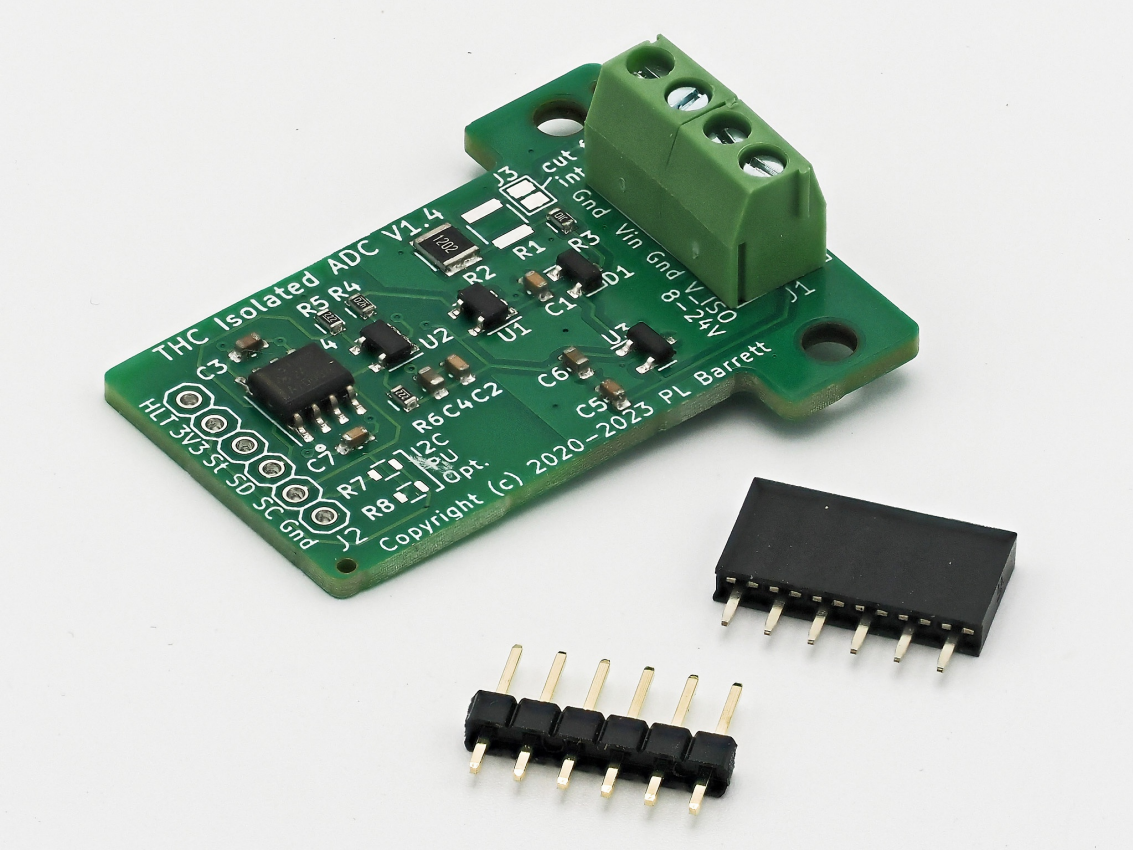
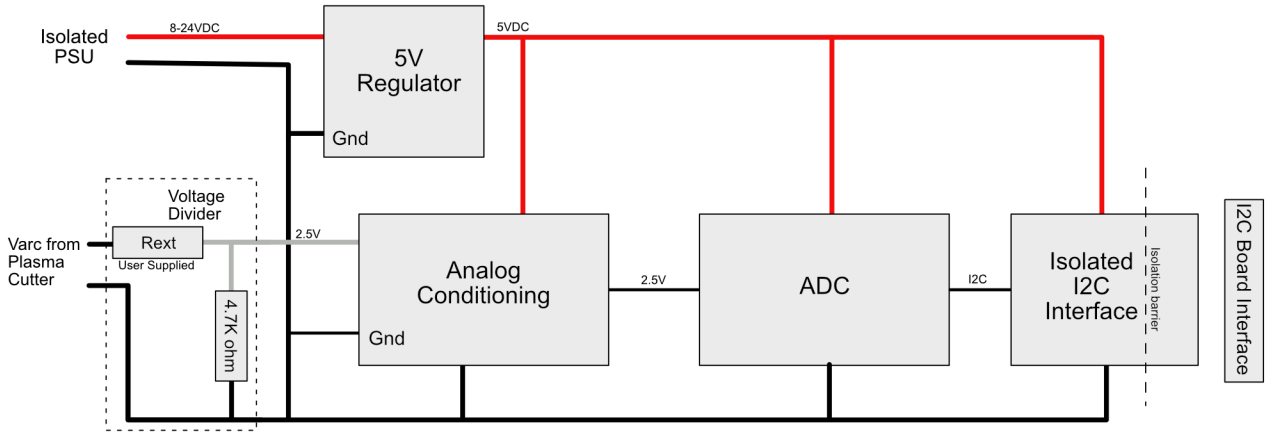
GrblHAL THC Isolated ADC for Torch Height Control
User Manual

