Precision full-wave signal rectifier needs no diodes

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Rectifier circuits based on semiconductor diodes typically handle voltage levels that greatly exceed the diodes' forward-voltage drops, which generally don't affect the accuracy of the rectification process. However, the rectified signal's accuracy suffers when the diode's voltage drop exceeds the applied voltage. Precision rectifier circuits combine diodes and operational amplifiers to eliminate the effects of diode voltage drops and enable high-accuracy, small-signal rectification. By taking advantage of modern operational amplifiers that can handle rail-to-rail inputs and outputs, the circuit in **Figure 1** dispenses with diodes altogether, provides full-wave rectification, and operates from a single power supply.

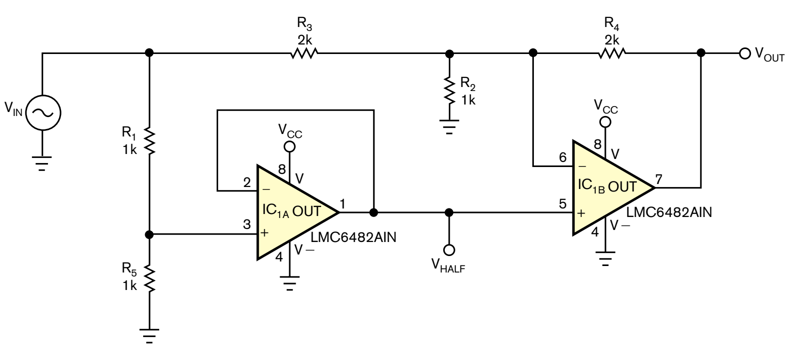

Figure 1 This precision full-wave-rectifier circuit uses two op amps and no diodes. When altering the basic design, note that resistors R_3 and R_4 are both twice the value of R_2 and that R_1 and R_5 are equal.

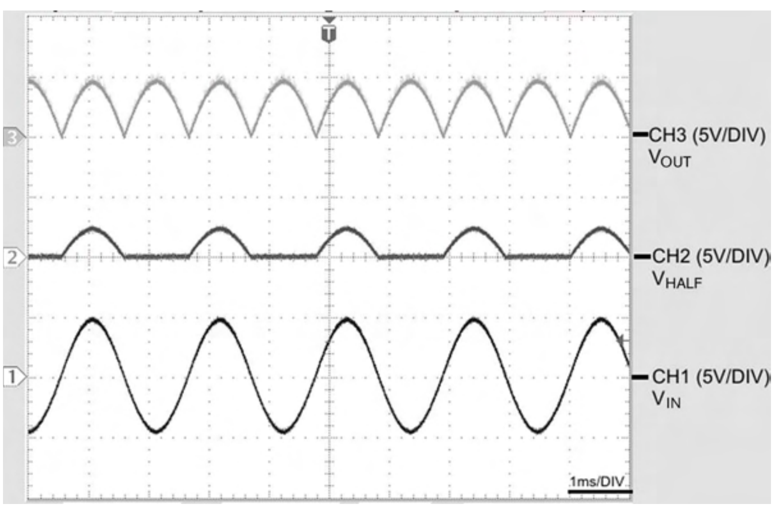

Figure 2 From bottom to top, the waveforms show V_{IN} (CH1), V_{HALF} (CH2), and V_{OUT} (CH3).

The circuit operates as follows: If $V_{IN}>0V$, then IC_{1A}'s output, V_{HALF}, equals $V_{IN}/2$, and IC_{1B} operates as a subtracter, delivering an output voltage, V_{OUT}, equals V_{IN}. In effect, the circuit operates as a unity-gain follower. If $V_{IN}<0V$, then $V_{HALF}=0V$, and the circuit behaves as a unity-gain inverter and delivers an output of $V_{OUT}=-V_{IN}$. **Figure 2** shows the circuit's input signal at V_{IN}; its intermediate voltage, V_{HALF}; and its output voltage, V_{OUT}.

The circuit uses a single National Semiconductor LMC6482 chip and operates in the linear regions of both operational amplifiers. Suggested applications include low-cost rectification for automatic gain control, signal demodulation, and process instrumentation. The circuit relies on only one device-dependent property: The amplifiers must not introduce phase inversion when the input voltage exceeds the negative power supply; the LMC6482 meets this requirement. EDN

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