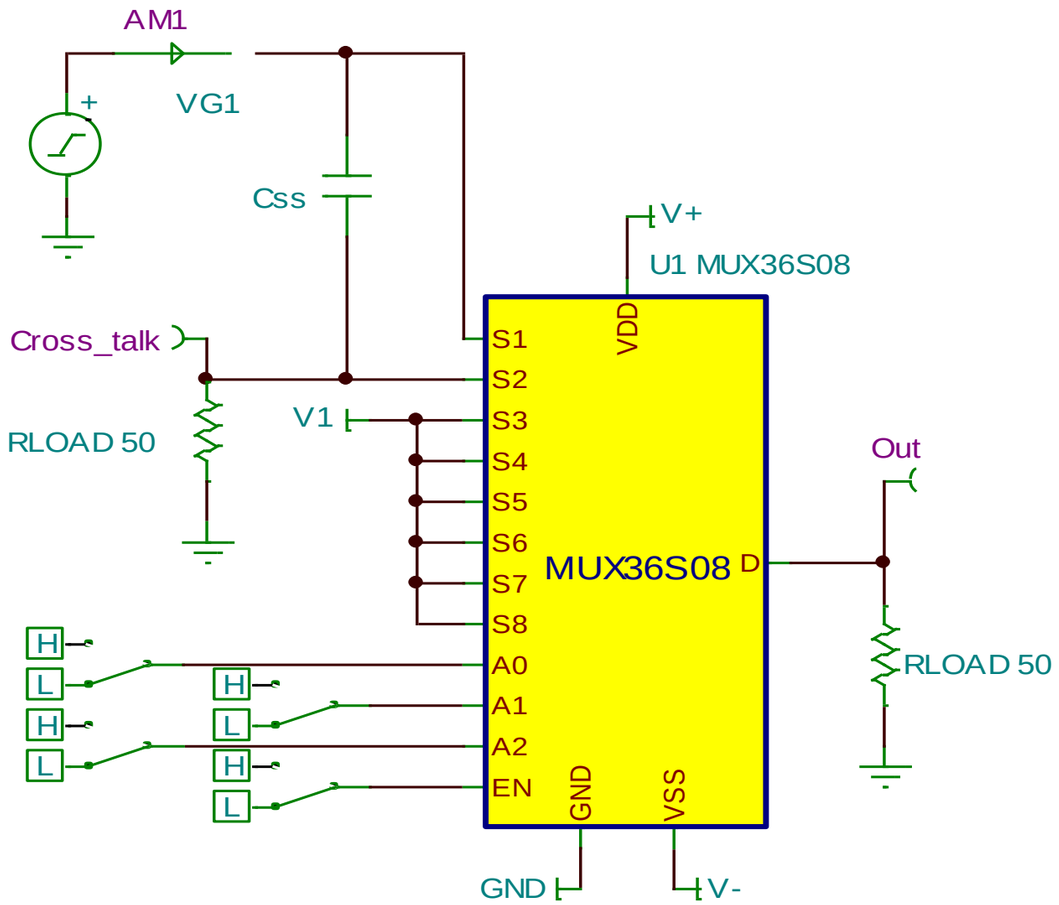
Basics of Analog Multiplexer – 3

Exercises

TI Precision Labs – Op Amps

1. **A data acquisition system is required to capture a sensor signal whose frequency varies from DC to 5MHz. The multiplexer used in this data acquisition system has an on resistance of 100Ω and a total output capacitance of 100pF. Is this multiplexer suitable for this application? (Neglect the effect of load resistance for this calculation.)**

2. **A multiplexer used in a particular application has a channel to channel crosstalk of -89dB at 1MHz. Due to poor board layout techniques, there is parasitic stray capacitance of 1pF between adjacent channels (C_{SS}) as shown below. Simulate and see how this affects the multiplexer crosstalk performance.**



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Solution

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1. **A data acquisition system is required to capture a sensor signal whose frequency varies from DC to 5MHz. The multiplexer used in this data acquisition system has an on resistance of 100Ω and a total output capacitance of 100pF. Is this multiplexer suitable for this application? (Neglect the effect of load resistance for this calculation.)**

Multiplexer bandwidth calculation

3 dB cutoff frequency is given by

$$fc = \frac{(R_L + R_{ON})}{2 * \pi * (R_L * R_{ON}) * (C_D + C_L)}$$

As $R_L >> R_{ON}$, the equation for 3 dB cutoff frequency

$$fc = \frac{1}{2 * \pi * (R_{ON}) * (C_D + C_L)}$$

Where R_{ON}=100 Ohms, $(C_D + C_L) = 100pF$. substituting these values in above equation

