Q150/Q150A Transistor Ladder Filter

Based on Bob Moog's famous design, the Q150 Transistor Ladder Filter changes the harmonic content of signals to create new, interesting sounds which is the basis of subtractive synthesis. The cutoff frequency can be controlled manually and/or controlled by another signal such as an envelope generator, oscillator, keyboard, etc. Frequency control signals can be attenuated and inverted. Resonance (Q) of the filter is adjusted with a panel control. Both -12dB and -24dB slopes are available.

In most ladder filters the output signal is greatly reduced as the resonance is increased. This usually requires resetting input levels (sometimes many) when changing resonance settings - quite annoying. Special circuitry in the Q150 keeps the output signal level at various resonance settings while keeping the harmonic content unchanged. This option can be disabled with a jumper if desired.

The Q150A is a single-wide version with only one attenuated input and one frequency voltage control. The frequency voltage control can be changed from reversable to attenuated by moving the pot and jack connectors on the pcb.

Specifications

Q150 Panel Size: Dual width 4.25"w x 8.75"h.
Q150A Panel Size: Single width, 2.125”w x 8.75”h
Low Pass Slope: -12dB/Oct or -24dB/Octave.
Cutoff Frequency: 1/V per Octave and adjustable.
Resonance (Q): 1 to self-oscillation.
Frequency Range: 20hz to 20khz.
Power: +15V@30ma, -15V@30ma.
Waveform Levels: 10V PP.

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Filter cutoff frequency manual adjustment →

Manual resonance (Q) control ←

Filter cuttoff frequency voltage controls. One is reversable, one attenuated, one is 1V/Oct to track keyboard. →

Signal input mixer with manual attenuation →

Slope Control -24dB is the classic Moog sound. →

← Filtered signal output

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Filter cutoff frequency manual adjustment

Filter cutoff frequency voltage controls. reversable is preselected, Attenuated can be set on pcb, Use 1V/Oct to track keyboard.

Manual resonance (Q) control

Signal input mixer with manual attenuation

Slope Control -24dB is the classic Moog sound.

Filtered signal output

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Controls and Connectors

Manual Frequency and Resonance Control Section

Frequency Control
Manually controls the filter's cutoff frequency.

Resonance Control
Manually control of the filter's resonance.

Frequency Control Section

Frequency Level Controls
Allows adjustment of the cutoff frequency control input.
One control provides inversion.

Frequency Control Input
Voltage control of the filter's cutoff frequency.

1 Volt/Octave Frequency Control Input
Voltage control of the filter's cutoff frequency at a fixed 1V/Octave.
Normally used to track the keyboard.

Signal Input Section

Signal Input
Signal to be filtered.

Signal Input Level Control
Allows attenuation of the input signal.

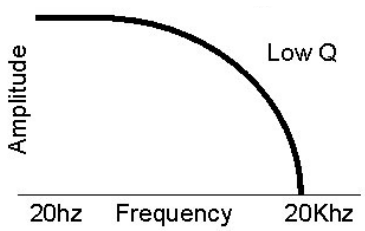
Output Section

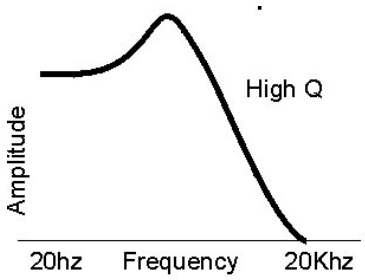
Slope
Allows selection of -12dB or -24db slope.

Low Pass Output
Filtered output signal where high frequencies are attenuated.

Response

The following plots show the frequency response.





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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 Q150 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 enhancing frequencies near the cutoff frequency.

Frequency Control
The frequency control gives you about 10 octaves of cutoff frequency response. The control inputs are added to the manual control's value to create the final cutoff frequency. All of these signals 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 inputs normally come from an Envelope Generator or from an Oscillator. You can attenuate, amplify or invert the incoming control signal right on the filter instead of having to use another module. The 0 to +5 volt outputs of the Q109 Envelope Generator will give you a total of 10 octaves of range when the attenuator is full on.

