Rectifier tracks positive and negative peaks

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Signals ranging from music to complex control-system waveforms may contain unequal positive and negative peak amplitudes. An "envelope-follower" circuit can track unequal peaks, but the ability to select a desired peak can enhance the circuit's performance (**Reference 1**). The circuit in **Figure 1** applies a new twist to a classic absolute-value circuit. Applying an input signal to R_1 (full) produces an output equal to the input's absolute value. Applying an input signal to R_6 (positive) or R_7 (negative) produces outputs of positive or negative half-cycles, respectively. **Figure 2** illustrates all three modes of operation.

Understanding the circuit is simple if you consider that op amp IC_{1A} strives to maintain its inverting input at virtual ground. For example, applying −1V to the negative input, R_7, drives the anode of D_1 to −333 mV. IC_{1A}'s output, Pin 1, drives D_2's cathode positive enough to force D_2's anode voltage to 333 mV. Because IC_{1A}'s inputs now rest at 0V, D_1 is effectively reverse-biased and out of the circuit. The 333 mV available at D_2's cathode also applies to IC_{1B}'s noninverting input, Pin 5, and IC_{1B} must balance its input voltages by driving its output, Pin 7, to 1V. IC_{1B}'s inverting input, Pin 6, goes to 333 mV. The voltage drop across R_4 thus equals 666 mV. One-third of the input current flows through the series connection of R_2 and R_3, and two-thirds flows in R_4. To achieve unity gain, R_7's value equals that of R_2+R_3 in parallel with R_4.

Applying a positive input to R_7 causes IC_{1A}'s output to go negative by a voltage equal to one forward-diode drop and thus holds D_1's anode at ground. D_2 is reverse-biased, and both of IC_{1B}'s inputs rest at 0V. The circuit's output is thus 0V. Applying an input voltage at R_6 yields similar operation. A positive input causes an equal-value positive output, and a negative input produces a 0V output. You can ignore the effects of IC_{1B}'s high input impedance, which are negligible. To maintain unity gain, the value of R_6 is twice that of R_3.

Resistors R_1, R_2, R_3, R_4, and R_5 are of equal value and close tolerance. Note that IC_1's power-supply connections require bypass capacitors (not shown). To minimize errors, use a low-impedance source or buffer amplifier to drive the circuit. You can use a three-posi-

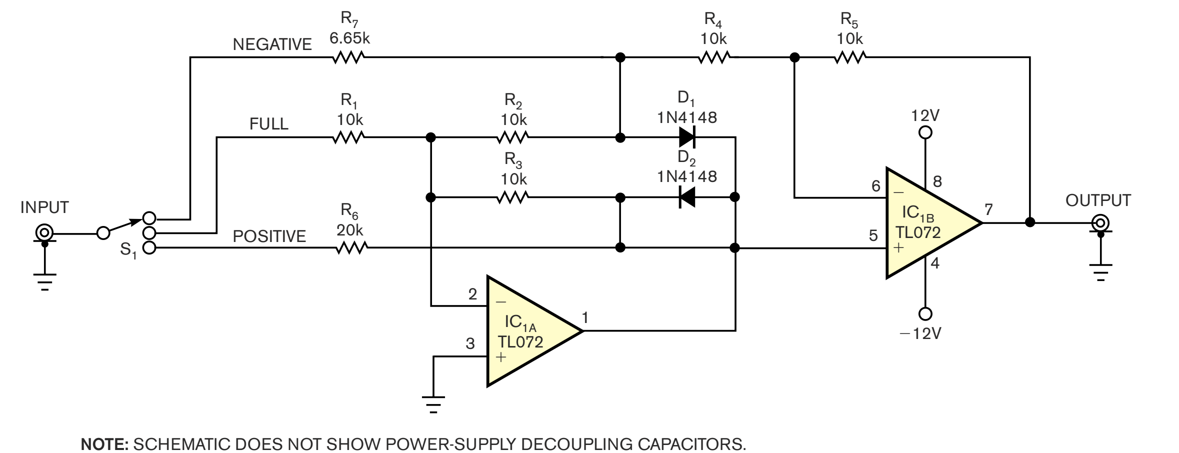

Figure 1 Use this versatile precision rectifier circuit to recover a signal's positive peaks, negative peaks, or both in full-wave mode.

tion rotary switch for input-mode selection, or an on/on/on toggle switch, such as C&K Components' 7211, available from Digi-Key Corp (www.digikey.com) and other sources, or a similar switch, wired as a three-way selector. (See the manufacturer's data sheet for a connection diagram.) You can also use separate connectors for the inputs, but connect no more than one input at a time. EDN

REFERENCE

1 Bissell, Harry, "Envelope follower combines fast response, low ripple," *EDN*, Dec 26, 2002, pg 59, www.edn.com/article/CA265499.

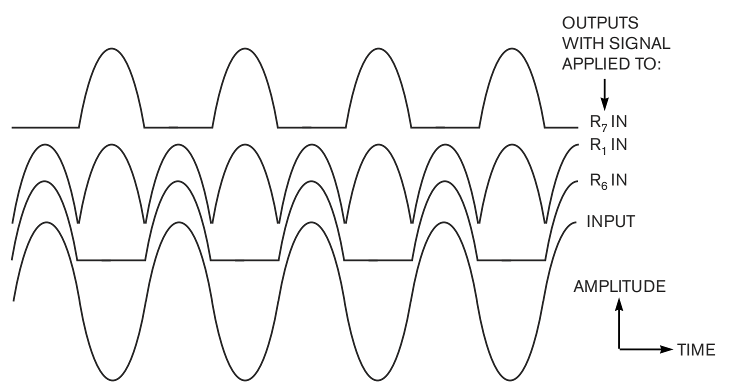

Figure 2 This waveform plot shows the circuit's outputs for a sine-wave input connected to the negative, full, and positive inputs, respectively. Traces are vertically offset for clarity.