



ZAGRZEB

STEREO FOUR
POLE VC FILTER

Model of 1979

OPERATOR'S MANUAL rev. 1979/1.1

SALUT

Thank you for purchasing this Xaoc Devices product. Zagrzeb [*'zagzɛp*] is a stereo multi-mode 4-pole (24dB/oct) state variable voltage-controlled filter (SV VCF). It offers five distinct frequency responses, three of which are available simultaneously. Zagrzeb is designed to sound smooth and clean unless it is overdriven with a hot signal—however, it does not lack character! We believe it will be appreciated by fans of old Japanese synthesizers but bear in mind that Zagrzeb is not a clone of any existing design. The four-pole state variable structure is a new development and offers unique sonic characteristics. While Zagrzeb is designed for filtering stereo signals (e.g. samples or stereo oscillators like Xaoc Odessa), it can easily handle mono signals and is capable of creating a faux stereo pair thanks to a special phase shifting network at the input.

INSTALLATION

The module requires 8hp worth of free space in the Eurorack cabinet. Always turn the power off before plugging the module to the bus board using the supplied ribbon cable paying close attention to power cable pinout and orientation. The red stripe indicates the negative rail and should match the dot or **-12V** mark on the bus board as well as the unit. Zagrzeb is internally secured against reversed power connection, however flipping the 16-pin header **MAY CAUSE SERIOUS DAMAGE** to other components of your system, because it will short circuit the +12V and +5V power lines. Always pay particularly close attention to the proper orientation of your ribbon cable on both sides! The module should be fastened by mounting the supplied screws before powering up.

To better understand the device, we strongly advise the user to read through the entire manual before use.

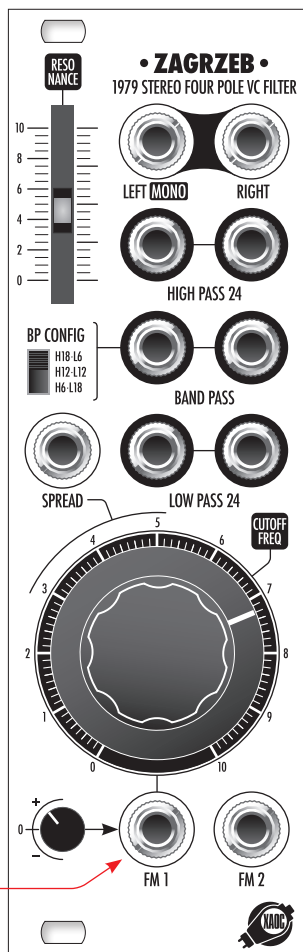
MODULE OVERVIEW

Zagrzeb's front panel is shown in fig. 1. The stereo pair of **LEFT/MONO** and **RIGHT** signal inputs ❶ is AC-coupled and accepts all Eurorack signal levels (up to 20Vpp), however, a conservative 10Vpp level is recommended as filtering certain signals may occasionally yield increased amplitude thus causing distortion. With a mono signal patched into the **LEFT/MONO** jack the module automatically creates a stereo signal. The three pairs of jacks below the inputs are the **HIGH PASS 24** ❷, **BAND PASS** ❸, and **LOW PASS 24** ❹ outputs of the filter. The **BP CONFIG** switch ❺ near the band pass outputs offers three variants of this middle type of response. The big **CUTOFF FREQ** knob below ❻ controls the cutoff frequency of the filter (10Hz to 20kHz) while the vertical **RESONANCE** slider ❼ controls the degree of resonance. The illuminated slider shaft indicates how much the peaks of the output signal exceed the peaks of the input signal (mostly due to the resonant ringing around the cut-off frequency). The **FM 1** ❽ and **FM 2** ❾ CV inputs at the bottom of the panel control the cutoff frequency. The sensitivity of the **FM 1** input is controlled by the small attenuverter knob ❿ from -2 oct/V through 0 to +2 oct/V. The **FM 2** input is fixed at 1V/oct (uncalibrated). The **SPREAD** CV input ⓫ allows the user to animate the stereo image by moving the left and right filter cutoff frequencies in opposite directions.

FREQUENCY RESPONSE

Zagrzeb is a state variable filter, hence it offers multiple outputs. Common 2-pole filters offer -12dB/oct low pass, +6/-6dB band pass, and +12dB/oct high pass responses. Zagrzeb's 4-pole structure gives the user as many as five different characteristics: from -24dB/oct low pass up to +24dB/oct high pass with all three possible combinations of 6dB/oct slopes that sum up to 24 in between. These interme-

fig. 1: INTERFACE



diate combinations are different variants of band pass (an asymmetric $+6/-18\text{dB}$, a symmetric $+12/-12\text{dB}$, and another asymmetric $+18/-6\text{dB}$) covering a wide spectrum between dark, mellow, boxy, honky, and harsh—and all that in stereo!

Some example frequency responses offered by Zagrzeb at the **HIGH PASS 24** and **LOW PASS 24** outputs are shown in fig. 2. Please note that low frequencies are not attenuated when the resonance is high. Note also that the high pass response is particularly steep at 24dB/oct . This results in quite a radical filtering effect.

