



Circuit Simulation Project on

State Variable Filter

Shekhar Maruti Nandanwar
Kc College of Engg and Mgmt Studies and Research.

Title of the circuit: State Variable Filter

Theory/Description: The state variable filter is a type of multiple-feedback filter circuit that can produce all three filter responses, Low Pass, High Pass and Band Pass simultaneously from the same single active filter design.

State variable filters use three (or more) operational amplifier circuits (the active element) cascaded together to produce the individual filter outputs but if required an additional summing amplifier can also be added to produce a fourth *Notch filter* output response as well.

State variable filters are second-order RC active filters consisting of two identical op-amp integrators with each one acting as a first-order, single-pole low pass filter, a summing amplifier around which we can set the filters gain and its damping feedback network. The output signals from all three op-amp stages are fed back to the input allowing us to define the state of the circuit.

One of the main advantages of a state variable filter design is that all three of the filters main parameters, Gain (A), corner frequency, f_c and the filters Q can be adjusted or set independently without affecting the filters performance. We have also seen here that the filter is also easy to tune as the corner frequency, f_c can be set and adjusted by varying either R or C without affecting the filters damping factor. However, at higher corner frequencies and larger damping factors the filter can become unstable so is best used with low Q , less than 10, and at low corner frequencies.

State variable filters are frequently **used** for modifying frequency response in audio signal processing. At low Q settings they are often used in parametric equaliser circuits, and at high or variable Q settings to create resonant filter modules in analog synthesizers.

Circuit Diagram :

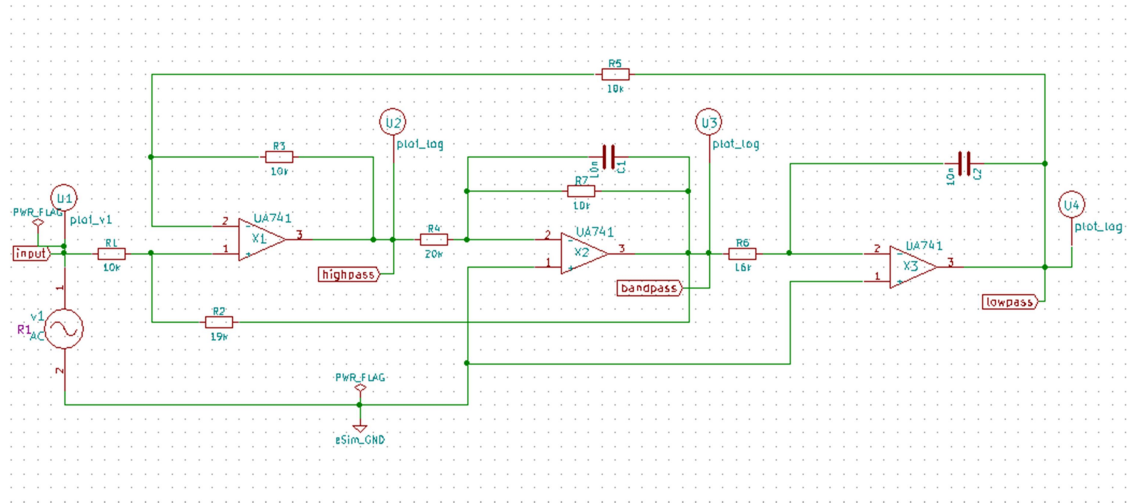
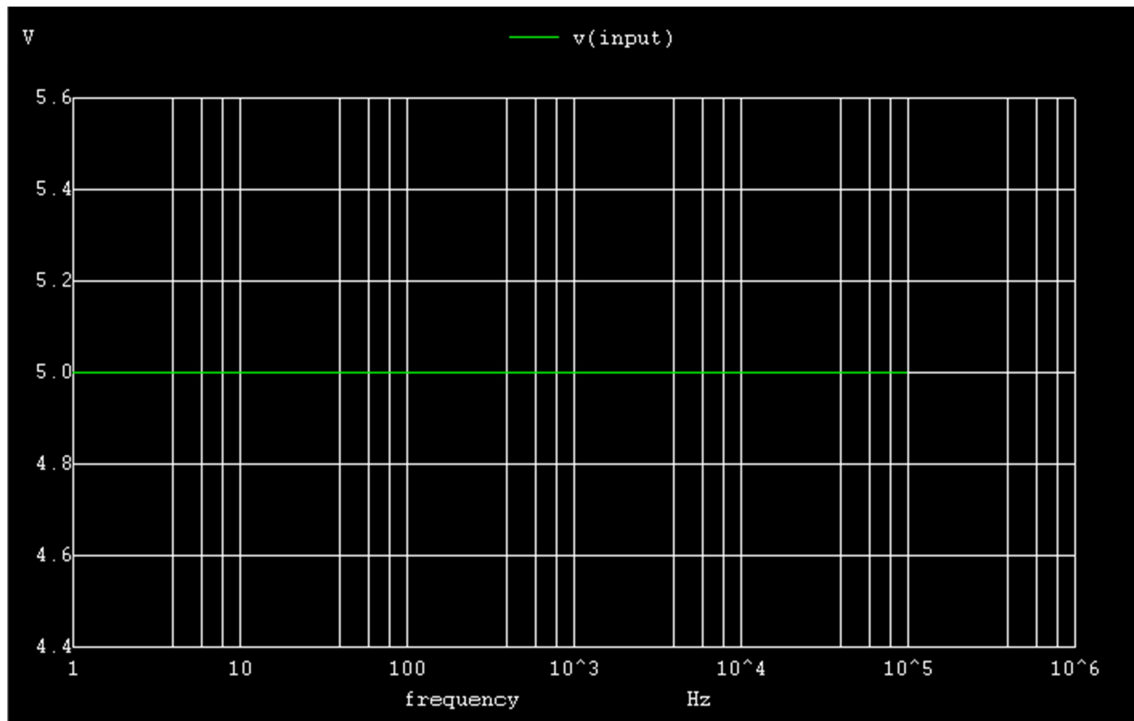


