



# S3THC V2 User's Guide

Stepper3 Plasma Torch Height Controller

Version 2



## Features

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- Fully integrated with S3CNC software suite
- Easy to use material tables allow fast material selection
- Uses industry standard RS-422 data transmission for reliable and long range communication
- Comes standard with front mounted LCD that is used for displaying useful diagnostic information and torch data
- Can accept both raw and divided voltages and uses both a terminal block connection or an integrated Hypertherm connector allowing for flexibility
- Compatibility with multiple Stepper3 Products (adapters may be needed)

### ***Product Brief***

The S3THCV2 torch height is the flagship torch height control product in our lineup of plasma CNC products. This device was designed with ease of use and reliability in mind. It uses industry standard RS-422 data communication allowing for reliable and long range data communication between it and our controller. The front mounted LCD screen allows you to easily view a variety of diagnostic and torch data. The S3THC V2 has two (2) modes of use, standalone mode and integrated mode (with S3CNC). The S3THC is fully controllable from within the S3CNC Software Suite, allowing users to easily monitor the status of the torch height controller or change settings using either the included material tables or custom tables that users can create.

The S3THC is compatible with the CSCNC controller line as well as our CS808 controller.

## S3THC Package Contents

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- 1 - S3THCV2 Torch Height Controller
- 1 - 25 Ft plasma interface cable
- 1 - 25Ft controller interface cable
- 1 - 25 Ft DB9 communications cable

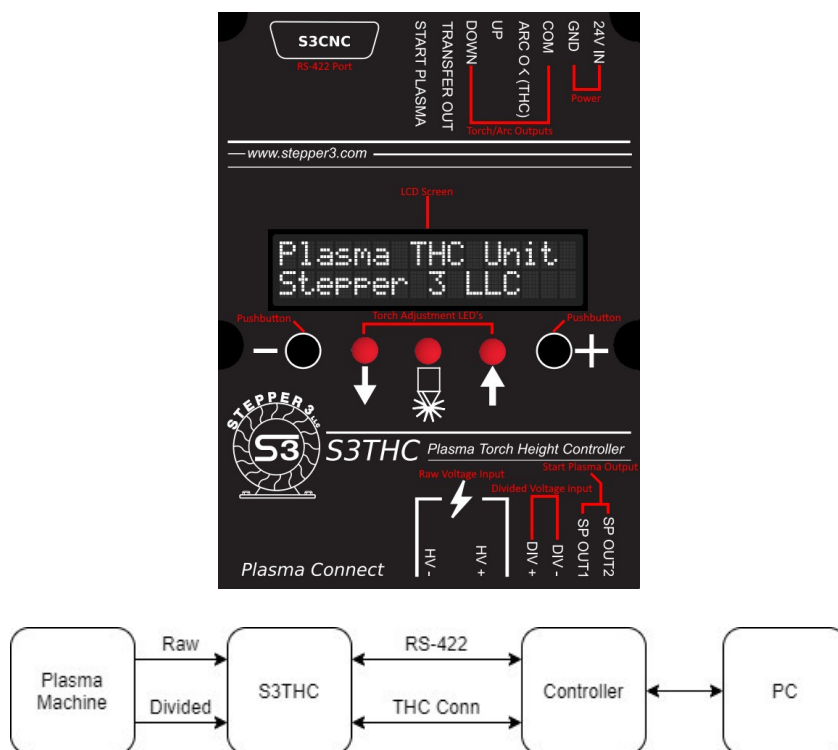
Optional Accessories – Contact your dealer to purchase

- CS1200 Adapter Board
- CS808-422 Adapter Board
- S3OHMICSENS – Ohmic Sensing Material Sensing Unit

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## 1 Operating Description



The S3THCV2 is version two of the S3THC torch height controller. This version offers improved torch height control algorithm, and two modes of operation, standalone mode and operation with the S3CNC operation.

Upon power up, the THC Controller continuously monitors the plasma arc voltage. If the arc voltage rises above the lower limit setting of 25V, the THC controller starts an internal timer (default = 500 ms). After the timer has expired, enables the ARC OK signal enables (closes the relay contacts), signaling the CNC controller that it is OK to move. If the voltage falls below the lower limit setting (default 25V), after the ARC OK signal has been established, an arc failure will be initiated in the CNC software.

Once the ARC has been established, the controller continuously monitors the arc voltage, and compares the arc voltage to the programmed SETPOINT. If the arc voltage is above the SETPOINT by more than 50% of the deadband setting, the controller closes the DOWN contact to tell the CNC system to lower the torch. Lowering the torch decreases the arc voltage. Conversely, if the arc voltage is lower than the programmed SETPOINT, the controller enables the UP output to signal to the CNC controller to raise the torch, thereby increasing the arc voltage. When the arc voltage matches the SETPOINT, the controller disables both the UP and DOWN outputs until the arc voltage.

