August 2010

Low-Cost Shunt Regulator Minimizes Standby Power For Always-On Applications

Designed for offline, always on applications such as utility meters and white goods, Supertex's SR10 is a capacitor-coupled, switched shunt regulator that minimizes standby power consumption. The SR10 provides a more-efficient alternative to simple capacitor-zener supplies, and a simpler, less-expensive alternative to nonisolated switching regulators.

Compared with the cap-zener approach, the SR10 exhibits much lower standby power (<20 mW for half-wave rectified versions) and has higher efficiency. Compared with switchers, the SR10 has a lower parts count, no magnetics, no high-voltage electrolytics, and is easier to design. The SR10's output can be internally programmed at 6 V, 12 V or 24 V, or can be externally adjusted with a feedback divider from 6 V to 28 V (Fig. 1.)

Output current can be scaled via a safety-rated, series coupling capacitor on the ac line. The SR10 also uses the safety-rated, high-voltage capacitor to meet voltage safety standards for the load. The SR10 solution also meets class B limits for conducted emissions. The regulator provides inherent short-circuit protection due to the reactance of the series coupling capacitor. In addition, the chip implements overcurrent protection (OCP), which shuts off the shunt during a line transient.

A switched-shunt regulator operates like a conventional linear shunt regulator, but instead of using a zener diode as the shunt element, a transistor is used (Fig. 2.) Using a transistor rather than a zener eliminates most of the power dissipated by the shunt, improving the regulator's efficiency—particularly at light loads.

The transistor is switched on and off to determine the amount of current that's shunted to ground versus the amount of current directed to the output. The output voltage is regulated by adjusting the duty cycle of the shunt. To avoid the power losses associated with hot switching, the shunt only turns on when the voltage across it is near zero. Assuming full-wave rectification, this occurs twice per 60-Hz cycle near the zero-crossings. Thus the maximum switching frequency is twice the line frequency or 120 Hz. Depending on load, the shunt may not switch every half cycle, so the switching frequency may be lower. (See application note AN-H65 for more details on SR10 operation.)

The SR10 is available in a RoHS-compliant, 8-lead SOIC package (Fig. 3.) Samples are available from stock. Pricing for the SR10LG-G is US $0.69 in 1000-piece quantities