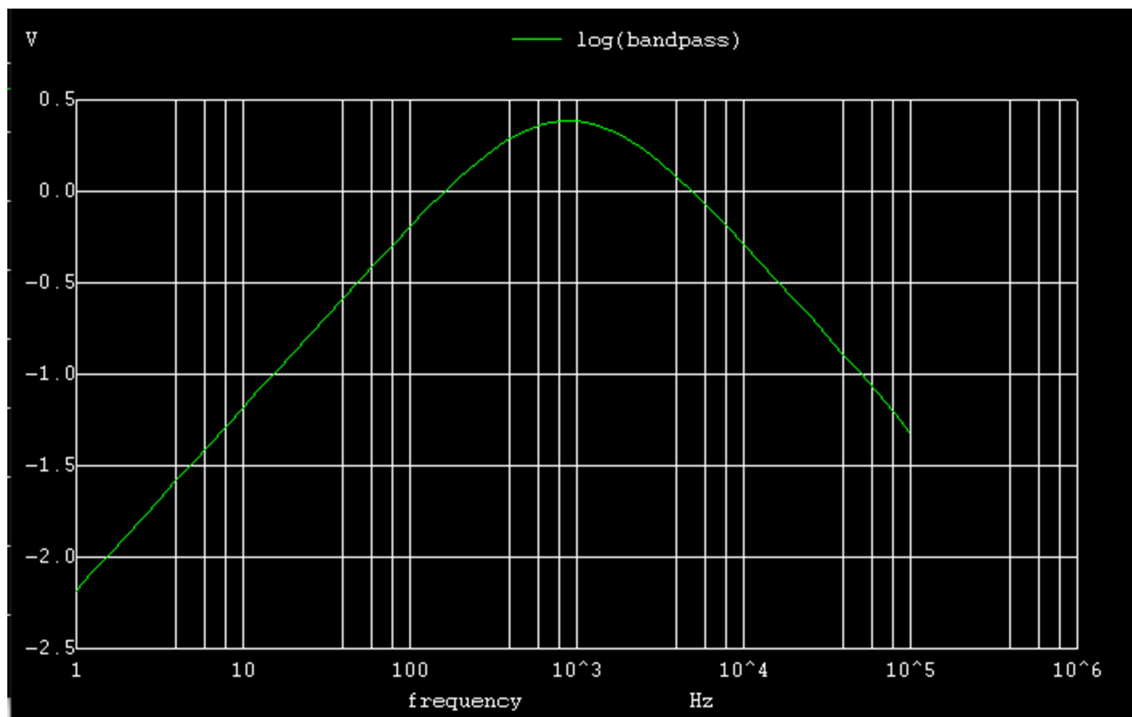
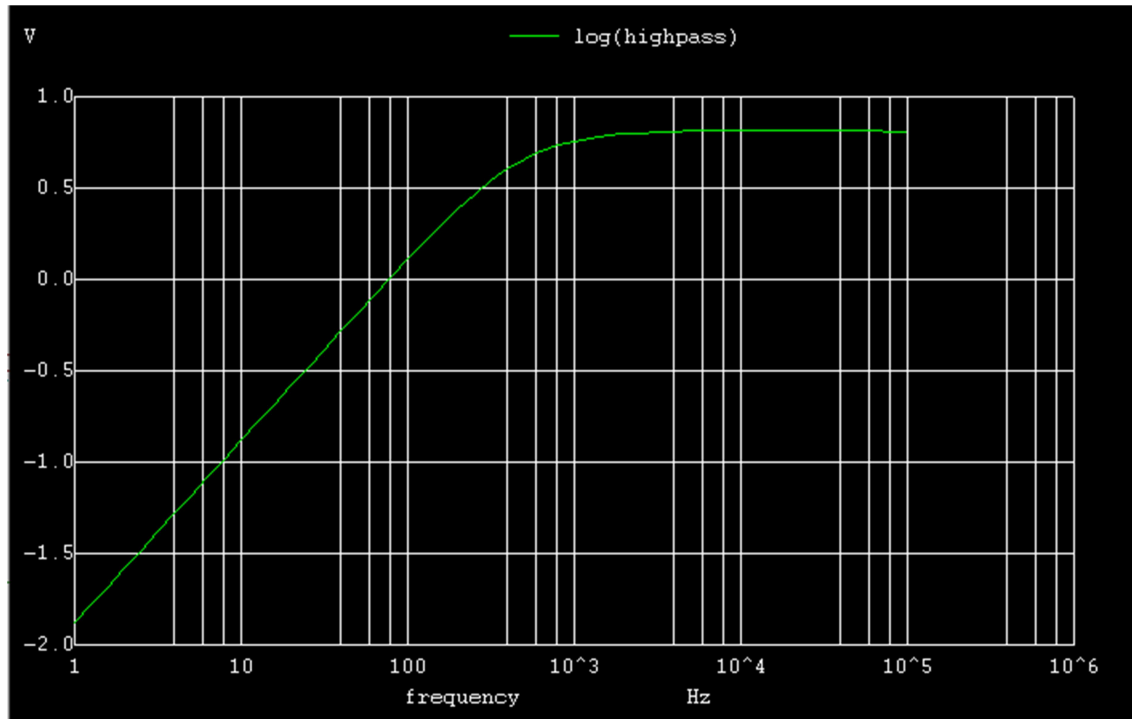
Fig : Schematic of State Variable Filter