The deadband functions to allow the arc voltage to increase or decrease slight amounts without causing a correction. Without a deadband around the SETPOINT, the controller oscillate around the SETPOINT, decreasing the cut quality.

When the CNC controller requests the plasma arc to shut down, the arc voltage will fall below the threshold value of 50 V, resetting the THC controller to its wait state where it remains dormant until the voltage rises about the threshold to re-initiate the control cycle.

### **1.1 S3CNC Mode**

When using the S3THC unit with Stepper3's S3CNC software, the unit will establish communications when the software is started. Once communication has been established the S3CNC software will download the system parameters to the S3THC controller. If communication fails or no connection is established user will be notified.

While the S3THC is in operation the status can be monitored from either the PC or the built-in LCD screen. The LCD can also be used to monitor the various settings it is receiving from the PC. For a detailed description refer to the LCD section of the manual.

### **1.2 Standalone Mode**

When not using S3CNC software as the CNC software the S3THCV2 controller falls back to standalone mode. In standalone mode, the user must set all of the parameters from using the LCD display and push buttons on the front of the torch height controller. Once set, the parameters will be stored in flash memory of the controller.

2 Plasma Generator Interface

The S3THC Controller has two system interfaces that must be wired properly for proper system operation. The controller must interface with the CNC controller as well as the plasma generator. The following sections describe proper wiring and configuration.

2.1 Plasma Connect CPC Connector

The Plasma Connect CPC connector is located on the bottom left hand side of the S3THC unit. This connector is used to connect the plasma generator to the S3THC torch height control unit. The pin-out matches the industry standard Hypertherm unit as shown below. Table 1 below describes the Hypertherm plasma control signals, which digital inputs and outputs the connector uses, and the corresponding signal names.

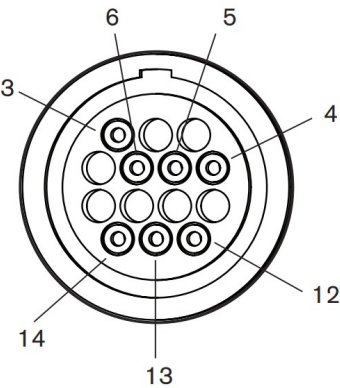


Table 1 - Plasma Generator Connector

Hypertherm Signal	CPC Connector Pin Number(s)	CSCNC Signal Name (Software)
Start Plasma	3, 4	DO-2
Transfer (start motion)	12, 14	DI-3
Voltage Divider	5 (-), 6 (+)	
Ground	13	

Below is a table listing the parts required to make a cable that plugs into the CSCNC controller and connects to a Hypertherm unit. Make sure to buy extra pins in case a few are damaged when crimping.

Description	Part Number	Quantity
CPC Connector	206044-1	2
CPC Strain Relief	206070-8	2
CPC Pins	1-66099-5	13
Shielded Cable	5304FE 008500	

## 2.2 Start Plasma Interface

The start plasma signal is a pass-through signal from the CNC controller to the plasma generator. When a start plasma signal is received from the CNC control software, the S3THC controller energizes a relay to close a set of contacts signaling the plasma generator establish the arc. The relay contacts exit the S3THC controller in two locations: on the Plasma Connect CPC Connector pins 3 & 4, and the SP OUT1 and SP OUT2 terminals of the terminal block on the bottom right hand side of the S3THC controller.

## 2.3 Arc Voltage Interface

After the arc has been established, the S3THC monitors the arc voltage and adjusts the torch height to keep the arc voltage within the controlled range. In order to accomplish this, the arc voltage (torch voltage) output from the plasma generator must be connected to one of the S3THC arc voltage inputs. Since the voltage generated by the plasma arc is a high voltage, a voltage divider circuit must be used.

Many plasma generator manufacturers include an arc voltage divider circuit that provides a low voltage output suitable for direct mentoring by the S3THC unit. Other lower cost plasma generators do not include such circuitry, and their arc voltage output is a high voltage.

The S3THC was designed to accommodate both high voltage and low voltage arc signals. **The S3THC is low voltage input circuit is designed for a 50:1 voltage divider.** If your plasma generator cannot provide the appropriate 50:1 voltage division, an external divider or high voltage input must be used. When connecting to a plasma generator with a low voltage output such as a Hypertherm Unit, the user can connect the arc voltage to the Plasma Connect CPC connector terminals 5(-) and 6(+). Be sure to observe the proper polarity. The + output must be connected to pin 6 and the – output must be connected to pin 5. **If the user connects the arc voltage improperly, damage to the S3THC unit will result and the warranty will be void.**

