VoIS Modular

15–Channel Vocoder
and Fixed Filter Bank
Eurorack Module

Revision 0.9 — DRAFT

User's Manual

http://vocoder.hoerold.com
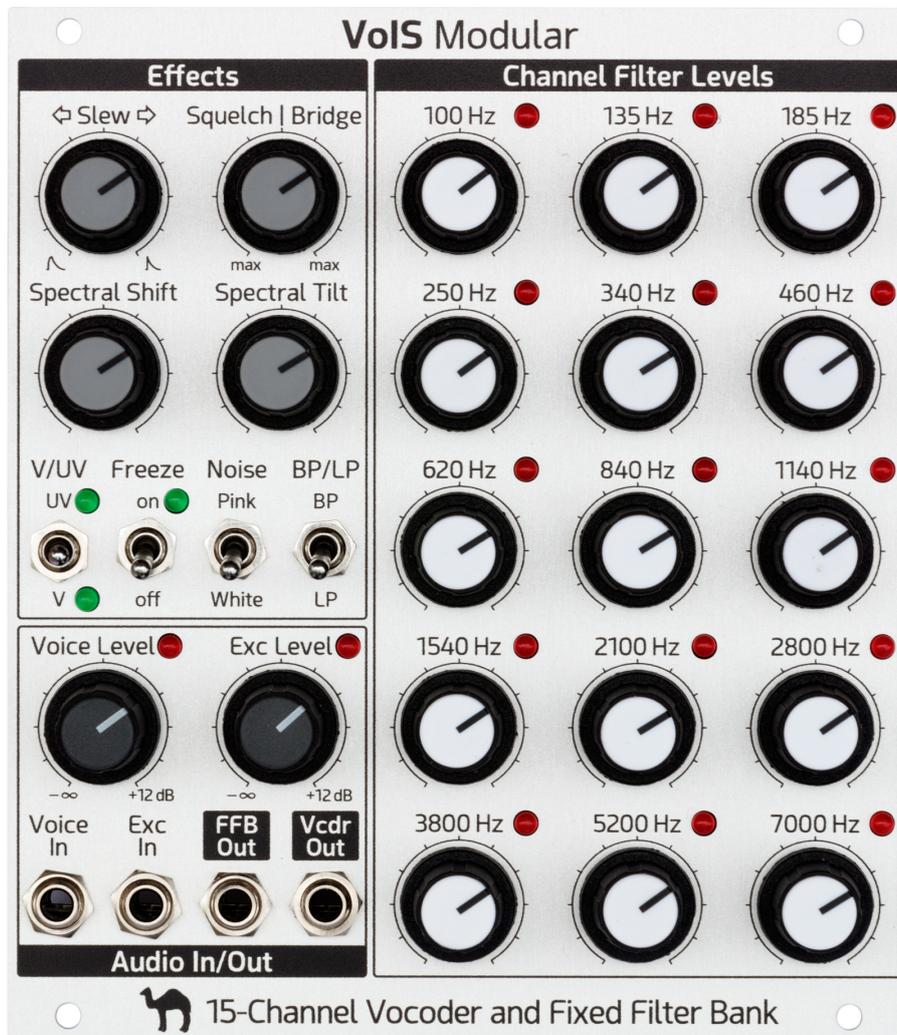
Main Product Features

- **15 adjustable 8-pole filter channels** with LED clipping indicators
- **Slew Control** to create unique slurring effects
- **Silence Bridging** to fill audible gaps with the filtered excitation signal
- **Squelch** to gate background noise
- **Spectral Shift** to shift the analysis filter frequencies up or down
- **Spectral Tilt** to manipulate the overall frequency spectrum
- **V/UV Detector** to automatically detect voiced and unvoiced signals
- **Freeze switch** to bring the vocoded signal to a standstill
- **Noise switch** to select either pink or white noise for the excitation of unvoiced signals
- **BP/LP switch** to select between band–pass or low-pass response of the lowest channel filter
- **Line inputs** for voice and excitation signals, with clipping indicators
- **FFB Out** to output the fixed filter bank audio signal
- **Vocoder Out** to output the synthesized vocoder audio signal

The overall concept, based on 16–bit analog–to–digital and digital–to–analog–converters and a powerful state–of–the–art microcontroller, enabled the design of this feature–packed 22 HP Eurorack module.

