Electronic Design & Research Inc.
http://www.vsholding.com

Universal Power Line Notch Reject Filters

Model EDR-82534
Model EDR-82534A Application. Note **1234**

New product for biomedical signal processing applications
AC line filter ----- EDR-82534

- Filter automatically synchronizes to any frequency in between 47 Hz to 70 Hz.
- Attenuates the fundamental line interference and its harmonics through the frequency range DC to 500 Hz.
- Optical coupled interfacing to the reference frequency.
- Small size ---- only 2" x 4"
- Dynamic Range ---- 10000
- Notch Width ---- 0.3 Hz
- Notch Q ---- 200 at power line (reference) frequency

The EDR-82534 is a low cost, multinotch (comb) reject filter for low frequency signal applications. A Power interference or bandstop filter is an important and needed sub-component to design and build medical recording systems where minute bioelectric signals, approximately millivolts to microvolts are measured. In the operation room, the cath lab, or in research facilities there is always present a substantial level of electrical interference produced by local power lines. EDR's filter is not just a notch filter. It is significant advance in analog/digital filtering technology.

The EDR-82345 is more than just a notch filter. It represents a significant improvement on other methods of signal filtering.

- The Filter allows a “clean” bandwidth of bioelectric signals right up through the frequency range used in His bundle measurement. In addition to the fundamental frequency of 50 or 60 Hz, all the upper harmonics including the troublesome 100 or 120 Hz second harmonic are filtered out.
- All useful bioelectric information is permitted to pass unaltered. The 82534 does not filter out every 50 or 60 Hz signal, but waits to be sure that a signal is constant before filtering it. A one-time occurrence such as a 60 Hz H-wave is not filtered out.
- If there is no ac interference, the Filter does not affect the signal. There is no unnecessary alteration of the output waveform, as only the noise is filtered out. (By contrast, a normal notch filter is always “on”.)

In a biomedical establishment, substantial electrical interference is often induced on a subject by local power lines. Most of the power line noise can be reduced to acceptable levels by common mode rejection circuits if a differential configuration of input amplifier is appropriate and can be applied. Some common mode rejection cannot always be removed because the applied noise is unbalanced. In addition, noise can be picked up from other equipment located near the source of a signal, or from interference caused by the location or positioning of the equipment installed. The situation is hopeless when a single-ended input must be used and only a notch filter is the solution. Analog-based notch filters can be built and applied to remove AC interference but the usefulness of it limited to just a handful of applications. Analog filters are unstable in time due to the deterioration of components in the circuitry. An analog type comb-filter (multi-notch) is very

expensive to build and maintain. A filter with a notch of Q: 200 and notch depth greater than 40 dB is almost impossible to build for a practical application. The EDR-82345 overcomes all typical problems of an analog only based filter.

Theory of Operation

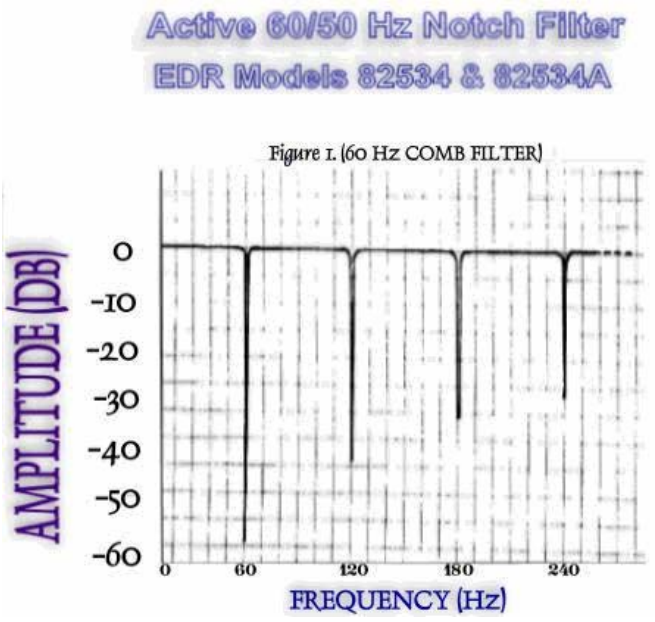
The principle behind the EDR80234 filter is to reduce line interference using multiplexed sampling of "hum" with a series of capacitors charging to the hum level, and subtracting that level from the overall signal. The main circuitry includes:

1. A multiplexer that commutates the signal across 64 storage capacitors in a cycle synchronized to the reference frequency.
2. Input for a reference signal is optical-coupled and any five Volt AC signal can be used.
3. A phase-locked loop oscillator and counter that provide line synchronization.
4. A post filters to remove residual high frequency components (greater than 500Hz) from the commutated signal.