If your torch output does not use a Hypertherm CPC connector then the user can opt to use the terminal block connections found at the bottom of the unit. The HV inputs accept a raw voltage input signal while the DIV inputs accept a 50:1 divided voltage signal. See Figure 2 below:

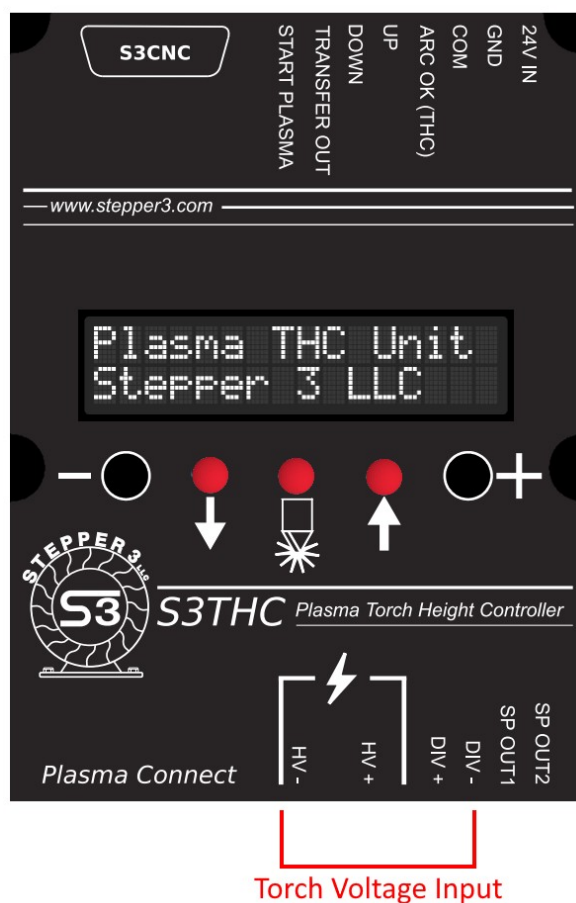


Figure 1- Arc (Torch) Voltage Input Connections

### 3 CNC Controller Interface

The S3THCV2 also interfaces with the CNC controller to send and receive commands to effectively manage the torch height. The interface is described below:

#### 3.1 Serial Communications Interface

The S3THC controller has a DB9 connector (upper left side of the S3THC) for serial communications between the S3CNC software and the S3THC controller. The data-link allows the S3CNC software to change the parameters of the torch height control on the fly, eliminating the need for the user to enter parameters manually.

In the S3CNC software, a materials table is provided with typical THC parameters for a Hypertherm Powermax 45XP. The tables provided are a starting point, and should give reasonable cut quality when using the Hypertherm Powermax 45 plasma generator. The user can be modify the materials settings as required for best cut quality. When the user selects the material from the table, the associated parameters are sent directly to the torch height controller.



If using Stepper3's CSCNC line of controllers, an optional CSCNC-1200 THC Adapter is required to make the serial communications interface available. If your controller was not provided with the CSCNC-1200 THC Adapter, contact your dealer or Stepper3 for assistance.

A standard 9 Pin Male to Female straight through shielded serial communications cable is used to connect the S3THC controller to the CSCNC unit. The unit comes with the serial cable, should a replacement be necessary, it can be purchased as below:

Description	PCcables.com Part Number	Quantity
25 ft DB9 M/F 9C Serial Straight Thru Extension Cable	PCC-00822	1

### 3.2 Hardwired Power and I/O Interface

The terminal block located on the upper right hand side of the unit provides for the necessary hardware I/O connections between the S3THC Unit and the CNC controller. The following table summarizes the I/O required for proper operation of the torch height controller:

Terminal	Signal Name	Description	S3THC	CNC Controller
1	24 VDC	Power Input for S3THC controller and relays	Power Input	
2	GND	Power Input Negative input from Power Source	Power Input	
3	COM	Common signal for the S3THC relay outputs (see below)	Common for Relay Outputs	
4	Arc OK (THC)	Indicates to CNC controller that Plasma arc has been established	RELAY OUTPUT (dry contact)	INPUT
5	UP	Command from the S3THC to Raise the torch	RELAY OUTPUT (dry contact)	INPUT
6	DOWN	Command from the S3THC to lower the torch	RELAY OUTPUT (dry contact)	INPUT
7	TRANSFER OUT	Command from the Plasma Generator to the CNC controller that the Plasma arc has been established	RELAY OUTPUT (dry contact)	INPUT
8	START PLASMA	Command from the CNC Controller requesting the Plasma Generator to initiate an arc	INPUT	OUTPUT

Note: that the terminal numbers are increasing when going from the right to the left.

