

THC Quick Start in simCNC





I. GENERAL

The THC feature in simCNC is not only a THC function but also a set of functions that form a complete and ready solution to quickly start working with a plasma cutter. By deciding to use simCNC in your plasma cutter you receive:

- simCNC software equipped with THC function supporting 4 modes (Manual, Digital, Analog and Smart Analog).
- Dedicated M3 macro controlling the process of switching on the torch blow and piercing.
- M5 macro switching off the torch blow and ensuring fast blowing in the case of Hypertherm aggregates.
- Dedicated simCNC screen that allows you to oversee the cutting process and configure cutting parameters.
- Cutting parameter editor that allows you to edit and create parameter tables (csv files).



II. THC Modes

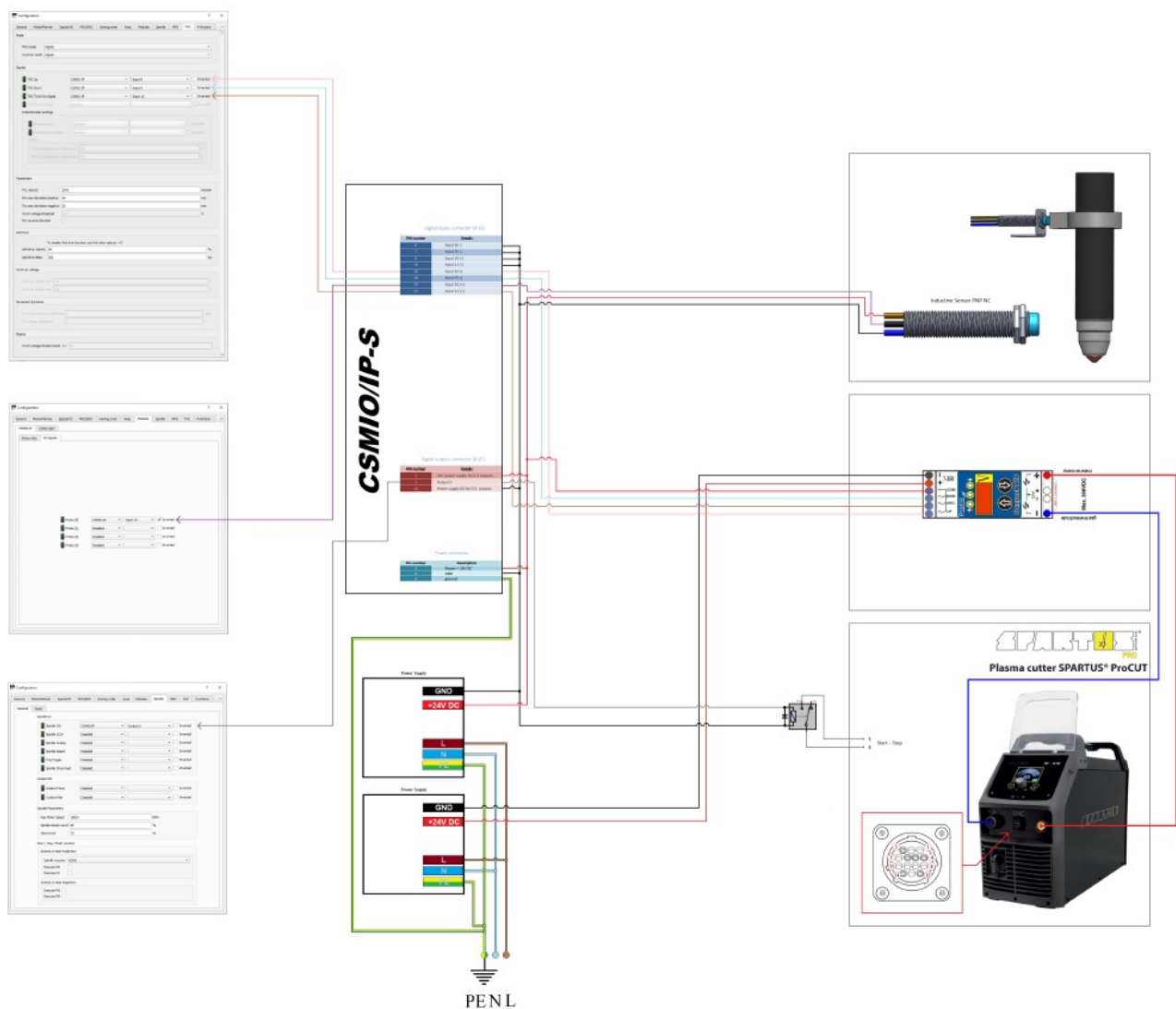
The THC feature has several modes but now we will only focus on the most popular, "Digital", and the most innovative, "Smart Analog".

