to flow in the electrode circuit. As the air flows it pulls the electrode away from the nozzle and creates an ARC. That is used to ionize the air and start the plasma.

The DTHC II can be used with all types of plasma units. The HF units tend to be very noisy and some even have large amounts of RFI. The total isolation of the DTHC II circuit from any low level (PC logic) including any common ground, stops any conducted noise. The internal circuits are protected from RFI with proper layout and careful attention to bypass components on all active circuits.

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**Hooking Up Your Plasma Machine to the MP3000-DTHC/BladeRunnerAIO DTHC II**

**CAUTION:** Portions of this install may include opening your plasma cutter machine and attaching wires. **MAKE SURE THE UNIT IS UNPLUGGED PRIOR TO REMOVING ANY COVER(S) OR MAKING ANY CONNECTIONS.** Plasma units have HIGH VOLTAGES present that can be dangerous or lethal. IF YOU ARE NOT EXPERIENCED WORKING WITH HIGH VOLTAGES, DO NOT ATTEMPT TO INSTALL THIS OR ANY OTHER DEVICE INSIDE YOUR PLASMA UNIT YOURSELF. SEEK PROFESSIONAL HELP.

In order to control your plasma unit, there are three main connections that need to be made to the plasma unit itself. All of the following operations are to be done with the power disconnected from your plasma unit.

You should determine which type install you will need for your plasma. There is a “decision flowchart at the end of this manual that can help. It breaks down like this:

There are 3 questions that need to be answered:

1.) Does your plasma unit have an internal ARC OK (dry contact) signal or one on a standard CPC connector?
   If not then you will need to purchase and install the Digital Current Probe Option (DCP-01)

2.) Does your plasma unit have an internal voltage divider (Automation Interface) with a ratio of 20:1 or 50:1?
   If not you will need to purchase and install the Raw Arc Volts divider card (RAV-01)

3.) Are you using a hand torch or machine torch?
   If using a hand torch (even with a unit that is setup for automation you will probably need to tap into the TORCH SWITCH wires from the hand torch to fire the torch remotely (from the computer). There is a page on how to do that from either the RAV-01 (if you already have it because of #2 above) or directly from the THC SENSOR PWM connector.

If you have a Plasma unit that needs the RAV-01 card you will need to install that card in your plasma unit of have it done. See the RAV-01 card section for instructions and warnings. If you are using the DCP-01 for ARC OK, there is an addendum at the end of this manual on installing and testing the DCP-01.
1. Most plasma units have connection terminals where wires from the torch or panel connectors attach to the internal PC Boards. The terminals provide a convenient place to do your connections. Use crimp-on spade or round terminals to attach the wires to the terminal strips. Make sure the new wires you install do not touch adjacent metal objects. On some machines there may be more than one set of small wires and are used for sensing tip shorts and other conditions. **To identify the correct pair for the Torch Switch** use an ohmmeter or continuity checker across each pair while you manually push the torch head button. When you identify the pair make note of where they attach. Use #22 to #18 stranded wire (twisted pair) to connect between the two screw terminals on the THC Sensor PCB marked “Torch Switch” to the two switch terminals in the plasma unit. There is no polarity. NOTE: IF your unit has noise filter chokes from the torch switch wires up to its internal logic card, it is recommended you place the two wires to the THC Sensor PCB on the other side of the chokes from their torch head connection (end closest to the internal logic card).

2. If your unit has a tip voltage connection point (i.e. like the Hypertherm 1000 series), you will need to use their manual and suggestions as to how to connect to the two points and run those wires to the THC Sensor card. Just make sure you use wire that has insulation rated for at least 400 V. Small signal wire like telephone wire (UTP) is not rated that high and can arc to nearby components. **The THC Sensor card is designed to take the full tip voltage and divide and filter it.** Open circuit full tip voltage can be as high as 300VDC in some machines.

3. If your plasma unit does not have a designated tip voltage measurement point, you will need to locate a place inside the unit where you can get one wire onto the workclamp lead and another on the heavy lead(s) that connects to the torch tip (electrode).

   a. Note: some machines like the Hypertherm 380 do not have a single heavy wire to the Torch tip and instead have a set of parallel smaller wires that all terminate into one connector. In the case of the 380 the WHITE wires are the tip volts.

   b. You can identify both locations by visually tracing the two leads as they come into the box. You should find several locations/terminal strips that have connections to these two points and you can use those for your sense wire connections. Use unshielded stranded twisted wire of #22 to #18 ga rated for at least 400V insulation.
c. Make a connection between the locations you have identified that tie directly to the two leads (workclamp and torch tip) to the two “TIP Volta” terminals. Make sure that these wires are routed where they cannot come into contact with hot or moving components. Starting with the REV 14 THC Sensor card the TIP VOLTS inputs have a polarity. The + side

5. If you are using the CandCNC Digital Current Probe (DCP), you need not hook up any ARC OK signals to the RAV-01 card or the THC SENSOR PWM input. The ARC OK signal is derived from the TORCH AMPS (cut current) feedback. ARC OK trip point is set in the CUT PROFILES in MACH3. See the section on installing and calibrating the DCP-01/02 on how to set the ARC OK trip point.

6. If you have a plasma unit that DOES have an Arc Good signal or you have the DCP module, DCP-01 unless you want the added features the DCP-01 can provide (see DCP-01 documentation) Just make the connection to the Arc OK terminals. Some units provide only relay contacts; (“dry Contacts”) For that type of signal the ARC OK inputs are J4 and J5 on the THC Sensor card.

Note: The term Arc Good is interchangeable with Arc Ok, Arc Xfer and OK to MOVE.

7. NOTE: IT is ESSENTIAL that the chassis of the plasma unit have a good earth ground. Refer to the suggested grounding section of the diagrams (#####) and provide for a good earth ground close to the table. A safety ground back to a breaker panel many feet away may be a good ground for AC frequencies (60hz) but poor for higher frequencies like plasma noise. Since we are bypassing any high frequency noise to the plasma chassis, if it has a poor noise ground it can actually put noise back into the tip volts rather than shunting it away!
Own or Buying a Plasma unit for CNC?

Is it a HYPERTHERM 45, 65 or 85 models OR TD A60/A80/A120?

Does it have the Rear Panel CPC Connector?

Does it have the internal Arc Voltage Divider? (Automation Interface PCB)

Purchase ARC Voltage Divider Card Option RAVD-01 Card

Purchase AMIC-01 CABLE

Purchase AMIC-02 CABLE

Purchase OPTION DCP-01

Does It have an ARC OK signal.? (aka Arc Transfer OK to Move, etc)

YES

NO

FINISH

YES

NO
DISCLAIMER AND LEGAL NOTICE

The following section covers the installation of a Voltage Divider card inside the plasma unit. There are dangerous and possibly lethal voltages present in a plasma power supply/unit. ALWAYS UNPLUG THE UNIT FROM THE AC POWER BEFORE REMOVING ANY COVERS. ALWAYS REPLACE ALL COVERS AND SAFETY BARRIERS BEFORE TURNING THE POWER BACK ON.

You do any install of a card inside of your Plasma Power Unit AT YOUR OWN RISK. If you do not wish to do the procedure either find a person qualified to do so OR contact us for options.

CandCNC/Fourhills Designs (hereafter referred to as “CandCNC”) nor any of its resellers or agents will be responsible for any damage to any plasma unit or the loss of any income resulting from using any of our electronics or using our instructions written or verbal to connect to any electronics. While we take care to provide accurate and concise information, we will not be responsible for any damages to equipment, personnel, or surrounding equipment, structures or land resulting from the direct or indirect use of our products.

The entire liability of CandCNC or any of its agents or employees is to replace or repair products provided by CandCNC. Under no circumstances will we be liable for any damages or loss exceeding the value of the actual products provided by us regardless if the products are used as described and in the proper manner. All CandCNC products carry a warranty that covers repair or replacement ONLY. Any labor, travel expense or costs to replace a component or product outside the CandCNC factory is NOT COVERED by warranty.

If you do not accept the terms of this notice DO NOT OPEN OR INSTALL THE RAV-01 CARD. Return the card for a full refund and seek an alternative way to sense the voltage.

CAUTION: Some plasma units use a very high voltage spark (Capacitor Discharge or CD) arc starting system. While the RAV-01 card is protected from high voltage inputs CD type systems can cause arcing in the connecting wires or to nearby components. If you have a CD start unit and do not have experience working with high voltage systems SEEK PROFESSIONAL HELP to do any install.
RAV-01 OPTION KIT
For Plasma Units WITHOUT Internal Voltage Divider

RAV-01 Raw Arc Volts CARD

CAUTION: High Voltages Present When TORCH is ON.

SHIELDED ANALOG CABLE
48" Min
Part# SAC-01

ScotchLOC™
IDC Splices (RED)
2 pieces

RAV to THCSensorPWM Interconnect

PART # CCAB-31
48" (min)
CandCNC RAW ARC VOLTS Voltage divider card

NOTE: PRINTING ON REV 18 PCB for Torch Switch and Arc OK are WRONG! Use this diagram.
Advanced Technology

THC SENSOR PWM
Plasma Pickup Module
for DTHC II

ARC OK
From Plasma

TO DTHC II
Module
USE CAT5 UTP
CABLE

ARC VOLTS
remove back cover for
access to test buttons

Divided Volts IN
From internal divider
card

CandCNC
IF YOU HAVE AN INTERNAL ARC OK SIGNAL: Connect one wire to Terminal 4 and Terminal 3 above (left two terminals)

IF YOU DO NOT HAVE AN INTERNAL ARC OK SIGNAL: You will need to purchase a DCP-01 Digital Current Probe. It plugs directly into the THC SENSOR PWM Module so the ARC OK TORCH SWITCH Terminals.

IF YOU HAVE A PLASMA UNIT with a Machine Torch you will need to locate the two torch fire connection points. in some units it is called START. IT is a REMOTE Fire set of wires.