Operating Principle

Vocoders are used in a variety of sound productions and are known for their characteristic sounds such as robotic voices. In general terms, vocoding is accomplished by a carrier signal that is articulated by a voice signal.

In this vocoder, the voice and excitation inputs are split up into 15 frequency bands. Each band, also called channel, has its own level control. For each channel, the envelope of the filtered voice is extracted and impressed upon the excitation signal in the same frequency band to create a synthesized signal. The sum of all the synthesized signals creates the distinct vocoder sound.
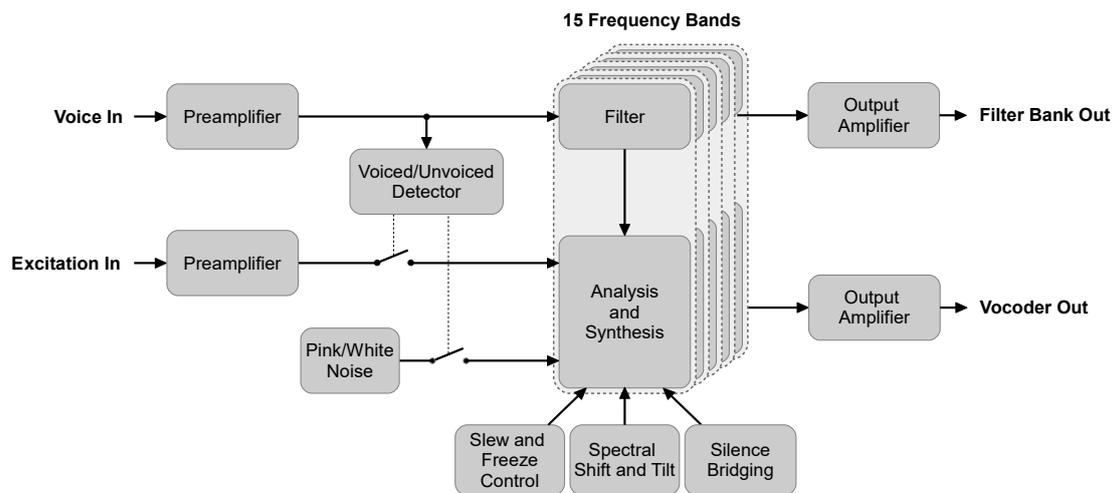
VoIS Modular block diagram

A voiced/unvoiced detector distinguishes between voiced sounds (such as *a*, *e*, *i*, *o*, or *u*) and unvoiced sounds (such as *s*, *f*, *t*, or *k*). As unvoiced sounds typically have a wider frequency spectrum than the excitation signal, intelligibility is improved by replacing the excitation signal with pink or white noise during the presence of unvoiced sounds.

The slew rates of the voice envelope impressed upon the excitation signal can either be slowed down, causing slurring effects, or even be stopped, effectively freezing the given part of articulation. In this mode, the vocoder can be used as a pitch–adjustable formant filter.

Silence bridging fills periods of silence with the filtered excitation signal. Using the filtered signal ensures that the excitation frequency characteristics, preset through the individual channel volume controls, remain the same during silence and articulation.

The analysis and synthesis filters are normally tuned to the same frequency for each band. Spectral shift moves the analysis filter frequencies up or down by up to one octave while keeping the frequencies of the synthesis filters steady. The overall spectrum of the analysis section is controlled via the 15 individual channel filter controls. Spectral tilt manipulates the overall spectrum for base or treble emphasis.

The fixed filter bank output signal is a mixture of all 15 voice frequency bands, not only controlled by the individual level controls but also by spectral shift and tilt.

