EasyEMG Users Guide

EasyEMG is the world's lowest cost electromyogram (EMG) system. EasyEMG comes as a kit that any student can assemble to measure the EMG coming off their own muscles. Low cost EKG sticky tab electrodes are used over the muscle for signal pickup. The electrodes connect to a low cost instrumentation amplifier with a gain of 123 and whose output goes to the microphone input of a laptop computer to take advantage of the computers sound card filtering, digitizing and amplification. The output is displayed on the computer screen using a public domain oscilloscope program. The inspiration for EasyEMG came from "EMG on a Shoestring"[1].

Safety Warning: EasyEMG is not isolated. Therefore it is imperative that EasyEMG be **used only with a laptop running off battery power**. Do not connect the laptop to the wall with its AC adapter. Do not use a desk top computer. Failure to follow this advice could lead to cardiac arrhythmias causing **injury or death**.

Your EasyEMG kit contains these parts:

INA126 instrumentation amplifier, solderless breadboard, 680 ohm resistor, 22g solid wire (rd, bk, yl), alligator clip leads (3), battery holder, AA batteries (4), 8 in. tie-wrap (2), microphone cable, sheet of 10 EKG tab style electrodes (2).

How to assemble

Prep the battery holder by soldering a yellow 22g solid hookup wire to the center voltage point. This will be the circuit ground.
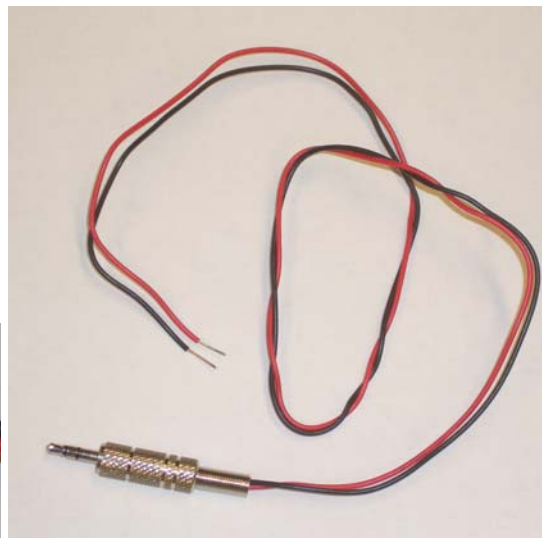

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[1] http://pni.unibe.ch/Chip.htm

Prep the electrode jumpers which are short pieces of 22g solid wire stripped at each end. Length and color do not matter.

Prep the microphone cable by soldering 22g solid wire to the tip and sleeve of an 1/8" stereo audio jack. Or, solder 22g solid wire jumpers to the ends of an audio cable that terminates in an 1/8" audio jack.


Examine the solderless breadboard.
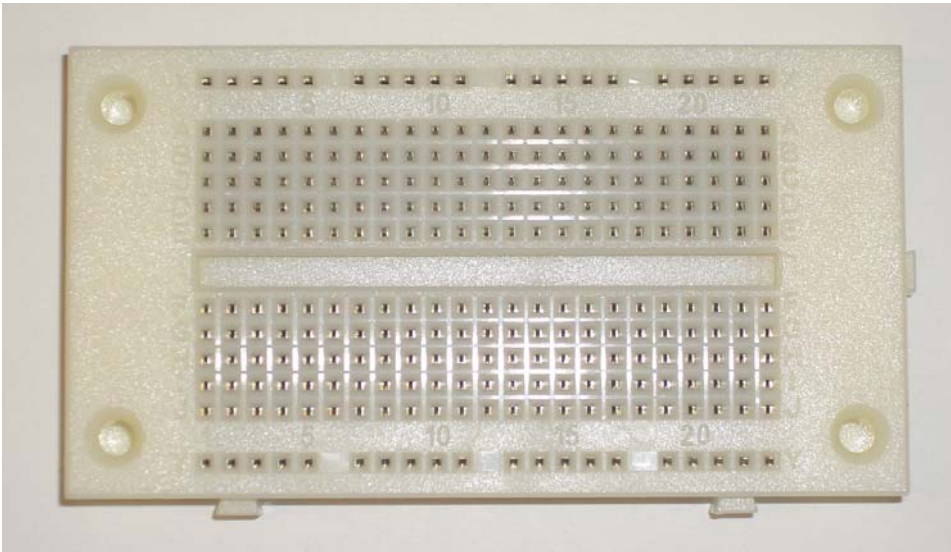
The breadboard is design to accept integrated circuits, passive components such as resistors and capacitors, and 22g solid wire. Vertical columns of five holes are connected internally as are the horizontal rows at the top and bottom.

