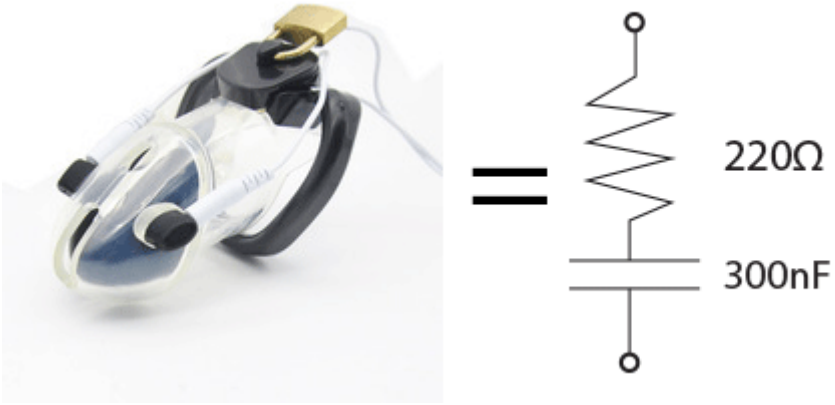
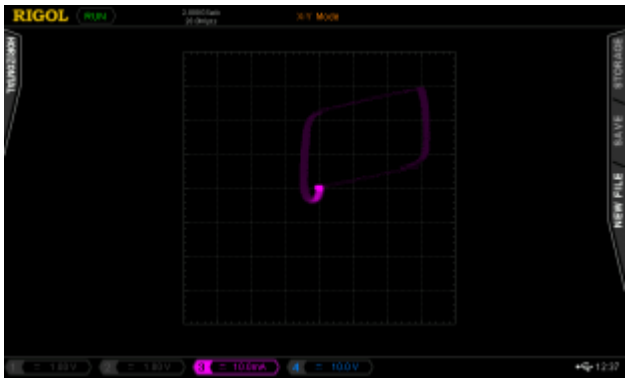
Results

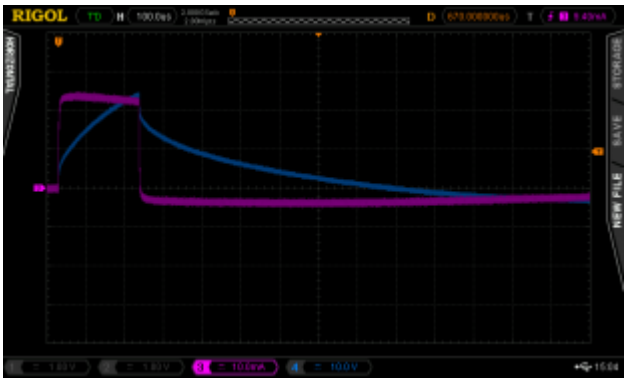
It might be tempting to model the human in an estim circuit as a resistance; values for the resistance of a person are easy to find on google. However, it appears that at frequencies employed by a typical estim, conduction happens primarily by capacitance, and with a far lower series resistance (220Ω) than one would find at DC (1MΩ). A dick in a CB6000-estim device cannot be properly modeled as an ideal resistor but must instead be modeled as a resistor and capacitor in series (perhaps with an additional 1MΩ in parallel if you care about DC):



Methods

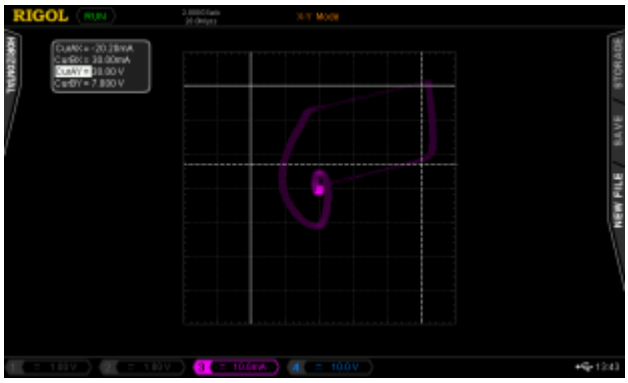
A TENS7000 device was connected to one of the CB6000-estim devices pictured above using the default settings of 210uS pulses at 100Hz. One terminal was grounded such that pulses on the opposite terminal appeared in the direction of positive voltage. A 20 ohm shunt was placed between the CB6000 and ground while oscilloscope probes were attached above the shunt (channel 3) and above the CB6000 (channel 4). Both probes were 10X probes, but the current probe's multiplier was overridden to 0.5X and the units were changed to Amps to obtain accurate display of current readings. The scope was configured to trigger on rising current, placed in the XY timebase, and the sample interval was increased until an entire pulse of the TENS7k fit within the buffer. This resulted in the following voltammogram (left) and time series (right), where in the voltammogram current increases to the right and voltage increases to the top.





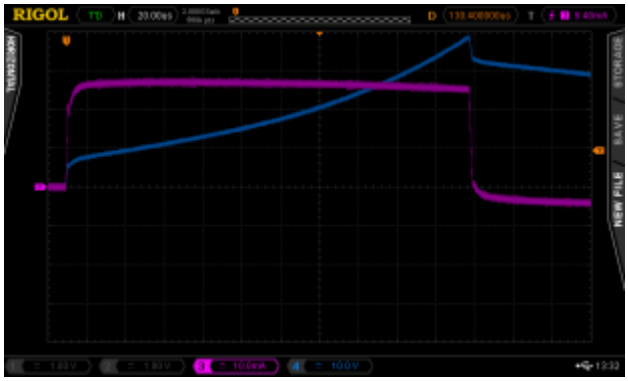
Resistance was read off the slope of the slanted IV segments in the XY timebase and capacitance was determined by I*t/V in the YT timebase. The resulting circuit was assembled from an electrolytic

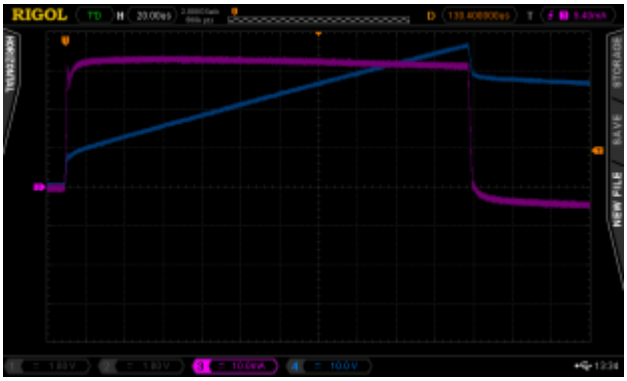
capacitor and the IV, IT+VT plots were compared. Evidently, the model captures the first-order behavior reasonably well.





The model could be improved by adding a second resistor in parallel with the capacitor to obtain a proper sharkfin waveform rather than flat slopes, however I do not believe that it will be necessary to consider such a refinement for the purposes of designing an estim circuit. As it stands, distortions introduced by using different cheap capacitors (pictured below, 50V ceramic on the left and 50V electrolytic on the right) exceeded approximation error due to ignoring the parallel resistance.





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