Version 1.1



Introduction

The THC Isolated ADC is designed to plug into the I2C port on either the T41U5XBB or PicoCNC. It contains an isolated 12 bit ADC, 5V voltage regulator, voltage divider and analog conditioning circuitry.



THC Isolated ADC block diagram.

User Supplied Resistor

The THC Isolated ADC uses a voltage divider to reduce the Plasma Arc Voltage (Varc) down to approximately 2.5V so that the signal may be conditioned and converted to digital. This uses 2 resistors in a voltage divider configuration. The lower of the two is mounted on the PCB and has a value of 4.7K Ohms. The upper one is user supplied and the value is dependent on the Plasma Cutter output voltage (Varc). Consult the following table for the correct value

Varc (volts)	Rext (ohms)	Resistor Wattage
100V	183.3K	½ W
50V	89.3K	½ W
20V	32.9K	½ W
10V	14.1K	½ W
5V	4.7K	½ W

You may substitute the nearest standard 1% resistor value. If your Plasma Cutter has an Arc Voltage that is not in the table, you may use the following formula to calculate the value of Rext:

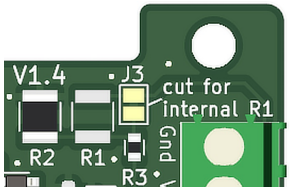
Rext = 4700 * (Varc/2.5 – 1)

Select the nearest standard value 1%, 1/2W resistor.

Note: you do not need better than 1% accuracy because you can adjust the expected value in the Plasma THC plug-in in grblHAL.

A SMD pad for an on-board external resistor is provided. (yes, we get the irony of that.) You may solder a 1206 SMD resistor on the R1 footprint and avoid having the external resistor. Use the same above process for selecting the value of the external resistor. You will need to cut the trace between pads labeled J3 where it says “cut for internal R1”.

