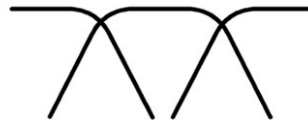


# CrossOverFilter

## BugBrand



The *CrossOver Filter* design came about driven by two areas of desire – in part I wanted to bring the filtering out of my modular range, to add wrappings that would allow easier studio integration, but I was also curious about the units I'd seen in PA racks which would split audio up into different frequency bands. The aim with such devices was typically to drive different speakers, so designs tended to be fairly functional – but how about splitting the frequencies for separate processing and making the whole approach more playful?! The result is a processor which can subtly or dramatically alter audio sources in creative ways, presented in a compact but tactile form.

Within the *COFilter* are two full spectrum Voltage-Controlled State-Variable Filters with Resonance adjustable up to self-oscillation (Voltage-Controlled via Expander). The filters, which can be run in either Series or Parallel arrangement, split the audio input into three frequency bands which each have an individual output or can be mixed via normalisation to a single output.

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Please consult the Block Diagram in tandem with the following section descriptions.

**Input Preamp** – The electronically balanced mono 1/4" Input passes through a buffer and preamp offering clean gain up to +26dB via the yellow *Drive* control. Internal signal levels are higher than typical line levels as the filters spring from modular synth designs and, as such, some input gain is usually applied to balance the signal levels with the self-oscillation amplitude. Input Impedance – 20k Ohms

**State-Variable Filters** – The two filters are identical, but their input & output arrangements are different. The filters are 2-pole 12dB/Octave with temperature compensation, cover the entire audio spectrum from approximately 20Hz to 20kHz, and each have Low/Band/High-pass outputs. Resonance is adjustable with the red *Q* control up to the point of self-oscillation (fully clockwise) at which point a pure sine-wave is produced.

Each filter has a Control-Voltage (CV) summer which combines the main black *Cutoff* dial with any modulation sources. Modulation can be switched between either an external source (blue *CVF* banana socket) or the internally routed Band-Pass signal from the filter for chaotic audio-rate self-modulation. The blue *FMod* dial is polarizing, giving negative modulation depth with counter-clockwise settings, zero depth in the mid position and positive modulation with clockwise settings.

CV scaling corresponds to the 1V/Oct exponential control standard when using an external CV source with *FMod* turned fully clockwise. This is adjusted to track over c.5 Octaves when calibrated – fine tuning via the internal trimmers may be required dependent on your system. CV inputs have standard 100k Ohm impedance.

**Series/Parallel Mode Switch** – The standard *COFilter* behaviour uses the *Series Mode* where the High-Pass output of Filter 1 passes to the input of Filter 2, thus generating a *Mid Band* with independently adjustable Low/High-Pass Frequencies.

It was, however, a simple design addition to offer a switchable *Parallel Mode* where Filter 2 receives the same dry input signal as Filter 1. In this mode the *Mid Band* now behaves as a Low-Pass filter in the same manner as Filter 1 but fully independent.

**Outputs** – The three frequency bands each pass through switches offering phase / polarity inversion or muting (centre position), before a green Output Level control and buffer. Each output is on Impedance Balanced 1/4" (Impedance 470 Ohms) and the Low and Mid bands are Normalised so that when nothing is plugged in to either one the signal passes on to sum at the High Output.

A note on phase inversion of frequency bands – due to the inherent phase responses of the filter sections, switching the polarity of different bands can enhance or dampen the apparent resonance of the filters. The switched polarities correspond with the outputs being in phase with the input signal.

In typical usage where all three bands are summed together in series mode, it is suggested to begin with the Mid band set to inverted polarity. An interesting further idea is to mute the High band and change to parallel mode, again with the Mid band inverted – this gives a bandpass response but without the limitation that the Filter 2 cutoff has to be higher than that of Filter 1 (aka Twin-Peak Response – see R.Hordijk).

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**Expansion Headers** – On the back of the main circuit-board are two 6-pin headers which can be connected to the optional *CrossOver Filter Expander* panel. These present extra Input/Output options, opening the State-Variable Filters up for greater integration with modular systems.

*AudOut* – This provides the individual Low/Band/High-pass outputs from each filter. Typical signal output amplitudes are +/-5V (10V Peak-to-peak)

*XCntl* – This provides each filter with a direct signal input (expects +/-5V amplitude) along with external CV inputs for Filter Cutoff and Resonance (Q).

**Power** – The standalone/cased unit comes with a universal (90-264V AC) power supply which provides 12VDC @ 300mA on a centre positive 2.1mm DCplug. An internal DC-DC converter generates a bipolar +/-15VDC supply within the unit.

The COFilter can also be used as a module in a larger Powered Frame system.  
Power draw: +ve 75mA, -ve 75mA.

**Interfacing with Banana Sockets** – As 4mm banana cables do not carry a 0V (Ground) connection, you *must* establish a common 0V reference between the COFilter and any external device before patching Control Voltages.

*Banana-to-Banana:*

External banana systems should have a 0V (Ground) banana socket, typically located on the power supply or case. Connect a banana cable between this and the COFilter's black 0V socket and then patch between systems as required.

