Stingray® Torch Height Control Hardware and Installation Manual
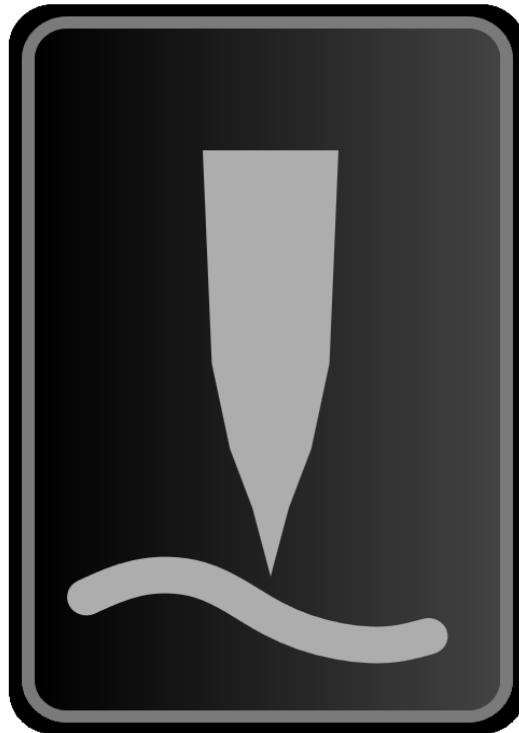
Getting Started

About This Manual

CNC is a unique application involving hardware and software. We recommend that you read all of these instructions before using the product.

Since automated machining is potentially dangerous, please take the time to completely read through this manual and the software User's Guide to understand the operation of the electronics, software and machine before cutting a part.

Turning Off the Controller

Always turn off the CNC Controller when it is not in use.

Legal

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Safety and Usage Guidelines

When running an automated machine tool, safety is of the utmost importance. For proper and safe use of the CNC program and your CNC machine, the following safety guidelines must be followed:

1. Never let the machine tool run unattended.
2. Require any person in the same room as a running machine tool to wear safety goggles and to stay a safe distance from the machine.
3. Allow only trained operators to run the machine tool. Any operator must have:
    - Knowledge of machine tool operation.
    - Knowledge of personal computer operation.
    - Knowledge of Microsoft Windows.
    - Good common sense.
4. Place safety guards around the machine to prevent injury from flying objects. It is highly recommended that you build a safety shield around the entire tool envelope.
5. Never place any part of your body within the tool envelope while the machine is online, since unexpected machine movement can occur at any time.
6. Always keep the tool envelope tidy and free of any loose objects.
7. Be on alert for computer crashes at all times.

WPI, Inc. is not responsible for the safe installation and use of this product. You and only you are responsible for the safety of yourself and others during the operation of your CNC machine tool. We supply this product but have no control over how it is installed or used. Always be careful!

WPI, Inc. or its affiliates are not responsible for damage to any equipment or workpiece resulting from use of this product.

If you do not understand and agree with all of the above safety guidelines, do not use this product.

Principles of Operation

The Stingray™ integrated Torch Height Control (THC) system is designed to provide the highest quality plasma cut. It achieves this by controlling the pierce and cut heights based on feedback from the plasma power supply itself. The major advantage of using an integrated system is that it also intelligently suspends height control when it wouldn't be beneficial.

Height Control
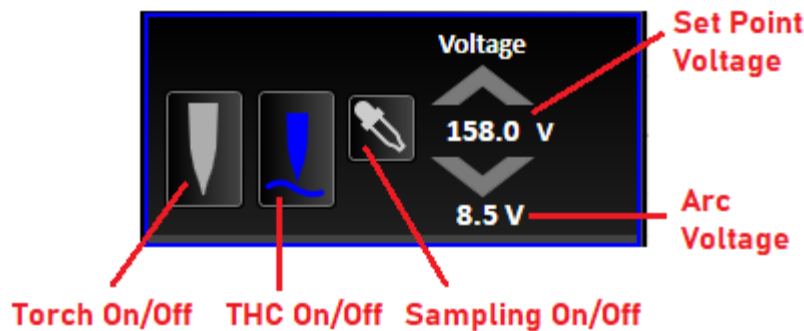
Arc Voltage

THC dynamically adjusts cut height based on the torch's reported arc voltage as well as a Set Point voltage in the software. This is possible because there is a direct relationship between the length of the arc and the arc voltage—a longer arc causes a higher voltage.

Set Point

The Set Point is the target voltage to produce an arc of the correct length. This Set Point can be pulled from the manufacturer's cut chart data, which is integrated for supported plasma systems. Alternatively, the Set Point can be determined measured using the Sampling tool. This is useful for installations that vary significantly from the torch manufacturer's test environment.

Ohmic Sensing

The system can find the plate to achieve a consistent Pierce Height above the plate. This is done by monitoring continuity between the shield of the torch and the material. When contact is made, Input 19 will become open.

Ohmic Sense Sensitivity

By default, the isolation box is set to maximum sensitivity. This can be decreased by installing a jumper in the Isolation Box on JP501. Jumping pins 1&2 yields medium sensitivity while pins 2&3 set the system to minimum sensitivity. Pin 1 is denoted by the arrow printed on the card.

Ohmic Disconnect

When using a high-powered torch, it's necessary to provide extra separation between the shield and input circuitry to prevent damage to the controller. With this equipment, the Ohmic Disconnect relay must receive power from the Isolation Box in order to correctly sense. This power is removed any time the torch is commanded to fire, thus isolating the torch shield from the circuit. The indicator LED on the Ohmic Disconnect relay will be lit when sensing is possible and turn off when the torch is commanded to fire. The isolation box can be configured for this functionality by installing jumpers across pins 2&3 on JP301, 302, and 303.

