Automotive Engine Noise Sensor

Devin Ott
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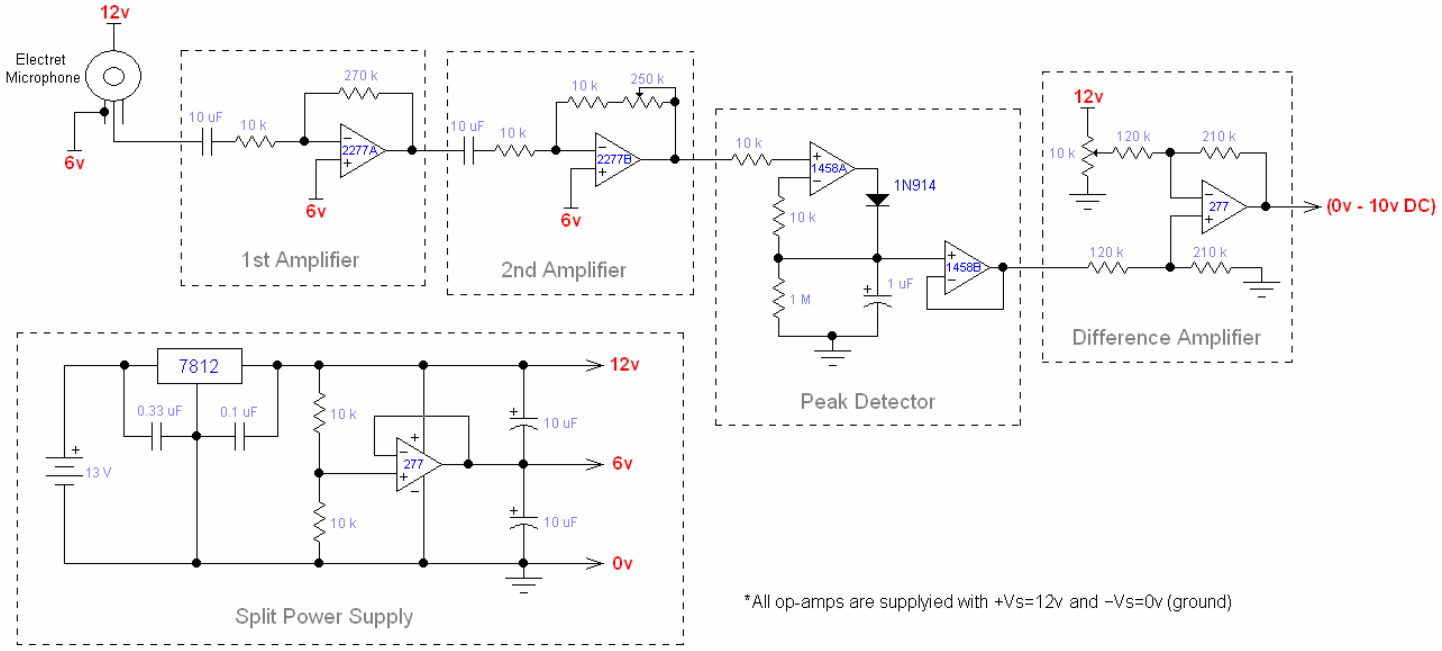
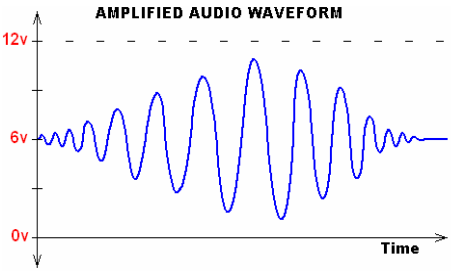
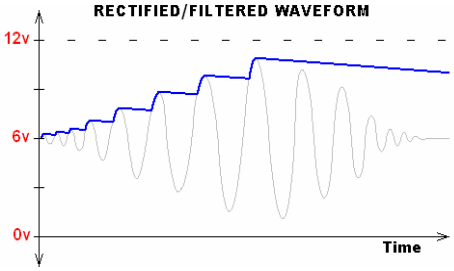
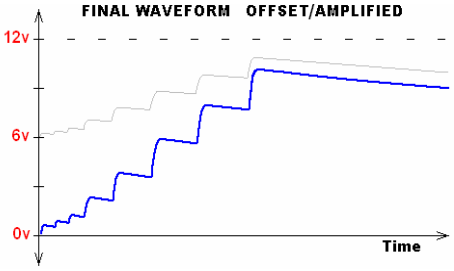


This circuit uses an electret microphone to convert the audio engine noise to an electrical AC signal that fluctuates above/below 6 volts. This signal is sent through two amplifier stages built around the OPA2277 dual op-amp, providing an adjustable voltage gain from 27 to 675. The series RC inputs of these amplifiers create a low cut-off frequency of 1.6 Hz, allowing them to block DC while amplifying audio frequencies. The 2nd stage can be adjusted to output a maximum 6 volt amplitude when the engine is loudest, creating a 0 to 6 volt AC amplitude that changes proportionally with the engine noise.

The AC signal is then rectified and filtered by the peak detector which smoothes out the positive peaks and represents the signal as it's 6 to 12 volt DC equivalent. In reality, the peak detector's 1458 dual op-amp is not equipped with rail-to-rail outputs, so the real output voltage range is from 6 volts to about 11.7 volts DC.







This voltage range is then sent to a difference amplifier (OPA277 single op-amp) that subtracts about 6 volts from it, and amplifies the result by a 1.75 voltage gain. The subtracted voltage reference is programmed by a 10k pot, allowing one to account for the minimum engine noise level.

When the engine is off (no noise) the output of the peak detector is 6 volts. However, when the engine is running in the idle position (minimum noise) the peak detector is outputting 6.5 volts. By adjusting the subtracted voltage to 6.5 (instead of 6), the difference amplifier would output zero volts when the engine noise was minimum (no throttle), and about 10 volts DC when the noise was maximum (full throttle).

The entire circuit is powered by the car battery voltage, which is immediately filtered and stabilized by the 12 volt regulator. The AC amplifier stages of this circuit require a dual polarity supply, so an OPA277 single op-amp has been configured to regulate its output at ½ the supply voltage (6 volts DC). This voltage acts as a ground reference, while the 12 volt and 0 volt potentials of the regulator are supplying ±6 volts relative to that reference. So the AC signals are fluctuating above and below 6 volts DC, relative to the ground potential of the car battery.

Here is the Prototype: