# Circuit protects against ac-line disturbances

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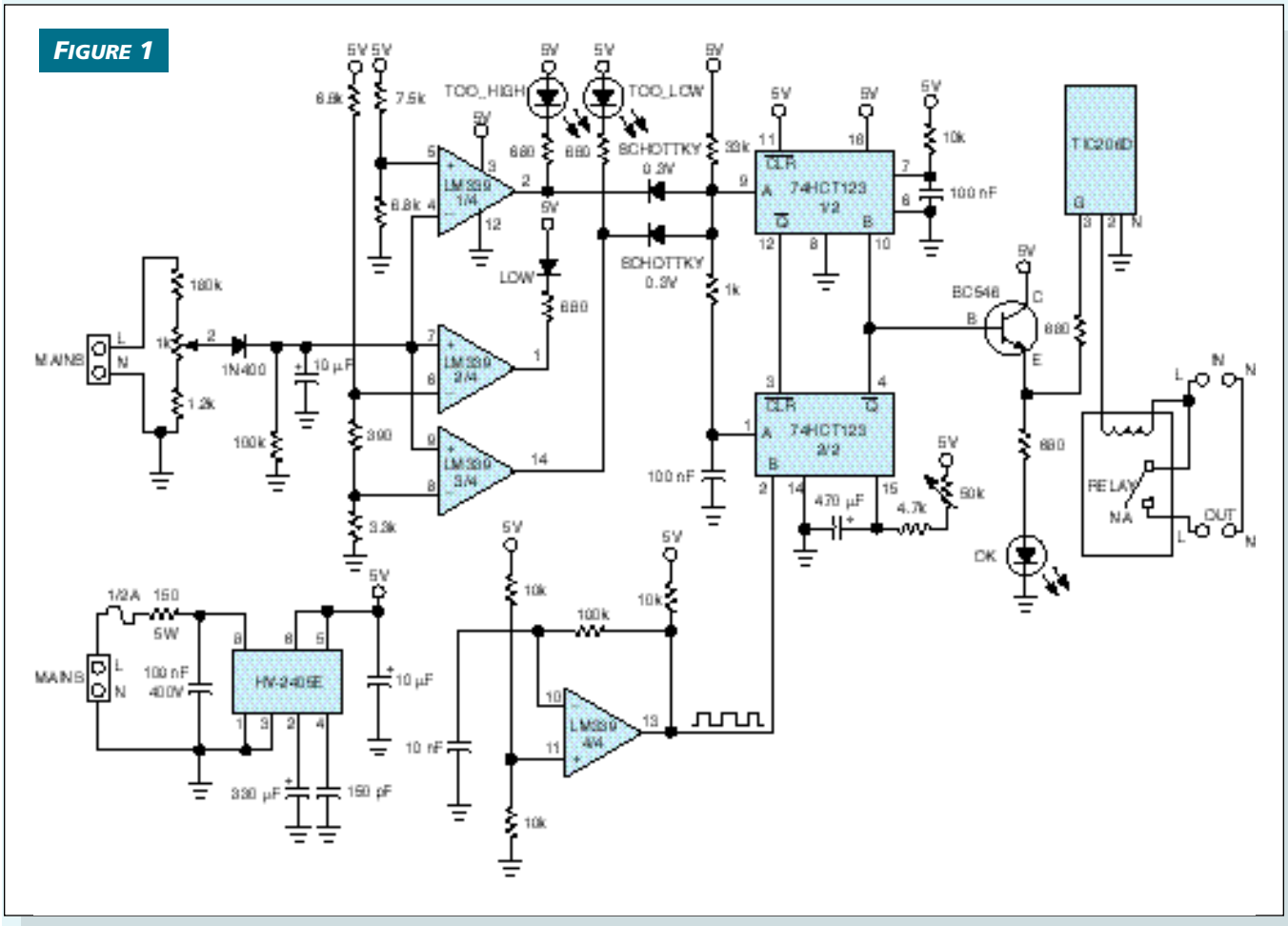
The circuit in **Figure 1** protects the ac line against disturbances. It operates by switching off the power supply upon detection of undervoltage or overvoltage conditions. The circuit thus protects refrigerators, washing machines, air conditioners, and other appliances from permanent damage that could accrue from working outside their specified power requirements. The problem assumes particular importance in underdeveloped countries or regions where the ac-supply network is incorrectly configured, and the voltage frequently drops to levels low enough to damage coils and motors. When the ac-line voltage returns to its nominal level, the circuit automatically resets a switch and reconnects the line voltage.

The input stage contains a voltage divider, which you can adjust with the 1-kΩ potentiometer. The circuit incorporates a rectifying diode and a 10-µF storage capacitor that provides lowpass filtering to stabilize the ac-supply voltage-comparison level. You should adjust the potentiometer such that the normal condition of the ac supply, 220V, corresponds to a 1.97V voltage-comparison level. Three comparison voltages verify the ac-line status, using resistive voltage dividers. The voltages correspond to a 10%-undervoltage warning, a 20%-undervoltage failure level, and a 20%-overvoltage failure level. These comparison voltages correspond to ac-supply voltages of 198, 176, and 264V, respectively. Three sections of the quad open-collector LM339 comparator convert these voltage thresholds to digital signals.

The 10%-undervoltage warning condition turns on a yellow LED. Failure conditions turn on a red LED and trigger

**FIGURE 1**




**Avoid motor burnout, using this circuit that provides undervoltage warning signals and disconnects the line from the load for severe under- and overvoltage conditions.**

the dual retriggerable monostable multivibrator, $IC_2$. The output of the first ,$IC_{2A}$, is narrow and serves to define a time window that prevents sudden transient disturbances from triggering $IC_{2B}$. Consequently, if the ac-line voltage quickly returns to its nominal condition, the circuit does not disconnect the load. The output pulse width of the other monostable, which you can adjust via the 50-kΩ potentiometer, defines the time the load remains disconnected after the return of the nominal ac-line voltage.

An RC delay line ensures that when the second monostable triggers, the first one has already activated its Clear input. The fourth comparator of the LM339 produces a high-frequency square wave that continuously retriggers the monostable while the fault condition is present. To save power from the regulated 5V supply and to allow use of this circuit to protect high-current equipment, you should use an output relay whose coil control comes from the power-supply rail. A TIC206D triac, gated by the monostable, switches the relay coil. A green LED indicates that the ac-line level is normal and the relay's contact is closed. $IC_1$, a Harris HV-2405E offline regulator, supplies the regulated 5V. Because this circuit connects to the ac line, you should use an insulated enclosure, and take care in testing the circuit. (DI #2215)

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