I/O

Start Signal

To fire the torch, the controller provides a closed contact driven by Output 1. The torch can be fired manually from the CNC module and will automatically fire as needed while running a G-Code program.

Arc Transfer

This signal from the plasma power supply indicates that the torch has fired and that the plasma arc has 'caught' on the material. This is used to verify that the torch has pierces and a cutting arc is active before continuing with the cut.

Lockout Conditions

Certain cut conditions can cause THC to stop adjusting height. These are primarily used to prevent the torch from diving towards the material.

Feedrate Lockout

This type of lockout activates when the cut speed drops below the commanded speed, such as when cutting a radius or corner. By default, this occurs at 94% of the commanded feedrate. Height control reengages when the system once again reaches full speed.

Kerf Crossing Detection

The other lockout type occurs when arc voltage spikes. This usually indicates that the torch is crossing a previous cut path or that it's leading out over a cutout that's dropped away. However, this can falsely lock the height if the metal is very warped.

THC Hardware

THC Kit Parts

Before getting started, ensure that your THC kit contains all of the correct components for your installation.

Standard THC Kit

1. Torch to isolation box cable
2. Isolation box to controller cable (35')
3. Blue ohmic clip cable (35')
4. White/blue ohmic return clamp
5. White/blue ohmic return cable (35')
6. Grounding ring terminal
7. THC isolation box
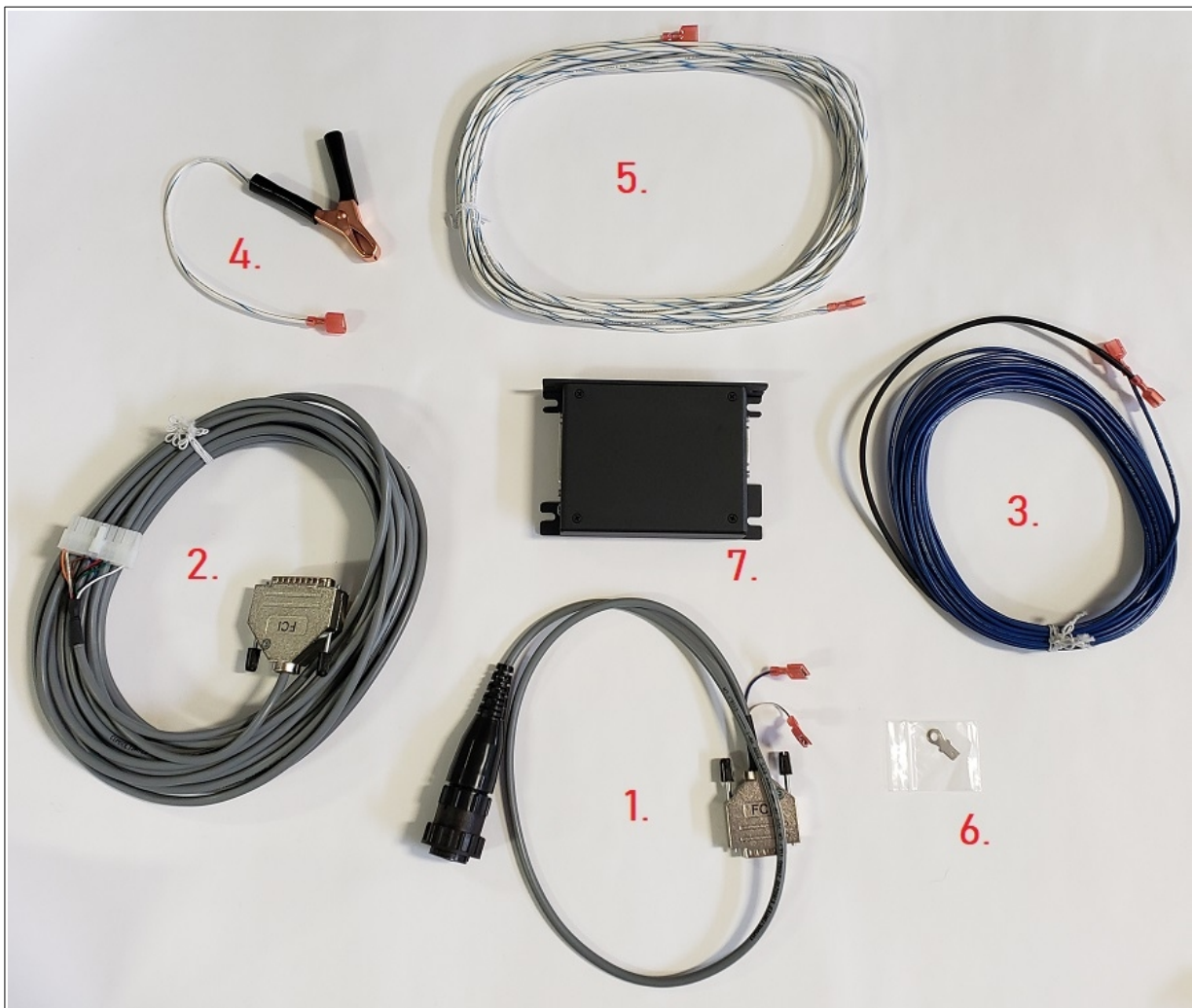
THC with Ohmic Disconnect

