

Energy360.ca

Main Board Build for 12V 4DOF simulators

Introduction

I came across the Dr-Adhd 4DOF simulator build project and wow what a great build and what a great project. I was lucky to meet the Dr in person and ride his rig.

You can check out his you tube channel <https://www.youtube.com/@Doctoradhd1> and his Discord <https://discord.gg/2RUEuKFFvZ>

After a lot of research and reading forums online I came across a common thread, that the electronics and wiring was very confusing, hard to complete and even harder to find problems when they exist down the road. I saw many people struggling, wiring it wrong or creating a wiring mess and a noisy environment which translated into problems, gremlins in game play and a nightmare to maintain.

So I created a few circuit boards to deal with this.

1. POT board to mount and terminate the position sensors
<https://www.energy360.ca/4dof-race-sim/position-sensors>
2. PSU board to enable server power supplies which are designed for harsh switching currents
<https://www.energy360.ca/4dof-race-sim/l1100a>
3. Main Board to tie all the electronics together and mount the Sabertooth, Arduino, Resistor and enable Emergency Stop and Wind
<https://www.energy360.ca/4dof-race-sim/main-circuit-board>

Initially I was going to just make the boards for my rig, but after connecting to the Sim community I decided to make them available to everyone.

Main Board Build

The mainboard will come partially populated and you will have to install your Sabertooth 2x32, Arduino Uno R3 and the Power Resistors, this guide will lead you through the assembly of the board.

Materials and Preparation Required

Power Resistors

3.3 Ohm 100W \$1.05 each will need 4 resistors

https://a.aliexpress.com/_mND5lkH

Mount Screws for Resistors

8 x #4-40 by ½" UNC or M3 x 12mm Metal Screw – Machine screw or Pan head



16 x matching nuts – One nut will go under the resistor to lift it off the board for ventilation and the other nut will secure the resistor to the board



16 x Nylon insulating washers that go on each side of the circuit board



Mount Screws for Sabertooth

The Sabertooth comes with 4 screws and nuts, you should get 4 additional nuts and 8 nylon washers to lift the sabretooth off the circuit board for ventilation

Wire Jumpers for Sabertooth Input

Input B+ & B- of the Sabertooth to the Energy360 Board

You need to build 2 Wire jumpers 12AWG / 4mm and 2.5" / 60mm in length – Solid core or Stranded



Wire Jumpers for Sabertooth Output

You will need 8 wire jumper with one end of the jumper with a ferrule connector (this goes in the Green Connector) and tin the other end with solder (this end goes into the Board)

14 AWG / 2mm and 2" / 50mm in length – Solid or Stranded - Stranded preferred – easier to work with

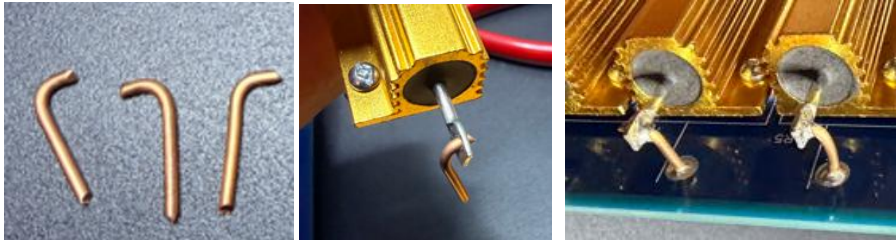


Wire Jumpers for Resistors

You will need 8 wire jumpers

14 AWG / 2mm and 1" / 25mm in length – Solid

Bend one end for wire over like this



Assembly and Installation

Power Resistors

Put the mount screws through the metal resistor housing and secure it with a nut

Add Nylon washer and then place it into the Board

Add Nylon washer to other side

Add Nut to secure, leave it loose at this stage as its easier to place the jumper wires.

Add the jumper wires and solder them to the resistors

Tighten up the bottom nut

Solder the jumper wire into the circuit board.

Trim the excess wire

The resistor is lifted off the board to allow airflow

Repeat for the other resistors



Sabertooth

Program your Sabertooth first – instructions below – Ensure DIP switches are set

Place the mount screws through the Sabertooth and tighten

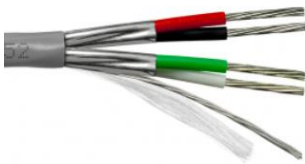
Add Nylon washer
Place Sabertooth onto Board
Add Nylon washer to the other side
Add nut but keep loose as its easier to wire.
Add the input wires jumpers B+ to POS and B- to NEG
Add the output wire jumpers
Tighten the Sabertooth mount nuts
Solder the Input and Output jumper wires into the board
Ensure all wires are insulated from each other
Trim wires as required



