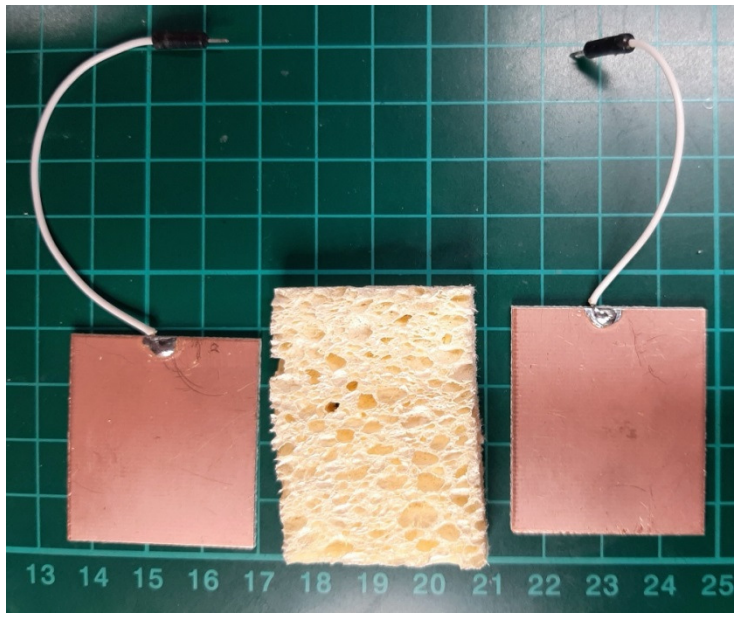
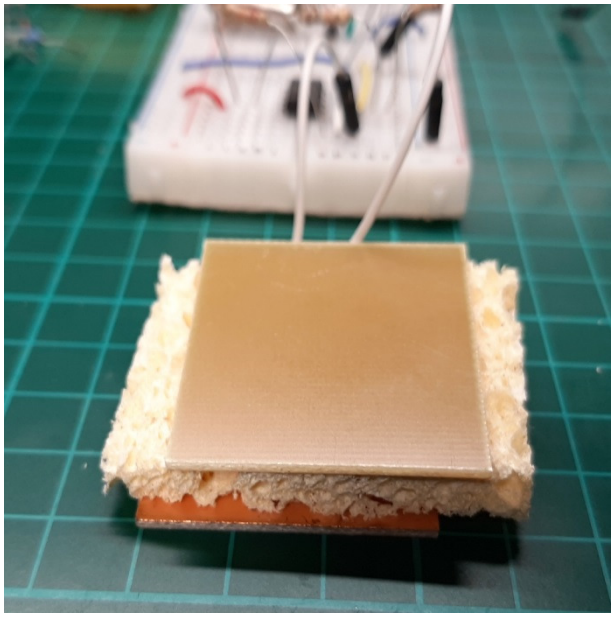
R.Schouten

Spongetronics electronics use for sponge material

Sponge material (cellulose based) shows an extremely high diëlectric constant that increases further when compressed. A capacitor can be made by clamping the material between two metal plates.
With 2 wires connected to the plates this construction can be used as a pressure-controlled capacitor.

A test on a dry sponge slice of roughly 4x3 cm and 0.8cm thickness (see pictures) resulted in a uncompressed capacitance of <1nF and a compressed value of nearly 100nF !!
Note that this capacitor has a relatively high series resistance and a high leakage, more on this on page 4

