Q107/Q107A State Variable Filter

Apr 28, 2017

The Q107 is dual-wide, full-featured State Variable filter. The Q107A is a single-wide version without the Notch output and input mixer attenuator. These two models share the same circuit and this document applies to both.

The Q107 Filter changes the harmonic content of signals to create new, interesting sounds. This removal of harmonics is the basis of subtractive synthesis. Both the cutoff frequency and the resonance (Q) of the filter can be controlled manually and/or controlled by another signal such as an envelope generator, oscillator, keyboard, etc. Control signals can be attenuated and inverted. Low Pass, Band Pass, Notch (Band Reject), and High Pass responses are provided simultaneously.

Specifications

Panel Size: Dual width 4.25"w x 8.75"h.
Low Pass, High Pass Slope: -12dB/Oct.
Band Pass, Notch Slope: -6db/Oct.
Cutoff Frequency: 1/V per Octave and adjustable.
Resonance (Q): 1 to self-oscillation.
Frequency Range: 20hz to 20khz.
Power: +15V@20ma, -15V@20ma.
Waveform Levels: 10V PP.

Controls and Connectors

Frequency Control
Sets the filter's cutoff frequency. This manual control's position is mixed with the signals at the frequency control connectors.

Frequency Level Control
Attenuates and/or inverts the cutoff frequency voltage control input.

Frequency Connector
Allows voltage control of the cutoff frequency. This input can be inverted and/or attenuated using the Frequency Level Control.

1V/Octave Frequency Connector
Allows voltage control of the cutoff frequency at a fixed 1 volt/octave response. Normally used to track the keyboard.

Resonance Control
Sets the filter's resonance. This manual control's position is mixed with the signal at the resonance input connector.

Resonance Level Control
Attenuates and/or inverts the resonance voltage control input.

Resonance Connector
Allows voltage control of the resonance. This input can be inverted and/or attenuated using the Resonance Level Control.

Signal Input Connectors
Apply the signal(s) to be filtered here. One connector's signal can be attenuated and/or inverted.

Output Connectors
Simultaneously provides all filter responses.

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1V/Octave Frequency CV for keyboard tracking →

Frequency CV with invertable attenuator →

Resonance (Q) CV with invertable attenuator →

Input Signal Mixer 1-fixed, 1-variable →

← Manual Cutoff Frequency Control

← Manual Resonance (Q) Control

← Filter Outputs All available simultaneously

Q107A State Variable Filter

Manual
Cutoff Frequency
Control

1V/Octave
Frequency CV for
keyboard tracking

Frequency CV
with invertable
attenuator

Manual
Resonance (Q)
Control

Resonance (Q)
CV with
invertable attenuator

Input Signal
Mixer

Filter Outputs
All available
simultaneously

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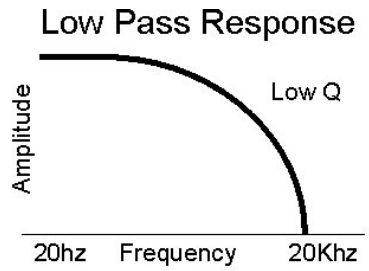
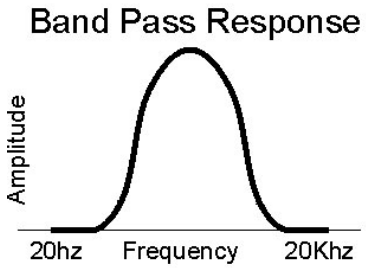
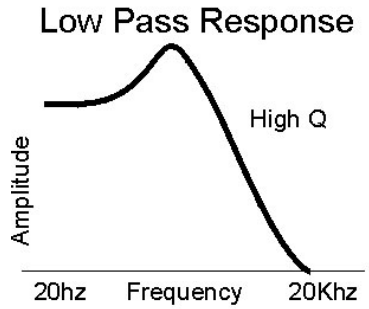
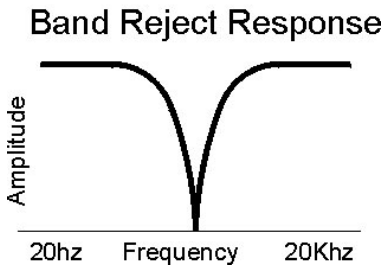
Responses

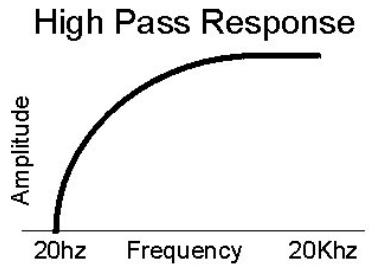
The following plots show the frequency response for each mode.











