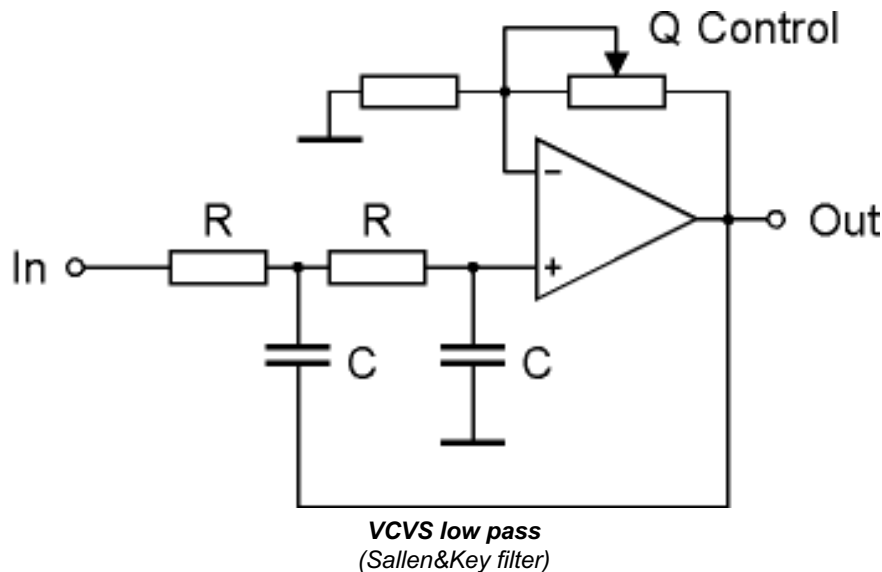


DOEPFER MUSIKELEKTRONIK

Technical details for the A-101-1 Vactrol Multitype Filter (Steiner Filter) and A-106-1 X-treme Filter



Both the A-101-1 Vactrol Multitype filter and the Both the A-101-1 Vactrol Multitype filter and the A-106 MS20 filter have their origins in the standard non-inverting amplifier low pass filter design (so-called VCVS low pass, VCVS = voltage controlled voltage source) shown on the left. With identical resistor and capacitor values it is even known as Sallen&Key filter.

The frequency of this low pass filter is $f = 1/(2 * \text{Pi} * R * C)$. The resonance is $Q = 1/(3 - a)$. With $a = 1$ one obtains a filter without resonance, $a = 1.268$ leads to a Bessel filter, $a = 1.586$ to a Butterworth filter and $a = 2.234$ to a Tschebyscheff filter. When a reaches 3 the filter is self oscillating.

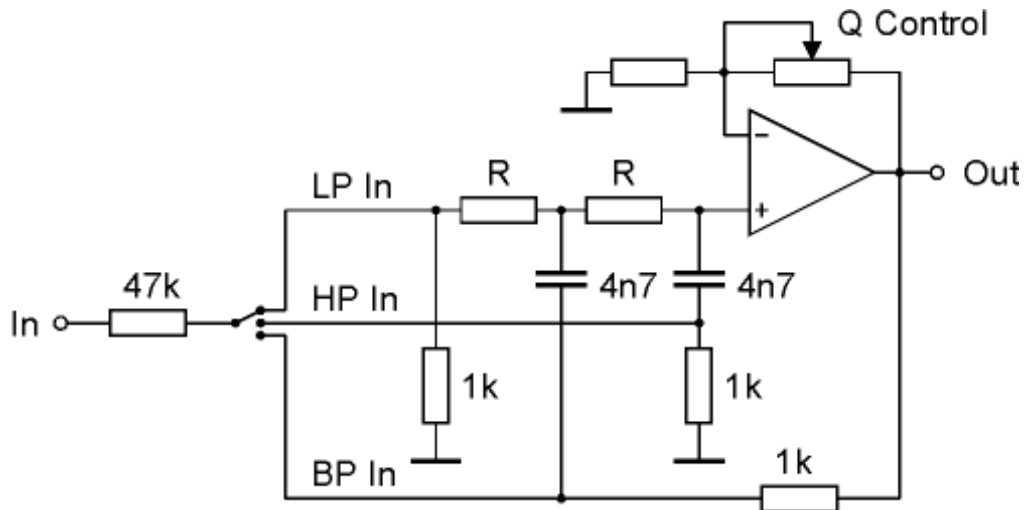
If the two resistors "R" are voltage controlled one obtains a voltage controlled filter. Voltage control can be realized e.g. with operational transconductance amplifiers = OTA, VCAs, vactrols, or other variable resistors like special diode or transistor circuits.

A-106 MS20 filter have their origins in the standard non-inverting amplifier low pass filter design (so-called VCVS low pass, VCVS = voltage controlled voltage source) shown on the left. With identical resistor and capacitor values it is even known as Sallen&Key filter.

The frequency of this low pass filter is $f = 1/(2 * \text{Pi} * R * C)$. The resonance is $Q = 1/(3 - a)$. With $a = 1$ one obtains a filter without resonance, $a = 1.268$ leads to a Bessel filter, $a = 1.586$ to a Butterworth filter and $a = 2.234$ to a Tschebyscheff filter. When a reaches 3 the filter is self oscillating.