Insert batteries in the holder (using the correct orientation) and attach the holder to the right side of the breadboard using a tie wrap.
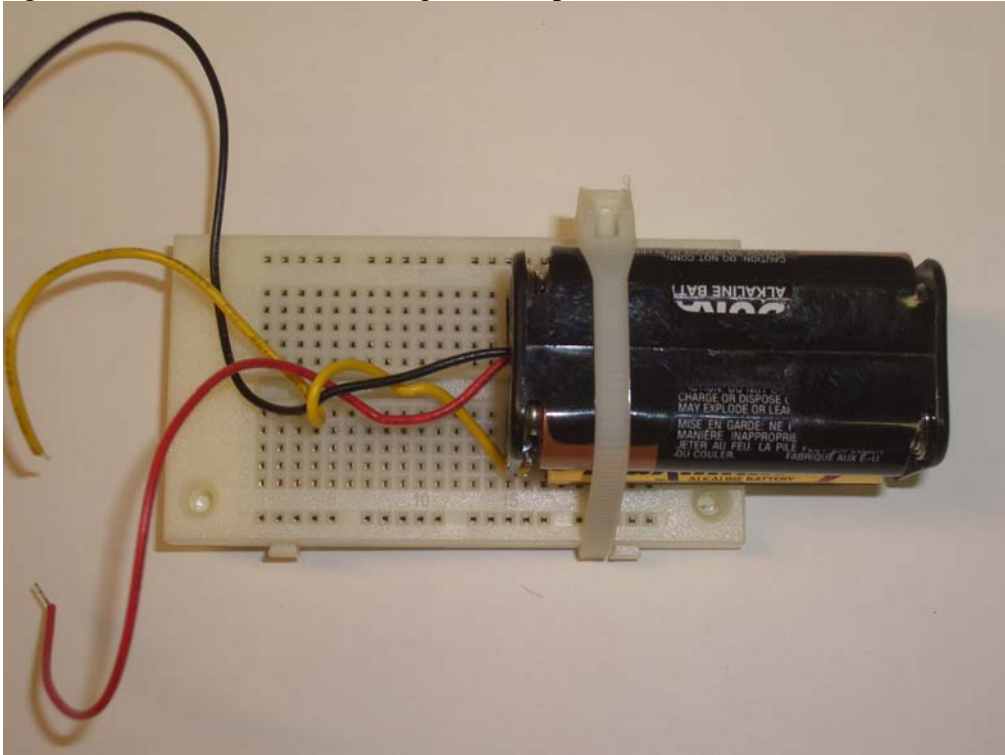

The INA126126 instrumentation amplifier comes in an 8 pin plastic package with the pins spaced by 0.1 in. The package looks like this

From the top, the pin numbers look like this. Note that pin 1 is marked by the hole.