1. Torch to isolation box cable (25' or 50')
2. Isolation box to controller cable (w/ external relay) (25' or 50')
3. White/blue ohmic return clamp
4. White/blue ohmic return cable (35')
5. Grounding ring terminals
6. THC isolation box
7. Ohmic disconnect relay
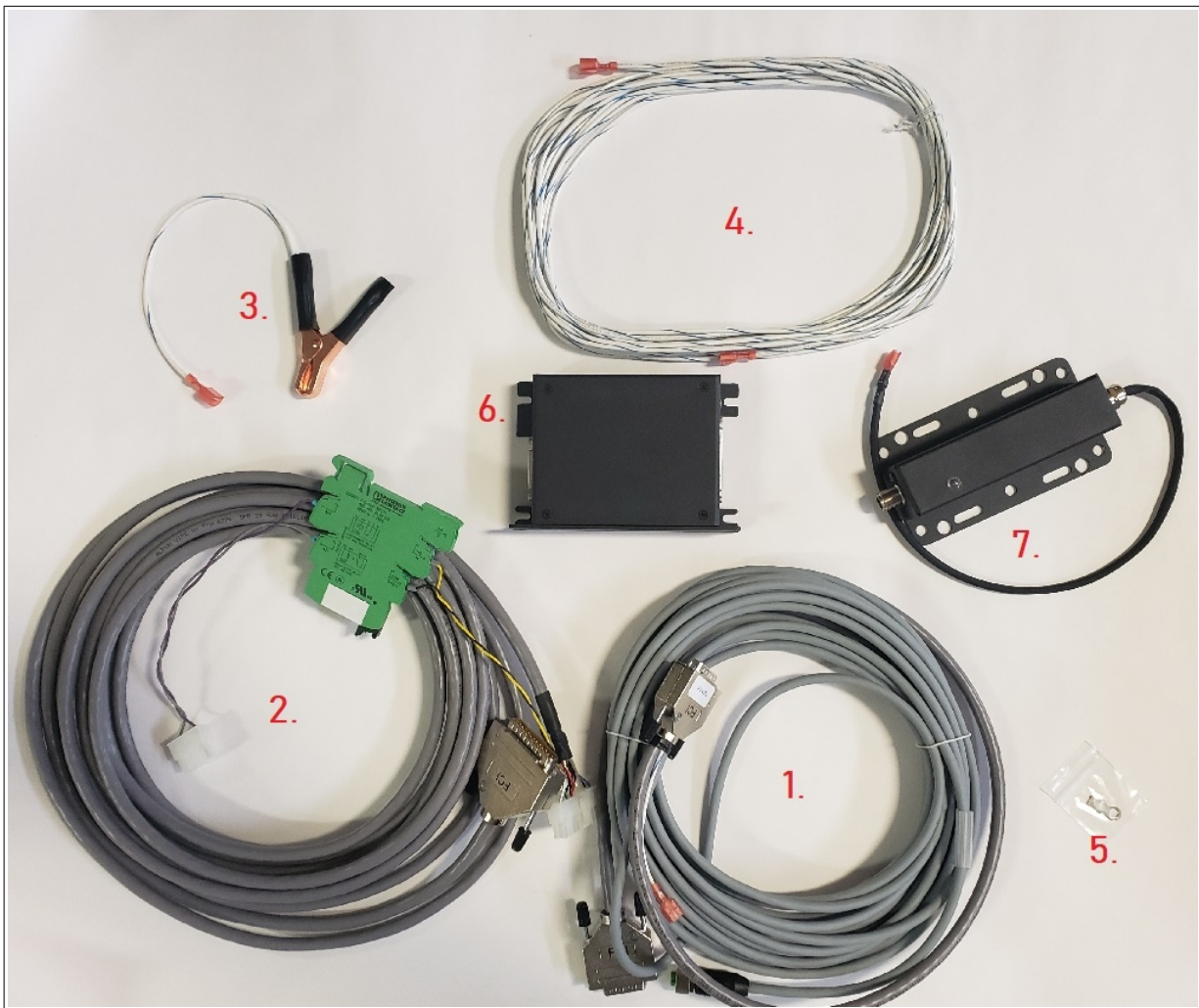
THC Isolation Box Jumper Settings

There are several settings and tests available with the THC isolation box's internal jumpers.