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 is very large. If you have too much resonance the filter might oscillate and clip. We let you decide if this is good or not. You can increase the maximum resonance possible by turning down the input signal level control so that there is more room for resonance without clipping.

Self-Oscillation
Turning the resonance to maximum without an input signal will cause the filter to self-oscillate. This allows the filter to act like an oscillator creating a very pure sine wave. Oscillation works best in –24dB mode.

Signal Inputs
There are 2 signal inputs which are mixed together - both are adjustable. Normally you will adjust the input levels to 50% or less to allow larger resonance peaks.

Outputs
The output is available at the bottom of the module. A switch allows selection of -12dB or -24dB slopes. Traditionally ladder filters have had -24dB slopes but we are also offering the -12dB slope to give you even more sound possibilities.

A sine wave has almost 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

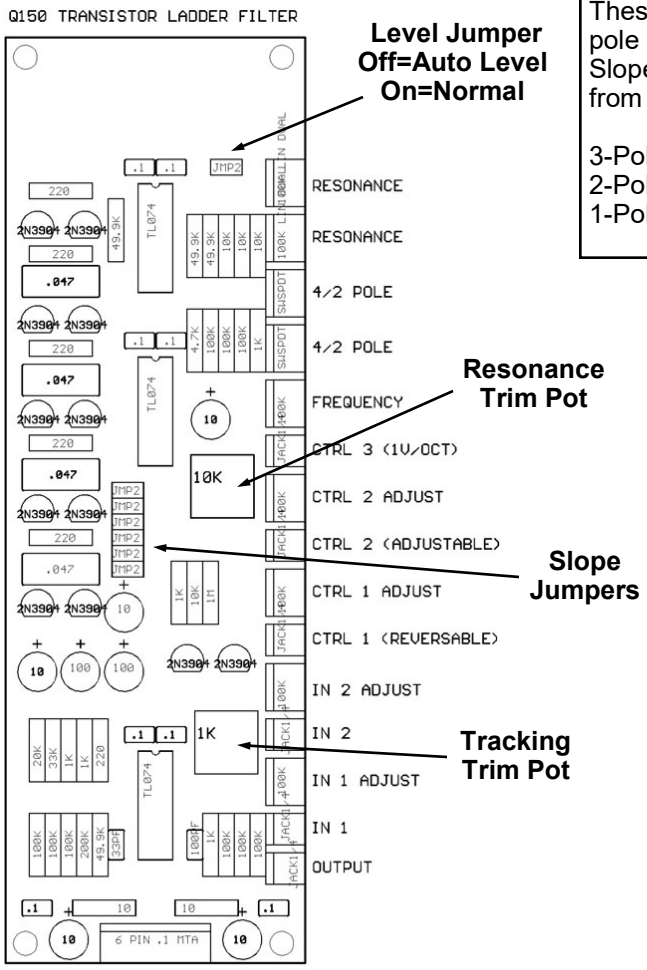
Calibration is accomplished with two trim pots. The Tracking trim pot is the one closest to the power connector. The Resonance trim pot is near the center of the board.

* Setup
  Turn resonance to 10, Slope: -24dB.
  Set Tracking trim pot to center, set Resonance trim pot to full CCW
  Connect an oscilloscope & frequency counter to the output

* Set Resonance trim pot
  Turn frequency knob to achieve 80hz, should be around 3.
  Set the Resonance trim pot to get 10v PP signal

* Set Tracking trim pot
  Turn frequency knob to achieve 500hz, should be around 5.
  Attach a precision voltage calibrator to the 1V/Oct jack and set to 1.000v
  Turn tracking trim pot to achieve 1000hz
  Go back and forth between 0v and 1v to get 500hz, 1000hz
  Check the 2v setting for 2000hz. Should be within 10hz

PC Board Layout



Slope Jumpers

These jumpers allow you to select a 1-pole, 2-pole (default), or 3-pole filter response when the Slope switch is in the –12dB position. Numbered from top to bottom #1 – #6.

3-Pole: Jumpers #1 and #4
2-Pole: Jumpers #2 and #5 (Factory Default)
1-Pole: Jumpers #3 and #6

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.

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