IF YOU HAVE A HAND TORCH you will need to identify the two Torch Switch wires that come from the Hand torch and tap into them using the two ScotchLOC connectors furnished in the kit

IMPORTANT: When making any connection inside the PowerMAX disconnect the unit from the AC Line (unplug it). Do not open the case with power on the AC line. THERE ARE DANGEROUS VOLTAGES present in the unit anytime it is connected to an AC source EVEN IF IT IS TURNED OFF.
Use ScotchLoc IDC Splices (RED) to tie Torch Switch output on THC Sensor (J10) Screw Terminals. Locate Orange and Violet wires at J10 in the PowerMAX box and tap each wire as shown. To test short two screw terminals on J10 THC Sensor and torch should fire (Plasma Unit on)

**IMPORTANT:** When making any connection inside the PowerMAX **disconnect the unit from the AC Line (unplug it).** **Do not open the case with power on the AC line.** THERE ARE DANGEROUS VOLTAGES present in the unit anytime it is connected to an AC source EVEN IF IT IS TURNED OFF.
To test the voltage divider circuit you MUST have passed the TORCH FIRING TEST above.

1. To test to see if the voltage divider circuit is working use the two TORCH FIRE BUTTONS and depress the RAW VOLTS TEST BUTTON at the same time.
2. The RAW VOLTS PRESENT LED should light.
3. If it fails to light then check the RAW ARC VOLTS connections and their polarity. If the leads are reversed you will NOT get any divided volts and the LED will not light. Clip Meter across TIP VOLTS terminals set on 200VDC and fire torch with TORCH FIRE BUTTONS (Caution high voltage). Reading should be between 130 to 180 VDC on plasma units (open circuit voltage)

NOTE: With the RAW VOLTS TEST Button active the TORCH VOLTS reading in MACH will not be correct. The test loads the circuit. This is normal and it is used only to determine if the unit is getting and dividing the RAW ARC VOLTS.
Connecting a plasma with no internal voltage divider to a DTHC II using the Optional RAV-01 Card

Mounting the RAV-01 Card inside your unit

The mounting location for the card will vary from one type/brand of plasma unit to another. Pick a location and mount the RAV-01 using the Plexiglass shield using small self tapping screws (not furnished) or adhesive Velcro strips. Mount the card at least 1 inch away on all sides from any internal cards, terminals or bare wires. The standoffs of the card are insulated and so the card can be mounted with the plexiglass shield against the chassis. There is high voltage present when the torch fires at the end of the card where the RAW ARC VOLTS is connected. Keep that end of the card away from ANY conductive object closer than 2 inches.

Once you have the RAV-01 Card mounted in a safe location you will need to make provisions to connect the two low voltage cables (CCAB-31 and SAC-01). You need to provide holes on the rear or side of the unit (BE CAREFUL DRILLING METAL IN YOUR UNIT. TINY SHAVINGS CAN FALL ON PARTS THAT COULD SHORT.) Ream the holes smooth or drill them oversized and use a rubber grommet to protect the wires. Clean up with a magnet or blow the cabinet out with air. One hole needs to be able to pass the diameter of the SAC-01 Plug. The other needs to pass the diameter of the cable for the CCAB-31. NOTE: The 4 wide plug on the CCAB-31 cable is removable. You will need to remove the end that passes into the enclosure to fish the wire through for the RAV-01 Connection. BE SURE TO FOLLOW THE COLOR CODE TO REATTACH THE CONNECTOR. THE COLORS ON BOTH ENDS WILL GO ONTO THE SAME TERMINAL/PIN NUMBER. Connect the two cables where the diagram shows to the RAV-01 Card.

Making the connections

A WORD ABOUT ARC OK SIGNALS: “ARC OK” is our terminology of a signal coming back from the plasma unit that signals the unit has fired the torch and has a valid arc. Most plasma units made for manual cutting DO NOT HAVE an ARC OK (also known as ARC XFR; TRANSFER; OK to MOVE and other similar terms). It is a circuit that closes (relay contacts or sometimes called “dry contacts”) on a valid arc. Units that do have the signal will have it labeled, on a connector or covered in their manual. IF YOU HAVE DOUBTS, assume the unit does NOT have ARC OK and follow the guidelines below.

IF YOUR PLASMA HAS AN ARC OK CONNECTION POINT: There will be two connection points. Run a small gauge (18-24 ga) pair of wires from the internal ARC OK points to the two screw terminals on the edge of the RAV-01 Card. This wire carries no high voltage or current. Follow the diagram on Page ______. There is a board labeling program on some cards where the white printing is WRONG! USE THE PICTURES IN THIS MANUAL to make the connection. Make sure the connection is secure and that no stray wires are outside the opening of the screw terminals.

IF YOUR PLASMA DOES NOT HAVE AN ARC OK CONNECTION POINT: Turn to the section on the DCP-01 Digital Current Probe option. You will need to purchase and install this option to provide a reliable ARC OK signal to your DTHCII system.
Connecting a plasma with no internal voltage to a DTHCII using the Optional RAV-01 CARD

Finding the correct connections.

The first signal you need to identify and locate is the Raw Arc Volts (Raw Tip Volts). This is the voltage between the Electrode and the Workclamp. The Hypertherm 1000 thru 1650 series have two spade terminals (J15 and J16) that are for easy connection of Raw Arc Volts. On later models (45/65/85) WITHOUT the internal voltage divider the location of the Raw Arc Volts is not as obvious but they have Field Service Bulletins where they give detailed directions on finding the Raw Arc Volts. Our manual covers connection to the PowerMax 1000, 1250 and 1650 as well as the PowerMax 45.

https://www.hypertherm.com/Xnet/library.jsp/null is a search page where you can enter your model number and then search the FSBs. The files are in PDF format.

For other brands of plasma units or a model not designed to be automated the search for connection points may be a little more difficult but not impossible. The key is the leads going to the torch cable. On most plasma units you can locate these signals by opening the unit (POWER DISCONNECTED!) and visually tracing the wires coming from the plasma torch. The Workclamp will be connected to a stud or terminal inside and is pretty easy to identify. It is the POSITIVE (+) side of the circuit. The Electrode side goes up the plasma cable to the torch head. It will be one heavy wire or a series of smaller gauge (12ga or larger) stranded wires of the same color and they will all connect to the same electrical spot (bus) inside the plasma. In a lot of units these wires are all solid WHITE in color but do not use color as your clue. Some plasma manufacturers provide block level schematics in their use or service manual that give wire colors (and in some cases terminal numbers and locations).

WHEN YOU HAVE LOCATED THE WORKCLAMP AND ELECTRODE WIRES IN THE UNIT:

Using a two conductor wire (18-22 ga) [not supplied] with insulation rated to 400V or more crimp on two ring or fork terminals. USE WIRES OF TWO DIFFERENT COLORS and long enough to reach the RAV-01 Card using an indirect route (give yourself extra wire). Run the first color wire (red or the brightest color) to where the WORKCLAMP attaches. Normally that will be a heavy bus bar with other smaller wires attached. If it is a single large stud you will need a ring terminal that will fit over the stud. That will be your positive (+) wire.

Use the other wire color and run a connection using a ring or fork terminal to where the ELECTRODE wires attach.

Carefully route both wires from their connection points over to where they will attach at spade inputs on the edge of the RAV-01 Card. Keep the wires away from other high voltage wires or components on the circuit board. Use nylon wire ties to secure the wires to other wire bundles or to the chassis. DO NOT WIRE TIE THEM TO COMPONENTS ON THE PC BOARDS. DO NOT USE LOW VOLTAGE WIRES LIKE THOSE USED FOR WIRING PHONES OF NETWORKS.

The next internal signal you need to locate is the TORCH SWITCH. If you are connecting to a unit with a Hand Torch you will need to find and tap into the two wires coming from the torch switch in the hand piece. How will you know? First the wires will be smaller and different colors
That concludes the internal connections you will have to make for your unit. Make sure all leads are insulated and away from possible physical damage. Double check to make sure there are no loose connections and that you have attached/re-attached any wires mentioned in the above guidelines.

Replace all covers and safety devices on the plasma unit and plug the plasma unit into power with the unit switched off. Turn the unit on, and make sure the unit works correctly in manual mode. (i.e. cut a piece of metal by hand). If you have a machine torch manually fire the torch from the Torch On button in MACH3.
CONNECTING TO HAND TORCH SWITCH WIRES FROM RAV-01

ALTERNATE METHOD TO FIRE HAND TORCH IF NOT USING RAV-01 CARD

RJ45 (Cat5) cable to DTHCII Module

Divided volts from CandCNC Raw Arc Volts card

CAUTION: High Voltages Present When TORCH is ON.

CAUTION: High Voltages Present When TORCH is ON.
HYPERTHERM 1000/1250/1650
Connecting THC SENSOR PWM CARD
FOR OPERATION WITH DTHC II

TIP VOLTS CONNECTION

J15 and J16 are Slide-on connectors located on the PCB

Use 18 or 20ga insulated Hookup wire
Insulation rating to 400V Min

J19 Located inside Cabinet on PC Board

Internal connections

Connect to THC SENSOR PWM VIA CCAB-31 Cable

CandCNC
HYPERTHERM 1000/1250/1650 and Thermal Dynamics units with rear CPC connector and no Arc Voltage Divider

Raw arc volts connection points vary from one model to another. Refer to manufacturers manuals for locations.

Optional RAV-01 MOUNTED INSIDE PLASMA

Method to connect to unit with machine torch using rear CPC connector for torch firing and ARC OK

TO CPC CONNECT ON REAR OF PLASMA

MIC-02
For units with CPC but NO Internal Voltage Divider

Use 18 or 20 gauge insulated hookup wire. Insulation rating to 400V Min.