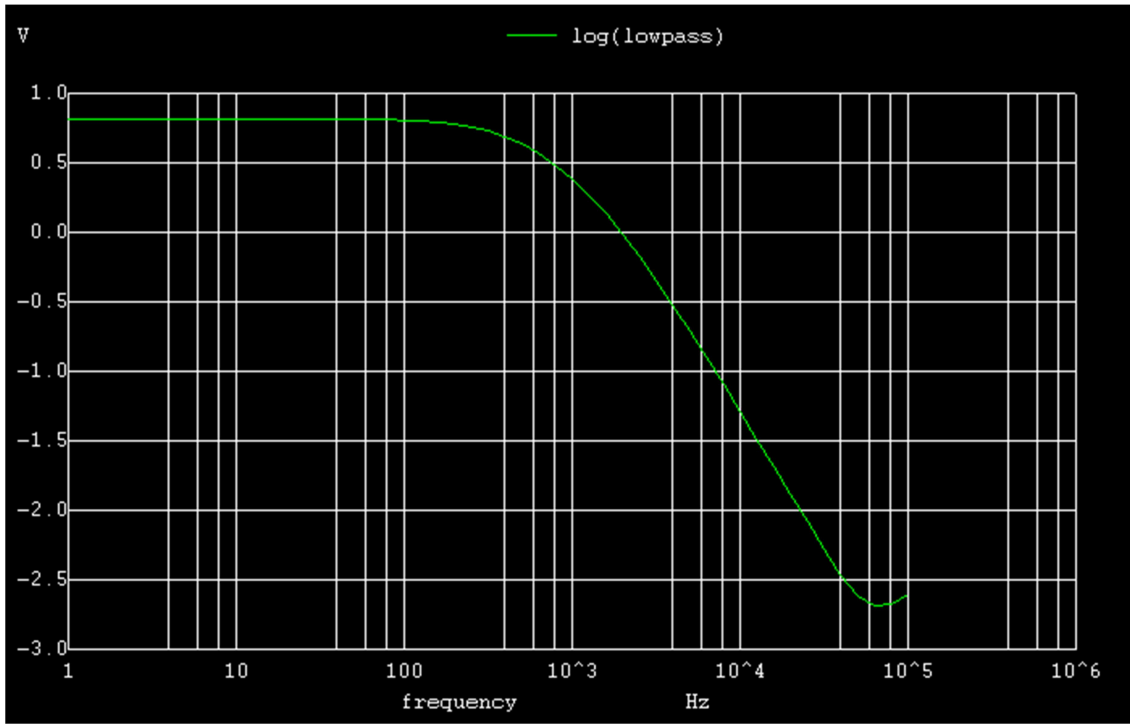
Results:

Ngspice Input plot

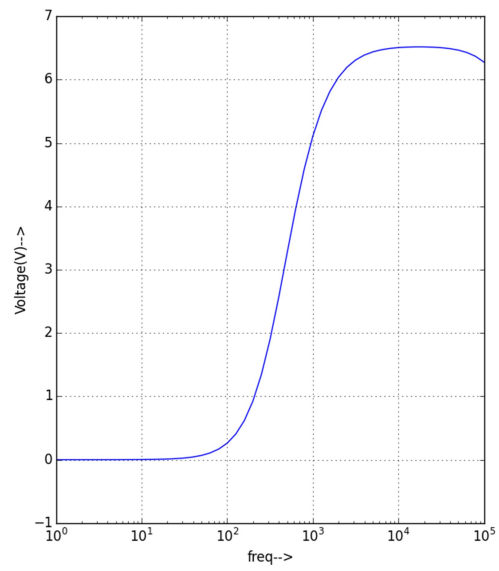
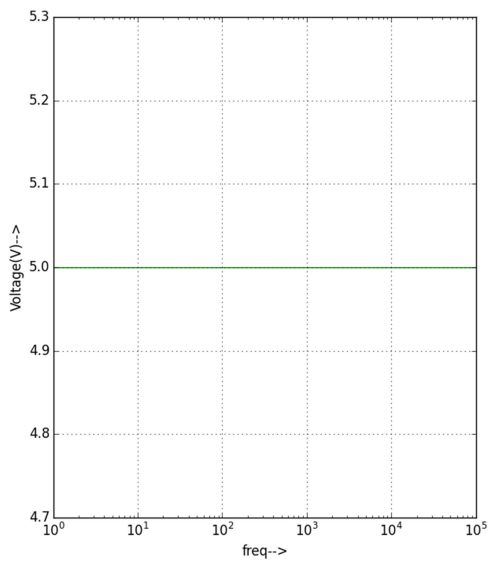


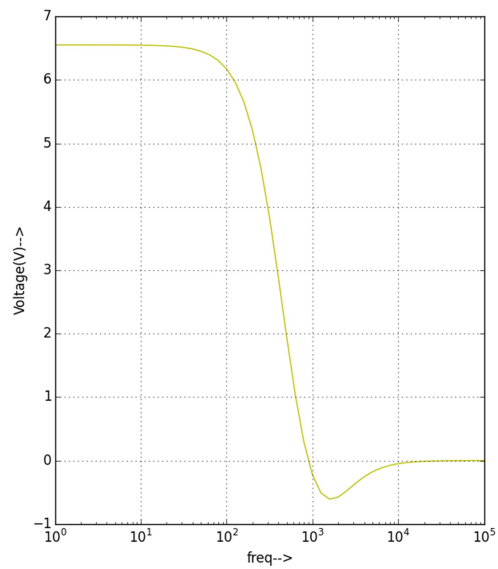
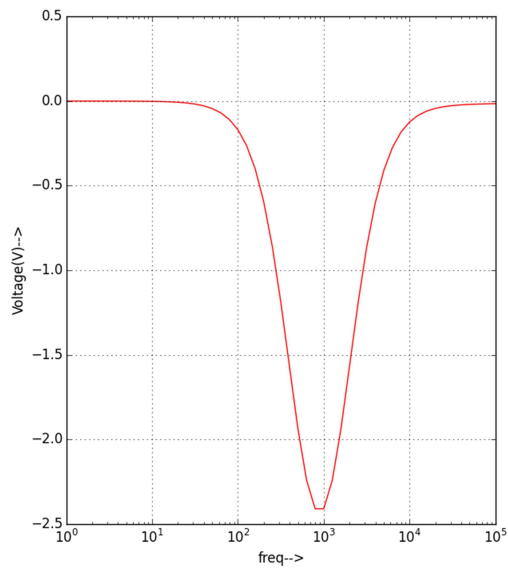
Ngspice plot : Output plot





Python plots :





Conclusion: Thus, we have studied the State Variable Circuit using eSim circuit simulation and the simulation plot of ngspice and python plot obtained in eSim.

Source/Reference(s):

1. <https://www.electronics-tutorials.ws/filter/state-variable-filter.html>
2. <http://www.circuitstoday.com/state-variable-filters>
3. https://en.wikipedia.org/wiki/State_variable_filter
4. <https://www.edn.com/three-op-amp-state-variable-filter-perfects-the-notch/>