As described in the table above, the S3THC outputs to the CNC Controller interface are all dry contact relay outputs connected to a common signal. This configuration allows for flexibility when interfacing the S3THC with CNC controllers other than the CSCNC line of controllers. T

### 3.2.1 Device Power Wiring

The S3THC requires a 24Vdc input power supply applied to the terminals 1 and 2 of the terminal block on the upper right hand side of the S3THC unit. Remember that terminal 1 is on the far right and terminal 2 is just to the left of terminal 1 as shown the front panel graphics.

Signal Name	Terminal #
24V In	1
GND	2

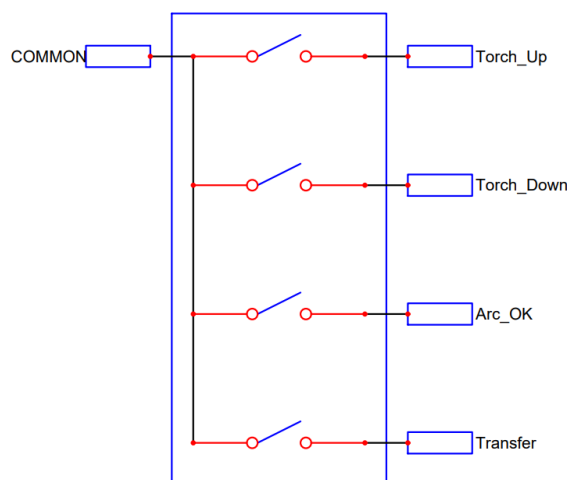
**Note: Make sure the polarity of the wiring is correct as damage will otherwise occur and your warranty will be void.**

### 3.2.2 I/O Wiring

#### Outputs to the CNC Controller

The S3THC has three outputs for controlling the height of the torch and the arc status. These are the UP, DOWN and Arc OK ports labeled on the front of the S3THC. Each output is a dry contact relay output with one side of the contact tied to the COM (common) terminal and the other side available to feed the CNC controller input. The common terminal does not have any wetting voltage tied to it. The user must determine the requirements of the CNC controller that will interface with the S3THC.

Outputs all share a common as shown in the figure below:



When using the CSCNC controller, the digital inputs in the CNC controller provides a 24 Vdc wetting voltage for each inputs and the COM (common) terminal will be tied to 0 Vdc (Gnd) to activate the signal.

The contact rating of each output is 250 mA @ 100 Volts AC (or DC) with a maximum switching rating of 10 Watts.

Wiring to the CSCNC Controller THC Connector

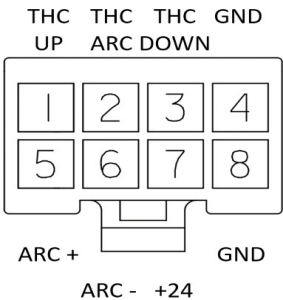


Figure 2- CSCNC Controller THC Output Connector

Figure 2 above shows the CSCNC (IOMOD1 or IOMOD2) THC Connector pin-out. The connector is located on the back of the CSCNC Controller just below the motor outputs. To make all necessary connections from the THC connector on your CSCNC controller to the S3THC, follow the table below and connect all signals to the labeled inputs on your S3THC device:

S3THC Terminal	Signal Name	Description	S3THC	CSCNC Controller THC Output Pin #
3	COM	Common signal for the S3THC relay outputs (see below)	Common for Relay Outputs	4 or 8
4	Arc OK (THC)	Indicates to CNC controller that Plasma arc has been established	RELAY OUTPUT (dry contact)	2
5	UP	Command from the S3THC to Raise the torch	RELAY OUTPUT (dry contact)	1
6	DOWN	Command from the S3THC to lower the torch	RELAY OUTPUT (dry contact)	3

Connector Parts List

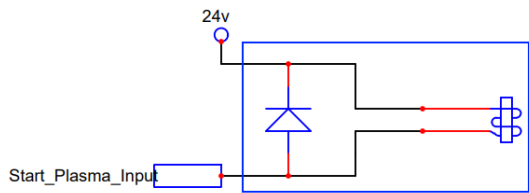
Below is a table listing the parts required to make a cable that plugs into the CSCNC controller THC connector. Make sure to buy extra sockets in case a few are damaged when crimping.

Description	Molex Part Number	Quantity
8P Mini-Fit Jr. Receptacle	39-01-2085	1
Mini-Fit Jr. Sockets	39-00-0039	8
Strain Relief		1

Inputs from the CNC Controller

The only input signal from the CNC controller required to operate the automatic torch height controller is the Start Plasma signal. This signal tells the plasma power supply when to initiate an arc.

Within the S3THC unit there is a relay that has 24 Vdc supplied internally to the coil. The start plasma input on the unit must be grounded to complete the circuit of the relay coil. The diagram below represent the circuit for the start plasma input.



In order to activate, connect the input to the COM terminal.

