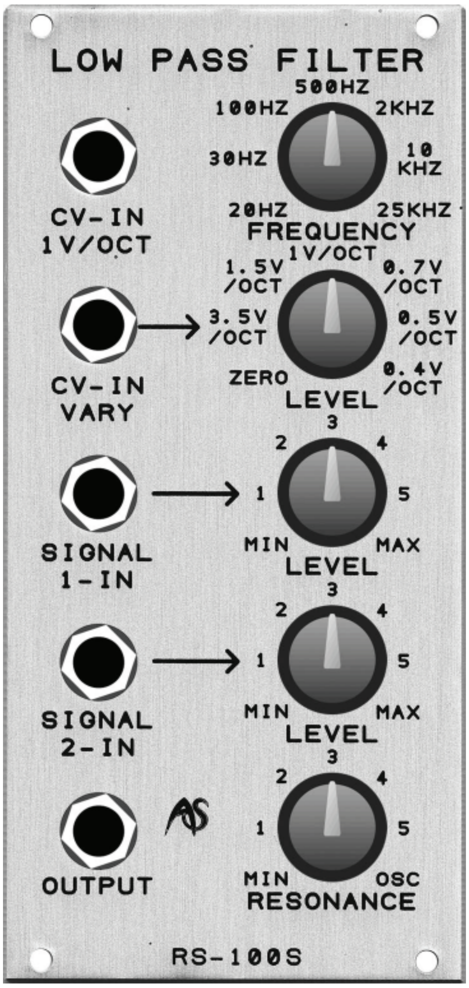
RS100S

ENHANCED LOW-PASS FILTER



The original version of the RS100 was designed to emulate as closely as possible the classic Moog "transistor ladder filter" design and sound. This decision was made because popular opinion was (and remains) that this type of filter is the most desirable of all synthesisers' low-pass filters. However, there are many reasons why this design is less than ideal, so we looked for ways to eliminate the problems while retaining the desirable audio characteristics of the original.

The results first appeared in 2006 in a revised RS100, and more recently in the RS100S, which continues to employ the transistor ladder architecture of its forebears, but embodies numerous updates that improve its stability and response without losing the essential *Mooginess* of its sound.

The improvements are:

Reduced drift:

The cut-off frequency of the Moog filter and, therefore, the original RS100, is prone to drift with changes in temperature. Not too important when using the filter at low resonance (or 'emphasis' in Moog terminology), this becomes problematic when using high resonance to accentuate harmonics, or when the filter is self-oscillating.

Recognising this, Moog's rival, Alan Pearlman of ARP designed the ARP1006 filter for the ARP2500 modular synthesiser released in 1970. This too is a 24dB/octave low-pass filter, and it used Moog's transistor ladder architecture. However, it also incorporated temperature compensation that audibly improved its pitch stability.

The RS100S employs heater circuits that stabilise the operating temperature. Once this temperature has been reached (which takes approximately one minute) you can demonstrate the improvement by increasing the resonance to maximum and playing the filter as a sine wave oscillator. You will find that it remains correctly tuned and stable over a wider range of pitches than before.

Improved stability:

Over the past few years, a mythology has grown around the use of discrete components, claiming that they offer better sound and performance than integrated circuits. This is not axiomatic. In carefully designed circuits, there is no reason why devices utilising ICs and Op-amps should sound less appealing. Furthermore, circuits based on integrated components can be less prone to drift and instability than their discrete equivalents.

The original RS100 used discrete components in its differential output amplifier, but the use of low-noise operational amplifiers (Op-amps) in the RS100S improves this instability without damaging the sound.

Improved distortion characteristics:

Many filters distort the waveform of the incoming signal even when you do not want them to do so. This is easily verified. If you set the cut-off frequency of a low-pass filter to its maximum and its resonance to minimum then, provided that the cut-off frequency exceeds 20kHz, there should be no significant difference between the input and output signals. Unfortunately, this is rarely the case.

In the RS100S, the components in the ladder have been carefully selected to ensure that there is no audible distortion between the input and the output when FREQ = HIGH and RESONANCE = MIN.

Improved gain:

If each of the pairs of transistors in a ladder filter are matched, its response can be optimised across the whole filter response spectrum. In early Moog filters, every pair was hand-picked and matched, but later designs matched only the top and bottom pairs, which led to subtle degradations in performance.

To improve the HFE (frequency dependent gain) characteristics of the RS100S, the transistors and capacitors (which are of a type specifically recommended for use in tuned networks) are matched and paired along the length of the ladder network to ensure optimum balance and response at all frequencies.

Low noise:

Not only are the transistor pairs matched for HFE, but they are selected for low noise. This means that the RS100S can handle low level input signals and generate higher level output signals without generating an unacceptable amount of noise. This allows you to create high resonance effects and to play the self-oscillating filter without introducing unwanted noise into the patch.

Improved frequency response:

The original RS100 had a frequency response of around 40Hz to around 17kHz. This has been greatly increased in the RS100S, which boasts a range of 10Hz to around 35kHz when external CVs are applied, emulating the response of the very best filters from the early 1970s. Not only does this make the filter brighter at the top end and deeper at the bottom, but it improves its ability to handle transients, and it further improves the stability of sounds utilising high resonance and self-oscillation.

IN USE

Notwithstanding the increased frequency response, all the inputs, outputs and controls on the RS100S function in the same way as on the original RS100.