R_G | 1   8 | R_G

V^-_{IN} | 2   7 | V+

V^+_{IN} | 3   6 | V_O

V− | 4   5 | Ref
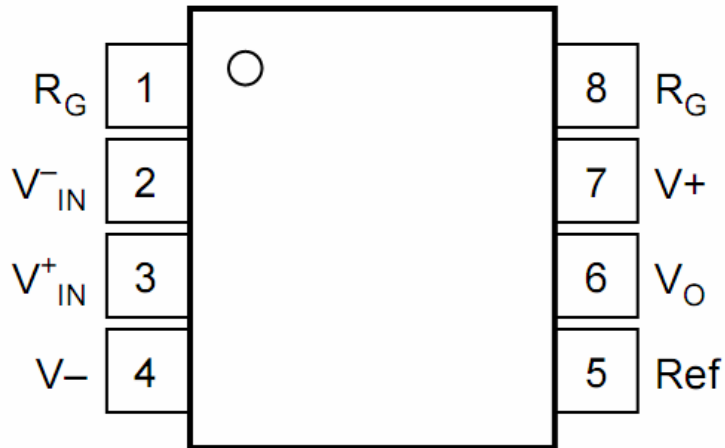
Insert the INA126 into the far left of the breadboard oriented so that pin 1 is at the lower left. Insert the 680 ohm resistor to connect pins 1 and 8 of the INA126.
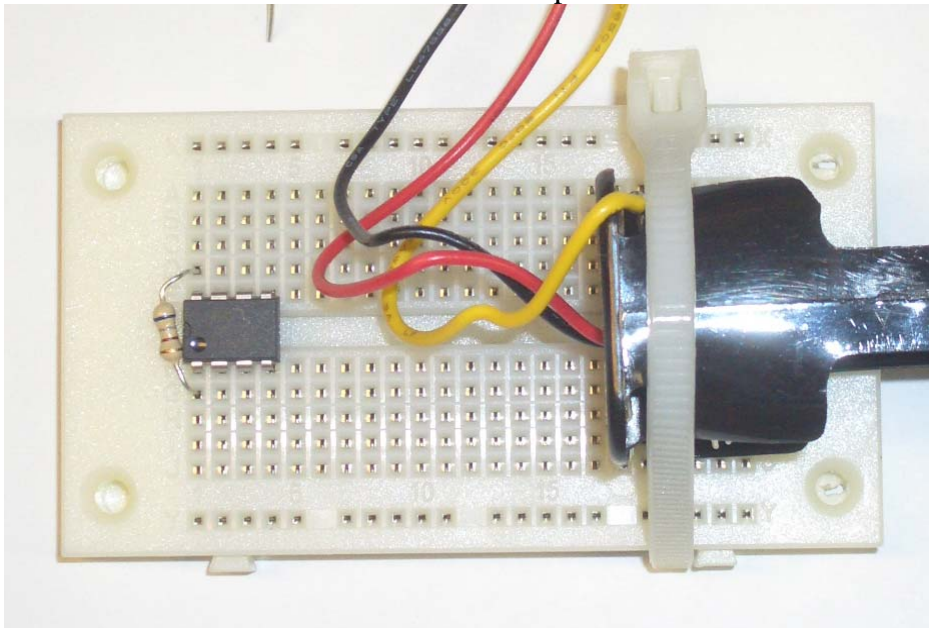
Make the following connections into the breadboard where the pin numbers refer to pins on the INA126:

1. Ground (yellow wire) of the battery pack to pin 5.
2. V+ (red wire) of the battery pack to pin 7.
3. V- (black wire) of the battery pack to pin 4.
4. First electrode jumper wire to pin 3.
5. Second electrode jumper wire to pin 2.
6. Third electrode jumper wire to pin 5.
7. Microphone plus wire (red) to pin 6.

8. Microphone ground wire (black) to pin 5.

Connect one end of three alligator clip leads to the free ends of the three electrode jumper wires. The electrode wires leading to INA126 pins 2 and 3 are the plus and minus electrodes that go to the muscle. The electrode wire leading to INA pin 5 is the reference electrode that goes to the opposite limb.

