Authors, Jonathan Olesik, Tibi add your name here

Electronic Design: Piezo Driver Circuit HV Power Supply

This is a co-creative doc
If you contribute to this doc **make sure you respect** the Content rules

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Authors, Jonathan Olesik, Tibi add your name here

History

This project started within Phil's project.

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Description

The piezo driver circuit requires a high voltage bipolar power supply, we have identified 3 manufactures of DC-DC converter modules. They all have serious drawbacks; price primarily, power output, voltage levels. The 3 that we have worked with modules from the following companies:

- Emco
- Recom
- Traco

EMCO and Traco units are not isolated, therefore they come in both positive and negative versions. The EMCO units are expensive, low output power and large size.
The Recom unit cannot be adjusted down to 0v, the minimum output is 95volts. Both the EMCO and Traco modules can be 0V to full scale.

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Last Modified on June 01, 2013. Please keep us updated if you use this protocol and make improvements.
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Electronics

Bipolar EMCO

Here we can see the prototype of the bipolar high voltage supply. The left is the batteries configured to provide 12v, then the HV bipolar supply and at the far right is the piezo driver circuit.

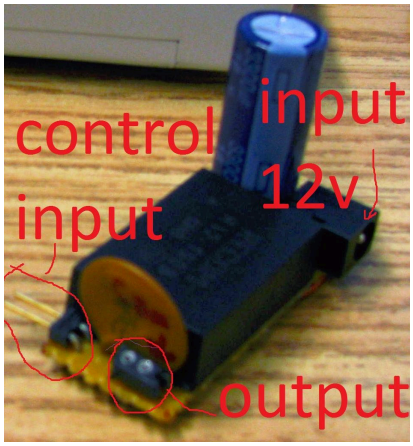
The HV supply circuit uses a dual 5k ohm potentiometer to adjust the output voltage between +/- 95 and 200 V. The recom units are used in this prototype. The batteries were used as there can be problems when using switching power supplies having miss matched switching frequencies and can cause oscillations. The input side of the recom are completely isolated from the output, therefore the **grounds are NOT shared**.

PCB Layout

Schematic

BOM

One axis EMCO



The 2nd prototype pictured at the left was made quickly to put the z axis piezo to work in experiments at Phils lab, this one uses an analog voltage input to control the output voltage, the full scale input for the control signal is 0-4v and for the piezo stack can take a maximum input of 150v therefore the usable range of the control signal is 0-2.1V which corresponds to an output of 95-150V. This is not ideal since we would like it to be able to go down to 0v output.

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Connections sequence:

1. Connect the piezo stack
2. Plug in Control voltage to control input, use 0-4V sourced from a power ksupply or DAQ
3. Plug the power supply to the wall. (use 12DC source that plugs into barrel jack)

PCB Layout

Schematic

BOM

Single axis Traco

A third prototype was made with the traco units so we have an adjustable output **Vout** of 0 to 150 Volts for the piezo stack (this stack doesn't take negative voltage!), 0 to +/-300 Volts for the cylindrical piezos. **Vadj** should vary from 0 to 2.2 volts for the piezo stack and *** for the piezo cylinder. **Vin** is 12V.

See video of a test. As you can see in the video, the piezo jumps well when voltage is applied, mais takes some time to relax when voltage is put at 0. Why is this? The piezo reacts very rapidly, this must be related somehow to the electronic circuit.

Below you can see a photo of he setup. On the left we have the piezo stack. On the right, we have the electronic circuit with the DC/DC converter. Connections from left to right: Vout (to the piezo), red wire is +; Vcontrol (to the DAQ card), red wire is +, and Vin (to power supply) yellow