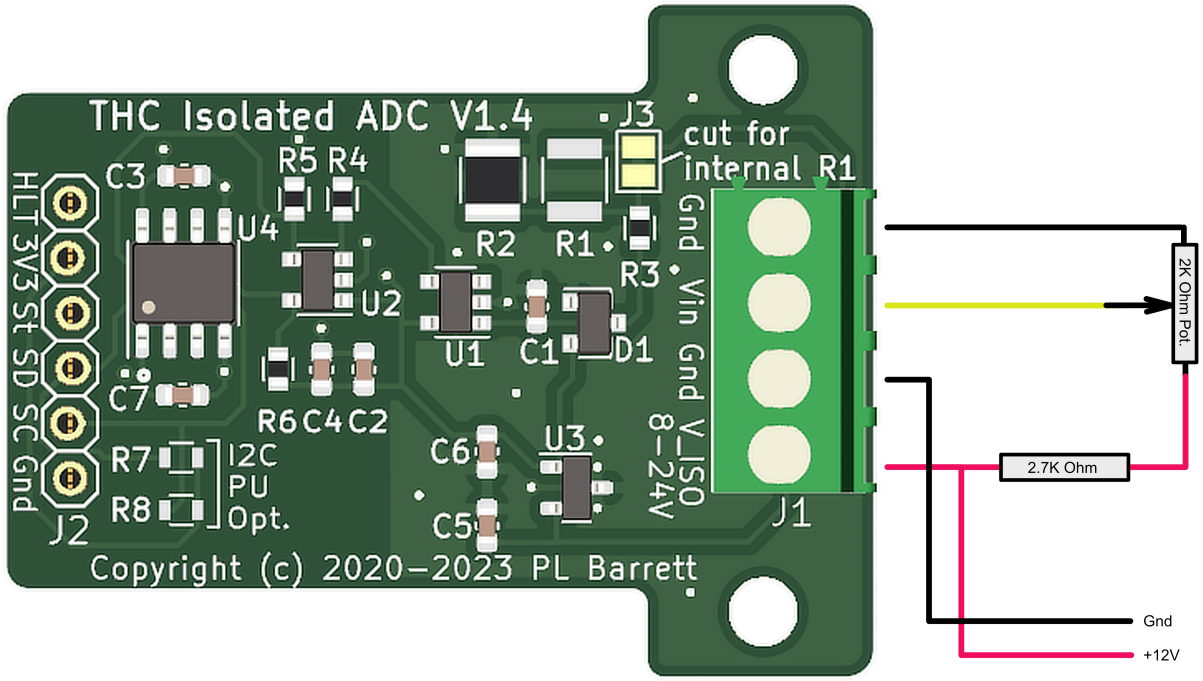
Note, allowing a Varc higher than 10V onto the PCB may bring EMI onto the ADC board. This can result in ADC disruption and possibly damage. Because of that, we do not recommend use of an internal R1.



Installing and Testing

