Sinewave Zero Crossover Detection

When using variable reluctance(VR) sensors in an automotive environment, the need to accurately determine positioning or speed of various spinning components(driveshaft, crankshaft, etc.) becomes an essential operation. Basic circuits can be constructed to provide a square wave response given a VR sinewave input signal. In figure 1, a basic comparator is shown with a few modifications such as the addition of D1 and the voltage divider R1 and R2. D1 ensures the noninverting input does not go below the negative input common mode limit of the comparator and the voltage divider protects the comparator against high voltages associated with fast spinning VR sensors. These modifications lead to satisfactory performance in theory.

However, in practice automotive environments produce an immense amount of electrical noise which must be considered when designing a circuit that deals with relatively high frequency square waves. Usually, a low pass filter will need to be applied to the input and output of the circuit; this prevents some high frequency ignition source noise from entering the signal processing path. Additionally, another low pass filter will need to be applied to the output to prevent the ringing phenomenon(Figure 3), which will cause voltage spikes and cause possible damage to sensitive high impedance devices such as microcontrollers. Another precaution takes the form of ferrite beads, which can be inserted in the signal path to provide inductance and reduce high voltage spikes which would otherwise produce undefined circuit behavior or damage sensitive devices. A final precaution involves enclosing the circuit in a faraday bag of metal enclosure; however, this may be omitted depending on how noisy the electrical environment is. These noise filtering components typically need to be designed on a case by case basis for maximum effectiveness, using an oscilloscope equipped with a FFT(Fast Fourier Transform) function decreases design time and usually improves circuit performance.

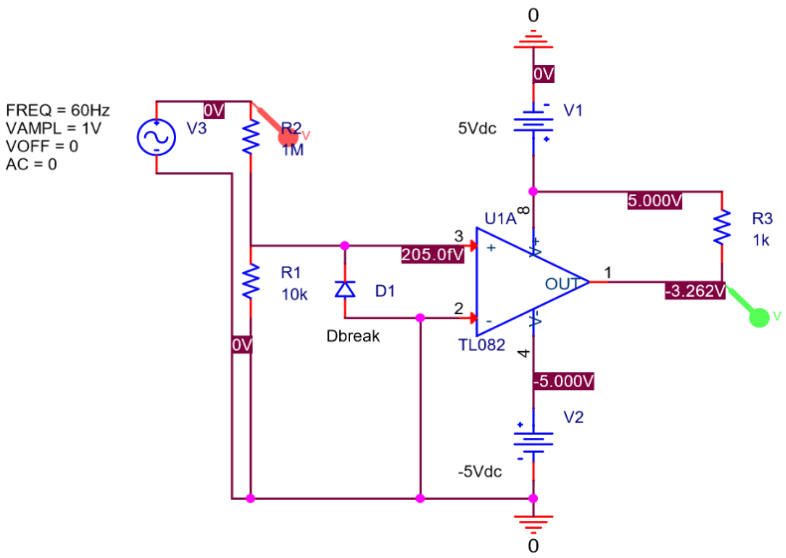

Figure 1

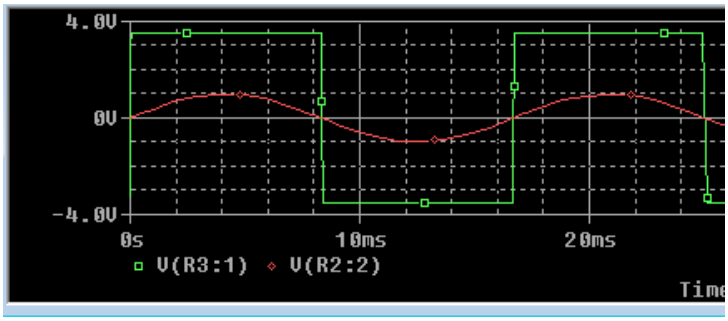

Figure 2

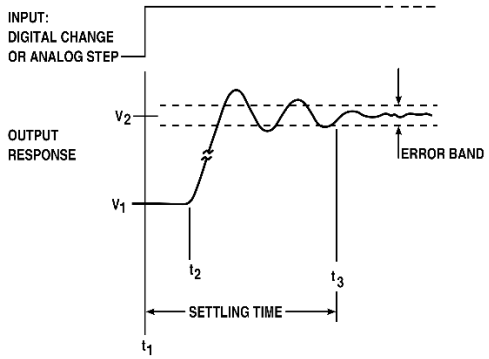

Figure 3