Power On Indicator

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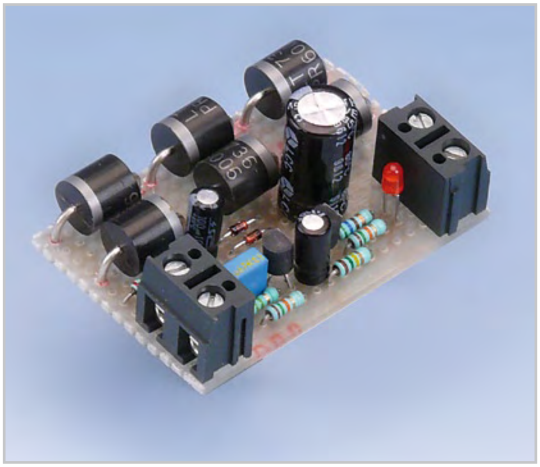
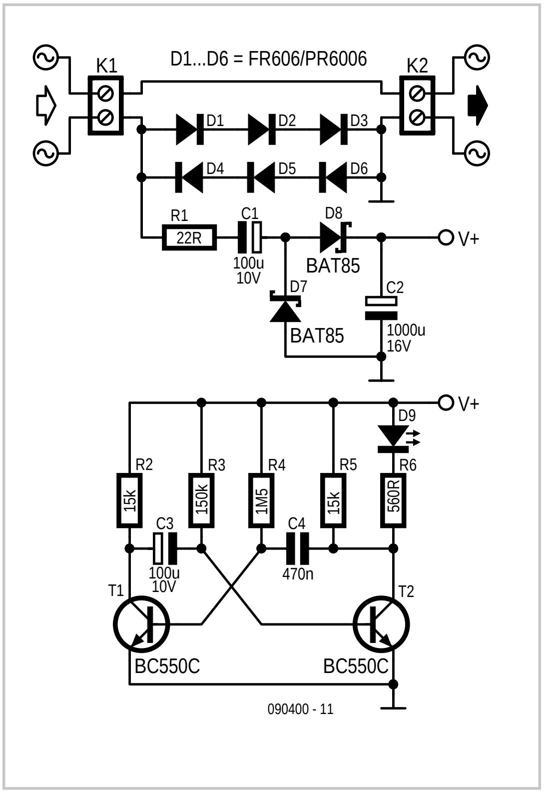


Some types of electronic equipment do not provide any indication that they are actually on when they are switched on. This situation can occur when the backlight of a display is switched off. In addition, the otherwise mandatory mains power indicator is not required with equipment that consumes less than 10 watts. As a result, you can easily forget to switch off such equipment. If you want to know whether equipment is still drawing power from the mains, or if you want to have an indication that the equipment is switched on without having to modify the equipment, this circuit provides a solution.



One way to detect AC power current and generate a reasonably constant voltage independent of the load is to connect a string of diodes wired in reverse parallel in series with one of the AC supply leads. Here we selected diodes rated at 6 A that can handle a non-repetitive peak current of 200 A. The peak current rating is important in connection with switch-on currents. An advantage of the selected diodes is that their voltage drop increases at high currents (to 1.2 V at 6 A). This means that you can roughly estimate the power consumption from the brightness of the LED (at very low power levels).

The voltage across the diodes serves as the supply voltage for the LED driver. To increase the sensitivity of the circuit, a cascade circuit (voltage doubler) consisting of C1, D7, D8 and C2 is used to double the voltage from D1–D6. Another benefit of this arrangement is that both halve-waves of the AC current are used. We use Schottky diodes in the cascade circuit to minimise the voltage losses.

The LED driver is designed to operate the LED in blinking mode. This increases the amount of current that can flow though the LED when it is on, so the brightness is adequate even with small loads. We chose a duty cycle of approximately 5 seconds off and 0.5 second on. If we assume a current of 2 mA for good brightness with a low-current LED and we can tolerate a 1-V drop in the supply voltage, the smoothing capacitor (C2) must have a value of 1000 µF. We use an astable multivibrator built around two transistors to implement a high-efficiency LED flasher. It is dimensioned to minimise the drive current of the transistors. The average current consumption is approximately 0.5 mA with a supply voltage of 3 V (2.7 mA when the LED is on; 0.2 mA when it is off). C4 and R4 determine the on time of the LED (0.5 to 0.6 s, depending on the supply voltage). The LED off time is determined by C3 and R3 and is slightly less than 5 seconds. The theoretical value is R × C × ln2, but the actual value differs slightly due to the low supply voltage and the selected component values.

Diodes D1-D6 do not have to be special high-voltage diodes; the reverse voltage is only a couple of volts here due the reverse-parallel arrangement. This voltage drop is negligible compared to the value of the mains voltage. The only thing you have to pay attention to is the maximum load. Diodes with a higher current rating must be used above 1 kW. In addition, the diodes may require cooling at such high power levels.

Measurements on D1–D6 indicate that the voltage drop across each diode is approximately 0.4 V at a current of 1 mA. Our aim was to have the circuit give a reasonable indication at current levels of 1 mA and higher, and we succeeded nicely. However, it is essential to use a good low-current LED.

Caution: the entire circuit is at AC power potential. Never work on the circuit with the mains cable plugged in. The best enclosure for the circuit is a small, translucent box with the same colour as the LED. Use reliable strain reliefs for the mains cables entering and leaving the box (connected to a junction box, for example). The LED insulation does not meet the requirements of any defined insulation class, so it must be fitted such that it cannot be touched, which means it cannot protrude from the enclosure.

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