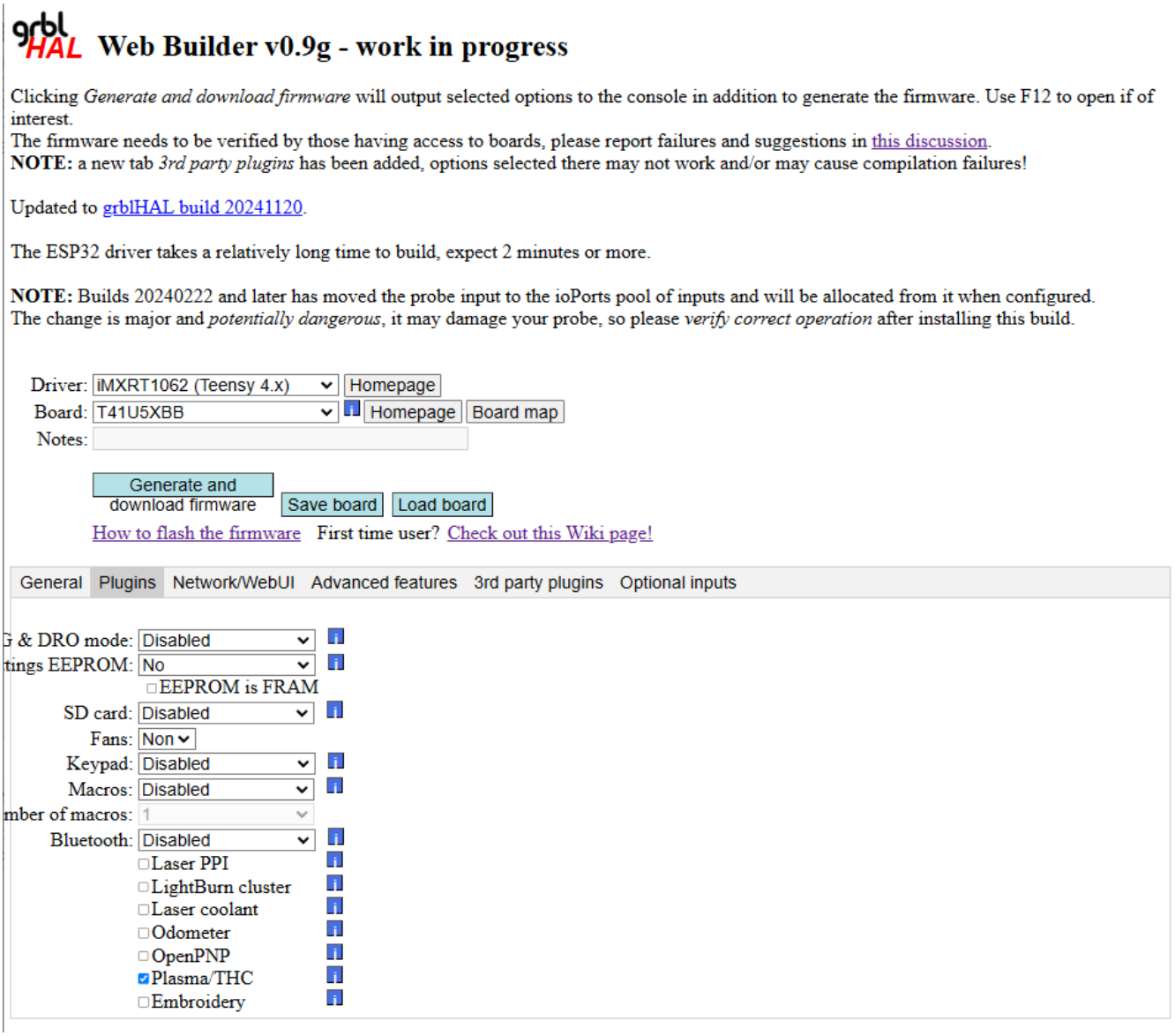
Insert and solder the proper connector (6x1 pin header or 6x1 socket) on the ADC, depending on what you have soldered in the I2C header on the breakout board PCB. Insert the ADC board onto the breakout board.