During each cycle of the hum, the storage capacitors are charged to a portion of the difference between the charge voltage built up during previous cycles and the hum voltage present at the Input. After a number of cycles, the capacitors are charged up to various voltages. Each capacitor now holds the average value of the hum voltage occurring during the interval of the hum cycle when the capacitor is connected into the circuit. Since an input signal not in timing relationship with a reference signal, build up little or no average charge on the storage capacitors, single events – even those with frequency components equal to the reference frequency 50/60 Hz – pass to the output virtually unaffected.

Because the polarity of the voltages across the respective capacitors opposes the hum voltage in the signal, the portion of the hum voltage appearing at the output is the hum voltage minus the previously "stored" capacitor voltages. The remaining interference consists of high frequency signal components. In the 64-capacitor circuit used by the Filter, the fundamental frequency of this interference is approximately 5000 Hz. A 500 Hz low-pass filter easily reduces the noise to a negligible amount without affecting the desired signal, such as an ECG waveform.

Specifications for EDR-82534 and EDR-82534A



A typical frequency response characteristic of the notch filter shown in Figure 1. A very narrow band-stop of only 300 mHz allows removing the unwanted frequency with all its highest harmonics with surgical precision.

Electrical specification applied for both models or otherwise indicated

Analog

Input signal (bipolar)	maximum 6 V p-p
Input Impedance	100 K

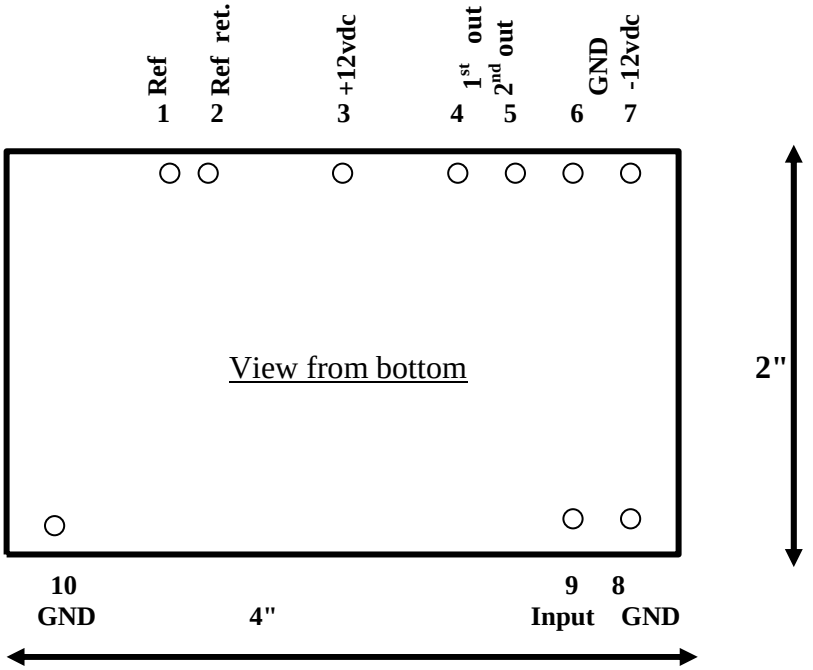
Reference input

AC signal (voltage)	Reverse Voltage 5VAC	
AC signal (current)	minimum	1mA
	Maximum	50mA

Reference input comprised of an optical-couple device (TLP127 by Toshiba) and 1.0 K resistor installed between terminal 1 and LED of the photocoupler.