Figure 3 below shows the digital output connections recommended for the start plasma signal when using the CSCNC controller with S3CNC Software:

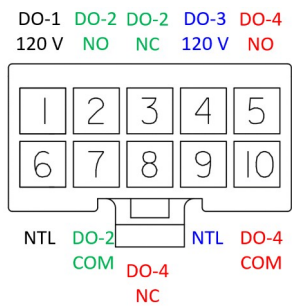


Figure 3-CSCNC IOMOD1 OUTPUT CONNECTOR

To connect the start plasma signal to your S3THC, follow the chart above

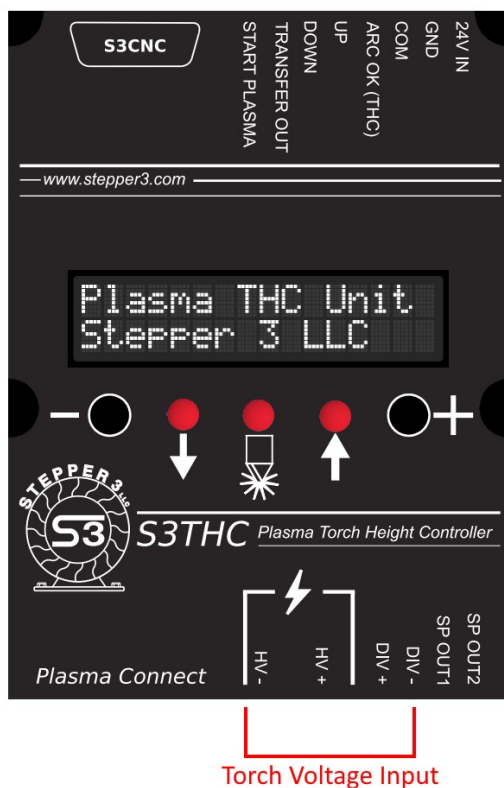
Start Plasma Signals	DO Connector Pin#
THC Conn Pin 4 or 8 (GND)	7
“Start Plasma” Signal	2

## 4 Front Panel Interface

The S3THC front panel provides real time feedback to the operator via a LEDs and an LCD display.

### 4.1 Indicator LEDs

There are three status LED on the front panel of the unit (shown in red on the figure below). Each of the LEDs indicates status of the outputs and will turn on whenever that output is active. These LEDs provide the status of the torch height adjustment can be monitored by the LEDs on the front flashing.



When illuminated, the center LED indicates that the plasma arc is established and the torch height controller is active.

When active, the LED on the left indicates that the torch height controller is commanding the CNC Controller to reduce the torch height to lower the arc voltage.

Conversely, when the LED on the right is active, the torch height controller is commanding the CNC controller to increase the torch height to increase the arc voltage.

## 4.2 LCD Screen

### 4.2.1 Screen Descriptions

The LCD screen is allows the operator to verify the torch height controller settings from the front panel. This section describes the use of the LCD screen.

#### **Splash Screen:**

Upon power up a splash screen is presented for 3 seconds while initialization functions are taking place.



#### **Main Screen:**

After initialization, the following screen will be displayed indicating that the torch height controller is ready to control.



#### **Connection Screen:**

After initialization when operating with the S3CNC software, if communications is lost, you will receive an error screen. The torch height controller will continue to function with the last parameters to prevent