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Usage and Patch Tips

Basics
Most waveforms contain many different frequencies. When an oscillator produces a sawtooth waveform, it can be thought of as a single sine wave, and additional sine waves which are at multiples of the fundamental frequency and are at lower amplitudes. These additional frequencies are called harmonics and different waveforms have different amounts. The Q107 Filter changes the way a waveform sounds by attenuating (lowering the amplitude) of these harmonics. This effect is especially useful when changing over time. The frequency at which attenuation starts (or close enough) is called the cutoff frequency. Cutoff frequency can be controlled manually or by voltage control. Resonance (also known as Q, Regeneration, or Emphasis) has the affect of bringing out frequencies near the cutoff frequency.

Frequency Control
The frequency control gives you about 10 octaves of cutoff frequency response. The control inputs will be added to the manual control's value to create the cutoff frequency. All of these signals to work together at the same time to set the filter's cutoff frequency.

It's very common to have your filter track the keyboard so that the response is the same over all frequencies. This is accomplished by using the 1V/Octave frequency control input. Simply patch your keyboard pitch voltage into a multiple then out to your oscillators and to the filter.

The other frequency control input normally comes from an Envelope Generator or from an Oscillator. You can attenuate or invert the incoming control signal right on the filter instead of having to use another module. Since the Q109 Envelope Generator's outputs are 0 to +5 volts, you will get a total of 5 octaves of range. To increase this range, use a Signal Processor to amplify the signal by 200% to get a full 10 octaves of response.

The Sequential Controller can also be used to control the filter frequency. You could use one bank to control an oscillator and another to control the filter at the same time.

Resonance Control
Resonance is the emphasis of frequencies near the cutoff frequency and has a great affect on the sound. The range of the resonance control and inputs is very large. The manual control and the input signal are combined to create the resonance amount. If you have too much resonance the filter will scream and clip. We let you decide if this is good or not. If you don't like it, turn the resonance down. You can increase the resonance possible by turning down the input signal level control so that there is more room for resonance without clipping. A jumper provided on the PCB that causes the clipping to be soft.

Signal Inputs
There are 2 signal inputs which are mixed together - one is full strength and the other is adjustable. Normally you will use the adjustable input since turning the signal level down will allow higher resonance. You can also attenuate the full strength input by patching the signal through a Signal Processor first.

Outputs
There are 4 different outputs on the filter, each with it's own affect on the input signal's harmonics. Since harmonics are higher than the fundamental frequency, it's common to use a low pass filter to remove them. Most filter sweeps used are low pass responses. Other responses are made available for your experimentation.

When using the notch response, use a low resonance or the notch will be so narrow that you can't hear the effect.

A sine wave has no harmonics and will only respond to the filter by lowering its amplitude. Sawtooth and Ramp waveforms have the most harmonics and respond quite nicely to filtering. Square and Pulse waveforms also have a great deal of harmonics and respond well to filtering.

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Calibration

1. Set the Frequency to 5, set Resonance to 0, clipping jumper ON, and set the signal level to 0.
2. Use a voltmeter connected to the lowpass output and adjust the offset trim pot to achieve 0 volts.
3: Set Resonance to 10 and view the lowpass output with an oscilloscope and frequency counter.
4: Connect a voltage calibrator to the 1V/Oct jack.
5: Set the voltage to 0.000V.
6. Set the frequency knob to achieve 1Khz.
7. Set the voltage to 1.000V.
8. Adjust the tracking trim pot to achieve 2Khz.
9. If the filter will not oscillate, try higher frequencies.

Power Connector

6 pin .1" MTA type connector made by AMP. Available from Mouser Electronics or Digi-Key. Modules have a male PCB mount connector and cable harnesses have a female.

Part Numbers:
Female cable mount: #6404416
Male PCB mount: #6404566

Pinout:
1 = +15v
2 = key (pin removed)
3 = +5v
4 = gnd
5 = -15v

Not all voltages are used on all modules.

PC Board Layout