When you are done, it should look something like this where in this example the black and white alligator clip leads at the bottom are the plus and minus muscle electrode leads and the green alligator clip lead at the top is the reference electrode lead.
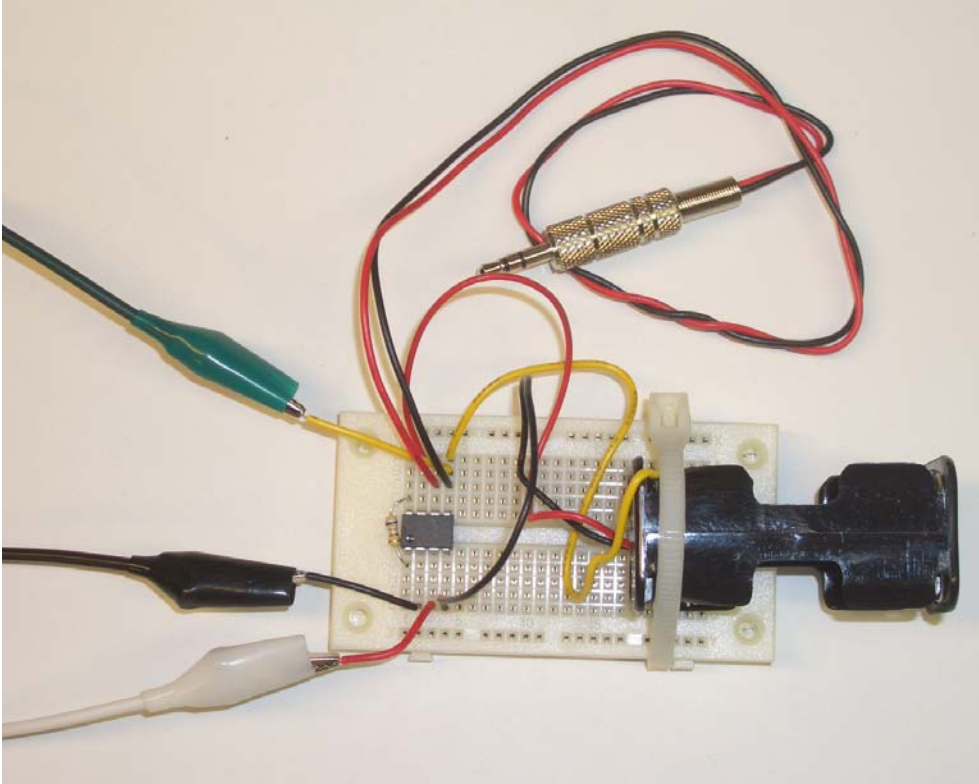

Connect the microphone jack to the mic input on your laptop.

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Attach two EKG sticky tab electrodes one to two cm apart on your biceps or other muscle of interest and connect the tabs to the open ends of the plus and minus electrode leads. The sticky tab electrodes can be reused until they lose their stick. Store on their carrier in an airtight bag, if possible.
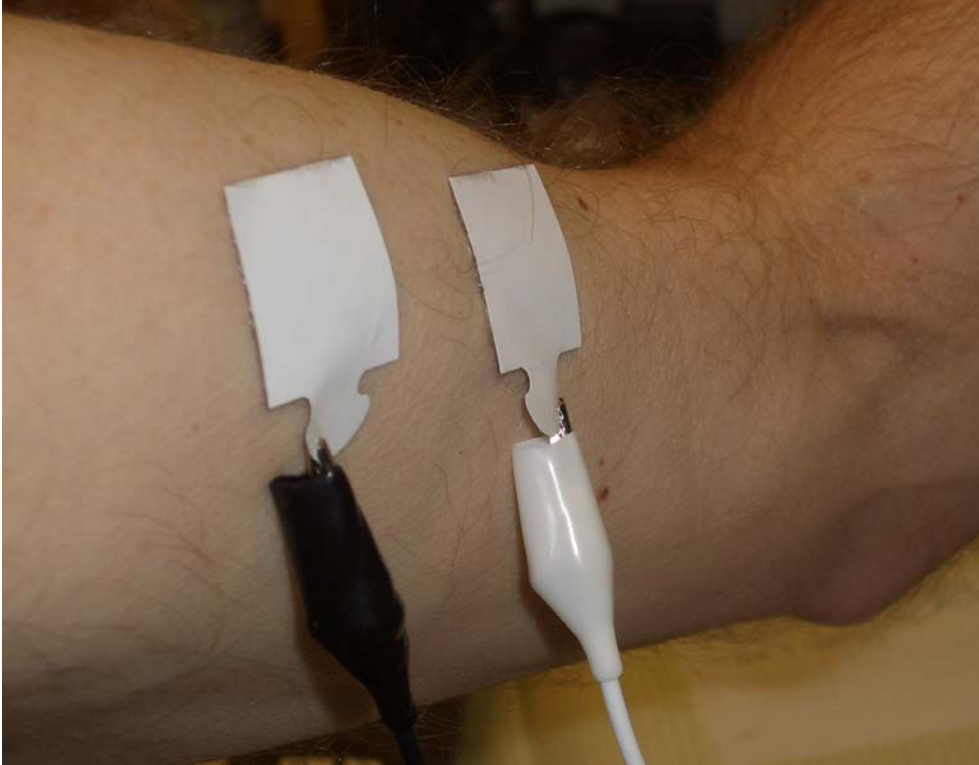
Attach the reference lead either to a shiny penny to grasp in the opposite hand, or to a third sticky tab electrode place on the opposite hand.
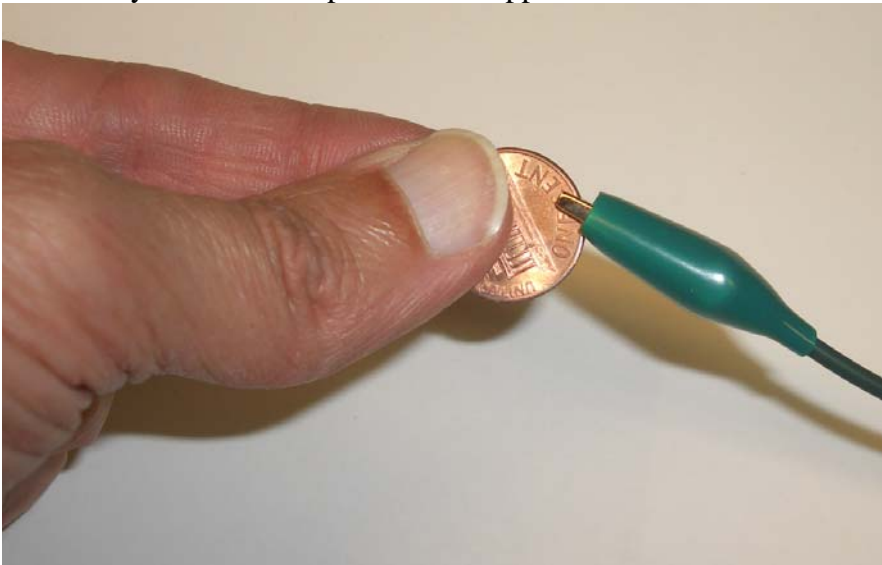

