flight of harmony

Plague Bearer

Voltage-Controlled Bandpass Filter
Eurorack Module Kit
~rev 2.0~

(PCB based on PB-1Er4.0 circuit)

Specifications

Supply Voltage (min –> max)	±9V –> ±15V
Supply Current (max draw @ ±12V)	+12V: 6.5mA –12V: 4.0mA
Input Voltage (@ ±12V)	$0V_{pp}$ —> $10V_{pp}$
Max Output Voltage	±5V
Input & Ouput (I/O) coupling	Capacitive (AC)
Control Voltage (CV) inputs	0V –> V+
CV input coupling	Direct (DC)
CV input impedance	100kΩ

Contents

(1) Front Panel
(1) PCB
(1) Resistor Card
(1) SMT Semiconductor & Capacitor Card

(1) Hardware bag
- (1) 9″ ribbon cable
- (1) 2x5 box header
- (1) 2x5 IDC socket connector with strain relief
- (1) 2x8 IDC socket connector with strain relief
- (2) M3x0.5 eurorack mounting screw
- (2) M3 nylon washer
- (1) Wire for jumpers J1-J4
- (2) 1X3 pin header
- (2) Shunt for 1x3 pin header (output limit select)

(1) Potentiometer bag
- (2) A100k Potentiometer
- (1) B100k Potentiometer
- (1) A1M Potentiometer
- (4) Washer
- (4) Nut
- (4) Knob

(1) Jack bag
- (7) 3.5mm TS jack
- (7) Washer
- (7) Nut

(1) Film Capactiors & Switch bag
- (1) Input attenuation slide switch
- (1) 2.2μF Film capacitor
- (2) 0.01μF Film capacitor

(1) Reference manual (this thing)

Overview (taken from PB-1E r4 manual)

Philosophy/What is it?

The Plague Bearer is called a filter, but that is just a description of the circuit topology, what it can actually *do* goes way beyond that. It has been described as a filter, a waveshaper, a mangler, a crusher, and – my favorite – as an "FSU module"[1].

I think calling it a filter may be a bit misleading, but I have no idea what else to call it. It *is* a filter, but it does more (all at the same time, really) excessive phase shifting, waveforming, ringing, formant generation, and so on. I guess it could be called a waveform modifier or enhancer, but those don't sound good either. I named it the Plague Bearer for a reason.

If you are looking for technical synthophile specs you are out of luck here. All f(h) devices are designed in accordance with how they sound, not to achieve mathematical perfection.

The most common question I receive is, "what is the filter slope?" Honestly, I never measured that. I specifically avoided the conventional approach while I was designing this circuit, so it's very problematic to try to describe this filter in the normal terms. The slope is directly tied to the gain of the circuit, making it variable, and the Q is affected by all three filter controls. The setup is actually a combined High- and Low-pass. The corner frequencies are adjusted by the controls and can be overlapped completely, which gives a comb-filtering effect.

The rest is for you to discover.

Changes in Rev 4

Input Attenuator: Earlier versions often required use of an external VCA to reduce input signal levels and prevent overdriving the input. This is now handled by the input attenuator.

Output limiting: The output levels of earlier versions could spike well beyond $\pm 5V_{p\text{-}p}$, so an output limiter was added. The limiter has a soft to medium curve and can be disabled by moving the two jumpers as shown on the PCB.

Specification Details

Supply: This design has been tested from ±9V up to ±15V and works well in this range, although performance specifics will vary with supply voltage. All measurements, unless stated otherwise, assume $V_{supply} = \pm 12V$.

Output: Limited maximum $V_{out} \simeq \pm 5V$. The modules are intended for use in modular synthesizers, so the output is set to the standard level.

1. F*ck Sh*t Up

Overview (cont.)

Input: This can physically handle pretty much any reasonable (e.g., < ±15V) signal you might throw at it. This is why there is an input attenuator. Lower signal levels will give a much wider range of signal coloration/alteration, while overdriving the input of the filter will give a very harsh distortion and destroy most of the filtering subtleties.

If you find that the filter seems too "touchy", and overdrives too easily for you, try attenuating the signal before the module. Another symptom of too-high input levels is if the controls seem to not do much at all - this is the most common question I receive.

Controls

High: Clockwise rotation of the High control increases the high end of the signal. This also increases the resonance of the filter. Applying an increasing CV to the High CV input will act the same as clockwise rotation.