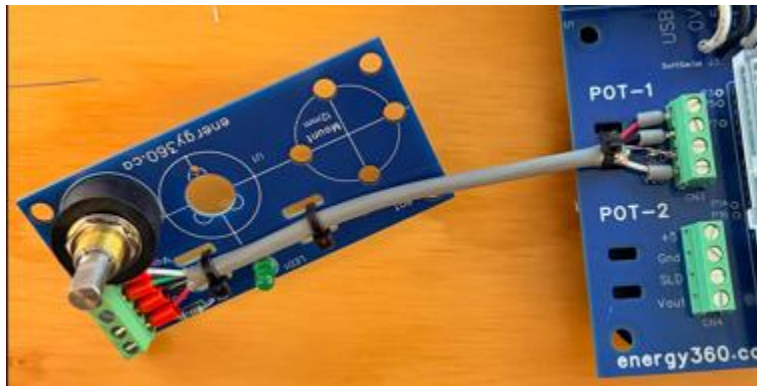
When you are ready to power the board from your PSU you will connect +12VDC to B+ and Gnd to B-. These connections will have 2 wires each, one for the input power from the PSU and the other connection is the jumper wires down to the Board.

Position Sensors

Use good quality 2 x 2 core wire like this, it has 2 shielded x 2 sets plus a outer shield
Provo 2252 Multi-Pair Cable 22AWG 4 Conductor (2 Pair) Stranded TC, Shielded, Gray PVC
<https://www.provowire.com/en/wire-and-cable/building-wire---automation/paired-stranded-shielded/2252-22-2pr-ind-sh-80c-csa-ft4>

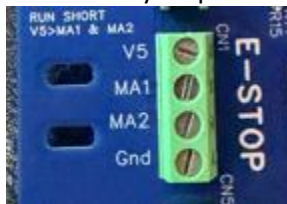


Ensure you terminate each end with a ferrule connector
Red wire is +5V
Black is Gnd
Bare wire is Shield and should only be connected to the Main Board SLD – One End only, the POT end is left floating and not connected (Very Important for Noise Immunity)
White Wire is Vout
Green wire not used.
Secure the cables with a zap strap for strain relief on each board



E-Stop

If you have configured the DIP switches on the Sabertooth to enable E-Stop you will have to wire V5 to MA1 and MA2 to enable motion of the motors. If the V5 circuit is opened – E-stop pressed the motor will immediately stop movement.



Wind

There are 2 PWM fan circuits on the board, FAN1 left and FAN2 right.

Fans must be 4-wire fans which support PWM speed control Typically +12Vdc, Gnd, PWM, speed

<https://www.noctua.at/en/products/nf-f12-industrialppc-3000-pwm>

At the moment wind is not supported in the default sketch

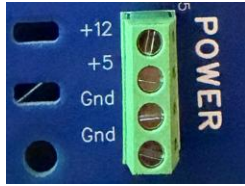
There will be an updated sketch which I have not done yet.



Power

There is an additional Power port for other accessories or indicator lights etc.

Do not exceed 1Amp on the 5V rail and 2Amps on the 12V rail



Arduino Uno R3

The Arduino is placed face down onto the headers on the main board with the USB port facing away from the Sabertooth (see image below)

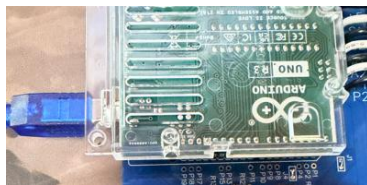
Ensure the pin alignment is correct and the header is in the right position

Do not use any shields in this installation (money saver 😊)

Use 2 x #4-40 by 1" UNC or M3 x 25mm Metal Screw one in each corner

Add Nylon washer to bottom

Add Nut



Capacitor Bank

Not setup as yet and not sure we will need it, but just in case.

The controller is configured to soft charge the capacitor bank at startup through the 3.3 Ohm additional Power Resistor R3 – not populated

The Arduino will monitor the charge voltage of the capacitor bank and when safe it will turn on the Power Relay RL1 – not populated

This will bypass the power resistor and connect the capacitor bank to the circuit directly

This will require an updated sketch which I have not done yet.

Wiring Suggestion and Comments

Additional Wiring Comments

Spend the time now and it will save time in the future, trust me. Here are a few points

- Use Ferrule for all captured wire connector – Green block. So many times I have seen a little strand of wire touching the connector next door and it creates a nightmare to debug.

Available on Amazon <https://a.co/d/fUUEnhx>



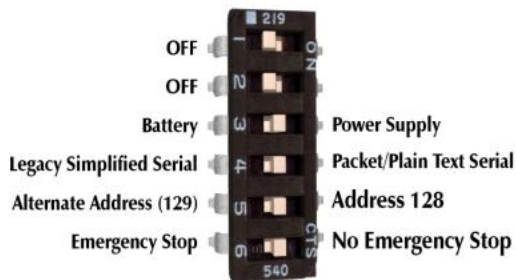
If you are using solid core wires they do not need ferrules