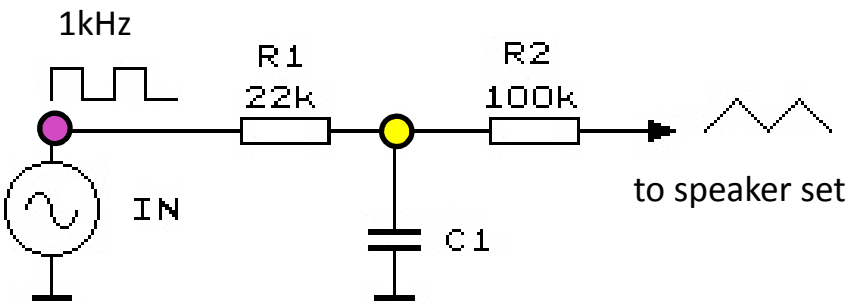


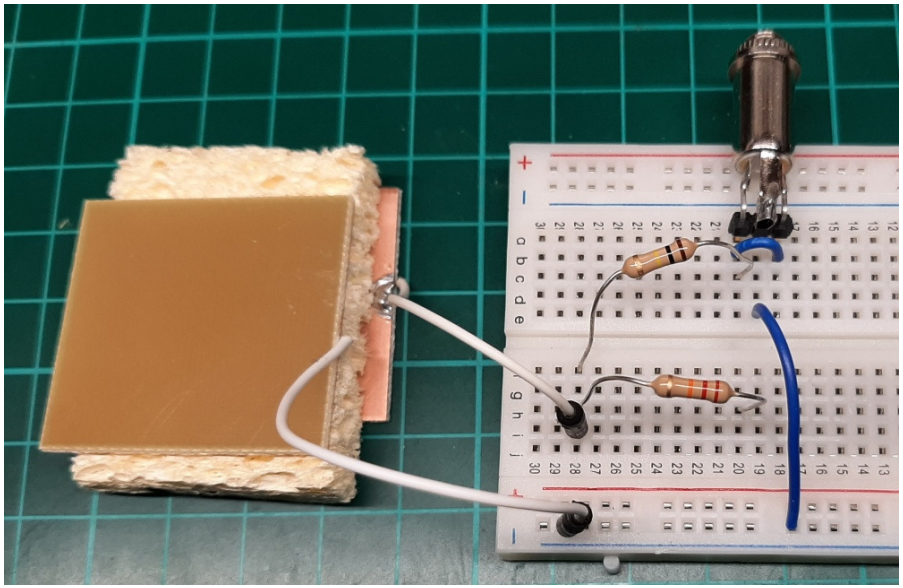


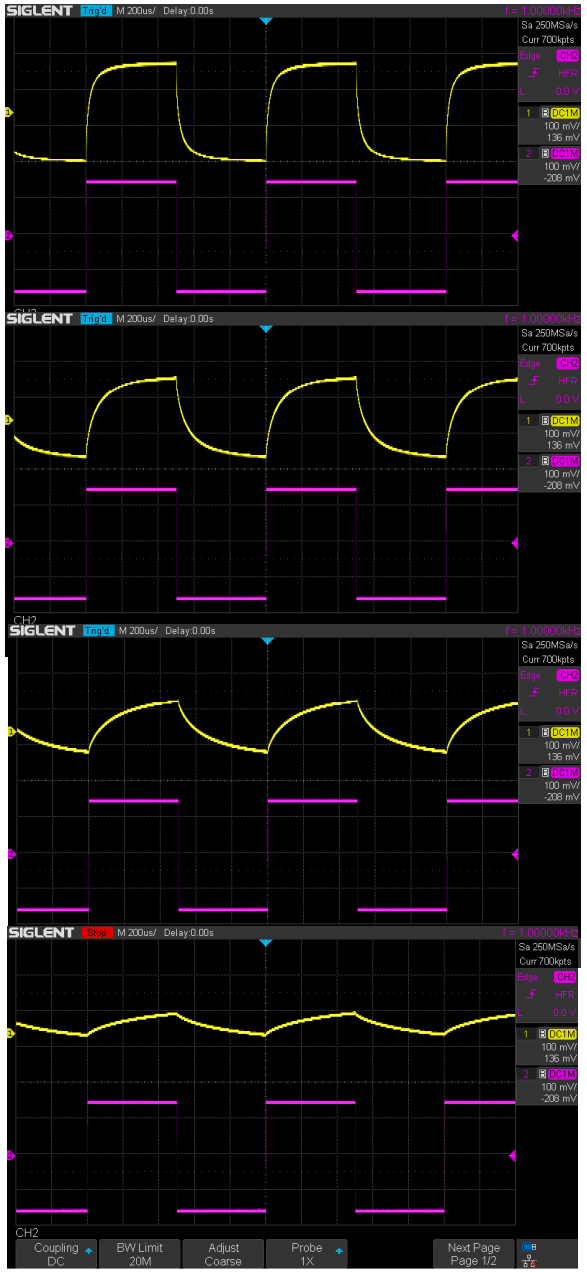
- **Two circuits were build using this capacitor, also shown in a movie** https://youtu.be/BFPNdyaWR40

1- a tunable lowpass filter
2- a tunable oscillator (Spongillator)

Spongetronics a tunable lowpass filter:





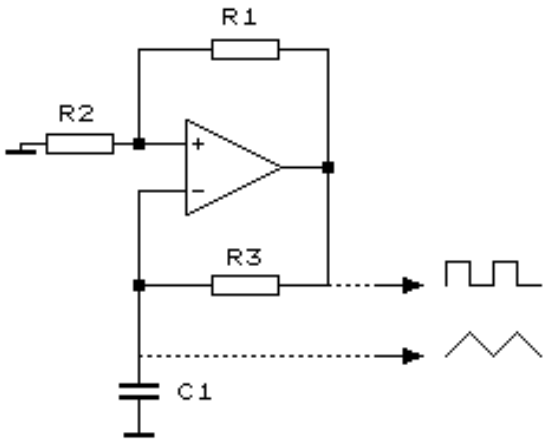


Sponge not compressed

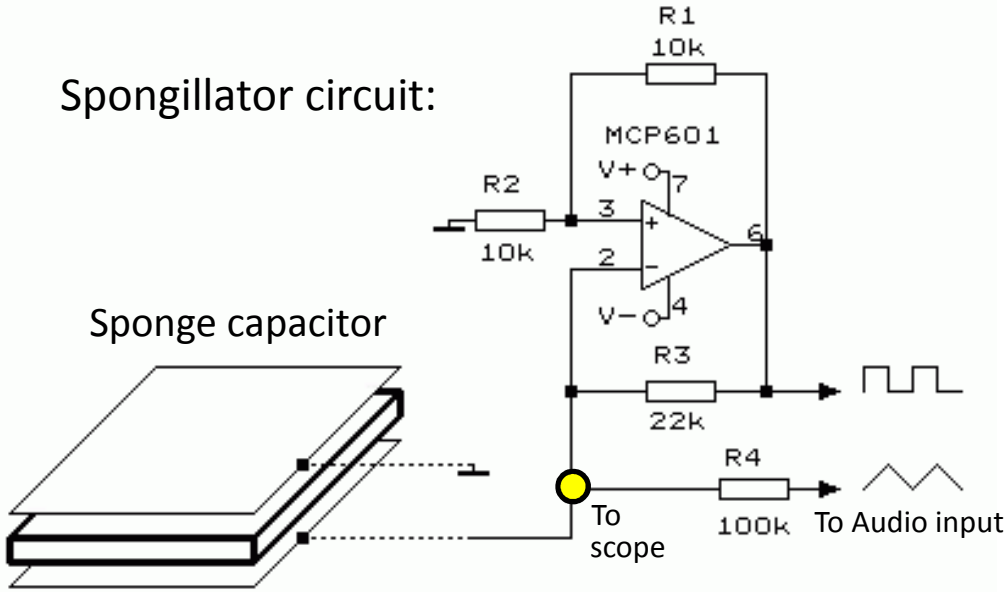
Fully compressed

Spongetronics a tunable oscillator (spongillator):

Standard opamp relaxation oscillator:



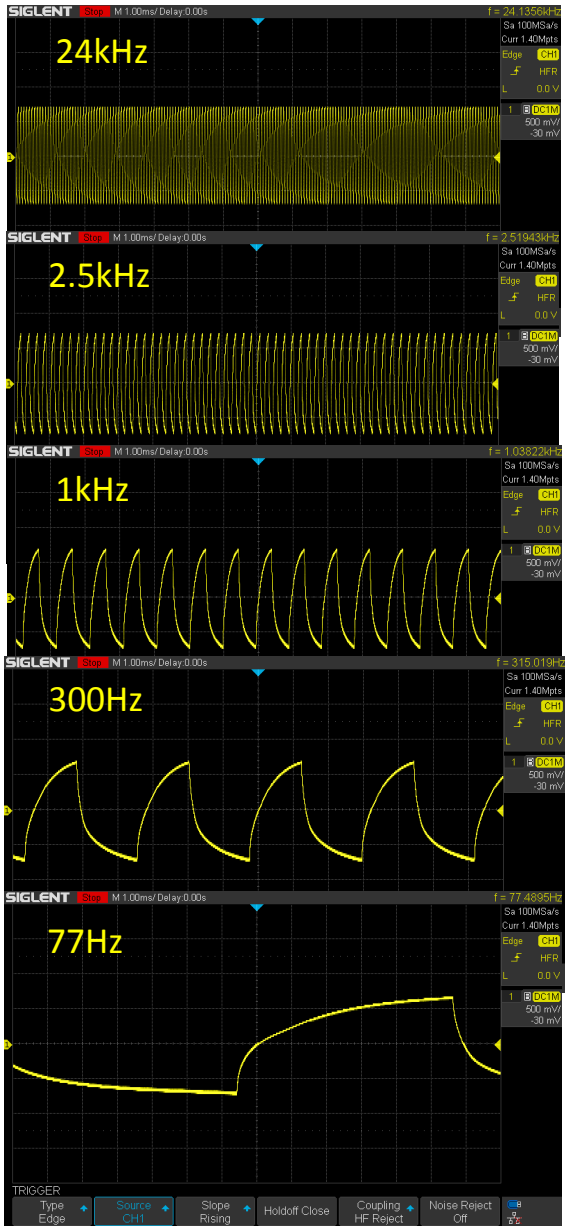
Spongillator circuit:



Make upper plate the ground connection for low interference when pressing

Supply:

V+=+1.5V, V-= -1.5V

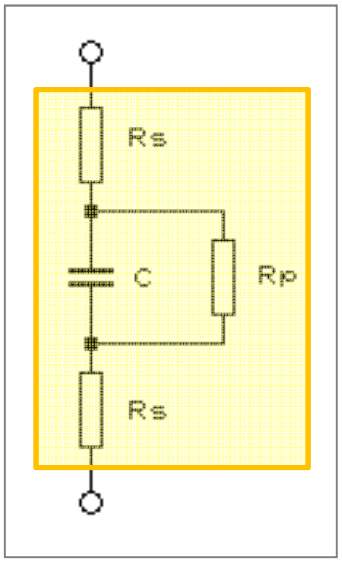


Sponge not compressed

Fully compressed

Spongetronics sponge background info

The sponge capacitor has relative high series resistance and large leakage, both also pressure dependant. These could be modelled like this:



No exact data, but for the (dry) sponge slices I used (4 x 3 x 0.8 cm) rough estimates are:

	compressed	uncompressed
Rs :	0.1k	5kΩ
Rp:	50k Ω	1MΩ
C:	100nF	0.5nF

Hint: to prevent leakage resistor dc-shifts when using this in a single supply circuit, connect one terminal to Vsup/2 instead of connecting to ground.

Note that only the cellulose based sponge works for this application:

Cellulose based works:

Plastic based fails:

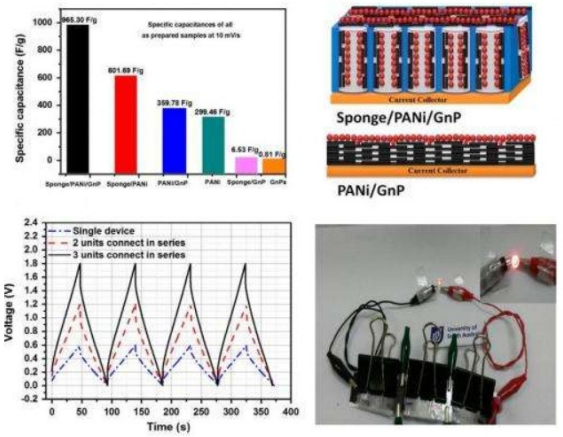
Additional reading for more serious applications:

https://phys.org/news/2015-02-kitchen-sponge-supercapacitor-porous-benefits.html

FEBRUARY 6, 2015 FEATURE

Kitchen sponge supercapacitor has many porous benefits

by Lisa Zyga, Phys.org



(Top left) The specific capacitances of several electrode materials. (Top right) S…

By dipping small pieces of an ordinary kitchen sponge into solutions of nanoscale electrode materials, scientists have created a light-weight, low-cost supercapacitor that benefits from the sponge's porous structure. The pores provide a large surface area for the electrode materials

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Nanotechnology **26** (2015) 075702 (11pp) doi:10.1088/0957-4484/26/7/075702

High-performance supercapacitors using graphene/polyaniline composites deposited on kitchen sponge

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some links:
https://phys.org/news/2015-02-kitchen-sponge-supercapacitor-porous-benefits.html
https://iopscience.iop.org/article/10.1088/0957-4484/26/7/075702
https://www.researchgate.net/publication/271536256_Highperformance_supercapacitors_using_graphenepolyaniline_composites_deposited_on_kitchen_sponge
https://www.researchgate.net/publication/231014778_Giant_Dielectric_Response_of_the_Sponge_Phase