JP200 – Arc Voltage Test

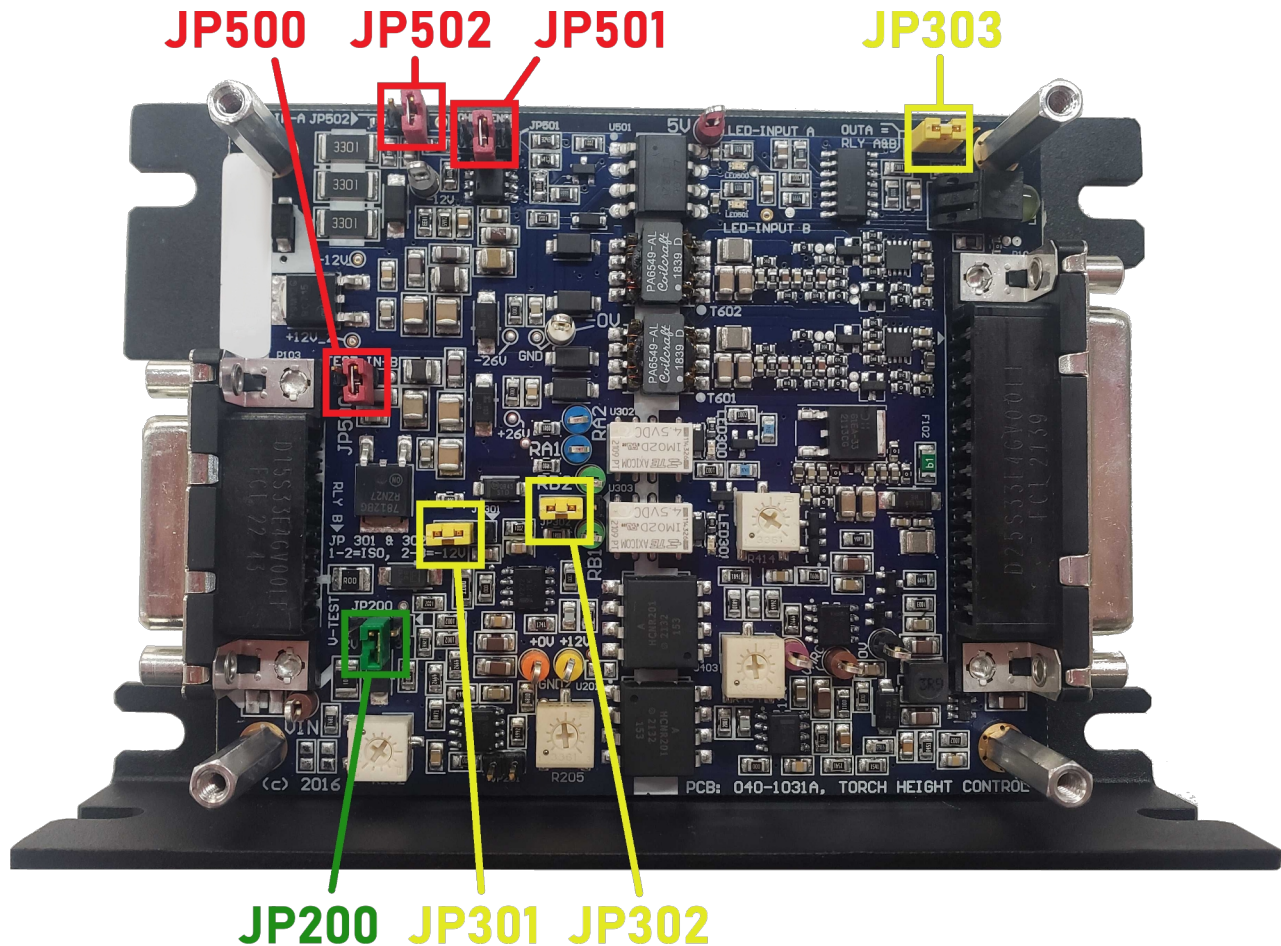This green jumper can be used to test Arc Voltage response in the software by installing the jumper across pins 1&2 (2V*voltage division) and across pins 2&3 (3V*voltage division). The plasma must be disconnected to perform this test. The jumper must be disconnected when in operation by installing it on only a single pin.

JP301 & JP302 – Relay B Output

This pair of yellow jumpers controls the output behavior of Relay B and must be moved as a pair. When jumping pins 1&2, Relay B will act as a contact closure. When jumping pins 2&3, Relay B will output 12V. This setting is only pertinent for plasma or ohmic systems that accept a second output control.

JP303 – Relay B Control

This yellow jumper controls whether Relay B is driven independently. When jumping pins 1&2, Relay B responds to Output 2. When jumping pins 2&3, Relay B responds to Output 1 alongside Relay A. This setting is only pertinent for plasma or ohmic systems that accept a second output control.

JP500 – Input B Test

When this red jumper is installed across its pins, Input B (typically Input 20) will activate. The jumper must be disconnected when in operation by installing it on only a single pin.

JP501 – Ohmic Sensitivity

This red jumper controls ohmic sensitivity. When disconnected by installing it on only a single pin, this will yield highest sensitivity. When jumping pins 1&2, this will yield lowest sensitivity. When jumping pins 2&3, this will yield medium sensitivity.

JP502 – Input A Test

When this red jumper is installed across its pins, Input A (typically Input 19) will activate. The jumper must be disconnected when in operation by installing it on only a single pin.