Low: Clockwise rotation of the Low control will increase the amount of the low end passed through the filter (i.e., it lowers the highpass f_c), and dramatically boosts the resonance. Applying an increasing voltage to the Low CV input also acts as clockwise rotation.

Gain: Controls the gain of the filter. Clockwise to increase, counter-clockwise to decrease. Increasing the gain increases the resonance, and the PB was designed to go absolutely nertz from this. The filter will easily oscillate and scream at you. This usually occurs when processing an audio signal and can be heard as an additional voice.

The gain also directly controls the amount of internally-generated noise fed through while the input is at or near minimum.

See page 4 for further details on self-oscillation and noise.

The VC Gain has inverted behavior: 0V is maximum gain, +12V is minimum gain.

Att: Input attenuation switch.

Input: Variable input level control.

Overview (cont.)

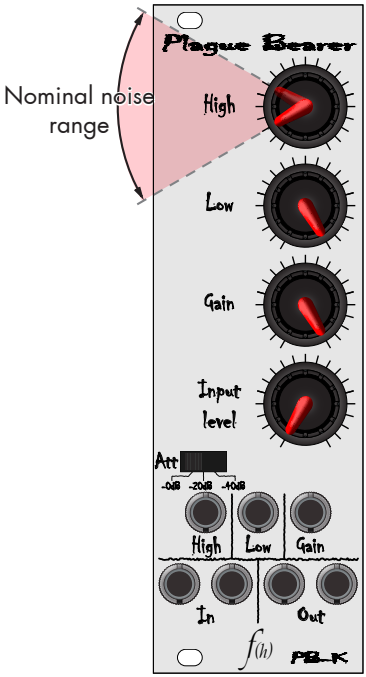
Making Noise

The PB filter can also act as a noise generator, and quite a variable one at that. To do so, just turn the input all the way down (CCW), turn the gain up a bit, and then adjust the High and Low controls to get the desired tone of noise. You can get some interesting percussion sounds by applying an impulse or saw wave to the High CV input, or some nice wind/whooshing sounds with a slow sweep. Daisy-chaining (series-connecting) a couple filters makes some nicely creepy ambient effects.

Caveat: *The noise feature is very quiet!* I'm talking millivolts here. It works, trust me, that is the first and last function I test before shipping. If you can't hear any noise, crank up your output amplifier. If you still can't hear it, use a preamp as well. It is worth it!

Self-Oscillation

The PB can be made to self-oscillate, turning it into an independent oscillator. I get a lot of questions about this, so here is the quickest way to get it working:

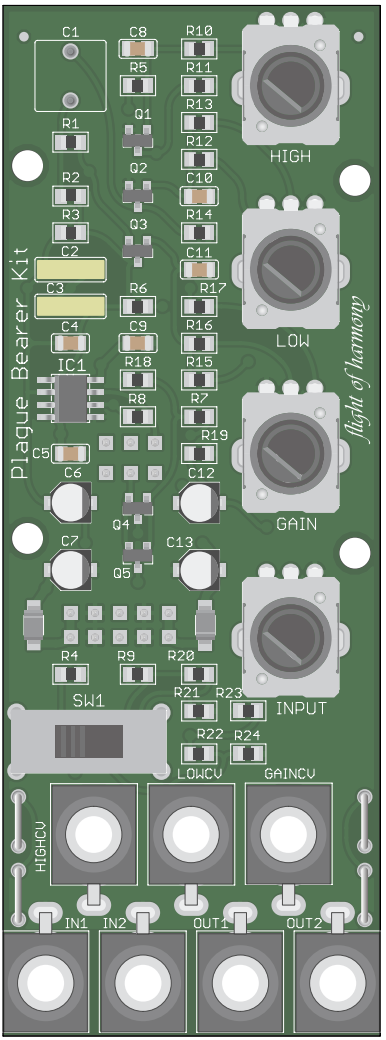


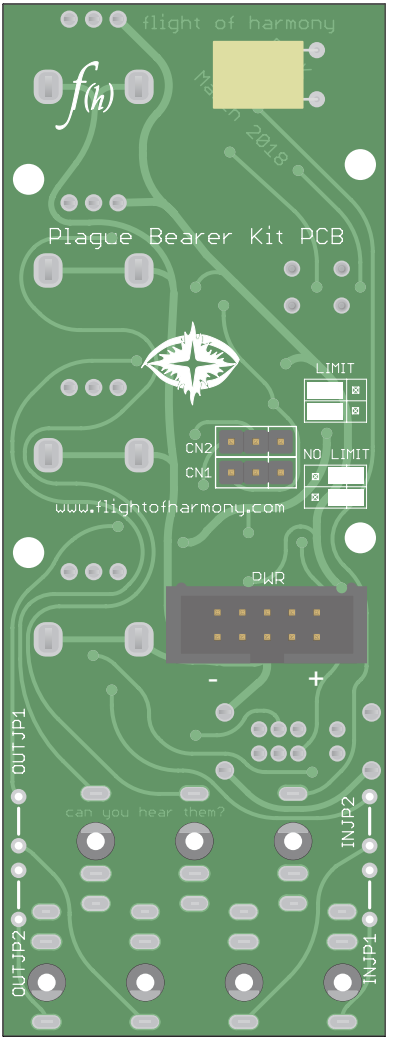
1) Nothing plugged into "Input"
2) Turn "High" all the way down.
3) Turn "Gain" all the way up.
4) Turn "Low" all they way up.
5) Slowly turn up "High"

As you can see in the image to the left, the usable range tends to be between 8:00 and 10:00. It will start out as a low moaning, then go up in pitch. The best way to get fine control over the pitch is by CV control - in the High to start, but the others will affect it as well. Once you've figured out how to start the oscillation, experiment. There are many variations and ways to obtain them. The high, low, and gain all interact, so there's a lot of possible combinations.

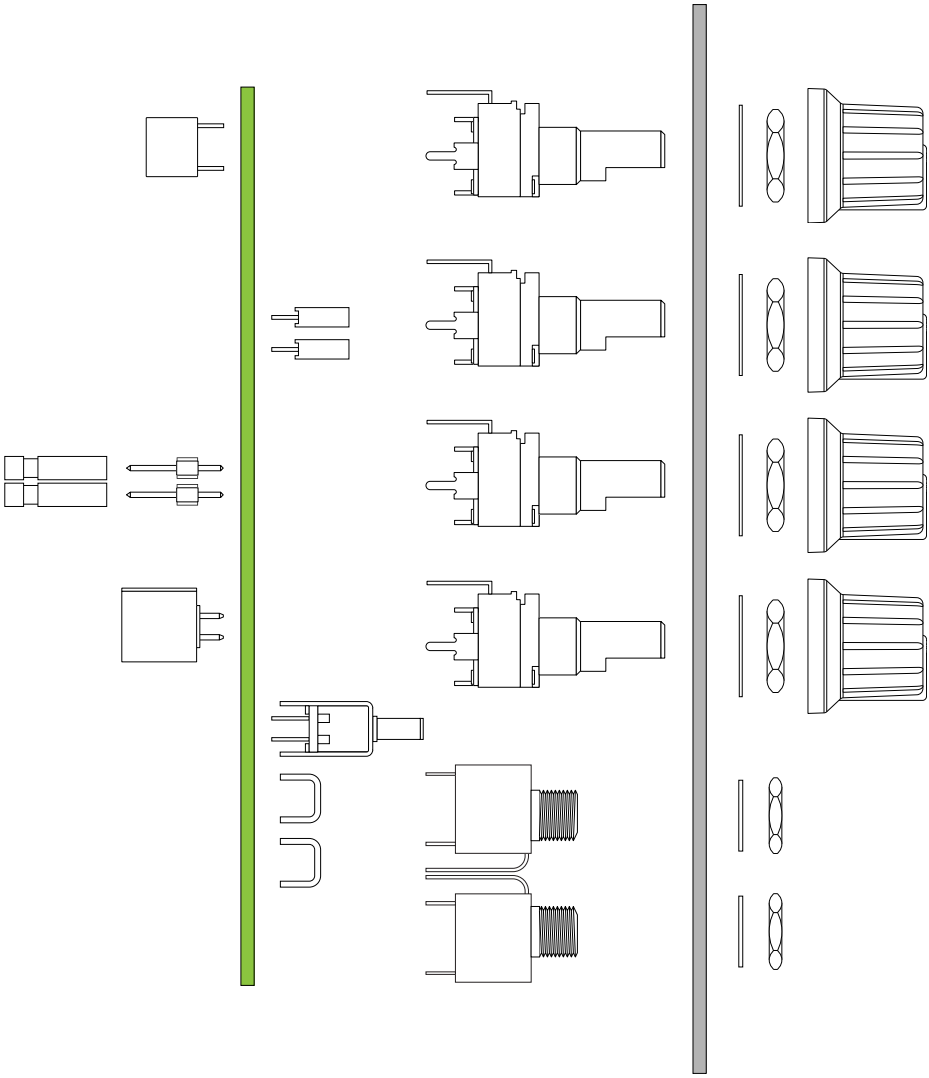
Don't even ask me about volts/octave, that's not the point of this thing. It's a filter, the self-osc is just an added bonus.

