Retriggerable monostable multivibrator quickly discharges power-supply capacitor

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Universal power supplies must work from mains power lines ranging from 90 to 264V ac at 50 or 60 Hz. Directly rectifying the input voltage charges the filter capacitor to 120 to 370V dc. Such voltages present a serious threat to personnel who are prototyping or repairing the power supply. It is desirable to discharge the filter capacitor when mains power is off so workers can safely deal with the power supply. An intuitive solution is to use an ac relay. However, relays cannot operate in a wide range of input voltages, they consume significant power and space, and they have a limited number of cycles. **Figure 1** shows an alternative circuit, which you can apply to a filter capacitor of almost any value. It uses a MOSFET, Q_1, and a current-limiting resistor, R_D, to discharge the high-voltage filter capacitor, C_P, within one second after you switch off the mains power. The trick is to use a retriggerable monostable multivibrator to control the MOSFET.

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While the mains power is on, optocoupler IC_1 and the associated passive components continue to generate symmetrical square pulses that they apply to the A input of multivibrator IC_2. Each pulse triggers the circuit, forcing the $\overline{Q}$ output to the low level. The multivibrator generates a 100-msec negative pulse; then, $\overline{Q}$ should turn high. However, because triggering pulses arrive before the multivibrator's pulse is complete, the $\overline{Q}$ output never turns high, the MOSFET is always off, and the rectifier works as usual. When you turn off mains power, the $\overline{Q}$ output stays low for 100 msec after the last triggering pulse;

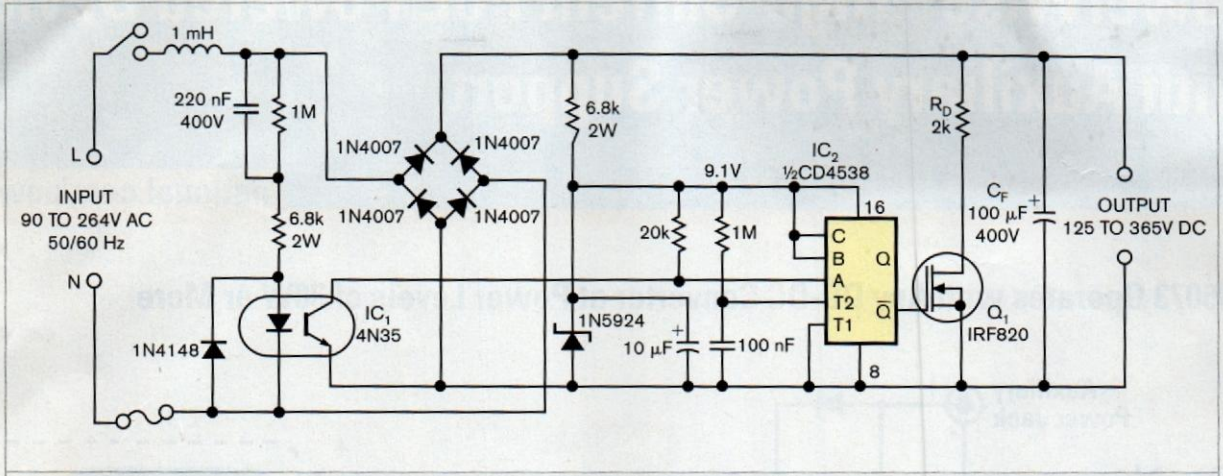

Figure 1 Because of the retriggerable feature of the CD4538 IC, the discharge network, Q_1 and R_D, remains off when mains power is present; otherwise, it turns on and quickly discharges high-voltage filter capacitor, C_F.

it then turns high. The MOSFET turns on and quickly discharges the output capacitor to a safe level.

The circuit underwent testing at both limits of the input voltage: 90 and 264V ac. The filter capacitor is of moderate value, 100 µF, and so is the peak-discharge current of 0.06 to 0.18A. The MOSFET's peak current is 8A; hence, the circuit can readily work with much larger-value capacitors. If this current is still not enough, you must use a MOSFET with a higher peak current rate. You need to change only R_D to fit the desired discharge time, t_D. The $t_D=3\times R_D\times C_F$ relationship is a good guideline. It ensures that the output voltage drops to 95% of its initial value, which is well below the user-touchable safety limit for any value of the output voltage. EDN