THC Isolation Box Test Points
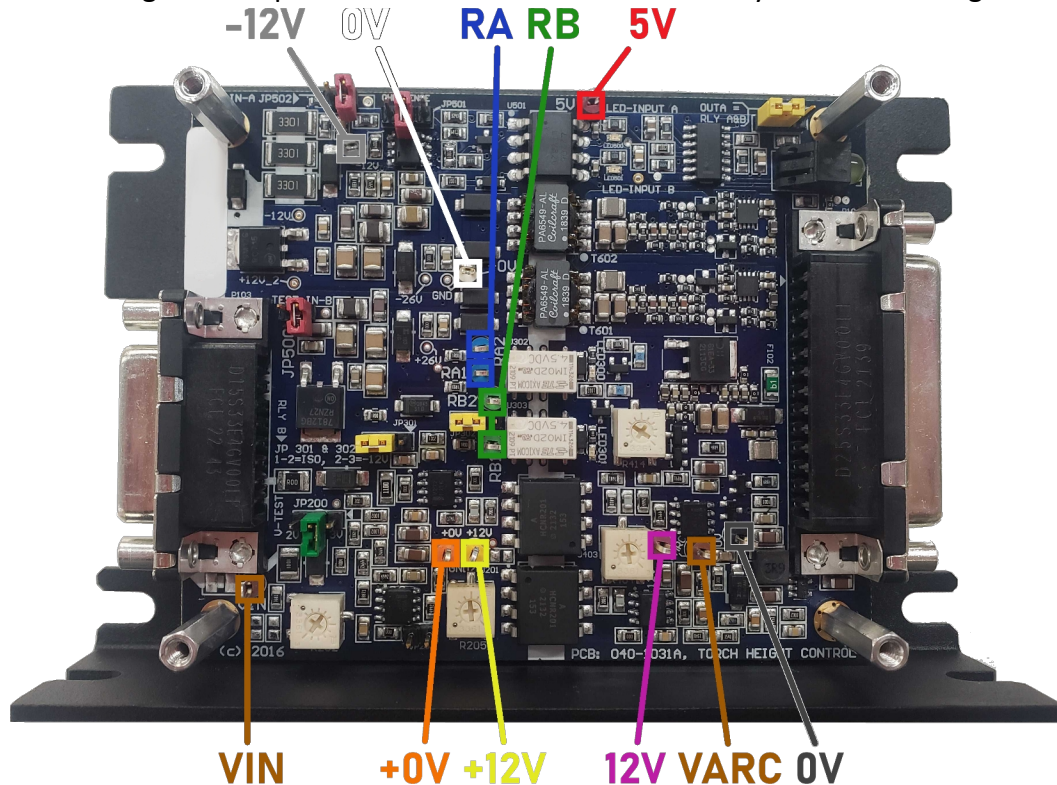
There are several test points available for diagnostics inside of the isolation box. All tests between multiple points should be performed only on a single side (plasma-side or controller-side). Performing tests on points from one side to the other may have misleading results.

Plasma-Side Test Points

RA (1&2)—These blue test points are the output of Relay A.

RB (1&2)—These green test points are the output of Relay B.

-12V—This gray test point is the power for the -12VDC rail.

0V—This white test point is the ground for the -12VDC rail.

VIN—This brown test point is the divided arc voltage from the plasma.

+0V—This orange test point is the ground for VIN and the +12VDC rail.

+12V—This yellow test point is the power for the +12VDC rail.

Controller-Side Test Points

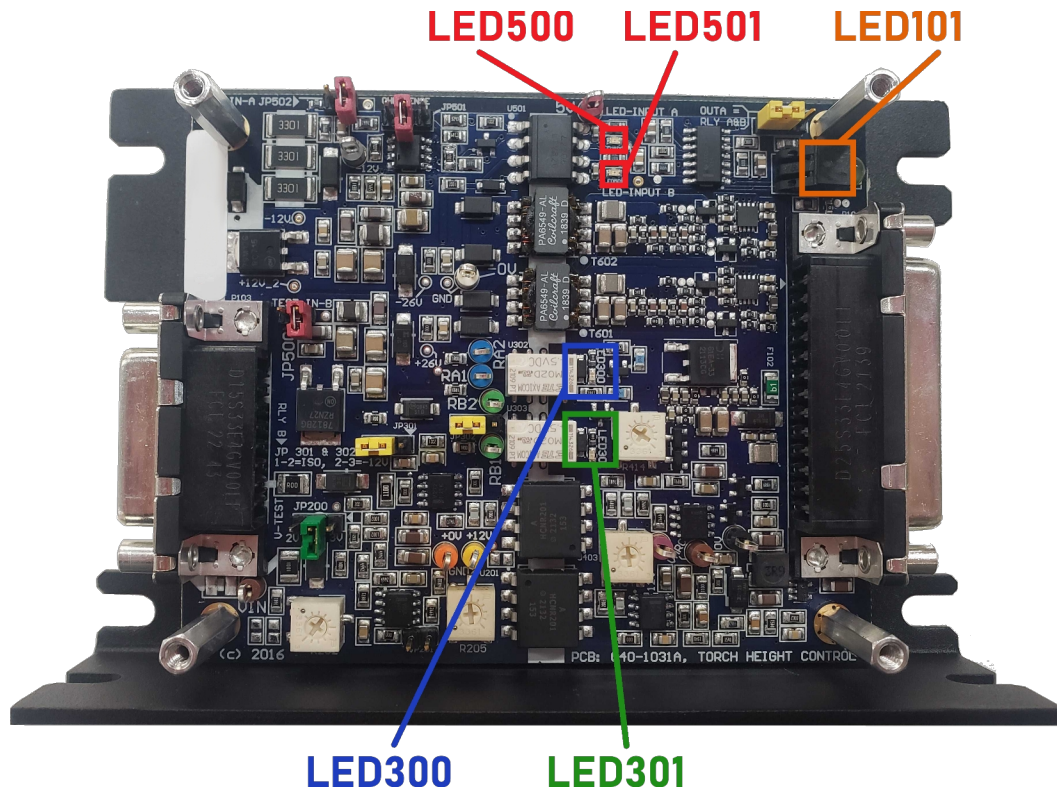5V—This red test point is +5VDC supplied from the controller.

12V—This purple test point is +12VDC from on-board.

VARC—This brown test point is the divided arc voltage output to the controller. It should be 2x the voltage of VIN.

0V—This black test point is the ground for VARC, +5VDC and +12VDC.

THC Isolation Box LEDs

There are several LEDs on the board for diagnostics.

LED101

This amber LED is simply a power indicator. It is visible with the lid installed.

LED300

This blue LED indicates that Relay A is receiving driving coil voltage from the controller.