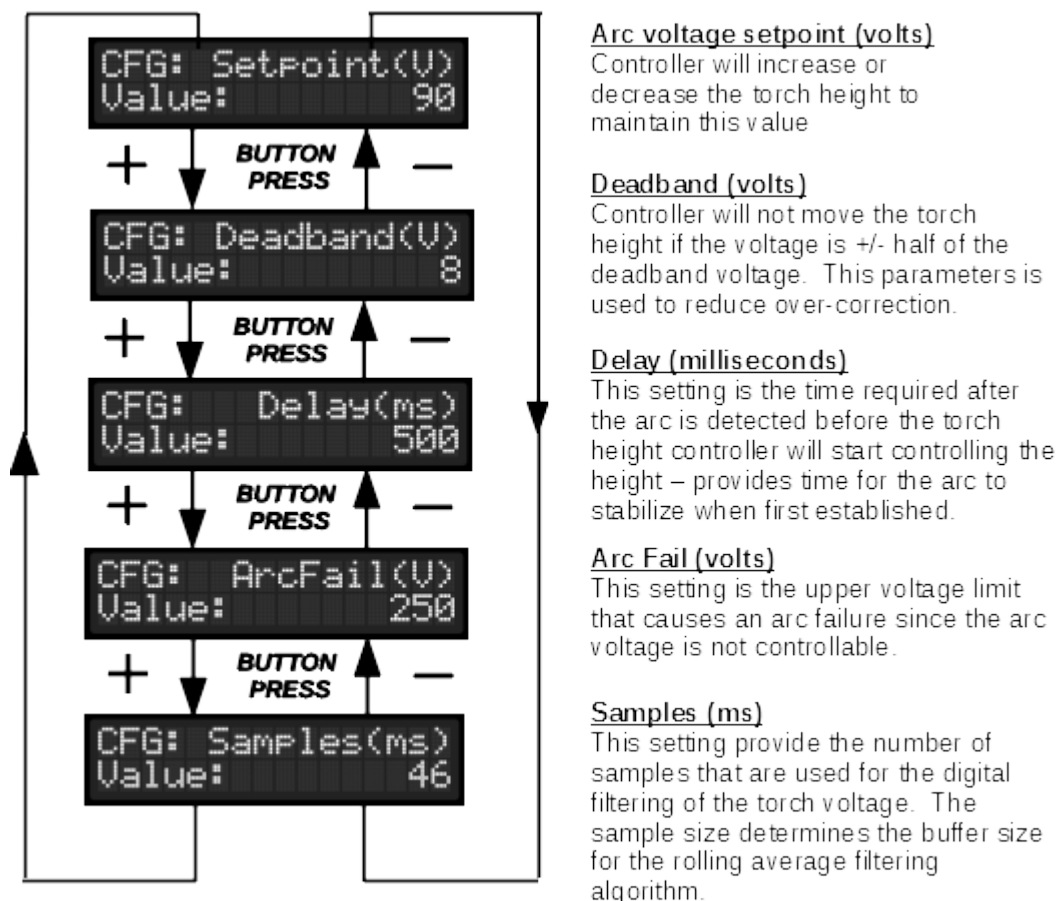


#### **Parameter Screens:**

By using the buttons located under the LCD screen, the user can view or edit the parameter settings in the torch height controller. After 3 seconds the settings screen will go back to displaying the main info screen.

### 4.2.2 Screen Navigation

The navigation structure is shown below:



### 4.2.3 Changing Parameters

When operating in standalone mode (without S3CNC Software) the user can set each parameter from the buttons on the S3THC front panel as shown below:

Steps to change parameters:

- Navigate to the parameter to be changed
- Press and hold both the + and – buttons at the same time until the parameter changes to EDIT mode. When in EDIT mode, the word EDIT is displayed in the upper left side of the LCD Display. For example:

```
EDIT Samples(ms)
Value:          46
```

- Using the + and – buttons, change the parameter to the desired value.
- Press both the + and – buttons to exit EDIT mode. Upon exiting the EDIT mode, the LCD will return to the CFG display. For Example:



- Navigate through the parameters to confirm that changes were successfully made.

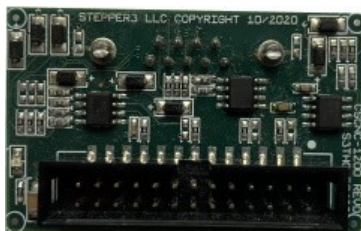
**NOTE: When using the S3CNC software, the manually entered parameters will be over-written when the S3CNC software is re-started, or when a new material table entry is selected.**

## 5 Communications Adapters

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When using the S3CNC Software, if your controller was not provided with a S3THC communications adapter, you will require one of the following adapters:

### 5.1 CSCNC-1200 THC Adapter



The CSCNC 1200 is an optional add-on for Stepper3's CSCNC stepper and servo controller products. The adapter is installed internally and adds the S3THC RS-422 DB9 connector to the front panel of your drive/stepper

To setup your S3CNC software to use the S3THC, go to the settings and open the Configurator. Once you are there proceed to the torch settings section (Step 4), enable the "Uses S3THC", and then choose "Select Standard H/W Config." From the pop-up menu select "CSCNC" and hit apply S3THC Settings.



*Additionally, you will need to set the hardware ports and pins settings:*

Signal Name	Port-Pin #
Arc OK Input	Port 1 Pin 15
Torch On Relay Output	Port 1 Pin 14
THC On Input	Port 1 Pin 15
THC Up Input	Port 2 Pin 10
THC Down Input	Port 1 Pin 12

5.2 CS808-422 Adapter



The CS808-422 Adapter allows the user to connect their CS808 to the S3THC. Plug the adapter into the DO and DI ports labeled on your device.

To setup your S3CNC software to use the S3THC, go to the settings and open the Configurator. Once you are there proceed to the torch settings section (Step 4), enable the “Uses S3THC”, and then choose “Select Standard H/W Config.” From the pop-up menu select “CS808” and hit apply S3THC Settings.

To connect your S3THC to your CS808 device, use the pass-through connector found on the top of your CS808 adapter. When connecting your devices, note that the GX16 port is the only port that is reserved (GX16 is used for the RS-422 communication).

To Setup your CS808 adapter in the S3CNC software, for a guide on the Digital Inputs and Outputs (DI and DO ports) correlating S3CNC Ports and pins.