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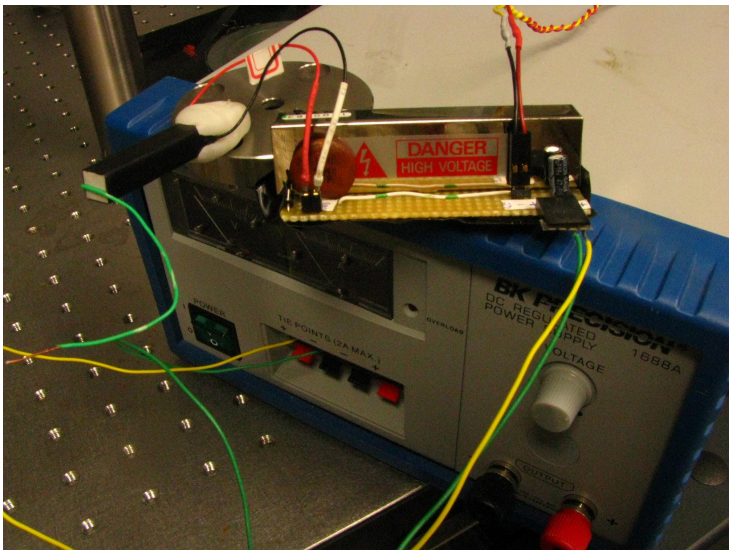
wire is +.



PCB Layout

Schematic

The schematic of the prototype circuits were taken from the Recom datasheet.

BOM

3-axis Traco system

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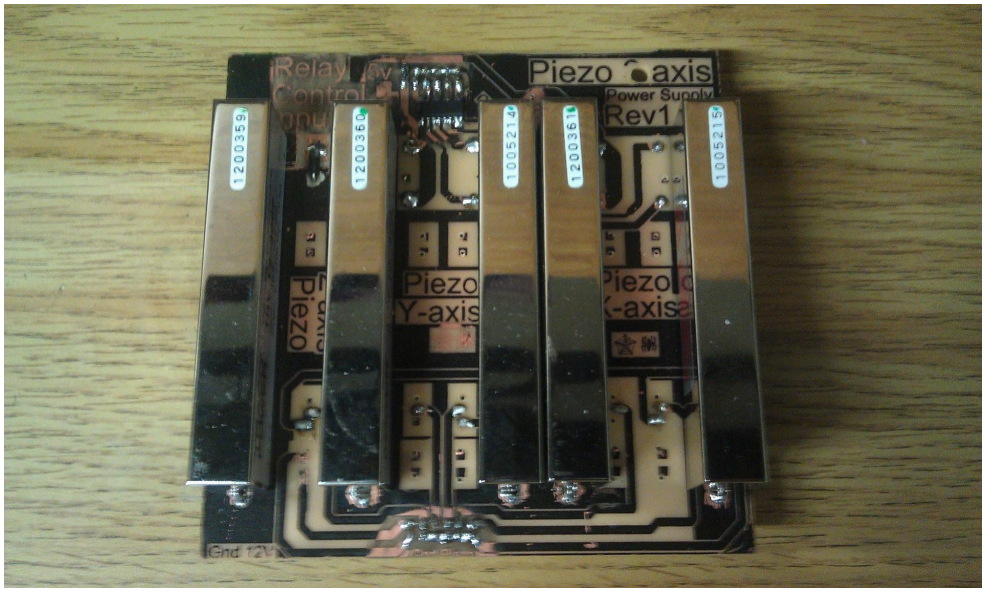

It hasn't been properly tested. It's location is at SENSORICA Montreal lab.

PCB Layout

Schematic

BOM

EMCO 2 axis stack or one axis cylinder controller

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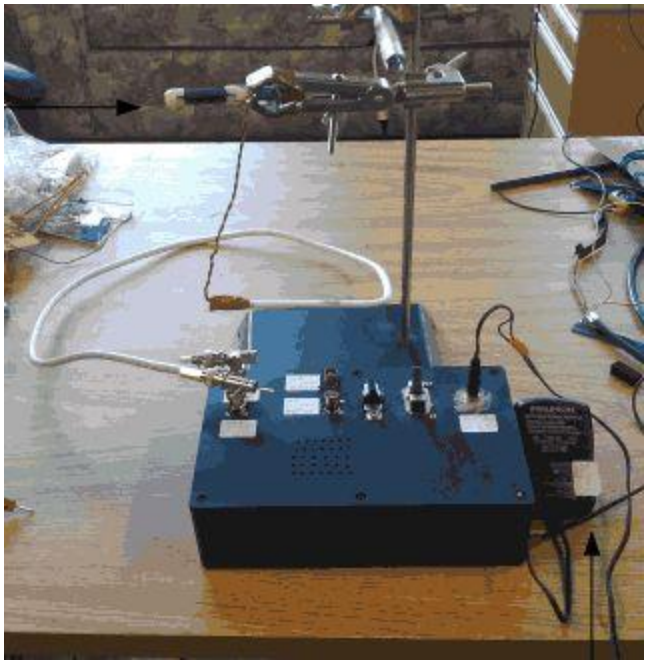