- **The THC „Digital”** mode applies to a situation where a plasma generator does not have a dedicated analog output 0-10V with a voltage divider and a digital output confirming the presence of an electric arc. In this situation, an external torch height control should be used.

The diagram includes:

- connection with an inductive sensor for measuring the height of a sheet metal
- connection of an external sheet height controller (PROMA).
- connection of a plasma generator (SPARTUS).

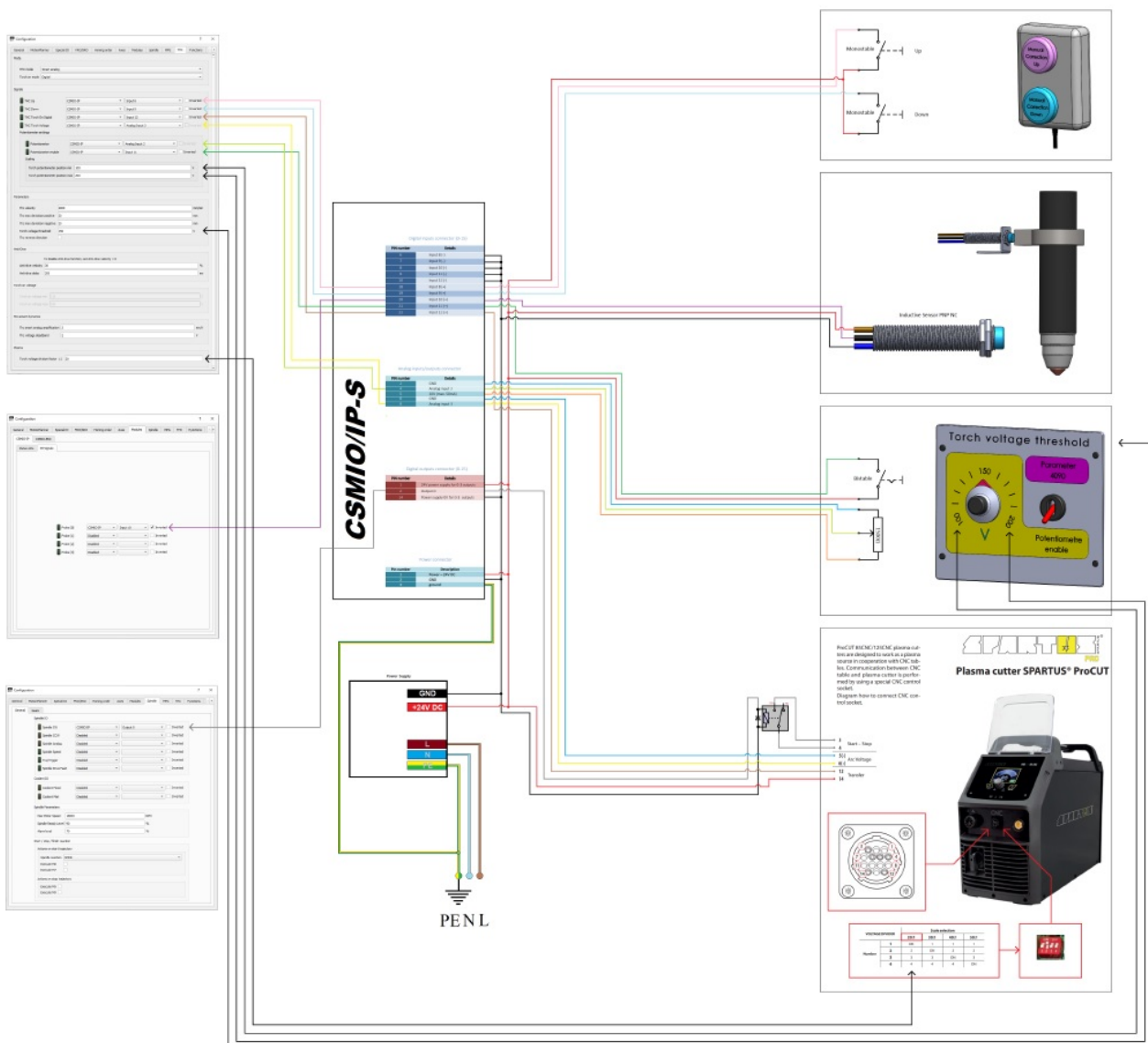
[higher resolution drawing is available on CS-Lab website: <https://en.cs-lab.eu/connection-of-thc-in-simcnc-thc-analog-smart-thc-digital/>]





- **The THC “Analog Smart”** mode applies to the situation where a plasma generator has a dedicated 0-10V analog output with a voltage divider and a digital output confirming the presence of an electric arc. In this situation, an external torch height controller is not required to start the automatic torch control, because a CSMIO/IP controller and simCNC software fully replace it, and even guarantee better precision and dynamics of the torch height adjustment. The diagram includes:
 - connection of a manual manipulator for temporary manual correction of the torch height.
 - connection with an inductive sensor for measuring the height of a sheet metal.
 - connection of an operator panel, equipped with a potentiometer for setting an arc voltage, along with a switch that allows the selection of the arc voltage setting through the potentiometer or a digital value from the simCNC screen (parameter 4090)
 - connection of a plasma generator (SPARTUS) using the full capabilities of the CNC socket.