- For the motor wires, use stranded 10 AWG / 6mm and use a crimped ring lug at the Sabertooth connector
- Do not use the connector at the motor, remove this and crimp the Motor wire (keep it short) to your 10 AWG / 6mm wire
- For the PSU wires, use stranded 8 AWG / 8mm and use a crimped ring lug at the Sabertooth connector and the Energy360 Power Supply Board
- All Signal wires should be shielded, take care with the position sensors !!
- Use good quality USB cables, hot glue the USB into the Arduino when your complete
- Strain Relief, the board supports strain relief for all the wires, including the motor connection wires !! use a simple zap strap through the holes, it will go a long way

Configuration and Setup

Follow Sabertooth details here <https://www.dimensionengineering.com/products/sabertooth2x32>

Dip Switches



Switch 1 & 2 OFF

Switch 3,4,5 ON

Switch 6 ON for NO Emergency STOP

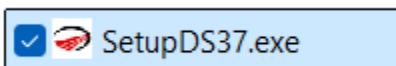
Switch 6 OFF for Emergency Stop - Requires short circuit between Energy360 Main board V5 and MA1 and V5 and MA2, if this circuit is broken the motors will stop

For the serial connection between sabretooth and Arduino is Default Baud rate is 9600 baud, 8N1

Getting Started Step 1 – Describe Software

Download the software and install it on the PC

<https://www.dimensionengineering.com/info/describe>



Start Software

Plug in Sabertooth you should get Red/Green Light flash every second

Select sabretooth 2x32

Press Connect and Download Setting – Note some micro usb cable will not work.

Click on Serial and USB

Serial and USB

Change Baud rate to 115200 and timeout 100mSec (0.1)

Baud Rate:	115200	▼
Plain Text Serial Addresses:	1 and 2	▼
Serial Timeout:	0.1	s

Then click Upload Setting to Device

This is now complete you can close Describe Software.

Unplug the Sabertooth, its ready to be mounted to the Energy360 Board

Next Step Arduino IDE

Install the Arduino IDE from the Arduino website

Download the Sabertooth Arduino Libraries and install it

 SabertoothArduinoLibraries.exe

Grab the soft start sketch 8.2 and extract them

 SPS_8.2_softstart.ino

Double click on the SPS_8.2_softstart.ino file and open it in Arduino IDE

Remove the Arduino Uno from the Energy360 Board while you are programming it

Plug the Arduino Uno into the USB port the orange light on the board will flash once per second.

It should auto detect the board when its plugged in

Now compile and upload the sketch by the -> button



SMC3Utilities

Download and Install

Check the ini file to ensure it contains the correct COM port for the Arduino

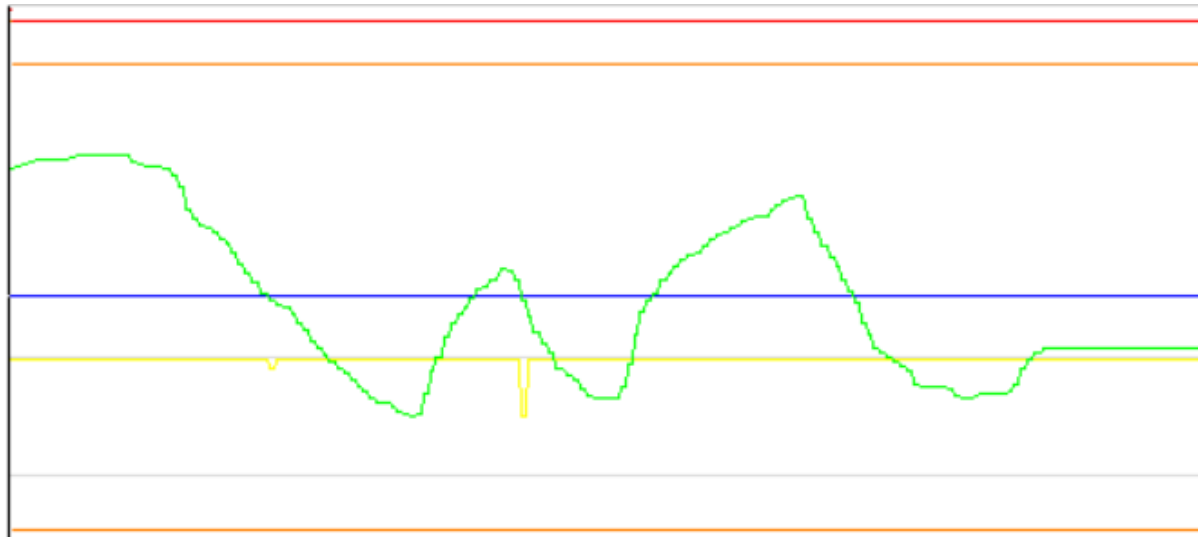
```
# SMC3Utils.ini

UDP_PORT=20017
COMM_PORT=8
IMG_PATH=c:\temp
```

Power down the Arduino and put it back on the energy360 board
 Put the Arduino uno back on the Energy360 board and plug in the 2 x POTS.
 Power up the +12V supply to the sabretooth.

Open SMC3

If you vary the POTS now you should see the green line vary for POT 1 like this as you move it back and forth.



Congratulations it is up and working, happy Siming !!