ROUTE SHIELDED CABLE THROUGH REAR BULKHEAD

RJ45 (Cat5) cable to DTHCII Module

Divided volts from CandCNC Raw Arc Volts card

CANDCNC Model

THC SENSOR PWM Module

TO DTHCII Module

Use CAT5 UTP CABLE

ARC VOLTS

Divided volts in MAX VOLS

+5V

+12V

TO TEST BUTTONS

CANDCNC

Remove back cover for access to test buttons.
## HYPERTHERM PowerMAX 45
Connecting THC SENSOR CARD
FOR OPERATION WITH MP3000-DTHC I
and BladeRunner Dragon-Cut series

<table>
<thead>
<tr>
<th>SIGNAL NAME(s)</th>
<th>POWERMAX REF</th>
<th>RAV-01</th>
<th>NOTES</th>
<th>WIRE Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>TORCH SWITCH; START - MECH TORCH</td>
<td>PINS 3 &amp; 4</td>
<td>Screw Term 1 &amp; 2</td>
<td>For use with mechanical Torch ONLY.</td>
<td>18-22Ga stranded low voltage Insulated</td>
</tr>
<tr>
<td></td>
<td>J12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TORCH SWITCH HAND TORCH</td>
<td>ORG &amp; VIO</td>
<td>Screw Term 1 &amp; 2</td>
<td>Parallel taps where Torch Cable Plugs into J10 In PowerMax</td>
<td>18-22Ga stranded low voltage Insulated</td>
</tr>
<tr>
<td></td>
<td>wires at J10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARC VOLTS; RAW TIP VOLTS</td>
<td>J19 &amp; J21</td>
<td>J14 (neg), J15 (pos)</td>
<td>This Is NOT the 50:1 divided voltage at J12. See detailed instructions</td>
<td>18-22 PVC stranded, Insulated, twisted pair min 600V rated Insulation</td>
</tr>
<tr>
<td></td>
<td>Inside Powermax45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARC OK ; ARC XFR</td>
<td>PINS 12 &amp; 14</td>
<td>Screw Term 3 &amp; 4</td>
<td>Dry Contact output from PowerMAX (no voltage)</td>
<td>18-22Ga stranded low voltage Insulated</td>
</tr>
<tr>
<td></td>
<td>J12</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Location of J19 and J21 Inside PowerMAX 45**

**Front**

**CAUTION:** Make sure wires and terminals do not touch anything but the screws for J19 and J21. **HIGH VOLTAGE IS PRESENT WHEN TORCH IS ON.**

---

**To RAV-01:**
- J14 NEG input terminal
- J15 POS input terminal

**Diagram not to scale**
THIS SECTION RESERVED FOR POWERMAX 65.85 HOOKUP DATA
Use CandCNC part # MIC-01

APPENDIX 7: INTERFACE PCB SWITCH SETTINGS
(MOST COMMON SETTINGS)

Automation Interface Switch Setting Chart -
Common Voltage Divider Output Settings

<table>
<thead>
<tr>
<th>SW 4</th>
<th>SW3</th>
<th>SW2</th>
<th>SW1</th>
<th>Volts Out for 100vdc In</th>
<th>Volts Out for 200vdc In</th>
<th>Division Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>6.00</td>
<td>12.00</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>5.00</td>
<td>10.00</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3.3</td>
<td>6.6</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.5</td>
<td>5.0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2.0</td>
<td>4.0</td>
</tr>
</tbody>
</table>

0 = DOWN = OFF, 1 = UP = ON

Factory Default Settings
Suitable for Thermal Dynamics SC-11 Standoff Control:

Other Common Settings:

Preferred Setting: Match THC Sensor PWM setting to this
Thermal Dynamics

AUTOMATION INTERFACE PC BOARD

SWITCH LOCATIONS

Arc Volts Divider
Set Switches

Automation Interface PC Board
Use the drawing to determine if your Thermal Dynamics Plasma cutter has the rear panel CPC connector and/or the complete Automation Interface (provides Arc Voltage divider). Some 52/82/102 units may have the rear connector and the Automation interface. All “A” series units have the rear panel connector with the two signals. Your A series MAY have the Automation Interface Option as well.

Once you have determined the options you have installed then use the flowchart on page to determine what CandCNC options you may need to purchase.
Refer to the following table when connecting the Powermax65 or Powermax85 to a DTHC II torch height controller with a Custom CandCNC Machine Interface Cable

<table>
<thead>
<tr>
<th>Signal</th>
<th>Type</th>
<th>Notes</th>
<th>Connector sockets</th>
<th>CandCNC Cable wires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start (start plasma)</td>
<td>Input</td>
<td>Normally open. 18 VDC open circuit voltage at START terminals. Requires dry contact closure to activate.</td>
<td>3, 4</td>
<td>Green, White</td>
</tr>
<tr>
<td>Arc Transfer (ARC OK)</td>
<td>Output</td>
<td>Normally open. Dry contact closure when the arc transfers.</td>
<td>12, 14</td>
<td>Red, Black</td>
</tr>
<tr>
<td>Ground</td>
<td>Ground</td>
<td></td>
<td>13</td>
<td>Shield</td>
</tr>
<tr>
<td>Voltage divider</td>
<td>Output</td>
<td>Option. Not on all units</td>
<td>5 (-), 6 (+)</td>
<td>Red (-), White (+)</td>
</tr>
</tbody>
</table>

Note: Wire colors for CandCNC Hypertherm CPC Interface cables are different from the wire colors for a Hypertherm CPC interface cable.

Hypertherm and Powermax are registered trademarks for the Hypertherm INC.
HYPERTHERM 45/65/85 Machine Interface
Connection points

Connection Points for Hand Torch Torch Switch

Small headers (pins) on Main Control PCB

VOLTAGE DIVIDER BOARD

START
ARC OK
ARC OK

START
ARC OK
ARC OK

Divided Arc Volts (neg)
Divided Arc Volts (pos)
Physical Location of J21

Connection Points
For Machine Interface
Pin functions are listed
previous page
TORCH SETUP

SETTING THE 5 POSITION DIP SWITCH FOR USE WITH CandCNC DTHC II TORCH SENSOR PWM

To change the factory preset voltage divider from 50:1 to the 20:1 setting (recommended):

1. Turn OFF the power supply and disconnect the power cord
2. Remove the power supply cover.
3. Locate the voltage divider DIP switches on the left side of the power supply

Note: The figure below shows the default setting (50:1) with the number 4 switch up

4. Set the DIP switch

Note: The Hypertherm document has additional switch settings for other divider ratios but ONLY the 20:1 or 50:1 ratios work with the DTHC II and the THC SENSOR PWM module. The divider setting inside the THC SENSOR PWM case (bottom removed) is changed to work with a 20:1, a 50:1 and a 7:1 (CandCNC Raw ARC Volts divider card) input.

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Interfacing using Circular Plastic Connector on Plasma Units with Automation features.

NOTE: The presence of a CPC connector on a Plasma Cutter does not necessarily indicate that it has all (or any) of the signals for direct connection to the DTHC II system. The diagrams and examples listed in the following pages are for specific units that have CPC connectors and a pinout that is consistent with the cables we supply.

As of this published date the following units have CPC connectors with the correct pinout:

Hypertherm 1000/1250/1650 (no divided arc volts)  
Hypertherm 45/65/85 (option with divided arc volts)  
Thermal Dynamics 52/82/102 series (option for connector and Automation Interface)  
Thermal Dynamics A60/A80/A120 (CPC connector standard; Arc Volts divider is an OPTION)  
Thermal Dynamic Automation 151

There may be other models and brands with CPC connectors using the same pinouts. Check with your plasma authorized reseller or service representative for technical information about any automated connectors and pinouts.

On units that have the CPC connector but DO NOT have the Arc Volts Divider you will need to purchase an arc volts divider. The RAV-01 is an ARC VOLTS divider card that is available from CandCNC.

On units with a machine torch you can elect to make all of the connections via the RAV-01 card of use it only for divided Arc Volts and the MIC-02 cable to connect to the rear CPC for the TORCH FIRE and ARC OK.

For hand torch models you may not be able to fire the hand torch via the remote START signal. In that case you will need find and tap into the Torch Switch wires coming from the hand torch. It is suggested that for Hand Torch installs even if the unit has a CPC interface that all connections to/from the THC SENSOR PWM Module be made via the RAV-01 and it’s supplied cables.
MIC-01 is for use with Hypertherm models 45, 65 and 85 and Thermal Dynamics “A” series that have the CPC option installed. The CPC is a round plastic connector on the rear of the units. See the previous pages for the location of the receptical.

MIC-01
Shown with THC Sensor PWM Module

Connects THC Sensor PWM Module directly and picks up:

START (remote start)
TRANSFER (Arc OK)
Divided Arc Volts

Cable comes prewired to plug into the CandCNC THC Sensor PWM Module and the standard CPC plug on the back of 45, 65 and 85 units that have that option. See the previous pages for recommended settings.
SETTING UP AND PLASMA CUTTING WITH THE DTHC II SYSTEM
SETTING UP YOUR Z AXIS FOR AUTOMATIC TOUCH-OFF.

Make sure your Z is calibrated. When you move it 1" by the DRO it actually moves exactly 1". If it does not find the axis setup section in the manual for your control and run the axis setup and calibration. All axis MUST have the correct Steps per Unit setting in MACH.

Check to make sure your Z HOME is working. Make sure MACH is out of RESET. Open MACH to the DIAGNOSTIC Tab and watch the upper right quadrant while you manually trip the Z switch on the Floating Torch Holder. It should light the Y Home LED (only).

Raise your Z above a piece of material. Run a Ref Z move on Z by clicking on the Ref Z button next to the Z DRO (readout). The Z should start to move down towards the material. If it moves in the wrong direction STOP the move and use the CONFIG HOMING/LIMITS in MACH to change the polarity of the Home Neg value. To change it click on the symbol (green check or red X) and it will change to the other value. Save it by clicking OK.

When the Torch Tip hits the metal the Z will continue to move down until it trips the switch. The Z should stop and reverse slightly.

Use the Z Zero Button (next to the Z DRO) and reset the Z DRO to 0.000.

You may want to lower your Jog % in the Diagnostics Tab to 10% or less to slow down the manual jog rate. Carefully jog the Z up using the keyboard hotkey (default is Page Up Key) until you can slip a piece of paper under the torch tip.