LED301

This green LED indicates that Relay B is receiving driving coil voltage from the controller.
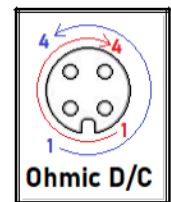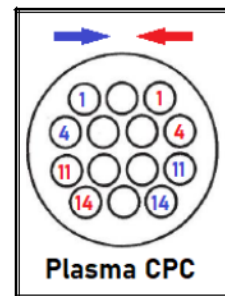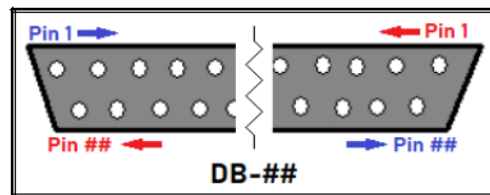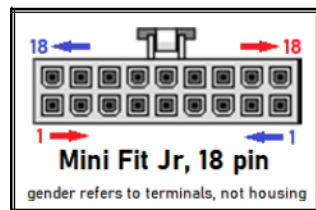
LED500

This red LED indicates that Input A (typically Input 19) is closed. This means it is normally illuminated at idle.

LED501

This red LED indicates that Input B (typically Input 20) is closed.

Comprehensive THC Pinouts

	Mini I/O, Mini Fit 18pin	Start Relay	Iso Box DB-25	Iso Box DB-15	14-pin CPC	Voltage Divider DB-15	HPR DB-37	VDC3; J2	4-pin Ohmic D/C
Present on:	*All*	*Hi-def/HPR*	*All*	*All*	*PowerMax*	*Hi-def*	*HPR*	*HPR*	*Hi-def/HPR*
Start (+)	15	14	10 (PowerMax)	5	3	2	34		
Start (−)	6	11/13	23 (PowerMax)	13	4	10	15		
Ohmic	10		1	7	Blue lead				3
Arc Xfer	12		2	6	12	4	23		
V Arc	18		3	1	6	8	[35 (legacy)]	6	
+5VDC	13		6						
Output 1		A1+ (CNC output)							
GND	4	A2− (CNC output)	19	2 (V Arc), 14 (Xfer), 15 (Ω)	5 (VArc), 14 (Xfer), white/blue lead	12 (Xfer), 15 (V Arc)	4, [16 (legacy)]	7	
Shield	9				13	Shell			
Ohmic D/C (+)				12 (Ohmic D/C)					2
Ohmic D/C (−)				4 (Ohmic D/C)					1

Mini Fit Jr, 18 pin
gender refers to terminals, not housing

DB-##

Plasma CPC

Ohmic D/C

MALE NUMBERING IN BLUE
FEMALE NUMBERING IN RED

Revised Jan 13ᵗʰ, 2020

Installation

Please read through instructions carefully prior to installing the kit.

IMPORTANT: Some models of torches do not have a built in voltage divider. A voltage divider will be required to get the system working properly. Contact the torch manufacturer for more information regarding voltage dividers.

Mount the THC Hardware

The THC Isolation box can be mounted to the torch or to the machine by fastening it down from one of the bolt patterns.
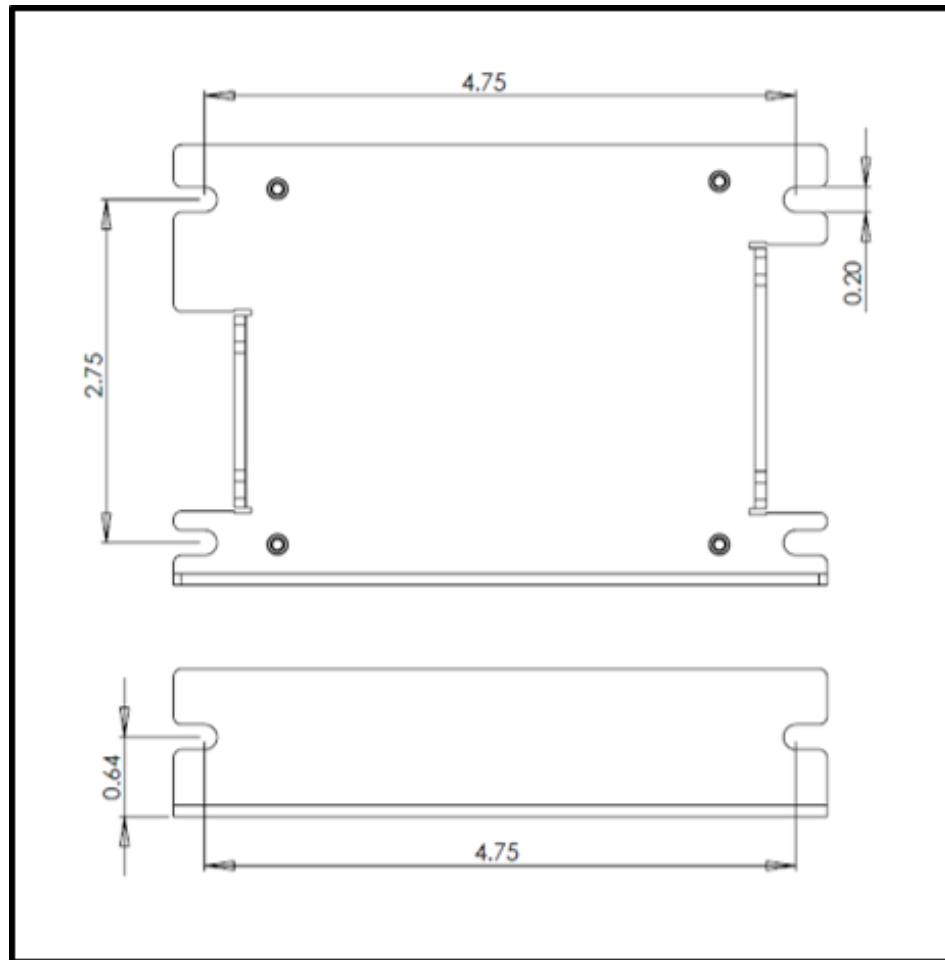
If the system requires an ohmic disconnect, mount the Ohmic Disconnect relay around the torch body using the provided U-bolts and hardware.