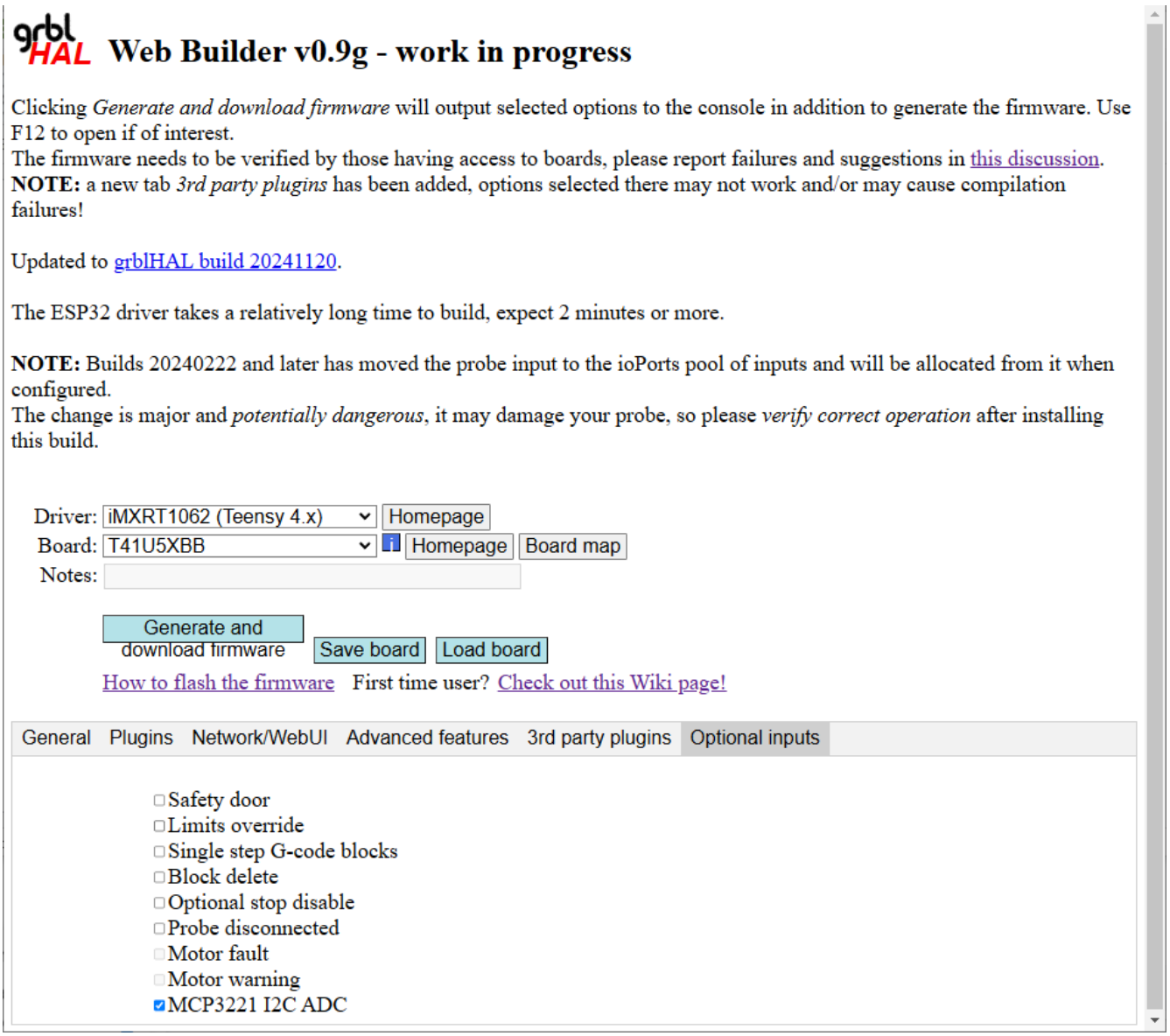
Use the following diagram to make a test jig. The 2K Ohm pot and 2.7K resistor form a voltage divider to bring 12V down to 5V, at most. You can use any combination of resistor and potentiometer that make the Vin voltage no higher than 5V.