Perform the move again and confirm the value. Once you have several readings within .005 then write down the Z DRO reading

The value you have is the Net Switch Offset and will be used in either MACH OR in SHEETCAM (post) but NOT BOTH.
**Note to SHEETCAM (and SheetCAM TNG) users.**

We have provided special Posts for MACH3 and the MP3000-THC to be used when generating output from SheetCAM. It has an automatic “touch-n-go” feature that reads the traveled distance and once it exceeds 500mm (about 20 inches) a Z reference is performed *just prior to the next pierce.*

This post is intended for use with the MP1000-THC and MP3000-DTHC and a floating head setup ONLY. The latest versions of SheetCAM TNG ship with several MP1000 named posts. They will work with all of our THC products (MP1000, MP3000, DTHC, LCTHC, etc)

If you are using SheetCAM you need to open the specific posts (or posts) you use with a text editor (Notepad, etc) and find the line in the post that sets the value of the SwitchOffset. It will look something like this:

```plaintext
dist = 9999999
refdistance = 10* scale
--Put your switch offset value here
  switchoffset = .052
  lastz = 0
```

The `switchoffset` value needs to be set to the number you wrote down when you did the tests on the previous page ([SETTING UP YOUR Z AXIS FOR AUTOMATIC TOUCH-OFF](#)). Make sure you save the file with the .post or the .scp file extension it had to start with.

`refdistance` is the distance you let XY travel before you do the next touch-off sequence. You can change how close (and how often) that sequence happens by raising or lowering the value. Scale in this context is 25.4. Refdistance in in mm so in the example above the actual distance is 254 mm (about 10 inches). That is the combined distance of both X & Y movement. On thin material that may need a touch off before every pierce that the number to 0. Save the POST with another name and select it when doing your final CAM post to G-code.

**b. For non-SHEETCAM users.**

Mach 3 provides added THC functionality and has inputs for pierce height, initial cut height, etc. At this point we have not tested those features so their use is discouraged. It is recommend that any references for the Z while cutting be edited into the g-code as:

```
G00 Z.75
G28.1 Z.5
G92 Z0
G00 Z[your switch travel here in decimal]
G92 Z0
G00 Z.5
```

This should be inserted just prior to the Torch ON (M03) event at any given pierce point where you wish to re-reference the Z
6. Cut quality in plasma is a function of several factors:
   · Clean DRY air.
   · Sufficient and consistent air pressure (typically 65 to 80 PSI)
   · Good consumables.
   · Accurate Pierce Height (Initial Height Sense)
   · Proper Cut Height (Proper adjustment of THC voltage)
   · Correct Pierce Delay
   · Proper Feedrate (cutting speed)
   · Proper settings of the THC Rate and CV settings in MACH3
   · Cut Profile Settings for Span and Tip Saver

If your cut edges are flared in or out check all but the last factor. If your MP3000-DTHC does not respond fast enough on uneven(warped/un-level)material you may need to increase the THCRate (percentage of MaxZspeed) in the MACH Settings Tab from 20% to as high as 50%. Do not go much higher than 50% on a stepper axis, since while the THC has control of the Z, accel/deccel settings for the motor are ignored. If the cuts are jagged on curves, or the movements of the machine becomes jerky, you may need to alter the values for Constant Velocity tuning in MACH3. Each machine is different and the values are preset for a value that works with most machines but your results may vary. See the section in the MACH Manual for

NOTE: If you are using the CandCNC Digital Current Probe (DCP) it can (and should) be used for ARC GOOD (ARC OK) sensing. The following section on the DTHC settings using the CUT PROFILE window explains how to use the DCP-01 and set the parameters for ARC OK. The DCP-01 is a recent addition to the DTHC product line and brings a new dimension to the plasma cutting process.
MP3000-DTHC Screen Section

The following pages cover the operation and screens involved with the CUT PROFILES and the DTHC section of the screen.

NOTE: The DTHC is used in all of our Plug-n-Run products including the MP3000, BladeRunner Dragon-Cut, and the UBOB Builders Kit + DTHC. If the text refers to one of the specific products then take that to mean the same as “any

TORCH HEIGHT CONTROL section

THC ON/OFF BUTTON: The THC functions in MACH are controlled by the THC ON/OFF button on the screen. If the LED above the THC ON/OFF button is greyed out (off) then the THC inputs to MACH are ignored. It also turns off the “Hold for Arc OK” function in MACH so that you can have XYZ motion without getting an ARC OK from the THC Sensor Card (at the plasma unit) If you have the Auto THC ON box checked (in the Cut Profiles Popup) the THC will automatically activate when the RUN button is pressed to run G-code. There may be times you want to run without THC or to tune the THC logic in MACH ON/OFF while cutting. You can use the THC button to do that.

The TORCH ON/OFF button controls turning the torch on/off. Under normal cutting conditions (e.g. running from code) the Torch ON/OFF is controlled from the software. You have the option of turning the torch on or off manually using the button. The Torch button will fire the torch anytime MACH is out of RESET. The TORCH LED above the button shows the status of the Torch output. When it is illuminated the signal is being sent to the Mp3000 to turn on the torch. Anytime the Torch is on (or should be on) through manual OR software activation that LED should will be on.

The TIP SAVER LED is an indicator to let the operator know that the DTHC TIP SAVER circuit has activated and has locked the Z down movement. The parameters used for the Tip Saver are set in the DTHC Cut Profiles Popup window. The settings and operation of the DTHC is covered the DTHC Operation and Setup and the CUT PROFILES part of the manual. NOTE: It is normal for the TIP SAVER to go active at the end of a cut where you would normally get a head dive or as it’s cutting if it cuts across or very close to an existing cut. If the torch preset value is wrong for the type material and tip you are using then the TIP SAVER may come on and stay on. Check your settings if this occurs.
TORCH HEIGHT CONTROL section (continued)

Tip Saver ON/OFF [new]. The Tip Saver ON/OFF button and Indicator LED allows the TIP Saver feature to be disabled. It’s used during setup to get the calibration (Preset Volts) within range and to test to observe the actual cut gap. Once you have those parameters set and stored in the Cut Profile it’s recommended you turn the Tip Saver back on to prevent head dives and tip crashes. If you have conditions where the Tip Saver stays on during a cut it indicates the voltage settings or cut current is set wrong. Correct the problem and run with the Tip Saver engaged.

UP & DOWN LED indicators. These two screen LEDs in MACH show the actual UP and DOWN commands MACH is receiving from the DTHC Module. As the torch cuts and with the DTHC active, you will see the UP and DOWN LEDs change. It will tell you at a glance that MACH is getting the proper signals and coupled with the TIP VOLTS DRO show you the activity of the DTHC. The UP and DOWN LED’s also function as feedback when the MP3000-DTHC Self Test is activated. Please see the setup and testing section for more information. The UP and DOWN signals come into the isolated inputs in MACH and are on the high speed parallel port. This information is not carried on the slower serial interface.

ARC OK Indicator. The ARC OK is a integral part of our cutting system. It is a signal that tells MACH (and the DTHC module) you have a fired the torch and it has a valid arc and you are ready to cut. It also detects the loss of arc and MACH will stop movement BUT not turn off the torch output signal. The DTHC can be set to do that function independent of MACH (see the section on General THC Settings). If you do not get Arc OK MACH will not release motion and the DTHC will not start processing data to send UP and DOWN commands to MACH. Some Plasma units have a signal (normally “dry contacts...which are basically relay contacts with no connection to the internal circuit or voltage. On other machines you may have to order the optional Current Transformer (CT) part # CT-01 kit to get an ARC OK signal. IT’s a REQUIRED SIGNAL.
Using Smart-Kut for Plasma.

Smart-Kut® is an exclusive feature of the DTHC from CandCNC. It allows the operator to let the DTHC II set it’s own PRESET VOLTS value rather than taking it from a Cut Profile or from the screen settings.

Here is how it works:

The operator presses the Auto Learn button once and the NEXT CUT LED will illuminate. At the next start point (Torch On event) the SMART KUT will wait until the torch has fired, moved from pierce height to Initial cut height (Beginning cut height as set in your CAM POST) and then delay for the period defined in the THC DELAY in the CUT PROFILES (see the DCP manual for setup and calibration). The Auto Learn process starts after the preset THC Delay in the Cut Profiles and runs for 1.2 seconds of cut. It averages all the readings during that period and then sets the PRESET Value to the averaged value.

The function can be put into continuous mode by pressing the Auto Learn button twice. The Continuous LED will light and the torch will Auto Learn on every cut. Pressing the button while in Continuous Mode turns the Mode OFF.

NOTE: It is not a good idea to use the Continuous Mode on a job with mixed types of cuts. Some cuts may not be long enough or may be small enough to keep normal cut rates from being achieved (like holes and detailed scroll work) so the Auto Learn will “learn” the wrong value.

IT IS EXTREMELY IMPORTANT that you have the Floating Torch Holder setup, operational and calibrated. The Auto Learn works on the principle that the touch-off sequence is finding the top of material, accurately backing off (Switchoffset value in SheetCAM), that the pierce height is accurate, that the Initial Cut height (height the torch moves to from the pierce height) is accurate, and is the correct value for the torch you have. If the touch off sequence is wrong, so will be the value the Auto Learn sets. DO NOT USE THE SMART-KUT Feature until you have the torch cutting correctly using presets and it is touching off correctly EVERY TIME! SMART KUT will not compensate for not having the system setup and working correctly!
The MP3000 Control provides controls to change the cut parameters for the DTHC. It allows the operator to set and change values before and while cutting.

**UP ARROW Button:** The UP arrow increases the PRESET VOLTS by one full volt per click in essence raising the torch and increasing the gap. It increments the PRESET VOLTS DRO and **automatically sends the value to the DTHC.** This can be useful since you can change the PRESET VOLTS while cutting which will adjust the CUT GAP at the TORCH. Sometimes a volt or two of “tweek” can improve the cut. At the end of the cut the Current Settings will remain (for the next cut) and they become the new “Current Settings” in the memory of the DTHC so if the system is shutdown, the next time it comes up, the values will be the new setting. See the section on using the Cut Profiles button.