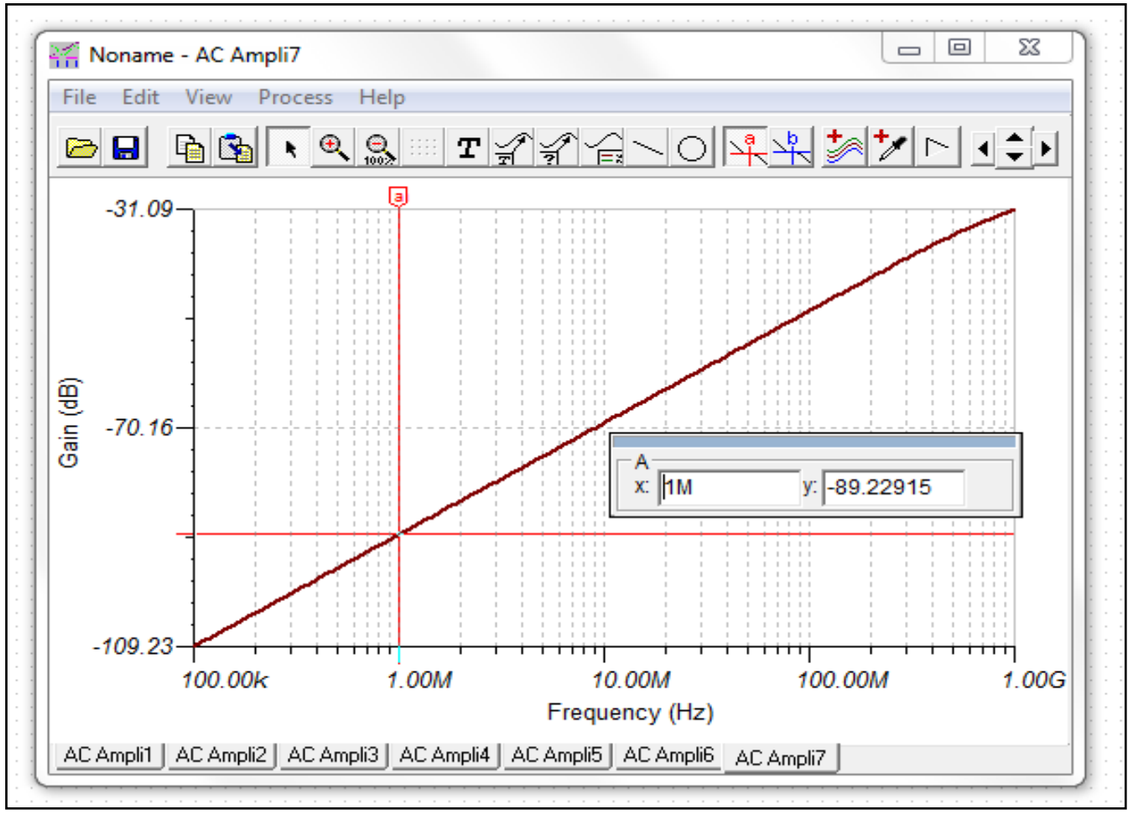
$$fc = \frac{1}{2 * \pi * (100) * (100pF)}$$

$$fc = 15.92MHz$$

Since the multiplexer 3 dB cutoff frequency is well above input signal frequency requirement, this multiplexer is suitable for this application.

2. **A multiplexer used in a particular application has a channel to channel crosstalk of -89dB at 1MHz. Due to poor board layout techniques, there is parasitic stray capacitance of 1pF between adjacent channels (C_{SS}) as shown below. Simulate and see how this affects the multiplexer crosstalk performance.**

1. **Open the TINA simulation file.**
2. **To see actual crosstalk performance of the MUX36S08, delete C_{SS} from the schematic and simulate the TINA file for AC transfer characteristics.**
3. **You will get crosstalk performance results as shown here.**



2. A multiplexer used in a particular application has a channel to channel crosstalk of -89dB at 1MHz. Due to poor board layout techniques, there is parasitic stray capacitance of 1pF between adjacent channels (C_{SS}) as shown below. Simulate and see how this affects the multiplexer crosstalk performance. (continued)

1. Open the TINA simulation file.

2. To see effect of stray capacitance on crosstalk performance of MUX36S08, introduce a C_{SS} of 1pF between channel 1 (S1) and channel 2 (S2) and simulate the TINA file for AC transfer characteristics.

3. You will get crosstalk performance results as shown here.

4. You can see that the device performance degrades from -89dB to -69dB due to the introduction of stray capacitance.