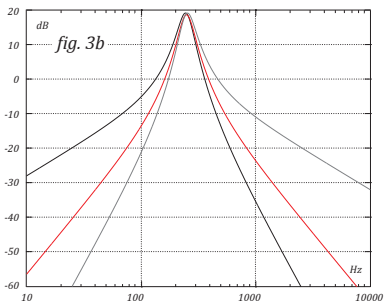
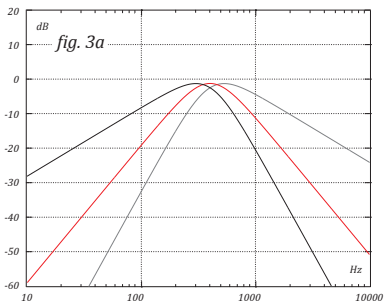
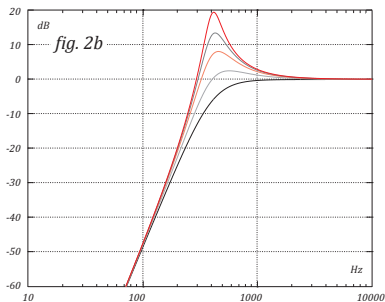
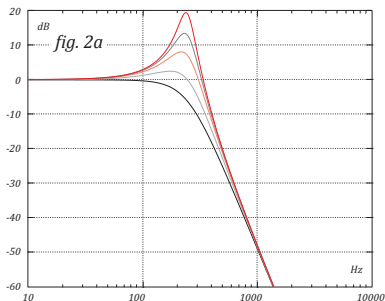
Fig. 3 shows the frequency responses at the **BAND PASS** pair of outputs, comparing three settings of the **BP CONFIG** switch: **H18L6**, **H12L12**,

and **H6 L18**. Different slopes result in less or more radical filtering of components below and above the center cutoff frequency yielding significantly diverse timbres. Please note that the middle symmetric response features two 12dB/oct slopes that are twice as steep (hence more selective) as a classic 2-pole SVF.

GAIN VS RESONANCE

In every resonant circuit, increasing the resonance introduces higher gain for signals close to the resonant frequency. In filters, this may yield increased amplitude of the filtered signal and some distortion at the output.

Designers of synthesizer filters handle this problem either by compensating for the gain



increase by mixing some inverted input into the variable feedback that controls the resonance (which results in a weaker response at bass frequencies), by introducing nonlinear saturation into the variable feedback (it causes specific distortion that is quite often attributed to “fatness”), or by providing advanced dynamics processing.

The feedback in Zagrzeb (which is necessary for satisfying the state variable equation) is fixed. The resonance is not controlled by changing the feedback, but by shifting the individual poles of the transfer function.

We have decided not to compensate for the increased gain, instead, aiming at a smooth and natural response up to the clipping point. The range of resonance is trimmed, though, so that the clipping point is hardly reached and is therefore non-intrusive. It is also one of the reasons Zagrzeb is by design incapable of self-oscillation.

VOLTAGE CONTROL

The two CV inputs at the bottom of the panel control the cutoff frequency throughout the entire audio range.

The variable **FM 1** input is equipped with an attenuverter featuring a center detent. Note that the range of this knob is up to $\pm 0.5V/oct$ (in other words: $\pm 2oct/V$), which is twice as wide as the fixed input **FM 2** thereby facilitating extreme sweeps while retaining shallow modulation near the middle position thanks to the attenuation curve of the potentiometer. The fixed input **FM 2** is not calibrated, but it provides fairly accurate tracking at $1V/oct$.

STEREO PROCESSING AND EFFECTS

Besides being able to filter two channels of a stereo signal with the same characteristics, Zagrzeb offers additional animation of the stereo image by introducing subtle changes

to the cutoff frequency. The **SPREAD** input is conveniently scaled at $1/10$ th the sensitivity of the **FM 2** input. $0V$ at the **SPREAD** input has no effect, while positive and negative CV results in the two stereo filters swinging slightly in opposite directions.

Patching a mono signal to the left input creates a pseudo-stereo effect. A special multi-stage phase shifting network introduces a slight delay between the left and right outputs, thus making a stereo output signal with a wider image. Please note, the effect is most noticeable with rich sounds that change over time and may be less spectacular with a static VCO waveform.

PATCH IDEAS

- It is quite easy to achieve a notch filter response, even though Zagrzeb does not offer it by default. Take the filtered signals from the **HIGH PASS 24** outs and invert and mix them with the **LOW PASS 24** outs (in other words, subtract them). Note: The effect is most pronounced with **RESONANCE** set to minimum.
- When one is willing to use the filter in mono, an interesting formant filter response can be achieved by mixing two detuned band pass filters. Patch a $5-10V$ CV offset into the **SPREAD** jack, mix the outputs of the two **BAND PASS** outputs, and set the resonance high.
- It is possible to achieve a steep $48dB/oct$ low pass or high pass filter response by stacking two of Zagrzeb's channels. For a low pass response, plug the audio signal into the input of the left channel, then patch from the left **LOW PASS 24** output to the input of the right channel, and use the right **LOW PASS 24** as the final output.

ACCESSORY

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MAIN FEATURES

Stereo, four-pole state variable filter

Five frequency responses, three available simultaneously

24dB/oct low pass and 24dB/oct high pass filtering

No LF drop at high resonance

Mono to stereo image effect

Voltage controlled stereo spread

TECHNICAL DETAILS

Eurorack synth compatible

8hp, skiff friendly

Current draw: +70mA/-60mA

Reverse power protection