[Higher-resolution drawing is available on CS-Lab website: <https://en.cs-lab.eu/connection-of-thc-in-simcnc-thc-analog-smart-thc-digital/>]



In this mode, a unique torch height adjustment algorithm was used, which consists in changing the adjustment speed. It is like the PID regulator, but it is more precise and easier to configure. The only parameter used to configure this algorithm is the "THC smart analog amplification" parameter (par 4055).

The greater the value of this parameter and the greater the difference between the value of the "Current Torch Voltage" (PAR 4091) and "Torch Voltage Threshold" (PAR 4090,) parameters the more rapid the Z axis reaction will be.





III. M3 macro

M3 macro is tasked with:

- Measuring the height of sheet metal with the probe no. „Probe_Index“ at the distance „Max probing distance“.
- Raising the torch to the pierce height „Pierce height“ or to the cut height „Cut height“ if both values are the same.
- Switching on the torch blow using the digital spindle switching output.
- Checking whether the torch blow presence signal "THC Torch on Digital" appeared in time „Timeout_Torch_is_on“.
- Performing a delay with value „Pierce delay“ while supervising the torch blow presence signal "THC Torch on Digital".
- Raising the torch to the cut height „Cut height“
- Switching on the THC function.

The red color marks the values that must be configured within the M3 macro. The green color marks the parameters configured from the simCNC screen dedicated to the plasma cutter.

Below are all parameters with their description and exemplary values that must be configured within the M3 macro.

Probe_Index = 0	# Probe number
Probing_velocity = 1500	# Probing Velocity (unit/min)
Lifting_velocity = 2000	# Lifting velocity to cut height and probing start height (unit/min)
Descent_velocity = 5000	# Descent speed at the cutting height (unit/min)
Sensor_hysteresis = 1.2	# Distance from touching the metal sheet to activating the sensor (unit)
Timeout_Torch_is_on = 1000	# Maximum waiting time for the "Torch is on" signal (ms)



IV. SIMCNC screen dedicated to the plasma cutter

This screen is a simCNC basic screen modified to evaluate the cutting parameters quickly and conveniently on the fly and modify them. The parameters have been grouped into two areas according to the frequency of their use and importance.

- **Area less used**

THC Configuration	
Max probing distance	0.000
Pierce height	0.000
Cut height	0.000
Pierce delay (ms)	0
THC Max Corr. ↑	20.000
THC Max Corr. ↓	20.000
Anti-Dive Delay (ms)	200

„Max probing distance” – the maximum distance on which the sheet height measurement will take place. After exceeding it, the measuring will be interrupted, and the torch will be raised to the starting point of the measurement.

„Pierce height” – the height to which the torch is raised with respect to the sheet to pierce the sheet.

„Cut height” – the height on which the torch is lowered with respect to the sheet to start the X and Y axis cutting movement.

„Pierce delay” – the sheet piercing time, during this delay the blow is switched on, all axes are stopped and the signal of the arc presence of "THC Torch on Digital" is supervised. In the event of the "THC Torch on Digital" signal loss, M3 macro interrupts its operation and stops cutting, since there is a possibility of the metal eruption reaching straight inside the torch causing the blow to go out.

„THC MAX Corr. UP” – Maximum correction range of the torch height towards the positive direction of the Z axis from the position of the THC function.

„THC MAX Corr. Down” – Maximum correction range of the torch height in the negative direction of the Z axis from the position of the THC function.

„Anti-Dive Delay” – The time for which the "Anti-Dive" function will be extended.

The values that are used by M3 macro are marked with blue. The values used to directly configure the THC functions are marked with purple.

- **Area more frequently used and with more importance**

THC		
Torch is on	THC pos. deviation	0.000
THC state is on	THC velocity	2000
THC work	Anti-dive vel. (%)	30
Anti-dive is blocking	Torch vol. threshold	150
THC Up	Amperage	0
THC Down	Feed Rate	0
Potentiometer		



Parameters:

„**THC pod. Deviation**” – deviation from the height of the Z axis during the THC function.