**DOWN ARROW Button:** Performs the same function as the UP ARROW but decrements the PRESET VOLTS DRO (value). It has the same effect as lowering the torch and decreasing the Tip Volts.

**SEND to MP3000 Button:** This button is provided in the event you enter a value directly into the PRESET VOLTS DRO and then need to update the current settings with that value. To enter a value into a DRO you must select the DRO (background color will change), Type in the new value and hit ENTER on the keyboard. If you fail to hit ENTER the value will not “stick” and reverts back to the previous value. Do not use the direct DRO input while cutting! It made to change the value by a large amount like when you change tip sizes or go to Fine Cut Consummables. Normally a few volts is all you need to adjust to make a big difference in the cut gap.

**TORCH VOLTS DRO** Shows the actual volts at the Torch Tip. It will change as the Torch cuts but with the DTHC engaged (and the THC button in MACH3 Active) it should track closely the PRESET VOLTS provided the TIP SAVER or THC FAULT has not been tripped.
MP3000 Conrol Secion (Cont)

**PRESET VOLTS.** This is probably the most important DRO on the screen. It displays the “target” voltage you need to achieve a given gap. It forms a feedback servo circuit that will read the actual troch volts, compare it the the Preset Volts and raise or lower the torch (via the Z) to try and make them match. If you have the Preset volts entered correctly for the specific tip, current and material the gap will be correct. If you are off a few volts you can get a condition where the torch pulls up and out if the cut OR moves down and hits the metal. It can cause another condition where the TIP SAVER locks the down motion (which is what it is supposed to do). It is important the you have the proper value if Preset Volts. If your plasma unit has an operator manual with cut charts then the preset (target) voltages will be listed and are a good starting point. If your plasma does not have a chart you will have to build one yourself. Set the Tip Saver Percentage to 10% in the Cut Profile (see CUT PROFILE Functions) and setup a manual cut so you position the cut gap manually (above the material) and make a line cut. Observe the TORCH VOLTS and establish a voltage average and use that as the beginning Preset Volts for your automated cut. Most plasma units cut from 100V to 150 VDC for normal nozzle (tip sizes) and from 75 to 90V for smaller (Fine Cut) tip sizes. The Preset Volts DOES NOT SET THE HEIGHT it establishes a voltage (reference point) like an auto-pilot that will adjust the Z to match the Torch Volts (actual gap volts) to the Preset Value.

**TORCH AMPS. This DRO is active ONLY if you have the optional Digital Current Probe.** It will display the ACTUAL cutting current of the plasma cutter in real time. It should display close to the setting you have on the front of your plasma cutter while the cut is being made. There are settings in the CUT PROFILE that can be used with the TORCH AMPS to provide trigger points to warn the operator and an option to STOP the machine.
USING TORCH AMPS FOR TROUBLESHOOTING A BAD CUT.

The TORCH AMPS can be a valuable tool to help diagnose and fix poor cutting or loss of arc and other annoying problems. Not all cut issues are from improper current but a good plasma cut cannot occur if the cut current is too far out of the specified value. The whole process of Torch Height Control depends on the current being constant and the value set on the plasma unit.

If you are experiencing problems cutting with the DTHC and it has passed all of the self tests, then setup and make a manual cut at a constant height (the recommended Cut gap) and watch the TORCH AMPS DRO. While cutting it should be close to the value you have set on the plasma machine front panel (dial value) If it is not here is a list of things to check:

<table>
<thead>
<tr>
<th>TORCH AMPS TOO LOW</th>
<th>Bad Workclamp Connection (either end)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Workclamp not on material</td>
</tr>
<tr>
<td></td>
<td>Current Setting on Plasma Unit wrong</td>
</tr>
<tr>
<td></td>
<td>Plasma Current not calibrated to knob</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>TORCH AMPS VARIES DURING CUT</th>
<th>Bad Workclamp Connection (either end)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Bad material (rusty/dirty)</td>
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<tr>
<td></td>
<td>Worn defective consumables</td>
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<table>
<thead>
<tr>
<th>TORCH AMPS TOO HIGH</th>
<th>Current Setting on Plasma Unit wrong</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Constant Current circuit in Plasma Unit not working</td>
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</table>
CURRENT SETTINGS BUTTON: Shows the current profile and settings being used by the DTHC. The DTHC uses a real time processor to process the torch volts and send the proper signals to MACH. The processor stores the settings in NVRAM (non-volatile ram) Changing any setting in the Settings Group or the General THC Settings and using OK (closes the window) saves the profile (writes it to the DTHC processor RAM. You must close the window to be able to access the MACH screen and to move the machine (JOG) or RUN g-code. Cancel cancels any changes you have made before you exit.

The DTHC module "remembers" the settings you used last even if you power everything off. The Cut Profile values are sent to the DTHC module (via a serial connection from the PC to the UBOB and up to the DTHC module) The "Current Values are what is in the DTHC memory. Values are transferred when you hit OK NOT when they are just displayed. ONLY the CURRENT SETTINGS values are what the DTHC uses during cutting. If you pull up a profile and do not transfer it to the DTHC module.

PROFILE LIST BOX: Shows a list of all saved profiles. Any profile can be selected and those parameters will be transferred to the Current Settings screen. You can Add new Profiles using the Add button. To delete an entire profile, highlight the profile by clicking on it and hit the Delete Button. If for any reason the DTHC module has lost communication with MACH the settings on the screen ARE NOT SAVED to the NVRAM and opening the screen again to display CURRENT SETTINGS will show the old settings. Check to make sure the THC ONLINE LED is on.
Adding Profiles. As you do cutting on your table using the DTHC Digital Torch Height Control you will be able to choose optimized settings for each type of cutting you do. You can edit and save an existing Cut Profile or ADD a new one of your own. Since there are variables that change from one machine to another the sample values may or may not be usable in your environment. It’s best to start out with the default Settings and use the Tip Volt Preset recommended by your plasma manufacturer. **If your plasma machine has no documentation or recommended cut charts then go to the Plasma Setup section in this manual and use the Initial setup and calibration methods to establish a base line for building your own charts.**

The two most critical components are the feedrate (set in the G-Code and CAM program) and the Tip Volt Preset. Since both values vary between machines it’s best to run a series of tests. Even the cut gap (distance from the tip to the material) and the gap volts (actual tip volts) varies from one plasma manufacturer to another.

**Example:** A Hypertherm G series calls for .063 (1/16) cut gap and a tip volts reading of 140VDC on 10Ga material with a 40A tip. A Thermal Dynamics unit uses a wider cut gap (about .1 to .12) and lower tip volts (about 110VDC) for the same material. Other machines will vary. It’s best to develop your own values for your machine over time and store them in the Cut Profiles. **NOTE:** The Cut Profiles are stored in a flat file named THC_Profiles.txt located in the main MACH3 folder. It’s a good idea to back up your MACH settings (XML files), Screens (SET Files) and the Cut Profile listed. Restoring values from a backup copy can save hours or frustration.
INFORMATION GROUP:
The Information section at the top of the window is for storing information that you can refer to. It saves time by having the vital cut parameters instantly available to the operator. **The information group does not set anything for cutting and will not modify any cut parameters from the g-code.** It is there to use as a reference in place of having to go to the User Manual and Cut Charts to get the numbers.

**PROFILE NAME:** The Profile Name is important because that is the name that shows up in the Profile List Box. Use names that will help you find the right profile quickly.

**MATERIAL:** Allows you to list material detail. It helps the operator confirm that the setting matches the material being cut.

**FEEDRATE:** The recommended Feed Rate, This is informational for reference only and does not set the actual feedrate the file runs at. It gives the operator a value to confirm when the job runs. Feedrates are set in g-code (from the CAM program). The operator can use the Feedrate Override controls on the Program Run Screen to adjust the feedrate.

**TIP SIZE:** Memo field to remind the operator what size tip (nozzle) to use for cutting. Typically tips are rated in “AMPS” with common sizes being 25, 30, 40, 60, 80 and larger on bigger plasma cutters. The orifice size is the primary difference between tips. The smaller the orifice the lower the current rating. Smaller tips cut with a smaller kerf width and at lower feedrates and current settings. The plasma manufacturers suggest using the smallest tip (nozzle) size for a given material thickness (from their charts) to get best cut quality. If you cut 16ga with a 60A tip you should expect less than optimum cuts. Merely turning down the current on a larger rated tip is not the same as using a smaller tip size and results in different arc voltage (Torch Volts) requirements to maintain the correct arc gap.
### SETTINGS GROUP:

The Settings Group consists of important values that the DTHC uses to cut with. These values are not taken from code and need to be correct for the type of cutting you are doing. Changing a value in this group will change the way the DTHC reacts and cuts. Typically the default values will work fine. **Do not make large changes in numbers to try and fix a problem. Change one parameter at a time.** If you have been getting good cuts on the same type of material and the cut quality changes or the DTHC will not track correctly you should not start making changes in the Settings values to try and correct the problem. You should confirm that all external influences have been checked and eliminated. Worn or clogged tips, electrodes or vent holes around the nozzle will cause cut quality to suffer. The air supply must be dry and clean and of sufficient volume. The workclamp lead should be clean and clamped tightly onto the workpiece. Often just clamping it to the table is not sufficient and can cause tip volts to vary and the DTHC to cut above or below the proper height.

**Tip Volt Preset** (Volts) This is the value you use for the Preset for tip volts. It is sometimes called the TARGET value. Plasma cutting is done with the tip above the metal. The Arc Gap (distance between the tip/nozzle and the material being cut) determines the tip volts (and vice versa). Change one and you change the other. The wider the gap the higher the actual tip volts. The DTHC reads the actual tip volts and compares that to the Preset Tip Volts, and decides if the torch head needs to raise (UP) or lower (Down). It is, in essence, a servo system that tries to keep the gap constant by keeping the actual Tip Volts equal to the Preset Tip Volts. Study the section on Proper Plasma Cutting and understand the relationship of Preset and Actual tip volts.

