Voltage Detector Provides Sensitivity and Precision

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A function often needed in industrial and scientific applications is detecting the presence (or absence) of dc voltages in such components as safety interlocks and automatic sequencers. To detect the absence of large bipolar dc levels, the detector must assert a signal when its input is within a stable and precisely defined window around 0 V. The window width should be twice the magnitude of the maximum tolerable error voltage and centered at 0 V.

The detection circuit should have a high-impedance input to avoid affecting the system into which it is inserted. It also should tolerate an input level equal to the maximum voltage it supervises, plus the amplitude of any transient voltage that might occur. One example of a detector circuit that meets these requirements is shown in **Fig. 1**. This circuit produces a digital output signal when the input voltage is within a ±100-mV window.

Its input resistance is 22 MΩ, and its maximum input voltage is defined by the arcing specification of the 22.1-MΩ series-input resistor. Its well-defined window edges have about 10 mV of hysteresis (**Fig. 2**), which reduces the influence of noise-induced output jitter. Response speed is determined by a 10-ms time constant formed by the 1-nF input capacitor (a low-leakage film type) and the parallel resistance formed by the two 22.1-MΩ resistors.

The circuit operates from a single 5-V supply, due to the MAX4236 operational amplifier's low offset voltage, low offset-voltage temperature coefficient and low bias current, and its ability to operate at input voltages that include the negative rail. Temperature dependence of the trigger thresholds varies less than 1 mV (total) over the temperature range of 0°C to 85°C due to the thermal stability of the MAX6143 precision voltage reference. To ensure stability of these trigger voltages over temperature, the temperature coefficient of the two 22.1-MΩ resistors should be low and as closely matched as possible.

Very-high-input impedance makes this circuit sensitive to leakage currents. The negative input of each operational amplifier must be supported by a Teflon standoff, and a high-quality conformal-coating insulation should be applied to the whole assembly. The circuit in **Fig. 3** is a good option if the detector circuit must be galvanically isolated from the system-control circuitry. Data sheets and other information on the ICs shown in these figures can be found at www.maxim-ic.com. **PETech**

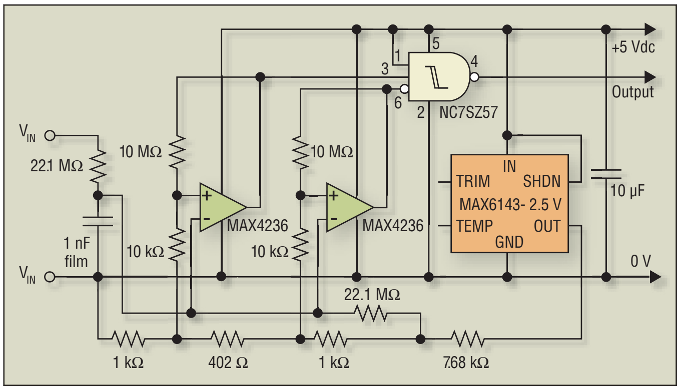

Fig. 1. *This detector of bipolar dc voltages asserts a digital output signal when the input is within a ±100-mV window, centered at 0 V.*

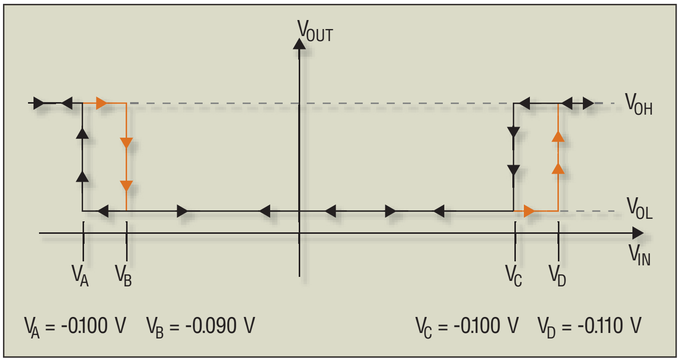

Fig. 2. *This hysteresis diagram of the Fig. 1 circuit shows the hysteresis bands at each edge of the voltage-detection window.*

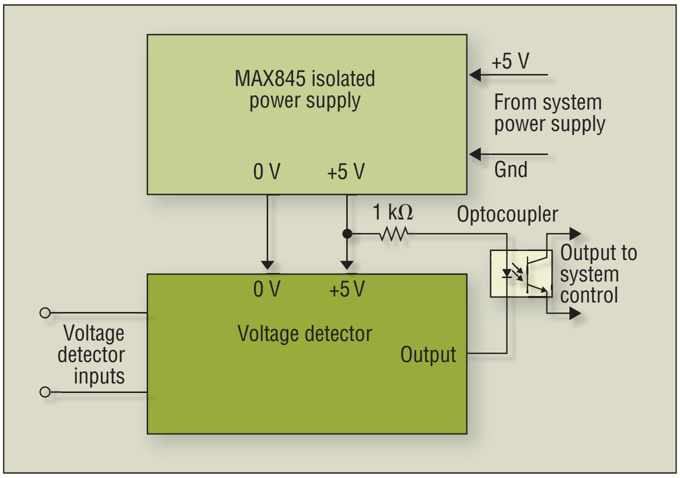

Fig. 3. *Additional circuitry interfaced to the circuit in Fig. 1 provides galvanic isolation between the detector circuit and the monitoring system.*