#### CS808 DI and S/SP Guide

CS808 Port	Port-Pin #
DI-2	Port-3 Pin-11
DI-3	Port-3 Pin-12
DI-4	Port-3 Pin-13
DI-5	Port-3 Pin-15
DI-6	Port-2 Pin-13
DI-7	Port-1 Pin-15

## 6 Software Requirements (S3CNC Mode only)

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- *S3CNC Version 1.35 (or later)*
- *Ether-mach Plugin Version 3.3.XX or later (ships with S3CNC installer)*
- *Standalone mode requires no specific software*

## 7 Electrical Ratings

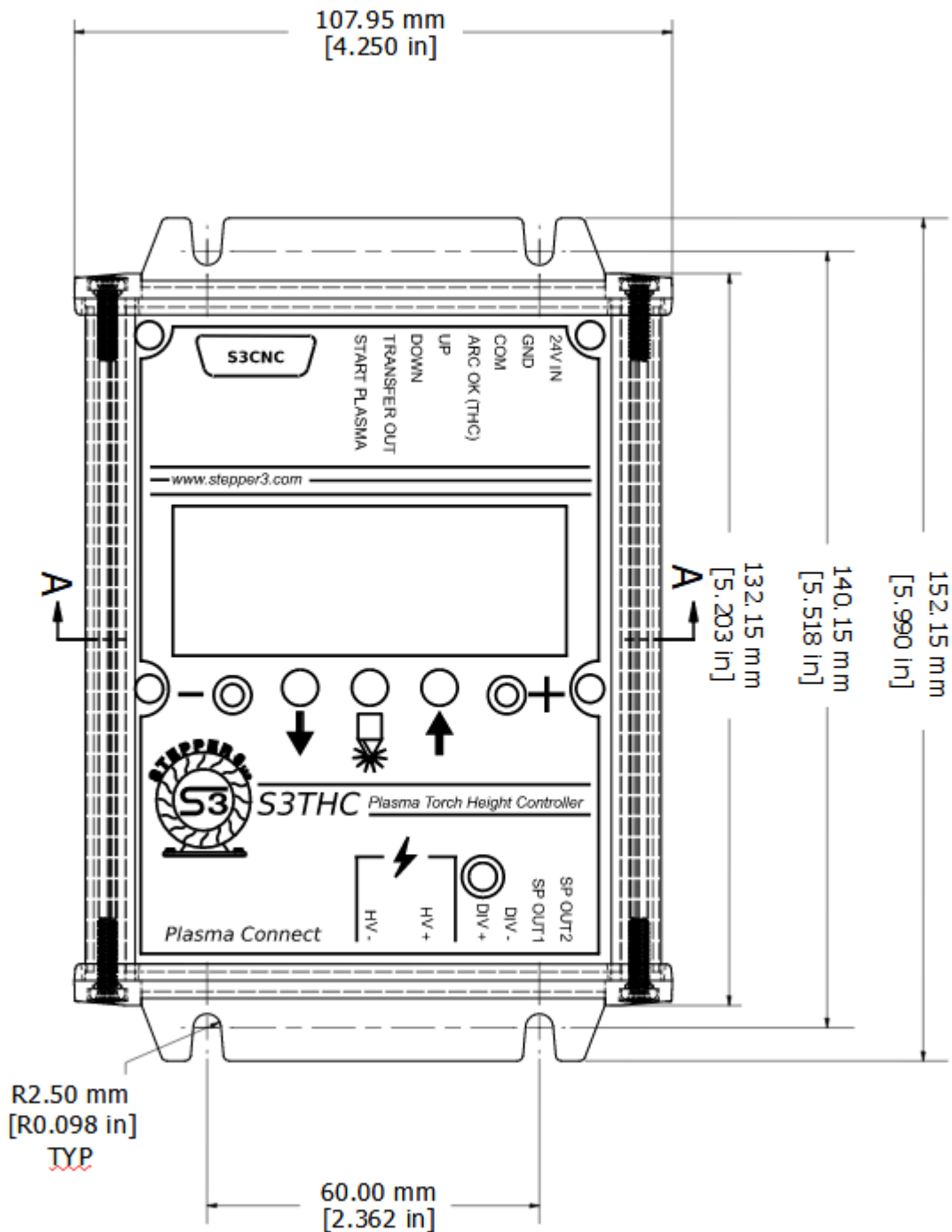
The following table show the electrical characteristics of the S3THC:

