1 Debounce Circuit

There are some tricks to designing the debounce circuit for the Bourns encoder nominally shown in Figure 9.9 of Horowitz & Hill. The revised circuit is shown in Figure 1.

![Debounce Circuit Diagram]

Figure 1: Recommended debounce circuit for the A and B Bourns encoder signals based on Horowitz & Hill Figure 9.9. Note the addition of the 741 op amp configured as a unity gain buffer so that the 74LS14 is not loaded.

1.1 Time Constant Selection

First, with $C_1 = 0.1\mu F$, the time constant of the circuit is about 10 ms. For our purposes, this is too slow. Although the Bourn encoder specifies a maximum bounce of 5 milliseconds, the actual bounce time is significantly less. You can observe this bounce with the oscilloscope. It will be helpful to trigger in the “Normal” mode rather than the “Automatic” mode. In “Normal” mode the scope will not trigger until it detects a trigger signal. It will then hold this image until the next valid trigger signal. A time constant of 1 ms is sufficient for our encoder since the bounce time is shorter than this. Choose $C_1$ in the circuit to achieve this.

1.2 Addition of Buffer

Second, Horowitz & Hill warns that “This method isn’t well suited to TTL because of the low driving impedance that TTL inputs require.” If you do not use a buffer, you will see that the input to the 74LS14 may not go lower than about 1 V. When you remove the 74LS14, the signal goes to zero. This suggests that the problem lies with the 74LS14 chip itself. In fact, the 74LS14 has a low input impedance (see Horowitz & Hill Figure 2.7). Thus it forms a voltage divider with $R_2$ and its input is significantly greater than 0 V (around 1 V). The solution is to use an op amp configured as a unity gain buffer (see Horowitz & Hill Figure 4.8) as shown in Figure 1. The buffer isolates the signal from the input to the 74LS14 and solves the problem.