„**THC velocity**” – the speed of the Z axis height adjustment.

„**Anti – dive vel.**” – X and Y resultant speed below which the torch height adjustment will be blocked. This speed is expressed in percentage of the cutting speed "F", including "FRO".

„**Torch vol. threshold**” – an electric arc voltage to be reached as a result of adjusting the torch height (only Analog and Smart Analog modes).

„**Amperage**” – current setpoint. This value is transmitted to the plasma unit if the communication procedure with the plasma generator (future parameter) is added to the M3 macro.

„**Feed Rate**” cutting speed dealt by M3 macro at its end.

LEDs:

"Torch is on"- signalling the presence of the blow (signal status "THC Torch On Digital")

"THC state is on" – signalling of the THC function.

"THC Work"- signalling whether there are conditions for adjusting the torch height.

"Anti-dive is blocking"- signalling the Z axis movement lock due to the actuating Anti-Dive function.

"THC UP"- signalling the correction movement of the torch height towards the positive Z axis.

"THC Down"- signalling the correcting movement of the torch height towards the negative Z axis.

"Potentiometer"- signalling the situation in which the adjustment of the voltage set "Torch vol. threshold" takes place using a potentiometer (see the diagram).

V. Cutting parameters editor.

Cutting parameters editor is a macro written in Python, used to create and edit cutting parameters tables. It is an open macro, i.e. you can make independent modifications to extend its functionality.

The cutting parameters editor is started with the "Select Material" button

The editor allows you to edit the parameters visible in the first row of the table, these parameters are described in previous chapters.



Cutting parameter table editor | File : C:/Program Files/simCNC/profiles/Template_Plasma_THC/scripts/Hypertherm - Stainle...

File Parameters

	Amperage	Feed Rate	Pierce height	Cut height	Pierce delay	Anti-dive Velocity	Anti-dive delay	Torch voltage threshold	THC velocity
Stainless steel 0.5mm	50.0	8000.0	3.0	1.5	0.0	30.0	0.0	101.0	3000.0
Stainless steel 0.8mm	50.0	7750.0	3.2	1.6	0.0	30.0	0.0	102.0	3000.0
Stainless steel 1mm	50.0	7115.0	3.6	1.8	100.0	30.0	0.0	102.0	3000.0
Stainless steel 1.2mm	50.0	6350.0	3.6	1.8	100.0	30.0	0.0	103.0	3000.0
Stainless steel 1.5mm	50.0	5335.0	3.6	1.8	100.0	30.0	0.0	106.0	3000.0
Stainless steel 2mm	50.0	4200.0	4.0	2.0	100.0	30.0	0.0	108.0	3000.0
Stainless steel 2.5mm	50.0	3300.0	4.0	2.0	200.0	30.0	0.0	111.0	3000.0
Stainless steel 3mm	50.0	2800.0	4.0	2.0	300.0	30.0	0.0	112.0	3000.0
Stainless steel 4mm	50.0	2300.0	4.4	2.2	400.0	30.0	0.0	116.0	3000.0
Stainless steel 6mm	50.0	1400.0	4.6	2.5	500.0	30.0	0.0	123.0	3000.0

(A) (mm/min) (mm) (mm) (ms) (%) (ms) (V) (mm/min)

Overwrite selected row Save as new row

"Menu File"- this is a standard write and read menu that can be found in other applications. This menu allows you to save and read csv files that are great for storing the cutting parameters tables. The csv files can also be edited using the "Open Office" package but during its use, you must pay attention to the correct file format. This is not necessary with the editor since it ensures the correctness of the csv file format.

"Menu Parameters"- this is a simple menu that gives you the ability to send parameters to simCNC or download them from simCNC and save them in the table.

„Download from simCNC” – after selecting this option, the parameters from the simCNC software and the record in the new row at the beginning of the table are read.

„Send to simCNC” – after selecting this option, the parameters located in the currently highlighted row are sent to simCNC by clicking it.

- Editing the parameters.
To edit the relevant parameter row click on it, in order to copy the corresponding values to the editing row over the "Overwrite selected row" and "Save as new row" buttons.
After changing the parameter values in the editing line, you can:
 - overwrite the contents of the selected row with a click of a mouse by clicking on the "Overwrite selected row" button
 - save values in a new row at the beginning of the table after clicking the "Save as new row" button.
- Deleting the parameter row.
In order to prevent accidental deletion of the row of parameters developed during the cutting process, the deletion options have been hidden under the right mouse button. Left-click on the selected row, right-click and select the row erasing options from the single-point menu.
- What if I do not use all parameters?
When you do not use one of the parameters, leave its field blank, and it will be skipped when sending parameters to simCNC.