If the two resistors "R" are voltage controlled one obtains a voltage controlled filter. Voltage control can be realized e.g. with operational transconductance amplifiers = OTA, VCAs, vactrols, or other variable resistors like special diode or transistor circuits.

DOEPFER MUSIKELEKTRONIK



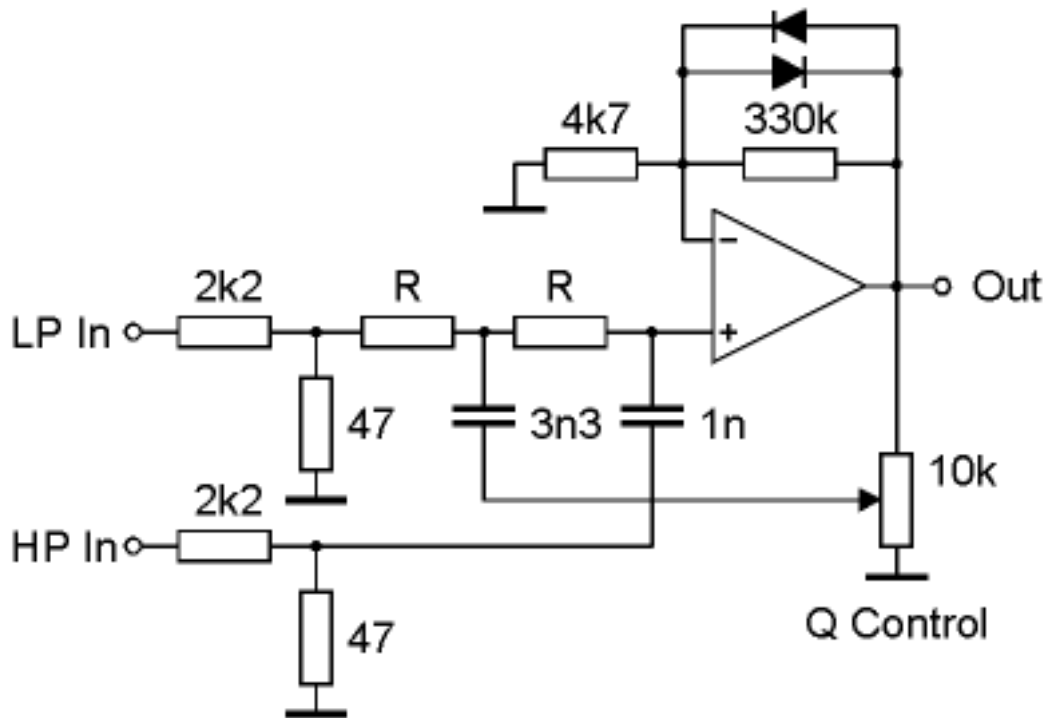
Steiner Filter

(published in Electronic Design, issue 25, December 1974, page 96 ff)

Nyle A. Steiner published a modification of this circuit in the magazine *Electronic Design* (issue 25, December 1974, page 96 ff). He extended the circuit by three 1k resistors and a three position switch that was used to feed the audio input signal into one of three different sections of the circuit. The three different inputs lead to different filter types (low pass / LP, band pass / BP, high pass / HP) with a common output for all filter types.

We cannot confirm Nyle A. Steiner's statement after what the resonance resp. Q remains essentially the same as the frequency is changed. Rather the resonance increases clearly as the frequency becomes smaller. We discovered this behaviour in the "real" circuit as well as in the PSpice simulation of Nyle A. Steiner's circuit. For the Sallen&Key filter Q is indeed nearly independent of the frequency. But the introduction of the three 1k resistors leads to a frequency depending resonance. The Q/f dependence can be lowered if the 1k resistors are made smaller (e.g. 100 Ohm). But in this case the output level becomes very small and requires an additional output amplifier to compensate the attenuation.

DOEPFER MUSIKELEKTRONIK



A-106-1 / MS20 filter principle circuit

Even the filters of the MS20 are modifications of the basic circuit shown at the beginning. The left picture shows the basic principle of the [A-106-1](#) filter. In contrast to the Steiner modification only two inputs are available and the feedback control is a bit different: the output amplifier has a fixed amplification ($\sim 70 = 330/4.7$) with diode limiters, the two capacitors have different values and the resonance is controlled by a 10k potentiometer that feeds back an adjustable share of the output signal. The resistors labelled "R" are realized by OTAs (operational transconductance amplifiers) to obtain voltage control of the filter frequency.

In the MS20 two separate filters are available:

- a highpass filter (for this filter the 2k2 resistor in the LP input is omitted and no LP input is available) and
- a lowpass filter (for this filter the 2k2 resistor in the HP input is omitted and no HP input is available)

Attention ! The highpass has a 6dB slope only but not 12 dB as said in most documents about MS20.

In the A-106-1 both inputs are available simultaneously with separate input attenuators to be able to mix the LP and HP shares of the input signal (i.e. the same input signal for both inputs) resp. input signals (i.e. two different audio signals for LP and HP input). In addition the function of the two limiting diodes is adjustable by two potentiometers to obtain symmetrical or asymmetrical clipping for high audio input levels.