Open Frederic's report
See presentation video

PROBLEM: This driver is very hard to reproduce. See more…

Software

You can use LabView program ***Motion_NI_DAQ_Piezo1axisV1_LV10.vi*** made to work with NI DAQ USB 6221 card. This setup is installed in Phil's lab.

Front Panel

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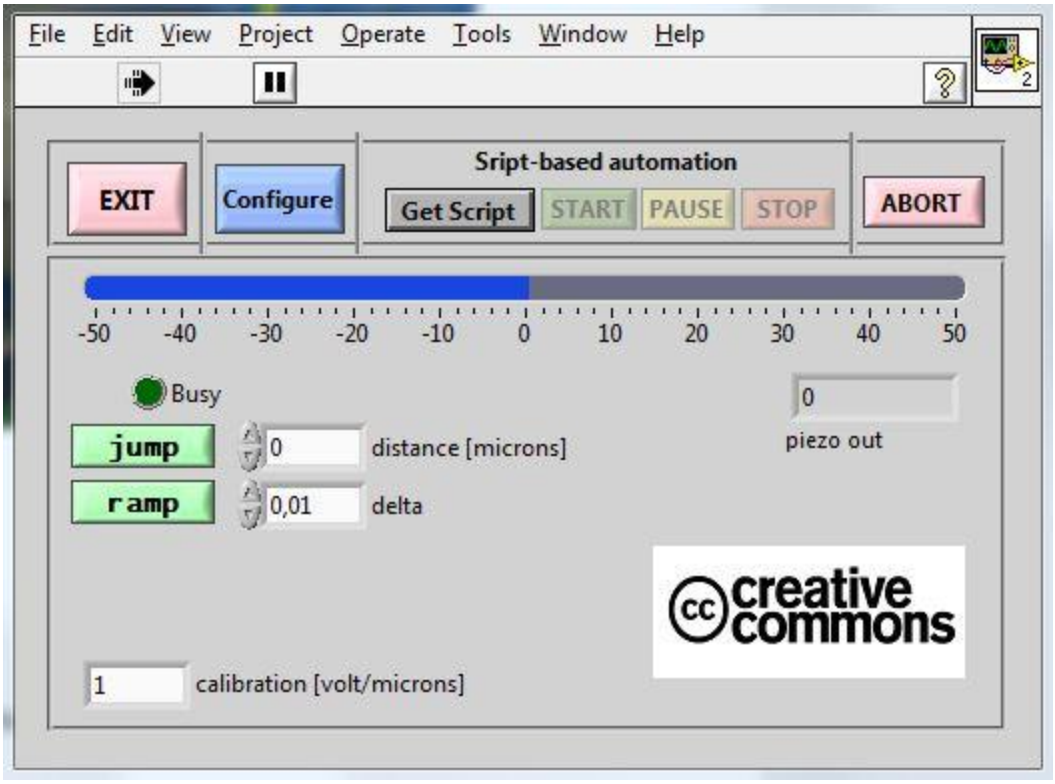
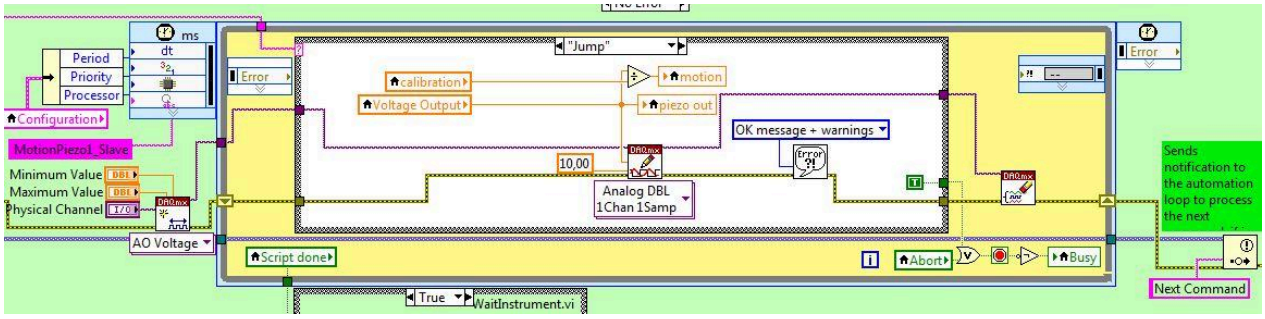
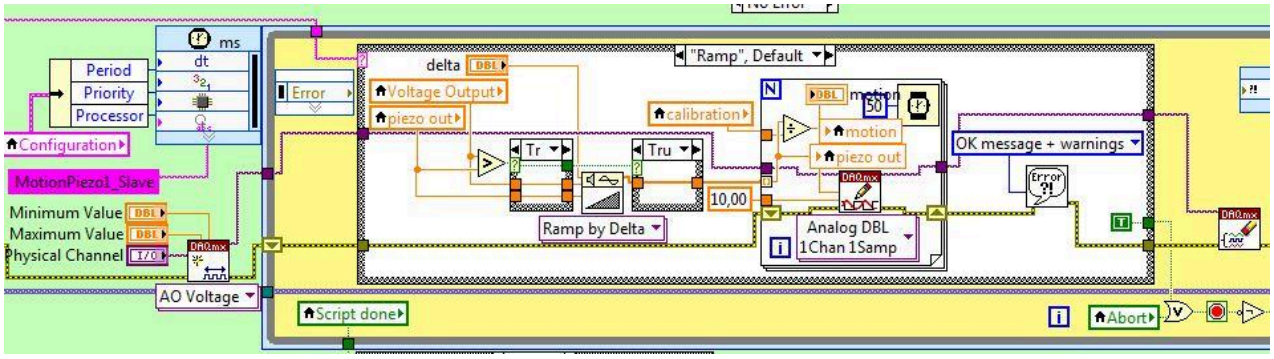