PCB Assembled View

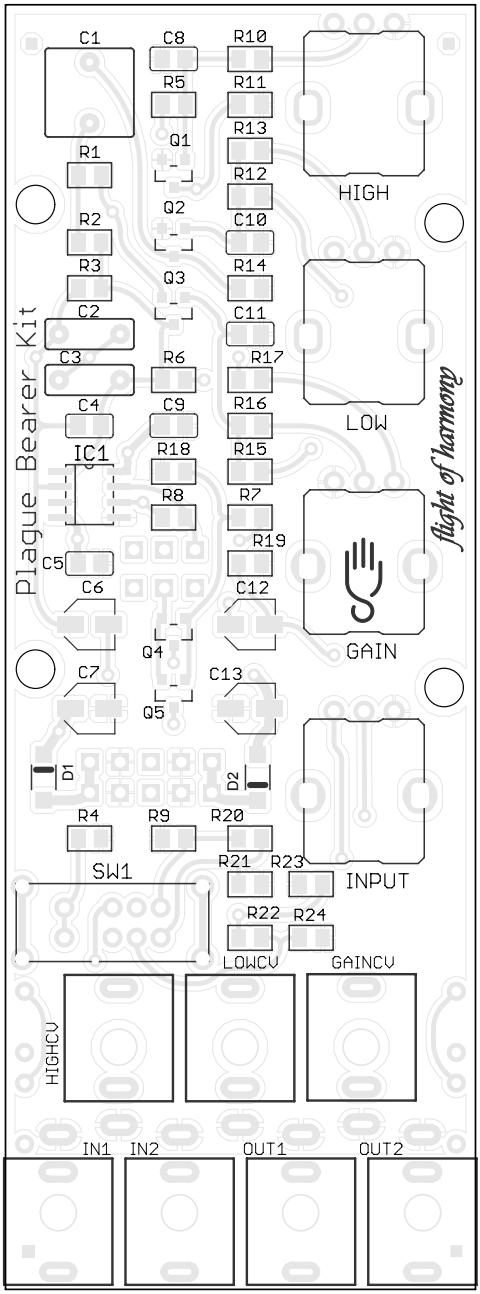




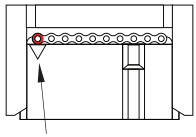
Exploded view



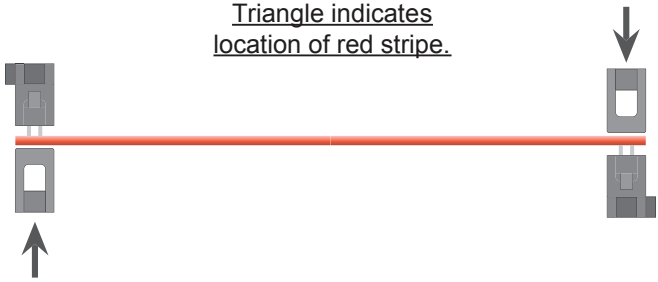
SMD Reference



Power Cable Assembly

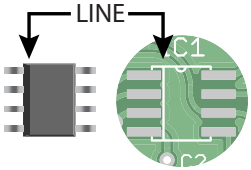


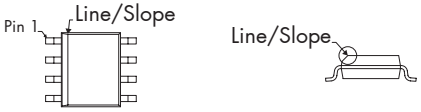
Triangle indicates
location of red stripe.



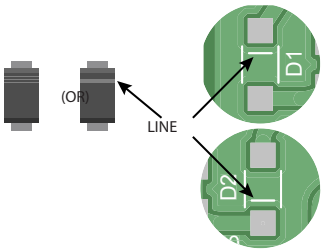
Miscellaneous

IC1 Orientation





D1 & D2 Orientation



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Can you hear them?