Connect to the Plasma

Plug in and screw down the DB-15 connector of the Torch To Isolation Box cable to the THC box. Then, plug in and screw down the other end of the cable. This is a 14-pin circular CPC connector for standard systems and a D-Sub connector for systems that require an ohmic disconnect.

Connect the Ohmic Sense

In a standard system, plug in the male quick connect on the blue ohmic sensing cable to the female quick connect on the blue wire from the DB-15 connector. If the system uses an ohmic disconnect, instead plug in and screw down the M12 connector to the top of the Ohmic Disconnect relay. Plug in the female quick connect to the ohmic clip on the torch.

Plug in the male quick connect of the white striped ohmic return cable into the female quick connect on the white/striped wire from the DB 15 connector. Plug in the female quick connect into the male quick connect on the table ohmic return clamp or the grounding ring terminal. If using the ohmic return clamp, make sure it is clamped to the material securely, where it is out of the way of moving parts and successfully acts as the return line for the ohmic sensor. If using the grounding ring terminal, make sure that it's securely affixed to the table's star ground.

Connect to the Controller

Install the Isolation Box to Controller cable. A Mini I/O Expansion Board must be installed in your controller to use THC. The 18-pin rectangular Minifit Jr connector plugs into the Mini I/O Expansion Board—labeled "Expansion Slot" on the back of the controller—and the DB-25 fastens to the THC box. If your system requires an ohmic disconnect, mount the green Start Signal relay near the controller and plug the 10-pin Minifit Jr connector into the Output port of the controller.

Preparing Plasma Table for Use

1) Verify that you meet all electrical power requirements, defined by the plasma system.

2) Verify that the air compressor is set up correctly.

- Is it powerful enough for your needs?

- Do you need an air filter or air dryer?

- Does it keep pressure at the recommended range? If not, you may need an additional regulator.

3) Verify that everything is hooked up correctly to the power supply and to the torch.

4) Verify that the power supply settings are correct, which are material dependent. On many torches you can change the amperage, air pressure, and type of cut.

5) It is recommended that an initial test piece is cut when the torch is initially set up to verify that the torch is working properly with our software. The test cut consists of cutting a short line downhill along an incline to verify that the THC is working.

Software Configuration

Standard THC Setup

Enable THC

Open the "Machine….Fabrication Heads" section of the configuration. Click on the fabrication head to edit its settings. Then, scroll down to the Torch Height Control subsection. Check the 'Use Torch Height Control' box and use the default parameters, as shown below:

M-Code Assignment

Find the 'Torch Control' subsection and enter the default On/Off M-Codes. (Torch On M50; Torch Off M51). Find the 'Cutting' subsection and enter the default cutting macros into the 'Automatic M-Codes' fields. (Start of Cut M80, End of Cut M81).

Sensing

In the 'General Sensing' subsection, make sure 'Direction' is negative, feedrate is a reasonable speed, and assign the ohmic sensing input line (19) under 'Monitor Input Line'.
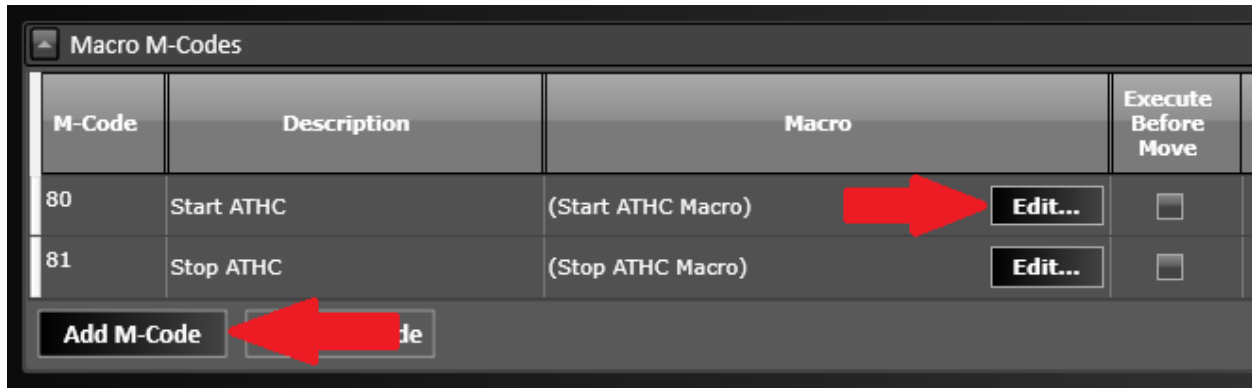
Configure Inputs

Navigate to "I/O….Inputs" in the configuration. Setup input lines 19 and 20 as follows:

Macro M-Codes

Navigate to the "Programming….M-Code Definitions" page. Scroll to the 'Macro M-Codes' section. Ensure there is a macro for both ATHC start and stop. By default, these are M80 and M81, respectively.