The **jump function** is implemented as a simple voltage analog out, single sample.



For the **ramp function** I use a For loop in this example. In the second version of the program this will improve.



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See video showing this program in action.

Dilson's piezo controller

From Granzier Lab in Tucson, where I (Brian Anderson) am in charge of getting our penguin system (v2) up and running:

I purchased a voltage source from EMCO as well as a chassis for this device (removing the need of wiring the voltage source to a circuit board). This device takes programming input voltage from the PCI card (0-2.048 volts) and outputs 0-200 linearly:

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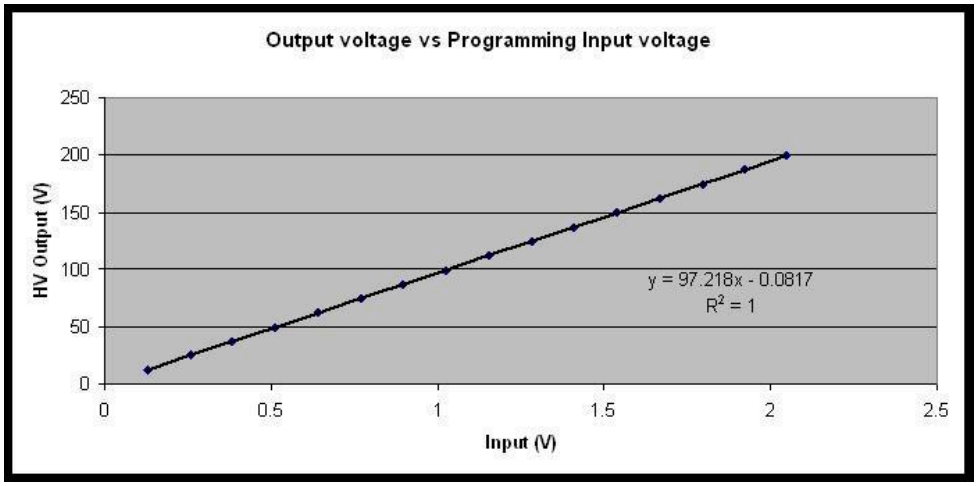
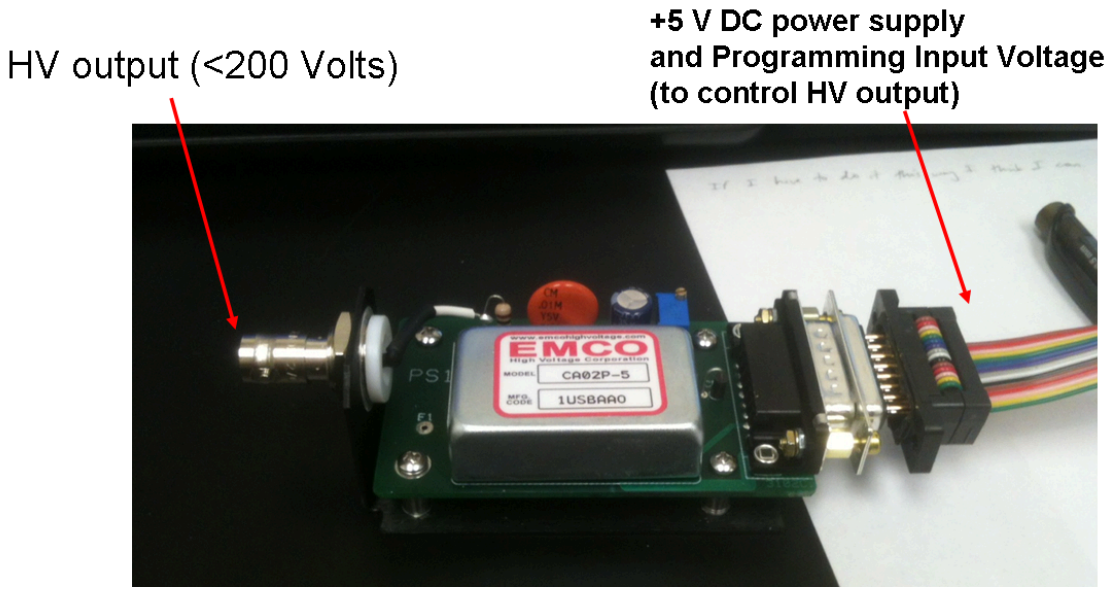


It is powered by +5V DC and has a high voltage BNC (MHV) output. I connect this to the piezotube wires to drive the piezo:



This device takes analog output from a NI PCI-7833R FPGA card and moves the glass needle (See Dilson's project) via the piezotube apparatus (using BPO piezo tubes).

When voltage is increased this displacement happens very quickly, but when voltage decreases this piezotube slowly creeps to the final position. This slow response when voltage is decreased is a function of the EMCO voltage source (ie the voltage decrease happens very slowly when the HV output is sent directly to an oscilloscope). Jonathan talked about an outlet for the charge stored on the piezotube to go when the piezotube relaxes, but I haven't even got that far yet. I still need to get a faster voltage response from this controller. I talked with EMCO and they recommended using an op amp in combination with their voltage source to get fast response

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times. I am trying to learn about op amps and how to integrate them with this simple setup. They recommended a company called APEX and I am reviewing their application notes regarding their op amps. If I am able to figure out how to get my controller to output voltages quickly (both while ramping up and ramping down the voltage) then I will probably have to figure out the piezotube discharge problem. This is where I am at now; I am not experienced with electronics/op amps, but I'm going to see what I can do. I'll update this information if I make any progress.

See more in Dilson`s Penguin System doc