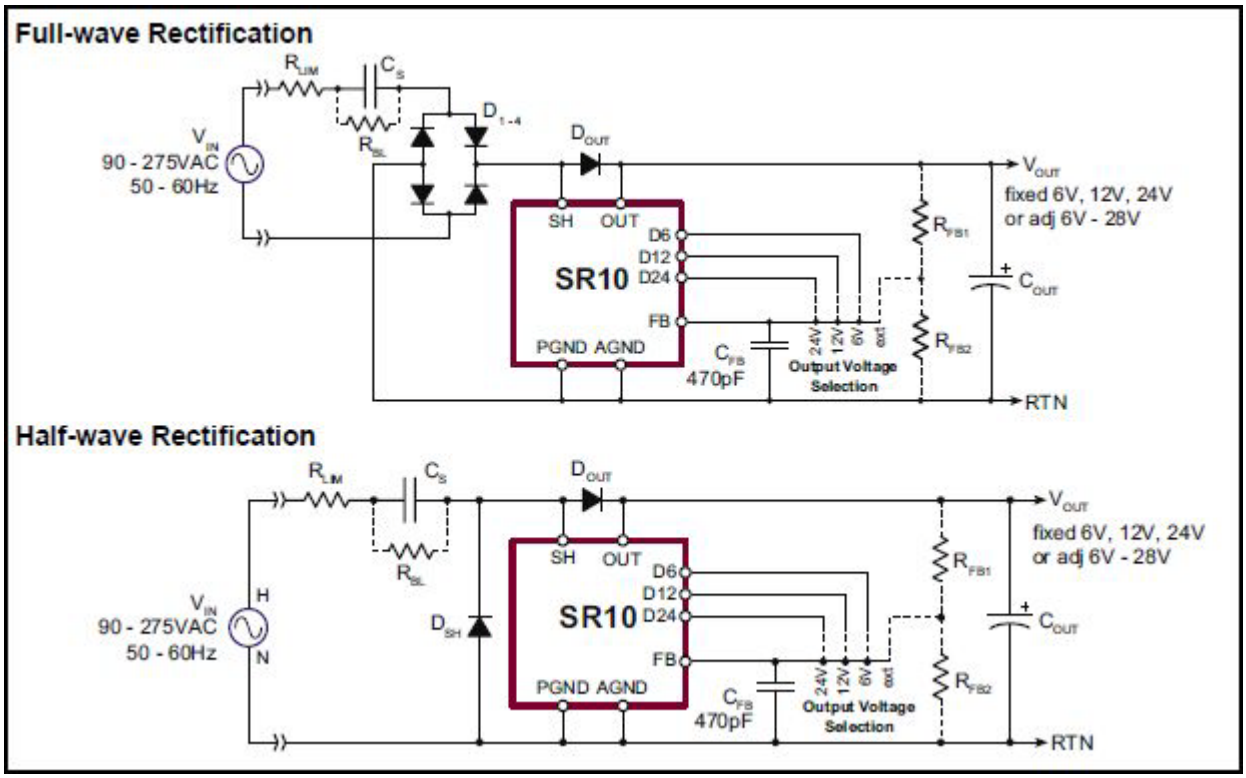

Fig. 1. For offline applications that require low standby power consumption, the SR10 capacitor-coupled, switched shunt regulator provides a more-efficient alternative to cap-zener supplies and a simpler, lower-cost solution than switching regulators.

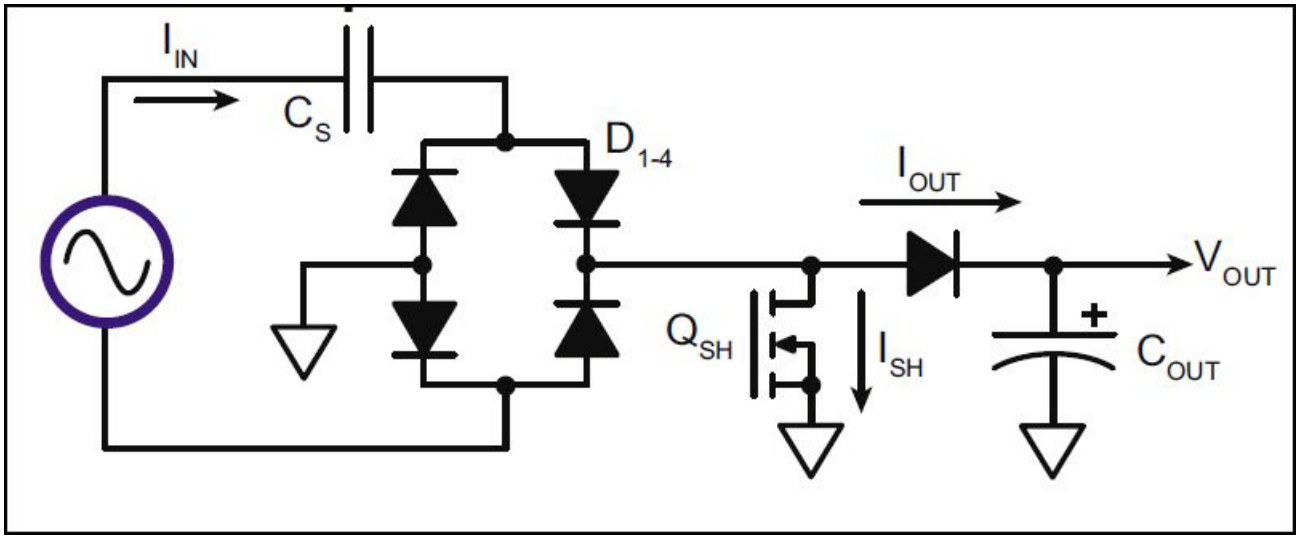

Fig. 2. A switched-shunt regulator employs a transistor as the shunt element rather than the zener diode used in a linear shunt regulator. Switching the shunt transistor on and off at a low frequency controls how much current is directed to the load, and regulates output voltage. The shunt only turns on when the voltage across it is near zero, which minimizes the shunt's power dissipation.

Fig. 3. The SR10 switched shunt regulator comes in a RoHS-compliant, 8-lead SOIC package.