Except for the lowest and the highest frequencies, all channels use band–pass filters. The 100 Hz channel filter can be switched to a band–pass or a low–pass filter. The 7 kHz filter is a high–pass filter. As a general guideline, setting the 100 Hz filter to a band–pass is more suitable for regular voice synthesis to avoid unpleasant audio outputs in the low frequency range. On the other hand, for the synthesis of sounds rather than voice, switching the 100 Hz filter to a low–pass ensures the full coverage of the entire frequency range.

Functions and Controls

Channel Filter Levels

At the heart of the vocoder are 15 independent analysis and synthesis filters with center frequencies ranging from 100 Hz to 7 kHz.

Each channel has an individual level control with a gain ranging from $-\infty$ to 6 dB and an LED to indicate voice input clipping on the corresponding channel.

The channel filter controls are also the essential element of the fixed filter bank.

Audio In/Out

This section comprises the 3.5 mm input jacks for the voice and excitation signals, including their level controls, and the fixed filter bank and vocoder outputs.

The gains for each input can be set between $-\infty$ and +12 dB. The LED's indicate if clipping occurs on the corresponding inputs. The analog input signals accept a voltage range of ± 5 V ($10\,\text{V}_{\text{pp}}$).

Note: For the use of a microphone, a separate dedicated preamplifier is required.

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Functions and Controls

Effects

Various effects are available via the following controls and switches:

Slew Control delays the voice envelope depending on the control setting, leading to slurring effects. Left of center, the attack–to–decay ratio is 1:5. Right of center, the slew rises immediately with the detection of an attack. For neutral behavior, leave the control centered.

Squelch and Silence Bridging are combined in one control. Left of center, the adjustable noise gate is in effect. Right of center, silence bridging passes the filtered carrier signal through to the vocoder output during periods of silence of the voice signal. The signal level passed through is adjustable. For neutral behavior, leave the control centered. Squelch also works on the fixed filter bank.

Spectral Shift moves the channel filter frequencies of the analysis section up or down by up to one octave. For neutral behavior, leave the control centered. Spectral shift also works on the fixed filter bank.

Spectral Tilt adjusts the overall frequency spectrum of the analysis filter section and allows the emphasis of base or treble frequencies with a single control. For neutral behavior, leave the control centered. Spectral tilt also works on the fixed filter bank.

The **voiced/unvoiced (V/UV)** detector enhances intelligibility. Three settings are available:
- In position **UV**, the excitation signal is permanently replaced with pink or white noise.
- In center position, voiced or unvoiced input is detected automatically, indicated by the corresponding LED.
- In position **V**, all input is treated as voiced signal

Freeze holds the envelope signal instantly. The LED indicates whether the signal is frozen.

Noise selects either the pink or the white noise source for the replacement of the excitation signal during the presence of unvoiced sounds.

BP/LP selects the filter type, band–pass or low–pass, of the lowest frequency channel (100 Hz).

Quick Start Guide

1. Install the Module

Install and power up the VoIS Modular.

1. Connect Voice In

Connect a voice source to the 3.5 mm **Voice In** input jack.

2. Connect Exc In

Connect an excitation source to the 3.5 mm **Exc In** input jack.

3. Connect Vocoder Out

Connect the 3.5 mm **Vcdr Out** jack to the module that you use for driving your speaker and adjust the volume.

4. Set Up the Vocoder

Turn up all 15 channel filter levels (fully clockwise) turn **Squelch|Bridge**, **Slew Rate**, **Spectral Shift** and **Spectral Tilt** in center position. Switch **Freeze** to **Off** and set **V/UV** to center position. Set **Noise** to **Pink** and **BP/LP** to **BP**.

6. Adjust the Levels

Turn on your voice and excitation signal sources and turn up the voice and excitation levels as far as possible for best signal–to–noise ratio without signal clipping if indicated by the corresponding LEDs.

7. Enjoy and Experiment

Play with the controls and switches to get a feel for the various features available on your vocoder and listen to the effects they create.

Tip: In the beginning it is best not to use a microphone because it is difficult to talk and listen to the vocoder at the same time. Use some recorded voice instead. (For the use of a microphone, a separate preamplifier is required.)

