Generate boost rails in a bridge-rectifier circuit

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Many single-voltage power supplies consist of a transformer, a rectifier, and a filter capacitor, as shown in **Figure 1**. This circuit is relatively inexpensive and easy to build but supplies only a single voltage. Circuits employing op amps, data converters, and other analog circuit blocks often require additional voltages to operate. These extra voltages can be either higher than the main supply voltage or negative. In such cases, additional transformer windings and rectifiers are added. This approach is practical if all supply voltages have similar power requirements, but analog bias voltages usually have relatively low power requirements that may not justify the

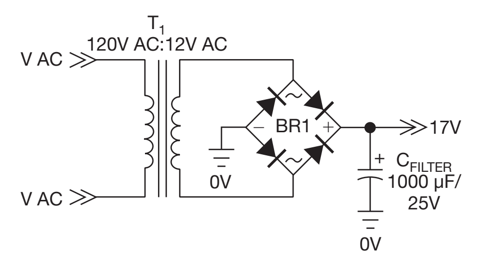

Figure 1 Many single-voltage power supplies comprise a transformer, rectifier, and filter capacitor.

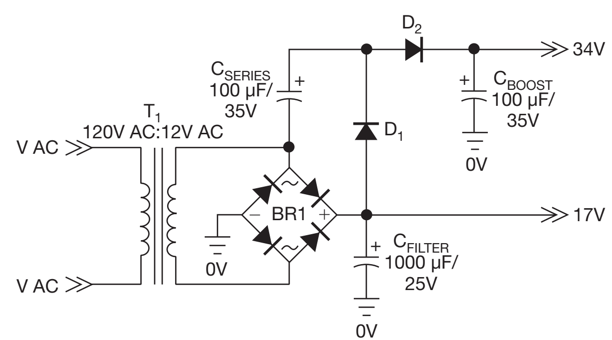

Figure 2 With some modification, a voltage doubler can be implemented.

overhead of additional transformer windings, rectifiers, and filters. Note that for voltages *lower* than the main supply voltage, a series voltage regulator or resistor divider generally is sufficient.

Because the bridge input and output do not share a common reference, standard negative peak detectors and voltage multiplier stages cannot be used. The bridge ac inputs, however, do have the ability to sink and source current with reference to the bridge-rectifier outputs. With some modification, a voltage doubler can be implemented (**Figure 2**).

Using the same structure and referencing it to the 0V rail can produce a negative bias. Note that positive and negative boost rails can operate at the same time. **Figure 3** shows a modified version of the circuit with both positive and negative boost voltages added.

A supply using a 12V transformer has been used as an example, but the technique can be used for other voltages, as well. Note that series and boost capacitors have a higher voltage rating than do filter capacitors. Filter capacitors see only the peak of the rectified ac waveform, while series and boost capacitors see about two times the peak value (less extra diode drops). Capacitance values of series and boost caps vary with output power, and there is no inherent need for series and boost capacitors to be the same value.

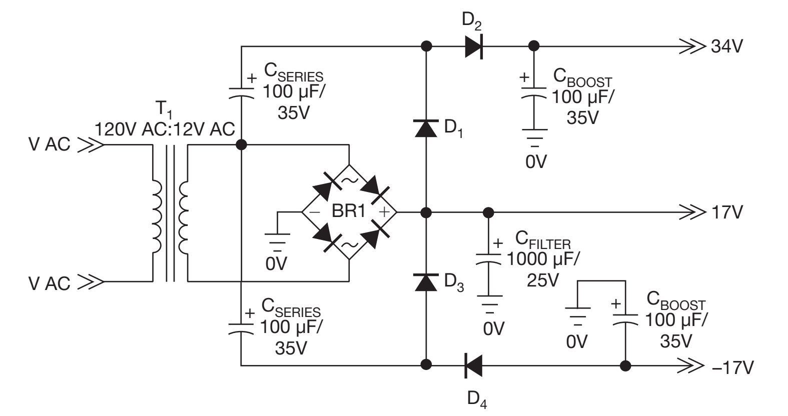

Figure 3 A modified version of the circuit has both positive and negative boost voltages added.

In theory, negative and boost rails are capable of power levels similar to those of the main supply voltage. Larger power losses are due mainly to the C_{SERIES} capacitor(s). Larger capacitors can be used to reduce losses, but they require an adequate ripple-current rating. If substantial power is required from boost voltage rails, you should still consider a separate transformer or additional windings. EDN