**SPAN GAP** (VOLTS): This is the tolerance range in which the DTHC is “satisfied” with the match between the Preset Tip Volts and the Actual Tip volts. It is set in 1/4 volt increments. The lowest setting is 1/4 volt. As long as the actual Tip Volts is within the setting the Torch will not go UP or DOWN. **For most cutting a value of “4” (meaning 4/4 volts or 1 volt) is recommended.** This value can be changed to give more or less tolerance. For small tips or Fine Cut tips a value of 2/4 (1/2V) will provide finer cuts. On bigger tips and thicker material the value can be raised slightly.

**THC DELAY** (sec). This is the time the DTHC waits before it starts to measure the actual tip volts immediately following a pierce. The pierce is typically down at a height greater than the cut height (usually about 2X normal cut height). The gap is wider and the voltage spikes as the pierce is being made. If the circuit starts to measure voltage before the end of the piece cycle it can cause the TIP SAVER cut in and prevent the Z from moving down from pierce height to Initial Cut Height (Head Lock) The circuit will remain locked as long as the voltage is the percentage out from the PRESET VOLTS VALUE. If the tip stays too high it may trigger the UPPER FAULT Limit and depending on the settings in the General THC Settings group, issue a STOP and turn off the motion and Torch. This can all happen in fractions of a second and just looks like a misfire and stop. For this reason we have a minimum of ½ sec (.5) in the THC delay. **IF you see conditions where the TIP SAVER locks on (LED stays on with the torch Fired, and keeps the torch from moving all the way down to proper cut height you should adjust the THC Delay value up by ½ sec increments until at the fault/lock condition no longer occurs.**
**TIP SAVER %**: This value determines the lowest the DTHC will let the torch head go **down** before it locks movement. It’s a percentage of the Preset Tip Volts. It constantly measures the actual tip volts and if the value is too high, it keeps the Torch from moving down any lower. (remember that if the actual voltage is ABOVE the Preset it will LOWER the torch until they match.) Under certain cutting conditions, for example where the cut passes over a void or another cut line, the voltage will go up, and the normal reaction is for the torch to “dive” down. The torch will dive any time the flame has less metal to cut. At the end of a closed cut (i.e a circle or polyline object) where the end is close to the beginning the voltage will climb and cause the torch to dive down. In some cases it hits the metal. By setting the Tip Saver % to a value that represents a voltage that will still have the tip off the metal, tip crashes are prevented. Since the head is free to climb up it just sets a minimum gap based on the volts. This feature can save tips and even end caps and torch damage from the head dropping into a void.

**UPPER FAULT LIMIT/LOWER FAULT LIMIT**: Consider this to be an outside (of the Lock %) set of limits that detect a serious fault condition and applies one or more of the General THC parameters. The Upper fault limit is in absolute volts. It’s in Tip Volts (rather than a percentage) It’s the highest volt reading you will allow before the fault triggers one or more of the **action parameters**. Since a high voltage would indicate a large gap and the possibility of the torch cutting air over a void the User can define that motion STOPs, the Torch turns off and the Torch raises rapidly to Safe Z height (set in MACH). Unlike the Head Lock, set by the TIP SAVER % value, this does not just inhibit the Z movement, but instead shuts down operation. The act of running off the side of a piece of material or entering a section already cut can drive the head down. The head lock will prevent it from going too low, but not stop the machine. The Faults will trigger after the head locks (and voltage still keeps climbing or lowering) and execute the selected items in the General THC Settings.

**NOTE**: THE FOLLOWING SETTINGS ARE FOR UNITS THAT HAVE THE DIGITAL CURRENT PROBE (DCP) OPTION. If you do not have the DCP installed and setup, the values listed have no effect. When the DCP is used the return current is displayed on the TORCH AMPS Readout (DRO).and used by the settings below to trigger certain functions. Please see the DCP section in this manual for setup and calibration of the DCP.

**Arc OK Current (AMPS)**. The minimum current to turn on the ARC OK signal. This works in parallel with any existing ARC OK signal from the plasma or can be used as the exclusive ARC OK sensor. By setting the ARC OK value for different materials you can fine tune the cut process so that thicker material requires more ARC OK Current. Set the ARC OK Current to approx ½ of the normal Cut Current of the material as a default starting point. You can adjust that value by material type if you want.
Cut Current  This is the *target cut current setting* in amps based on the specific nozzle (tip) you are using and the material you are cutting. The suggested Cut Current is listed on the manufacturer's CUT CHART. If you do not have a cut chart for your plasma, set the value to the current rating of the nozzle (tip) you are using. THIS DOES NOT REMOTELY SET THE PLASMA CUT CURRENT. You must still do that manually using the knob on the plasma control panel. What Cut Current does is set a reference point for the current you SHOULD be cutting at based on the tip and material. This value will vary based mainly on the specific nozzle size you are using.

Current Tolerance. This is how much you will allow the actual current (as measured by the DCP and displayed on the TORCH AMPS DRO) from the Current Setting above. For example, you might be cutting 10ga mild steel with a 40A nozzle. The plasma current setting (knob on the front of the unit) would typically be set to 40 and you would have the Cut Current setting in the Cut Profile set to 40. A tolerance of 20% would mean that you would allow the current to be as high as 48A and as low as 32A before an alarm or fault action was activated. By monitoring the actual cutting current, actual cutting voltage (TORCH VOLTS) and the ARC OK you have a complete set of parameters to measure your plasma cutting with.
GENERAL THC SETTINGS

The General THC Settings allow the operator to define certain actions and options that are applied when a Fault or MACH condition occurs. **The General THC Options are GLOBAL. They apply to all Cut Profiles.** Changing a setting changes it for all Cut Profiles. The following is a list of the General THC Settings and what they do.

**STOP on FAULT.** If a THC FAULT occurs based on the settings of UPPER FAULT LIMIT or LOWER FAULT LIMIT the Stop on Fault (if checked) issues a STOP command to MACH3. A STOP command stops execution of G-CODE and stops motion via normal deceleration. All outputs (including the Torch) are turned off.

**RAISE HEAD on FAULT.** If this box is checked the Z (torch) will rapid UP to the defined Safe Z (Settings TAB). It’s recommended you combine this option with the STOP on FAULT action above. If used alone it could result in the torch staying on and motion continuing but with the head at Safe Z.

**AUTO THC ON. This option is for the distracted or absent minded operator.** It automatically turns on the THC Button in MACH whenever the machine is out of reset and the RUN button (to start the G-Code program running) is pressed. After the DTHC turns on with the automatic option you can turn if off and back on at any point in the cut. If you want to run with no THC (MACH ignores UP & DOWN commands from the DTHC) you can de-select this option OR just turn off the THC via the screen button after the cut starts.

**THC OFF on ARC LOSS.** Usually (by definition) if you lose arc the plasma unit will turn off the torch or conversely you lose arc if the torch turns off. If the plasma unit turns off the torch (for any reason) MACH will continue to hold the Torch Output on. The TORCH OFF on ARC LOSS turns off the Torch Output any time the DTHC loses the Arc OK signal for more than 1 second. The delay is there in case the arc is reestablished and the torch should remain on. There are conditions where you can lose the Arc OK signal but it quickly comes back and the delay allows that to happen.

**STOP ON CURRENT FAULT.** This setting will issue a STOP if the TORCH AMPS falls outside the Current Tolerance Range of the Cut Current preset (in the SETTINGS section). Only check this box if you wish the machine to STOP if the actual cut current is out of the range set. This option works best for unattended cutting where poor cutting current would ruin a piece. **THIS VALUE NEEDS TO BE LEFT OFF (unchecked) IF YOU DO NOT HAVE THE OPTIONAL DCP.** The operator will still be warned on the main screen if the current fault occurs even if the Stop On Current Fault is turned off.
THC Status box

Gives visual feedback of THC ONLINE and the INCREMENTAL MOVES of the Z as it's under DTHC Control.

THC Moves DRO shows the actual realtime moves in incremental values of the Z. It does not show the absolute value of Z and changes to fast to be used as a position indicator but it allows the operator to confirm that moves are being sent to the pulsing engine in MACH to adjust the Z up and down. The numbers at any given instant may be positive or negative since each one is relative to the previous position. The THC Moves DRO reflects a register in MACH that is used to update the Z DRO. At intervals along the cut the THC Moves is totaled and sent to the Z DRO. At the end of a cut (torch off) it’s important that the THC Moves display 0.00 value, indicating that it has updated the Z DRO with the last moves.

THC ONLINE shows that the MACH DTHC Plug-in is talking to the DTHC hardware via the serial port. It should stay on anytime MACH is running and the DTHC is present and powered up. It’s an instant visual check that the DTHC is active on the Serial communications between the PC and UBOB are working.
Final Testing

Doing a startup test using a manual cut ....DO NOT SKIP THIS TEST!

1. To establish that the DTHC is working and to find the best Tip Volts setting and initial cut height parameters, you should make a cut with the THC Button in MACH turned off, with the tip at the right cut gap for your plasma and watch the TORCH VOLTS DRO on the MACH screen.

   a. Generate a cut file consisting of long straight cuts. You need enough time to watch the screen indications (DRO readouts and LED’s)
   b. At this point you should have your touch-off moves and distance setup and calibrated. IF YOU DO NOT or do not have a floating torch holder you will not be able to do automated cutting of thinner material.
   c. With the cut gap set to the recommended distance (varies from .063 to .130 depending on the specific plasma unit) Make a series of long straight cuts WITH THE THC BUTTON IN MACH TURNED OFF (Manual cut mode). NOTE: The THC is set to automatically turn on when the torch fires in most CUT PROFILES. Simply turn if OFF with the THC BUTTON to do the test. The Z should remain steady (no movement)
   d. As the cut is made watch the indicators on the DTHC screen in MACH. The TORCH VOLTS will display the actual volts at the cut. It should be close to the recommended volts the torch manufacturer calls for. If you don’t have those numbers then watch the voltage and pick an average and make note of it. If the voltage is way off from recommended, check the current setting on the Plasma unit. Check the tip size and for excessive wear. Replace consumables if necessary. Make sure you have a GOOD Workclamp connection to the Material (not just the table or cut grid).
   e. If the DTHC software goes into head lock (Tip Saver) during the test cut, open the CUT PROFILE (stored settings) Current Settings and widen the TIP Saver percentage and of spec cuts EVEN IF THE THC in MACH IS OFF!
   f. As the cut progresses and you have the TORCH VOLTS number THEN watch the other DTHC indicators. The UP and DOWN should be active if the Target Volts setting is close to what you are seeing on the TORCH VOLTS. Make sure you have a constant ARC OK indication while the torch is on.