Tip: Your excitation signal should be rich in harmonics. Start out simple with a sawtooth or rectangular signal source. Triangular or sine signals are less useful because they have very few or no harmonics and will hardly excite the 15 filters.

Tip: Use an excitation signal with frequencies between 40 Hz to 100 Hz for good intelligibility.

Tip: Sometimes one or more of the 15 individual channel LEDs may light up. While this indicates clipping, this usually just adds to the character of the sound. If clipping is not desired, adjust the levels of the affected channels accordingly.

Optional Hardware Configuration

Note that this product is configured by default for an audio output voltage range of ± 5 V. To boost the output voltage to a range of ± 10 V, insert two jumpers as encircled in orange in the picture below. The two jumpers are marked with "2x Voc" and "2x FFB" on the board.
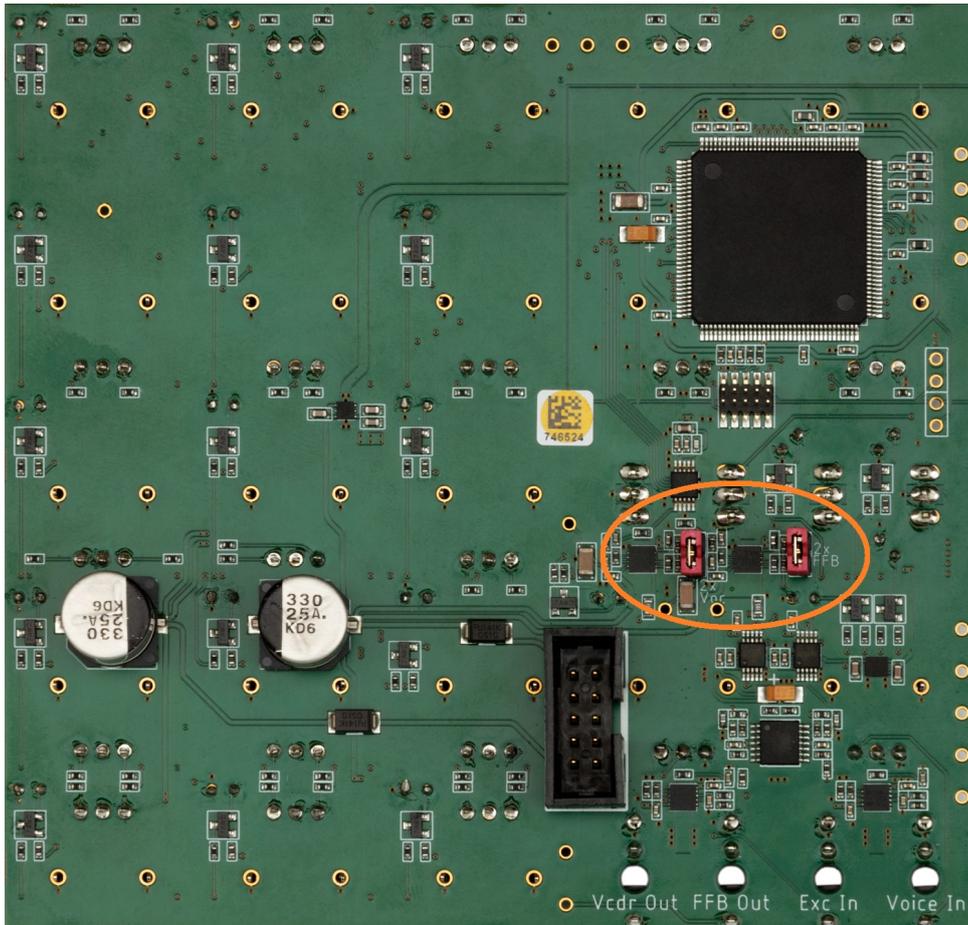
Models and Availability

The VoIS Modular comes either with a silver or a black front panel. It is available either fully assembled or as a do–it–yourself kit.

Note: This product and any associated documentation may be subject to change without notice.