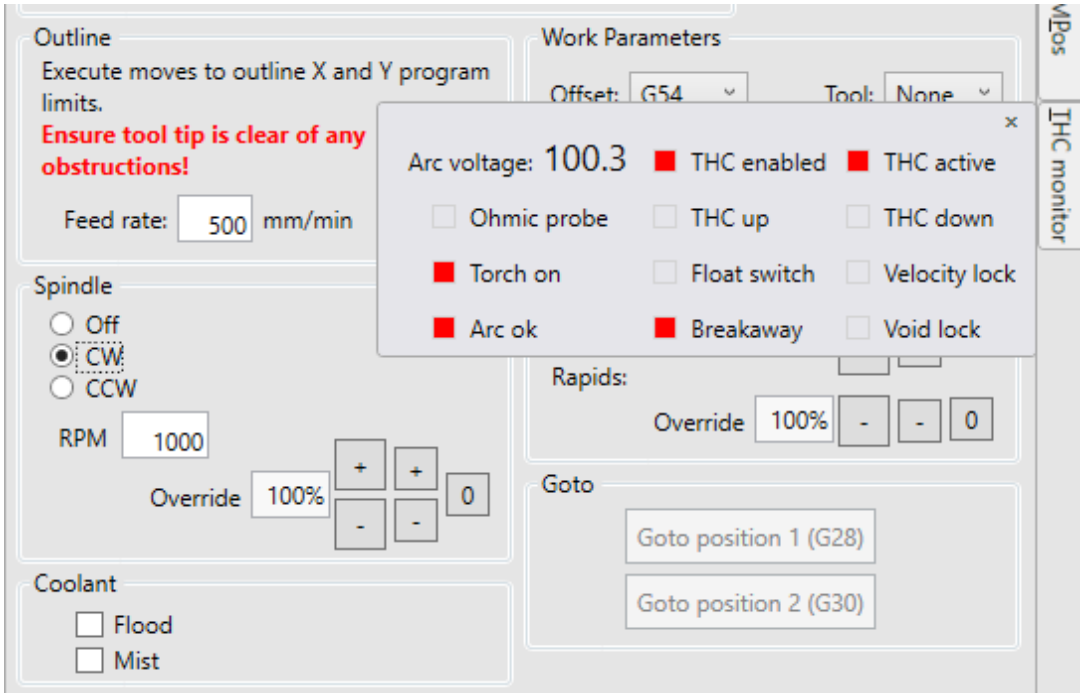
Test set up for ADC input

Make sure you have built grblHAL with the Plasma/THC plugin and enabled the MCP3321 I2C ADC. If using the Web Builder, check Plasma THC on the Plugins tab and enable the MCP3321 I2C ADC option on the Optional inputs tab. See the screenshots below. Note: the below screenshots are current as of Nov 2024. The appearance may change as grblHAL and Web Builder evolve.





Make sure you have at least version 2.0.44 of ioSender installed (or edge version 2.0.44p4). Load the new firmware onto the breakout board and start ioSender. A THC Monitor fly-out will appear on the right edge of the ioSender window. Click on it and you should see something similar:



Adjust the potentiometer and you should see the voltage change. If you have an Arc Voltage of 0, verify the voltage going into the Vin pin. You may need to adjust several of the Grbl plasma settings

Mode ($350) set to 1, external arc voltage

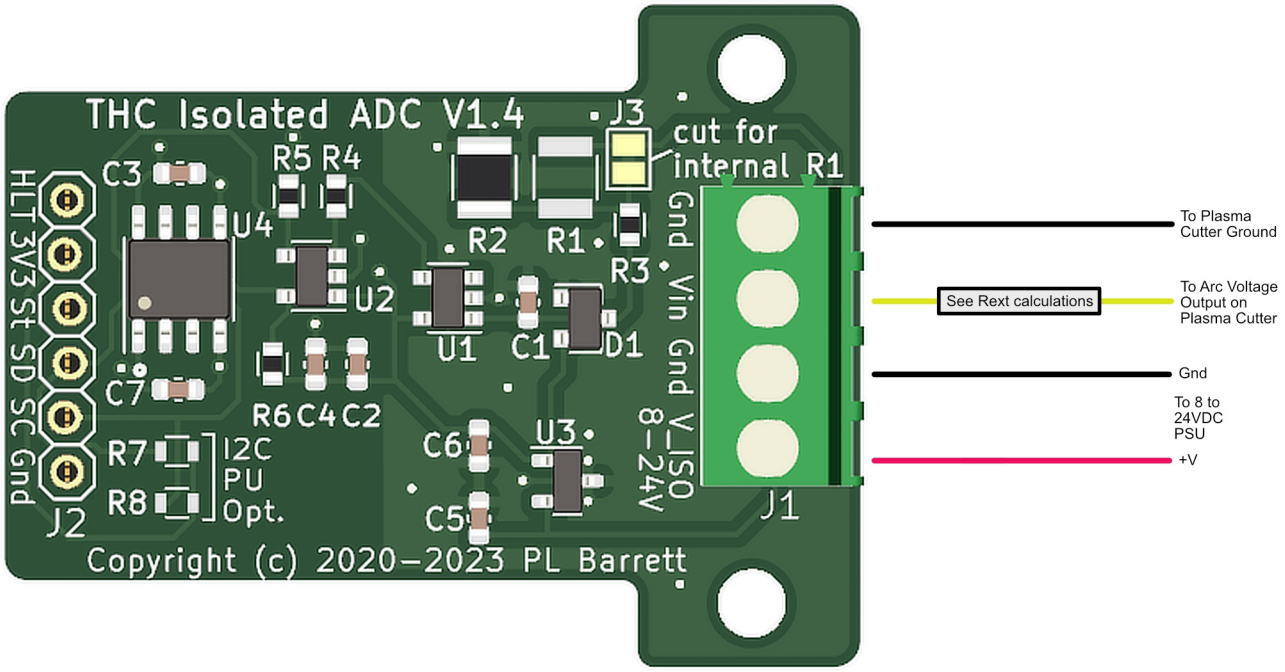
Voltage Scale ($361) set to a value that displays 100V in the THC monitor flyout in ioSender. We have been using 0.1 in our testing for a 2.5V input at the Vin terminal of the ADC board.