   **IMPORTANT CONCEPT:** Torch Volts reflects the Arc Gap (distance between the tip and the material with the torch cutting). It is what the DTHC uses to measure height. Because the ARC Gap is small it takes very little voltage change to indicate a relative major gap change. Changes of .020 in a gap of .063 are significant! The Preset Volts(Target Volts) tells the DTHC what you want that gap voltage to be. It is not a magic radar that senses the height. The manual test is to establish that the ARC Volts are indeed close to being correct with no adjustment of the torch that would change them. It also establishes a valid setting for the DTHC Target Volts. If you get a number from TORCH VOLTS that is more than 5% out or the recommend volts (on average) or you do not have a chart to work from then USE THE TORCH VOLTS setting you get from the manual test AS A BEGINNING POINT FOR THE TEST WITH THE THC BUTTON ON!

   g. After the first cut and you have a TORCH VOLT Reading, Use the UP or DOWN (or type the value and hit the SEND TO DTHC button) to load the value you have derived in the first test into the PRESET VOLTS DRO.
h. **Run the manual cut test again with the new PRESET VOLTS value.** Watch the UP and the DOWN LED indicators. You should see them turn on and change as the cut progresses. The ARC OK MUST be active (ON) for the UP and DOWN from the DTHC to work. The UP should come on any time the TORCH VOLTS is less than 1 volt LOWER than the PRESET VOLTS. The DOWN should come on any time the TORCH VOLTS is 1 volt higher than the PRESET VOLTS. All this happens pretty fast so you may need to make several manual test cuts. On each test it’s important that the actual ARC GAP (Tip to material distance) is constant and the material is flat so you get consistent readings.

**IMPORTANT!**

If you have skipped the manual cut test or did not get consistent results from it, your DTHC II is NOT GOING TO FIX THE PROBLEM AUTOMATICALLY. Just setting a random value (shooting in the dark) or just using the values in the cut chart and expecting it to just work is a formula for failure. **DO NOT CALL FOR SUPPORT IF YOU CANNOT GIVE US THE RESULTS OF THE MANUAL TEST.**

**TESTING THE DTHC II WITH an AUTOMATED CUT FILE.**

If you have the Floating Torch Holder setup (Auto touch off) then you should have it already setup with the correct values so that it will touch off, raise the Z up to the top of the material and reset the Z to zero (from the g-code). The automated test cut file needs to be generated from a POST that is for MACH3. If you have SHEETCAM, select **any post that is for an MP1000 or MP3000 in the name.** Those posts **ONLY WORK** WITH THE FLOATING HEAD setup.

1. Generate a series of basic shapes in your CAD/DRAWING. Process them in CAM to define the cut parameters. In SHEETCAM you define certain parameters for plasma cutting in the TOOL you use to generate the G-Code.

2. Use the DTHC II settings you derived from your manual tests. Make any adjustments to the PRESET VOLTS one volt at a time using the UP arrow or DOWN arrow buttons on the DTHC screen in MACH.

3. Remember that each tip (nozzle) size and material type/thickness needs different settings to cut properly. The PRESET VOLTS does not set an absolute height, it just defines a height **under specific conditions.** The CUT PROFILES is a Stored Settings feature that lets you enter and store various parameters for different types of cutting.

4. One of the most frequent mistakes made is either having the current setting on the plasma unit wrong for the nozzle you are using OR forgetting to clip on the Workclamp. The DCP-01 will detect those type of conditions and warn the operator.
Kerf width: Sets the width offset used for inside or outside cuts. If you don’t know the value go back to you manual cut you made and measure the width.

Feed Rate: The recommended feedrate for this tip. This is a default value and can be changed when you build the cut file to match the material you are cutting.

Preheat: Not used for plasma

**Pierce Delay:** Zero for material thinner than .187. The pierce dely is a total of this setting PLUS the time it takes the ARC OK to light PLUS the time it takes the torch to PLUNGE (at the Set rate) from Pierce Height to Cut Height. Excessive pierce delay can result in voltage spikes that will “confuse” the DTHC and cause the TIP saver to lock on or the torch to plunge. Whatever the recommended pierce delay is on your chart make sure you subtract the cycle time of the numbers above.

**Pierce Height:** The recommended piece height for your plasma. Usually 2 times the recommended cut height on material thicker than .125 (3mm). This define how far the torch will lift above the material after a touch off.

Plunge rate: How fast the Z moves down from Pierce height to Cut height.

**Cut Height:** The beginning cut height before the DTHC takes over after its programmed delay (default 1 sec).

Pause at end of cut: A pause after the torch is turned off from MACH to let the arc die out and voltage to go to zero. Recommended ½ sec to 1 sec.
ADDENDUM

1. Digital Current Probe Install & setup
2. Grounding Practices for plasma noise suppression
3. Troubleshooting Charts
Good connection to the workpiece with clamp is essential for proper operation of the THC.

- RAW ARC VOLTAGE
- TORCH SWITCH
- DCP Interconnect cable
- RJ45 (CAT5) to DTHC II Moduler Input connector
Digital Current Probe Model DCP-01

Physical install and hookup

DCP-01 Digital Current Probe uses the existing THC SENSOR (rev14 or above) and slips over the Plasma System Workclamp lead wire to provide DC amp feedback to the DTHC and to the MACH screen. The following series of photos shows the DCP being hooked up to a plasma cutter.

Start by removing the ground clamp from your plasma workclamp. If it has a large ring terminal on the end where it attaches to the clamp you will need remove the ring terminal and replace it with a new one after you push it through the DCP unit.

Loosen the cable strain relief/clamps on each end of the box by twisting the retainer nut counterclockwise viewed from the end. The Strain relief has an internal collar that clamps down on the wire the more it is tightened.

Straighten the wire as much as possible and start feeding it from the right hand side.

Push the wire through gently. If it hangs try rotating the wire and pushing but do not force it. There is a round hole in the Hall probe inside the box that the wire has to pass through. It is located close to the right side of the unit. If you have problems getting the wire to go though pull the wire out and remove the 4 screws holding the top and remove the top and the PCB with the Hall Probe (see next page). Thread the wire though the right side strain relief and pull enough through so you can thread the Hall Probe on the card and then over and out of the left side strain relief.
Workclamp Lead Wire goes through Hall Probe center as shown. Top shown flipped 180 degs

NOTE: Your DCP-01 unit will ship with a 8 ft interconnect cable to connect it to the THC SENSOR card. That connection is covered in the Setup and Test section for the DCP and comes in the side of the unit. If you remove the top cover pull carefully to prevent breaking or disconnecting the interconnect cable. If it comes loose the DCP setup section has the wire colors and hookup for the cable

When you have the Workclamp lead wire threaded through the box, hand tighten the outside nuts on each strain relief until it is tight around the cable. It is important that each end is sealed to keep out plasma dust and smoke. Position the DCP-01 along the cable close to the plasma unit and in a place it will not get stepped on, crushed or can will dragged across the floor if you decide to move your plasma unit or use it manually in the shop. The enclosure is sealed and rugged but it can be damaged by excessive abuse.
Do the following steps in order:

1. Connect the DCP-01 interface cable (RJ11 flat silver to the THC SENSOR PWM front panel jack labeled DCP. You should get a positive “click” as the cable is seated. Removing the cable should require releasing the locking pin.

2. If your THC SENSOR is mounted in a box or inside the plasma unit then you will need to make provisions to route the wire to the THC SENSOR. Keep the DCP interface cable away from the high voltage TIP Volts end of the THC SENSOR card.

3. If you are connecting up your DTHC II and THC SENSOR PWM for the first time, make the connections to the THC SENSOR PWM Module and the CAT5 cable back to the DTHC II module (front Panel connector on the MP3000-DTHC or the BladeRunner Dragon Cut. Do this BEFORE you make the Tip Volts (Arc volts) connection or the TORCH SWITCH. You can run some tests on the THC SENSOR Card and the DCP without having the plasma unit turned on or the Tip Volts present.
4. Start MACH3 on the controller PC and load the profile and screen set for the DTHC. If this is the first time you have used the DTHC and MACH you should have had MACH loaded and setup. If you do not, STOP! Go back to the MP3000-DTHC or the BladeRunner AIO manual and first setup MACH and get your table moving and the proper MACH profile loaded for your system.

This dialog box or one similar to it should appear in the center part of your MACH main screen if you are running the right profile. The important readouts (DRO’s) are the TORCH AMPS. We will be using the TORCH AMPS readout to calibrate the DCP and then use the Stored Settings Button to preset some values for the DCP. It’s important that you have gone through the DTHC setup in this manual FIRST and that you have confirmed (using the DTCH self-test button that it is working properly. The DTHC ONLINE Led at the bottom should be ON (Green). If it is NOT you cannot go further in the DCP setup until the issue is resolved!

5. Power up the MP3000-DTHC or the BladeRunner (or your UBOB Builders Kit + DTHC) so the DTHC module has power. The first thing you should see is that the +15 LED and -15 LED on the font of the DCP light up. The ACT (activity) LED will NOT be on.

6. Bring MACH out of reset. On any unit with our ESP smart power controller (including Bladerunners) you MUST have the DC power to the motors on to come out of reset. At this stage you should have MACH setup, running and know how to come out of reset.