Output Impedance		1 Ohm
Gain		Unity
Frequency Range		DC - 300 Hz (EDR-82543) and DC-1200 Hz (EDR-82543A)
Notch Width		0.3 Hz
Notch Q		200 at 60 Hz
Notch Depth	EDR-82543	36 dB at 60 Hz
	EDR-82543A	60 dB at 60 Hz
Number of notches		multiple to a reference frequency in all frequency bands
Power	maximum	+/- 15 VDC
	Typical	+/- 12 VDC
	Minimum	+/- 9 VDC

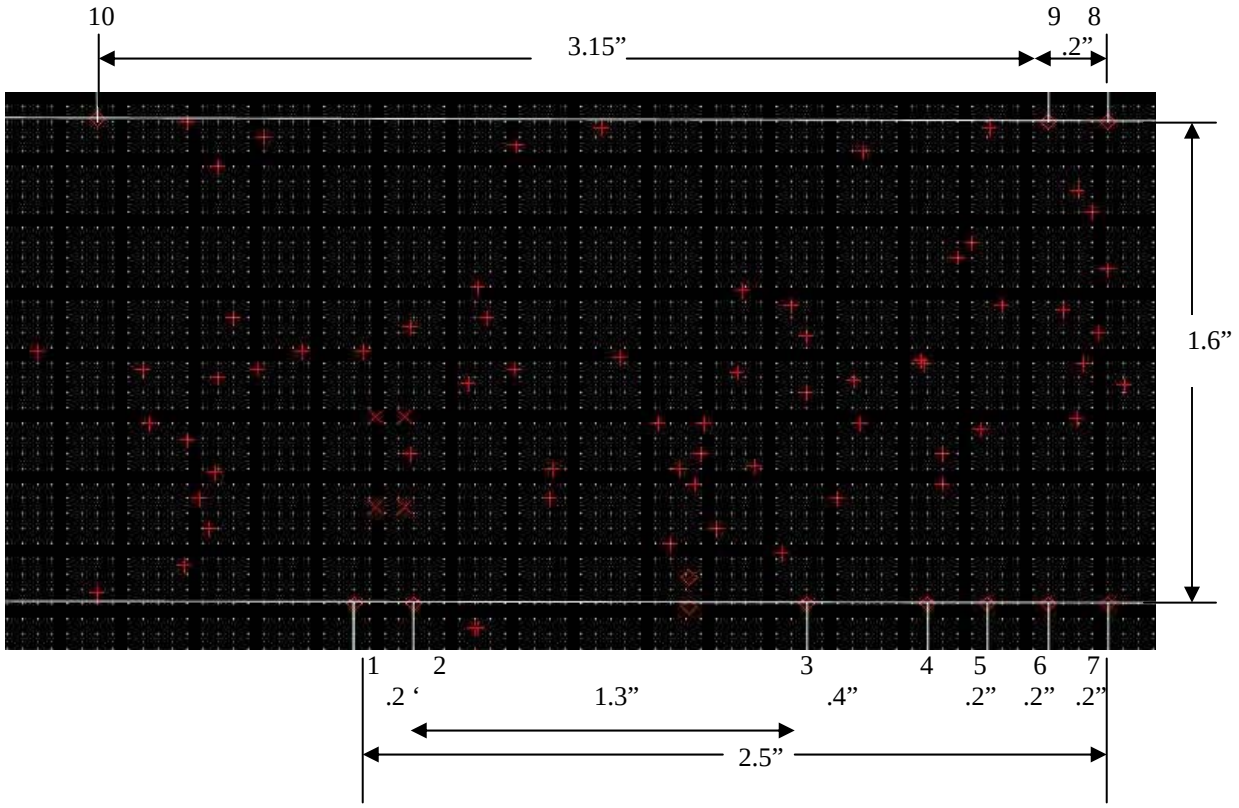
Dimensions



For more information, please contact: Electronic Design & Research Inc. Product Division
7331 Intermodal Dr. Louisville, KY 40258, Tel- 502-933-8660

Electronic Design & Research Inc.
We are at your service

7331 Intermodal Drive ** Louisville *** KY *** 40258
Tel: 502-933-8660 Fax: 502-933-3422 web-site: http://www.vsholding.com



Pins-out for EDR82534A

1	Reference signal 50/60 Hz, 10 VAC
2	Return reference
3	+ 15 VDC, 5 mA
4	non filtered or PLL output
5	DC – 1200 Hz bandwidth output
6	Power/output GND
7	– 15 VDC / 6 mA
8	Signal GND
9	Input Signal, 10 V p-p
10	CND