For other settings, look at the THC/Plasma plugin github repo (https://github.com/grblHAL/Plugin_plasma/).

The THC Isolated ADC is part of the evolving grblHAL plasma capabilities. As such, things may change. The github Plugin_plasma repo has Issues and Discussions pages. These are the best places to get questions answered and report bugs or other problems.

Connecting to Plasma Cutter.

The external resistor needs to be connected between the Plasma Cutter's Arc Voltage output and the Vin pin on the ADC. You need to use shielded wire and insulate the resistor pins (shrink tubing is a good choice). The 8-24V power supply only needs to deliver 25 mA and can be from any suitable supply including a wall wart style power supply.



Plasma Cutter ADC input Connections

External Resistor Value

ADCI_1 uses a voltage divider to drop the Plasma Cutter's Arc Voltage output to a usable level. This uses 2 resistors. One, the lower resistor, is on the ADCI board and the other, the upper resistor, must be supplied by the user. This allows support for any Arc Voltage value. The user supplied resistor should be in series with the signal cable running from the Plasma Cutter to the ADCI board. It should be outside the electronics box where the ADCI is mounted so that high voltage does not enter. To find the right value of the user supplied resistor, refer to the following table or use the formula after the table. It is acceptable to use the nearest 1% tolerance resistor.

Arc Voltage	Resistor Value	Resistor Wattage
100V	183.3KΩ	½ W
50V	89.3KΩ	½ W
20V	32.9KΩ	½ W
10V	14.1KΩ	½ W
5V	4.7KΩ	½ W

For an Arc Voltage not listed in the table, compute the resistor value via this formula:

4700 * ((Arc_Voltage/2.5) – 1)

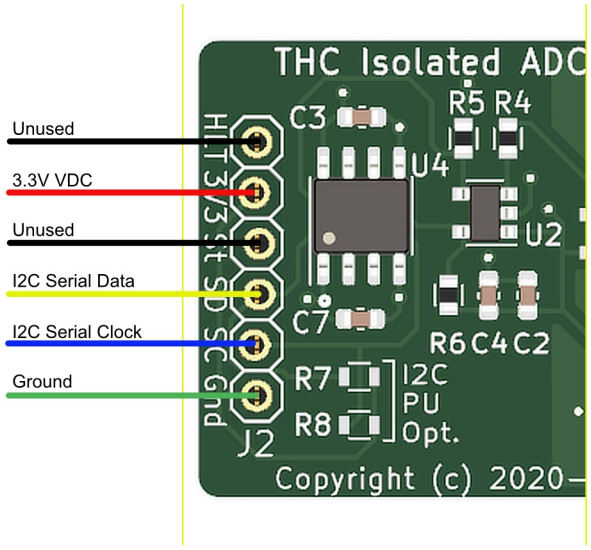
Round up to the nearest 1% tolerance resistor value. Use a ½ Watt resistor.

I2C Resistors

The THC Isolated ADC has pads for I2C Pullup Resistors (R7 and R8). These are for the interface to the processor on the breakout board. They are not needed for use with the T41U5XBB. If you need them, consult with the manufacturer of the processor to which you are interfacing for help in determining their values.

Using the ADC with other host boards

The THC Isolated ADC can be used with boards other than the T41U5XBB and PicoCNC. It uses a 3.3V I2C interface. The host processor must have an I2C interface. The following diagram shows the connections. The ADC is a Microchip Technologies MCP3221 12-bit A/D Converter with an I2C interface. The datasheet is available here. The isolator chip on the ADC board is transparent and simply passes through the I2C signals.



I2C Interface Connections

Schematic