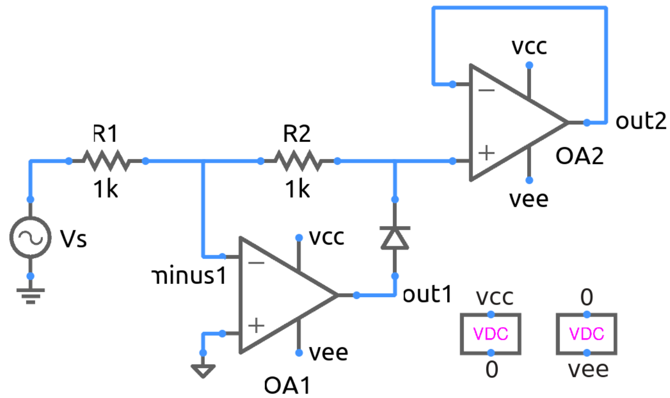
precision_full_wave_1.sqproj



A precision full wave rectifier circuit is shown in the figure. Of the two Op Amps, `OA2` operates as a buffer.

Consider first the case that the diode is conducting. The feedback loop is closed in this case, and the Op Amp (`OA1`) operates in the linear regime, making $V_- \approx 0\,\text{V}$. The diode current flows through R_2 and R_1, which means that V_s can only be negative. The circuit operates as an inverting amplifier, with $V_o = -\dfrac{R_2}{R_1} V_i$.

In the other case, i.e., $V_s > 0\,\text{V}$, the diode does not conduct, there is no current through R_1 and R_2 (since each of the Op Amps has a large input resistance, ideally infinite), and we have $V_o = V_s$. Note that the Op Amp (`OA1`) operates in the open-loop condition in this case, and with $V_+ = 0\,\text{V}$ and $V_- = V_s$, it enters saturation. Since $V_- = V_s > V_+ = 0\,\text{V}$, the Op Amp output voltage is $-V_{\text{sat}}$.

Putting the above cases together, with $R_1 = R_2$, we can conclude that the circuit works as a precision full wave rectifier.

Exercise Set

1. Run the simulation, plot $V_s(t)$ and $V_{\text{out2}}(t)$ (together), and verify that the circuit performs precision full wave rectification.

2. Plot $V_s(t)$ and $V_{\text{out1}}(t)$, the voltage at the output node of `OA1`, and verify that the Op Amp enters saturation when $V_s > 0\,\text{V}$ as we expect.

References

1. S. Franco, *Design with Operation Amplifiers and Analog Integrated Circuits,* McGraw-Hill, 1998.

2. A. S. Sedra, K. C. Smith, and A. N. Chandorkar, *Microelectronic Circuits: Theory and Applications*, Fifth edition, Oxford University Press, 2009.

3. J. Millman and A. Grabel, *Microelectronics,* McGraw-Hill, 1988.