Voltage-Controller Filter

QuBi

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This document summarises all the design choices and technical justifications for the Voltage-Controlled Filter module.

The filter is based on a State Variable Filter. Reasons:

- versatile functions with a single block
- no drop in the bass at high Q
- possibility extend it to very different topologies (Chebychev, Elliptic)

Filter structure

It follows that the cutoff frequency is directly proportional to the voltage gain.

Integrator Function

Voltage Controlled Attenuator

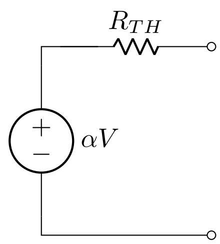
From the "Filter Structure" section, there is a linear relationship between the voltage gain and the cutoff frequency. Therefore, for a frequency sweep from 10 to 10kHz, the attenuation must reach a similar ratio i.e. at least 1:1000. Unlike a VCA, it is not necessary to reach a complete null signal.

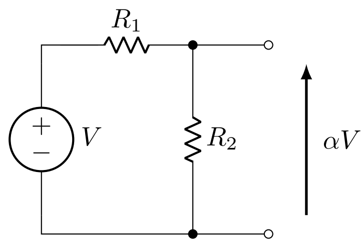
Also, in order to get a *spicy* resonance (high Q value), the attenuator must be capable of handling large signals (up to a few volts)

Annex 1: useful formulas

Resistive Voltage Divider with target equivalent resistor

With a resistor divider, there are multiple values for the 2 resistor to get the target ratio. However, there is only one pair of resistors (R_1, R_2) that will have a given series resistor in the Thevenin equivalent.





This is the formula you need:

$$\begin{cases} R_1 = \dfrac{R_{TH}}{\alpha} \\ R_2 = \dfrac{R_{TH}}{1-\alpha} \end{cases}$$

Generalized resistor divider

Annex 2: impact of non-linearities

In this circuit, the main source of nonlinearities is the VCA.