Download the Winscope freeware PC oscilloscope software onto your laptop and run. A later section of this manual tells where to find the software[2]. Set the scope to YT Single Trace, Y1 gain = 3.00 (approximate) and Sweep = 50.00 ms.
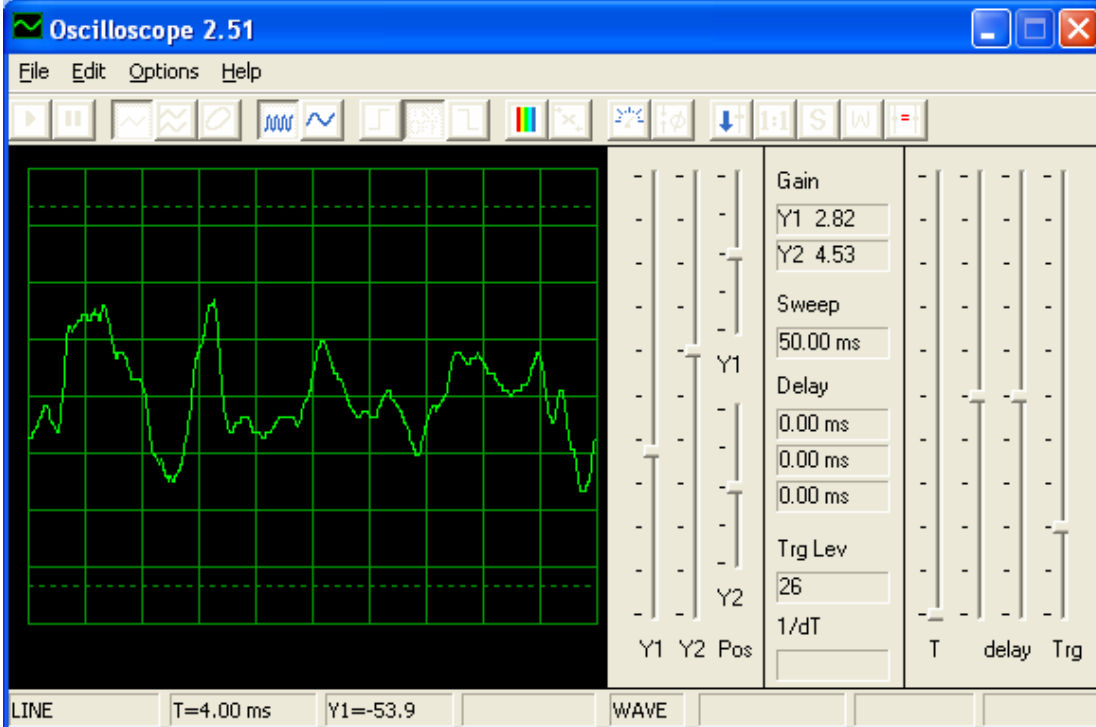
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[2] If you have a Mac laptop, the system should work, but you will need to Google to find a freeware oscilloscope program that runs on a Mac.