If you lack one or both of these, click the Add M-Code button to add a line for the macro. Enter the M-Code and name of the macro. Then, click the 'Edit' button and enter these default macros:

Start ATHC Macro (M80)

(Start ATHC Macro)

G605 (Move to Initial Height)

M50 (Torch On)

M101 I20 "Failed to detect arc transfer to material." (Wait for Arc Transfer Signal)

G04 X#PierceDelay (Pierce Delay)

G601 (Begin Plasma Cutting)

(M102 I20 S0 (Feed Hold When Loss of Arc)

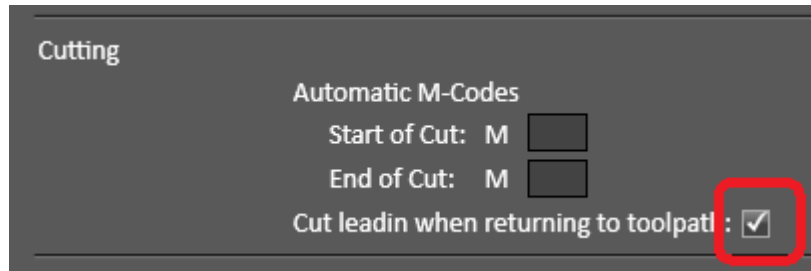**Stop ATHC Macro (M81)**

(Stop ATHC Macro)

G600 (End Plasma Cutting)

(M103 I20 (Disable Feed Hold When Loss of Arc)

M51 (Torch Off)

Pro-Only THC Features

Lead-in on Resume
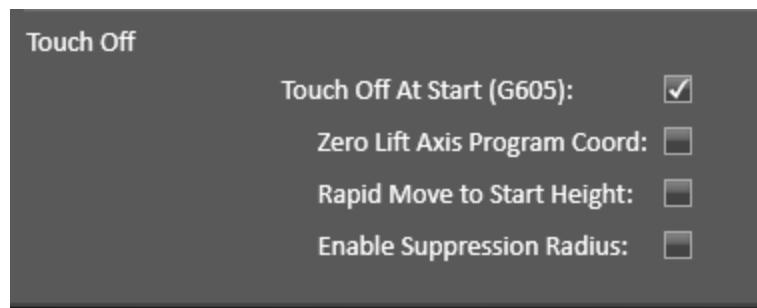
This option is found in the 'Cutting' subsection and aids in mid-program recovery. When this option is enabled, the system will begin cutting at its current position before returning to where it was feedheld. Using this, an operator can jog off the toolpath after a feedhold and create a new lead-in from the current position.

Smart Touch Off

This feature suite allows for advanced touch off behavior. Enable each feature by checking its box.

THC Troubleshooting

The torch moves up and down rapidly like a sewing machine

Software Settings

- "Configuration….Machine….Fabrication Heads"—Click the torch in the chart to drop down more settings. In the Torch Height Control section, decrease the Sensitivity. This will increase the Dead Band Voltage. The default value is 0.51V.

- "Configuration….Machine….Axes"—In the Feedrates and Ramping section, increase the Start/Stop Feedrate of the torch's axis (usually Z). This is only beneficial up to 40 ipm or the axis's stall speed.

Air Quality

- If the previously mentioned settings are at maximum and the problem persists, perform checks on the air compressor and filters/dryers.

The torch raises away from the material during a cut

Software Settings

- In CAM—make sure that the parameters in both the Project Settings and Plasma Settings are correct for the material being cut and the consumables installed.

- On the CNC screen, in the torch parameters panel (left hand side)—make sure that Kerf Crossing Detection is unchecked.

Arc Voltage Signal

- Verify that there is an idle voltage of approximately 4 to 8V measured in the software. When cutting, make sure that this increases to a reasonable value, based on the torch and material.

- If either of the above is false, perform arc voltage checks on the components and cabling from the Plasma Power Supply to the Controller.

Grounding

- If the controller is receiving a reasonable arc voltage, make sure there is proper grounding from the material to the plasma power supply.

The torch dives into or drags on the material during a cut

Software Settings

- In CAM—make sure that the parameters in both the Project Settings and Plasma Settings are correct for the material being cut and the consumables installed.

- On the CNC screen, in the torch parameters panel (left hand side)—make sure that Kerf Crossing Detection is checked.

"M100/M101 command has timed out." error message

Plasma Start Signal

- Check the CNC connection at the rear of the plasma power supply for the start signal. If this fails, test remaining connections.

Plasma Operation

- Ensure that the torch fired. If not, check for faults and incorrect settings.

- If the torch fired, see if the material was pierced. If it wasn't, verify that the Pierce Height is correct, all consumables and gases are in good shape and that the workpiece lead is intact.

The torch doesn't fire

Plasma Start Signal

- Check the CNC connection at the rear of the plasma power supply for the start signal. If this fails, test remaining connections.

Plasma Operation

- Check for faults and incorrect settings.

The torch tries to push through the material

Software Settings

- "Configuration….Machine….Fabrication Heads"—Click the torch in the chart to drop down more settings. In the 'General Sensing' section, make sure that the correct Input Line is being monitored. This is Input 19 for most systems.

The torch senses upward

Software Settings

- "Configuration….Machine….Fabrication Heads"—Click the torch in the chart to drop down more settings. In the 'General Sensing' section, make sure that Sensing Direction is Negative. Also make sure that the positive direction of the lift axis is up and the negative is down. This can be checked by jogging the axis.

Revision History

Revision D

Revision	*Date*	*Comments*
A	04/12/20	Extensive rewrite from original
B	09/06/22	Improved pinout chart and added ohmic jumper settings
C	04/24/23	Added jumper and test point callouts
D	06/20/24	Corrected J303 setting