Low Output Impedance MUX (HA5022)

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Two common problems will surface when trying to multiplex multiple high-speed signals into a low-impedance load, such as an analog-to-digital converter. The first is the low load impedance, which tends to make amplifiers oscillate and thus causes gain errors. The second problem involves the multiplexer, which supplies no gain, introduces distortion, and limits the frequency response.

Using op amps that have an enable/disable function, such as the HA5022, will eliminate the multiplexer problems. That's because the external multiplexer chip isn't needed, and the HA5022 can drive low-impedance (large capacitance) loads if a series isolation resistor is employed.

Looking more closely at the circuit, both inputs are terminated in their characteristic impedance; 75Ω is typical for video applications, see Figure 1. Because the output cables usually are terminated in their characteristic impedance, the gain is 0.5. Consequently, amplifiers U2A and U2B are configured in a gain of +2 to set the circuit gain at 1. R_2 and R_3 determine the amplifier gain; if a different gain is desired, R_2 should be changed according to the equation:
$G = (1 + R_3/R_2)$.

R_3 sets the amplifier's frequency response, so it's best to check the manufacturer's data sheet before changing its value.

R_5, C_1, and D_1 make up an asymmetrical charge/discharge time circuit that configures U1 as a break-before-make switch to prevent both amplifiers from being active simultaneously. If this design is extended to more channels, the drive logic must be designed to be break-before-make. Also, the inhibit input is only functional when the channel switch input is high. R_4 is enclosed in the feedback loop of the amplifier so that the large open-loop amplifier gain of U2 will present the load with a small closed-loop output impedance while keeping the amplifier stable for all values of load capacitance.

The circuit shown was tested for the full range of capacitor values with no oscillations observed. Thus, the problem is solved. The circuit's frequency and gain characteristics are now those of the amplifier independent of any multiplexing action. This essentially solves the second problem. The multiplexer transition time is approximately 15µs with the component values shown.

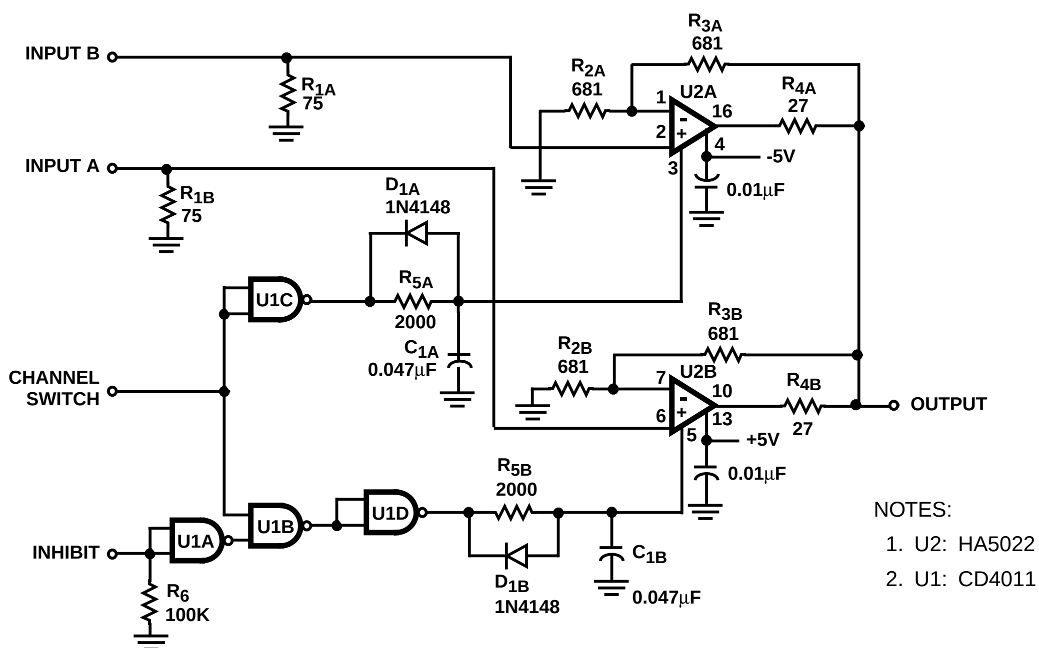

FIGURE 1. THIS LOW-OUTPUT IMPEDANCE MULTIPLEXER WILL SOLVE PROBLEMS OF OSCILLATION CAUSED BY LOW LOAD IMPEDANCE, AS WELL AS DISTORTION AND LIMITED FREQUENCY RESPONSE INTRODUCED BY THE MULTIPLEXER. THE SECOND PROBLEM IS SOLVED BECAUSE THE FREQUENCY AND GAIN CHARACTERISTICS BECOME THOSE OF THE AMPLIFIER, INDEPENDENT OF THE MULTIPLEXER.