If all is well a relaxed muscle should show a relatively quiet signal like this
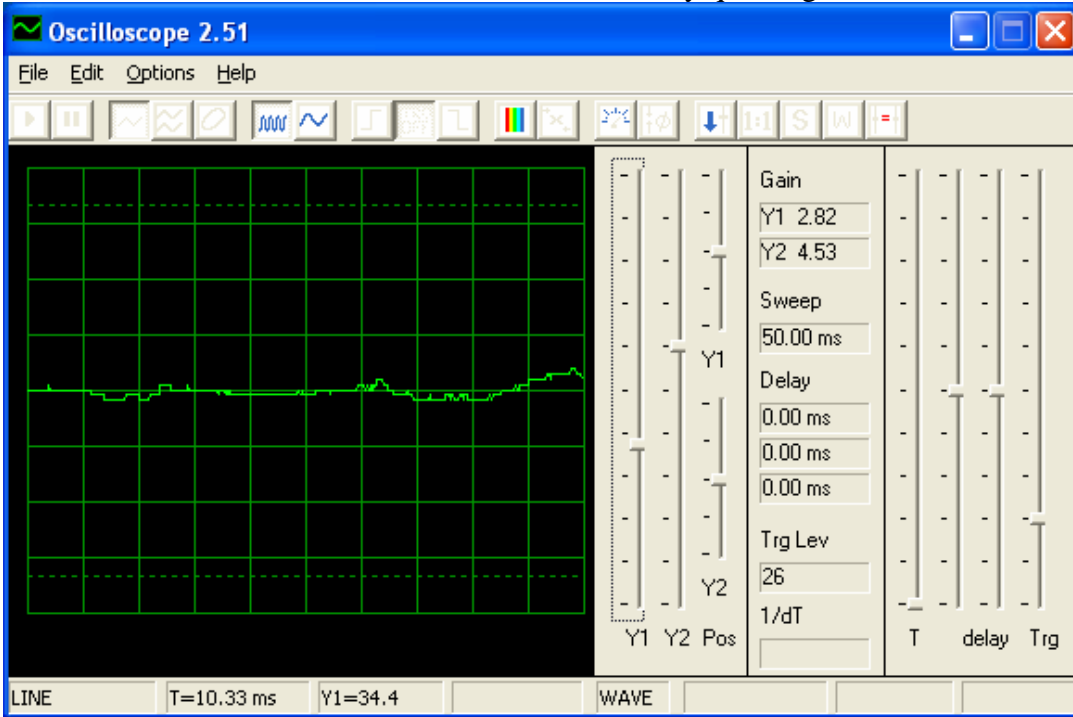
while a contracted muscle should show lots of EMG like this

So have a good time and look at EMG from lots of your muscles!

Sources

A color version of this manual, the bill of materials, including sources for the kit parts, the Winscope PC software, the INA126 data sheet are all available at
http://www.me.umn.edu/~wkdurfee/projects/easyemg/

To install the software, download scope.zip to any directory, unzip, and click on the application.

History

EasyEMG was developed by Professor Will Durfee, Department of Mechanical Engineering, University of Minnesota. The first use was by students studying neuroscience at Itasca in summer 2007.

Questions?

Contact Will Durfee, wkdurfee@umn.edu