Parameter	Units	Min	Typ.	Max	Notes
DC Power Input					
Input Voltage (VIN)	V	20	24	30	
Input Current @ 24VDC	mA	--	200	350	
Arc Voltage					
DIV (+) to (-)	Vdc	--	--	5	1. The Arc Voltage input is NOT polarity protected. Improper hookup will result in damage and void warranty.  2. Use only one input do not hook up both DIV and RAW at the same time or damage may result.
RAW (+) to (-)	Vdc	--	--	300	
Digital Inputs					
Ion	mA	--	15	17	Input is sourced by the S3THC controller. To activate the input tie the start plasma terminal to the common terminal.
Start Plasma					
Digital Outputs					
Relay Outputs	mA	--	--	500	These relay contact outputs all share a common internally connected to the COM terminal.
Contact Ratings	V	--	--	200	
Response Time	mS		1		
Up Down ArcOk Transfer					
Digital Outputs					
Relay Outputs	A	--	--	2	
Contact Ratings	V	--	--	200	
Response Time	mS		5	10	
Start Plasma					

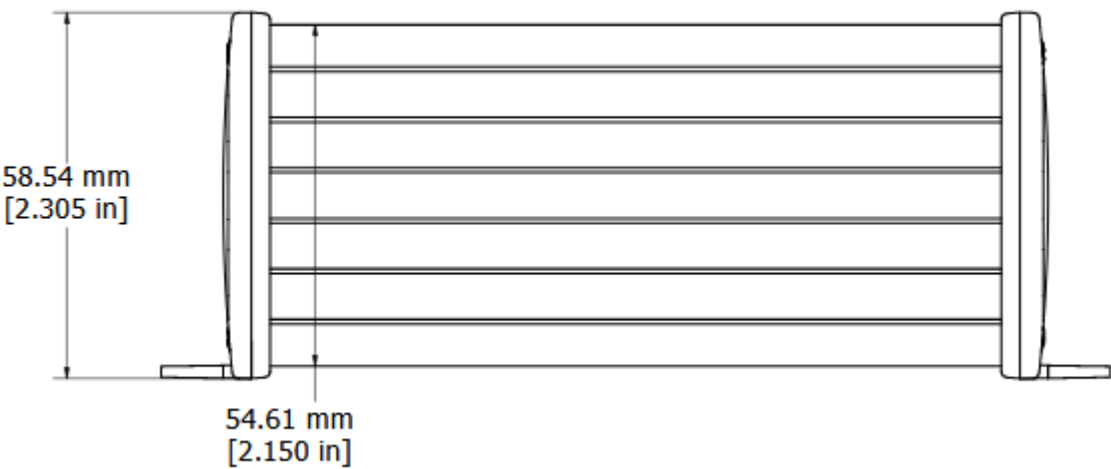
## 8 Dimensions

### 8.1 Front View

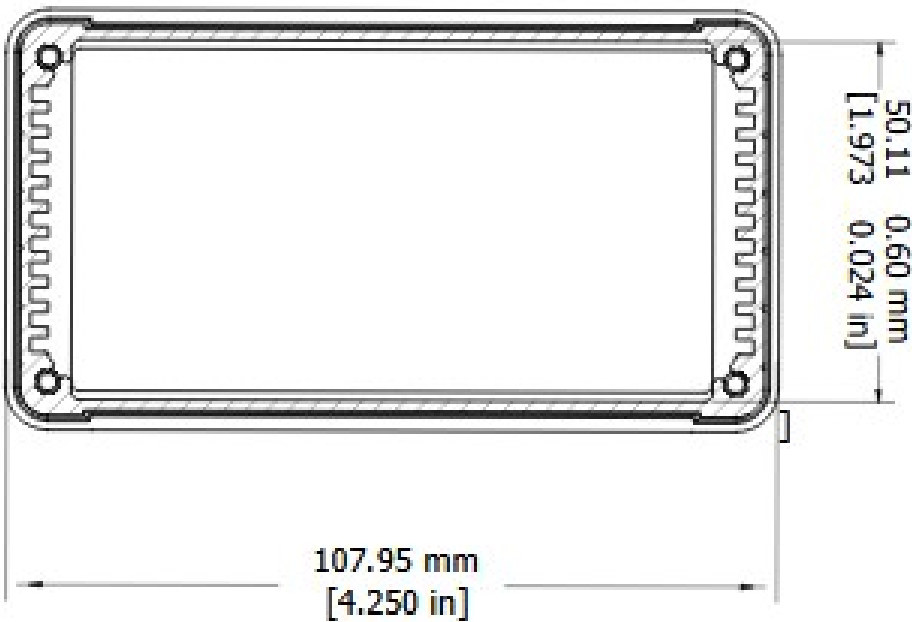
NOTE: Be sure to leave room for connectors and cables above and below the unit when mounting. Recommended minimum clearance is at least 3 inches.



8.2 Side View



8.3 Section A-A



SECTION A-A

## 9 Typical CSCNC wiring

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NOTE: Wiring diagram can be downloaded at [www.stepper3.com](http://www.stepper3.com) manuals section