7. Make sure that the DTHC II module is communicating with MACH. The DTHC ONLINE Led should be ON (green) When you activate the DTHC II Self-test the TORCH VOLTS should change from 100 to 150 and the THC UP and THC DOWN leds (and ARC OK) will alternate off and on. The TORCH VOLTS comes from the DTHC across the PC serial port connection to MACH. Without the serial communications you will not get Torch Volts and you will not be able to see TORCH AMPS.
8. Once you have determined the DTHC passes self-test then locate the small hole in the front of the DCP unit (marked CAL and TEST). You will need a small screwdriver or probe tip (paperclip?). You will feel the button click. Push it once to turn on the TEST/CAL function. When it is active the ACT LED (yellow) will flash.

TO TURN OFF TEST/CAL MODE on the DCP-01 push the recessed CAL/Test button once and the ACT LED should stop flashing and the TORCH AMPS readout should return to 0

9. While you are in TEST/CAL mode (LED blinking) the TORCH AMPS should display a value. If you are installing a DCP on an existing product with a DTHC the calibration will be off so the number you see could be anything from ___ to ___. If your unit displays 100 volts as shown then you continue on to final testing and CUT PROFILE Setup. IF YOUR VOLTAGE IS NOT 100 You will need to proceed to the CALIBRATION SECTION

CALIBRATION of the DCP-01
Use this section any time you put the unit into TEST/CAL and the displayed value in the TORCH AMPS readout is NOT 100 as shown.

1. To calibrate the DTHC module to the DCP-01 you must have access to the top of the DTHC Expansion Module. Refer to your product manual to identify and access the DTHC module. It is the small PCB card behind the panel on all CandCNC units where the DB9 cable from the THC Sensor plugs in. In most cases all you have to do to gain access is remove the top cover (MP3000-DTHC) or the Front panel (BladeRunner AIO). Use the photos below to find and identify the DTHC card and the correct adjustment point for the DCP. CAUTION there are two identical pots (variable resistors) in the card. One is the DCP calibration pot. The other is the TORCH VOLTS calibration pot and is set at the factory DO NOT ADJUST THE WRONG POT. IF YOU ACCIDENTLY CHANGE THE TORCH VOLTS (wrong pot) you will throw your DTHC unit out of calibration and you will need to run the TEST/CAL sequence on the THC SENSOR PWM module and reset the displayed volts. NOTE: SOME later rev’s of the DTHC II module may not have the arc volts calibration pot. If it does not exist then ignore the above procedure. Check the photos. Study the board orientation and MAKE SURE you are adjusting the pot. This calibration should only have to be done once so take the time to do it right.
DTHC EXPANION MODULE. Located above the UBOB III card in most CandCNC products. Ribbon cable connecting DTHC down to UBOB card may cover adjustment pots. If so, gently move it out of the way. Do not unplug the ribbon cable or the card will be disabled.

2. Using the diagram below and with the DCP in the TEST/CAL mode (LED flashing) adjust the DCP calibration pot while watching the TORCH AMPS DRO in the MACH screen. Adjust the pot until the value displayed is 100 AMPs.

Your calibration procedure is complete!

Green Power LED Should be ON

DCP Calibration POT ADJUST per the instructions

16 pin header (plug) for DTHC to UBOB Cable

RJ45 connector for cable to THC SENSOR CARD

DTHC Self Test LED

TORCH VOLTS Calibration
DO NOT ADJUST THIS POT.
Unit is calibrated at the factory.
OPERATION of the DTHCI with the DCP-01.

The primary purpose of the DCP-01 is to give the operator real time feedback of the actual Cut Current. Using the settings in the Cut Profile you can set fault points (based on a percentage of the variance from the current preset value to warn the operator if cut current is too high or too low. The ACT LED on the front of the DCP-01 (when not in Text/Cal mode) will light up anytime the detected current is above 20A. It’s just a visual indicator that the DCP-01 is reading current. If the LED lights when you fire the torch and have a valid arc and you do not see the Current displayed on the TORCH AMPS DRO on the MACH screen then go back through the test and calibration section. If you see cut current out of range or get a Current Fault then check the workclamp connection, the current setting on the plasma unit, the consumables, the Cut Current setting in the Cut Profile (stored settings) and determine why the current is not what it should be.

It’s important to understand that the CUT PROFILE does NOT set the cutting current. Only the manual adjustment on the plasma unit sets that value. The DCP-01 just tells you what the cut current REALLY is at the cut and tells you if the value is not what you have set in the specific Cut Profile you are running.

This LED comes on any time detected current is 20A or greater.
Grounding practices to reduce noise and increase safety

MP3000-DTHC Interface/Control Box

PC w/MACH3

Controller Cabinet

Note THC Sensor Card shielded cable is not connected to any ground in the Control box

Do NOT Ground PC or Controllers to Earth Ground Rod. Controllers will reference themselves to power ground through their AC lines

Controller Cabinet

CNC PLASMA TABLE

Use ground strap to gantry from table

Gantry

Grounding plate

Ground Rod or Metal pole in earth ground

#10 to #4 Ga heavy wire

#10 to #4 Ga heavy wire

MP3000 and UBOB have built in isolation on all inputs from the table to prevent noise transfer and ground loops

Tabel I/O Card (limits, home Aux relay)

THC Sensor Card

PLASMA UNIT

Attached to metal Chassi

#10 to #4 Ga heavy wire

Ground runs should be less than 10’

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1. DTHC does strange things after a pierce (TIP SAVER locks on or tip plunges to the metal.)

2. UP and DOWN (LED’s) not coming on (no Z movement)

3. UP & DOWN LEDs work but no Z movement

4. Z moves but erratically or loses steps.

5. UP or DOWN LED is on but Z stops moving (won’t go further down or up) Torch won’t cut low enough or high enough even though the UP or DOWN is on and THC Button is ON

6. Z DRO does not agree with actual height at the end of a cut.

7. Torch pierces at wrong height

8. Torch cuts too Low/High. UP and Down and Z is working.

9. TIP SAVER comes on and stays on (it is normal for the TIP SAVER to flash on/off especially at the end of a cut or if the feedrate has slowed down. Only make changes if the cut quality is poor.

DTHC settings are wrong (wrong PRESET VOLTS).

Pierce delay too long

THC Delay in CUT PROFILE too SHORT.

Arc OK not working. DTHC not working (run self-test). MACH inputs not working.

THC button is OFF in MACH. MACH license not loaded.

Z motor tuning wrong. THC RATE setting in MACH too high.

THC Corrections (Max and Min) are set too low/high. (settings tab in MACH). NOTE: MAX and MIN settings are in “units”. If you are running in MM units you need to change both settings by a factor of 25.4

Material has warped (a lot) OR Z is losing steps. Lower THC Rate in MACH for lost steps

Pierce height in G-code (from CAM) is set wrong. Touch-off values (switch offset) are wrong. Z is losing steps during a cut (see #6)

PRESET VOLTS is wrong for the material, tip and feedrate you are using. Preset needs to be adjusted in 1 volt increments and in the same direction as the error. Raise PRESET value to raise the torch. Lower PRESET VOLTS value to lower the torch. DO NOT GUESS AT A VALUE! Run the manual cut test to establish the proper PRESET VOLTS value OR run the SMART-KUT option (one time) if all of the pierce heights and beginning cut height are correct.

TORCH VOLTS is above the PRESET. Turn off the TIP SAVER or increase the percentage in the CUT PROFILE and try the cut. If it holds the correct height then either increase the THC Delay in the cut profile (NOT MACH) or increase the Tip Saver percentage in the CUT PROFILE.
<table>
<thead>
<tr>
<th>Torch oscillates wildly UP and DOWN while cutting</th>
<th>Torch is overshoing. Increase SPAN value in CUT PROFILE. Torch is losing steps. Decrease THC RATE by 5% in MACH. Check couplings and Z for binding or looseness.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torch slowly rises UP while cutting</td>
<td>Check Torch Volts reading. IF it is above the PRESET VOLTS then the DOWN LED should be on. If the TORCH is not going down then MACH is ignoring the down command (THC Corrections is wrong) If the UP LED is on then the PRESET VOLTS maybe set wrong. If neither LED is on but the torch moves up then Z is gaining steps from outside noise. Contact us. See also the TIP SAVER locking on issue.</td>
</tr>
<tr>
<td>DTHC works fine sometimes and then does not other times using the same parameters.</td>
<td>Possible noise problem. Make sure you have your table and plasma well grounded with a local ground rod. Try not to run your PC and Controller out of the same subpanel as the plasma. keep the gorunds for each side separated locally.</td>
</tr>
<tr>
<td>13 Torch runes for a while then shuts off while cutting or does not stay lit after the pierce.</td>
<td>Check the Indicator LED on the THC SENSOR card for the TORCH ON (relay) It should remain ON steady. If the torch still turns off (with it on) then the problem is with a connection (torch switch terminals or a problem at the torch.</td>
</tr>
</tbody>
</table>

**Do’s and Don’ts**

**DO**  run the manual cut test and record the conditions you see including the LED indications

**DO**  make sure you understand that the setups for Touch-off, pierce height and cut height are working correctly

**DO**  have the results of any testing ready for the support person.

**DO**  take the time to understand the basic concepts of how an ARC VOLTAGE THC (like the DTHC) works.

**DO**  realize there are external conditions and torch problems that can effect the DTHC.

**DO**  follow all of the grounding rules for the plasma. HF start units need extra attention to proper grounding for reliable operation.

**DO**  understand the relationships of Torch Volts, Torch AMPS, feedrate and air pressure/quality in plasma cutting.

**DO NOT**  assume there is an electronics problem until you have eliminated ALL possible problems of incorrect settings and things like consumables and air

**DO NOT**  attempt to run plasma without the proper MACH Profile (XML) loaded. Must be a CandCNC profile or a copy from our profiles.

**DO NOT**  call for support with vague descriptions or having not tested to a point

**DO NOT**  make changes in the MACH config to the base profile. Use a Clone copy and then only make one change at a time. The pin settings (mappings) are complex for our systems