*Banana-to-Jack:*

This first connection is made with a two wire cable assembly – jack to twin banana – to establish a common 0V reference.

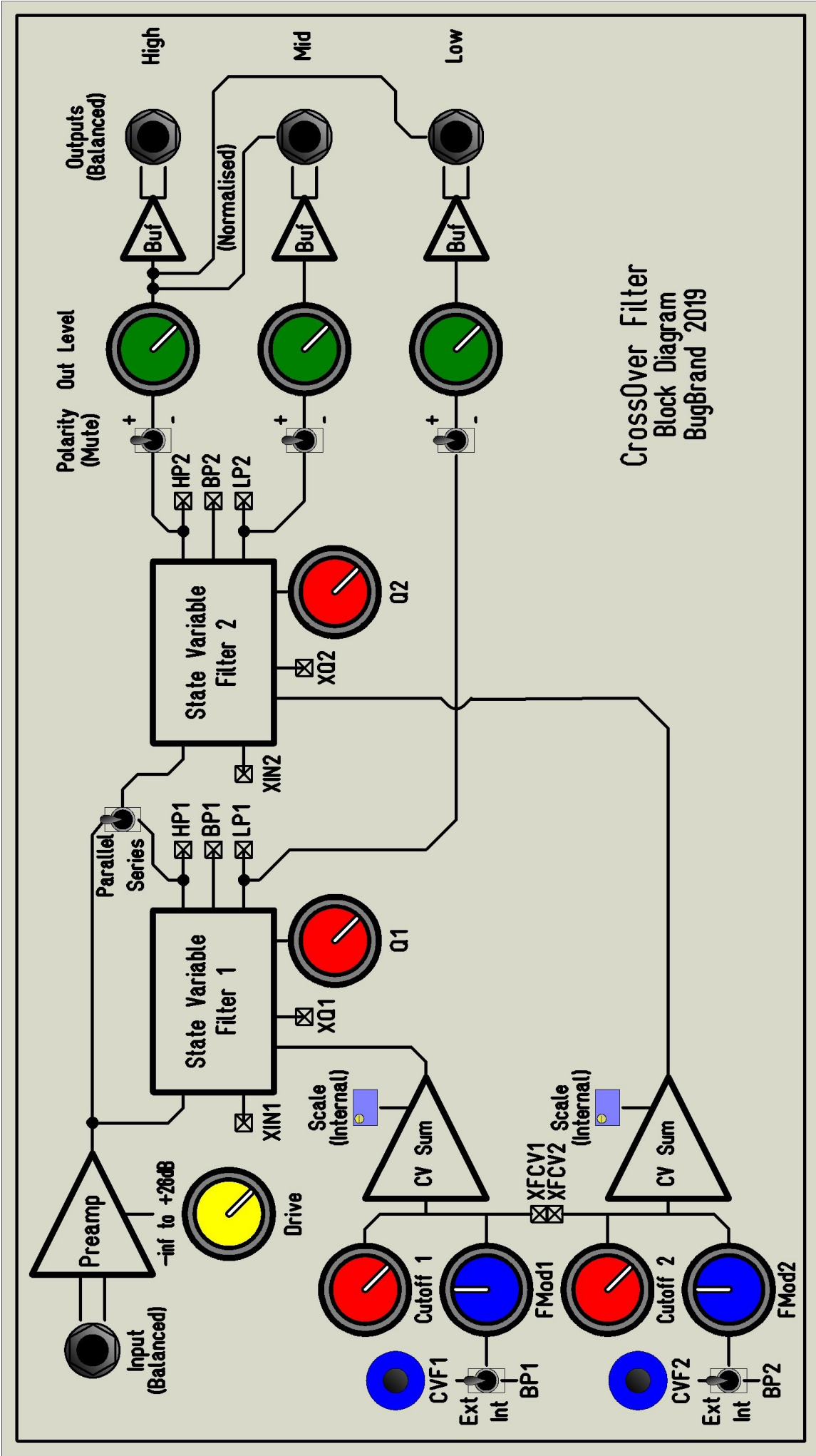
- the *BLACK* cable, from jack sleeve, plugs to the black 0V banana socket on the rear of the COFilter.
- the *WHITE* cable, from jack tip, then plugs to the CV source or destination.

Further connections from the same piece of external gear can then be made with just a CV signal cable – further 0V connections are only required when introducing further external gear.

**Guarantee**

The CrossOver Filter comes with a 2 year 'reasonable' warranty. If any mechanical or electronic failure occurs within the period, I will repair the fault free of charge. This excludes failure from maltreatment or modification and any cosmetic degradation. Contact should first be made via email to discuss the problem. Shipping to return the device is paid by the user and I cover return shipping. Failures that are not covered by this guarantee may be fixed at standard rates.

**Enjoy!** Tom Bugs – October 2019 – [tom@bugbrand.co.uk](mailto:tom@bugbrand.co.uk) – [www.bugbrand.co.uk](http://www.bugbrand.co.uk)



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 Block Diagram  
 BugBrand 2019