

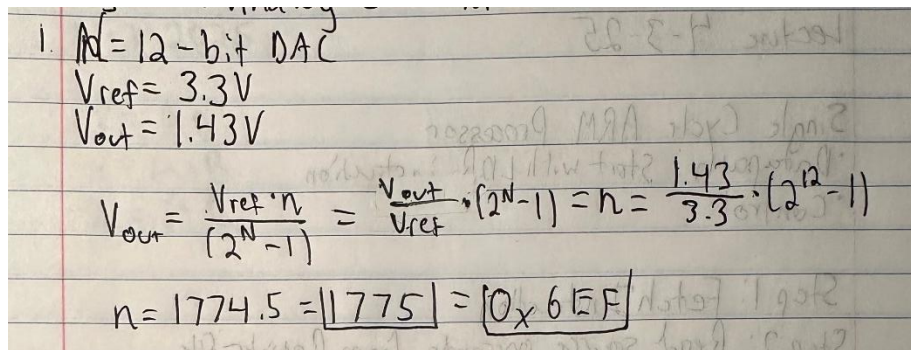
Instruction:

In general, these tasks will use some equations and examples we discussed during the lecture but may require rearranging those equations or some outside searching as well. You may search for other equations and examples to help you as necessary but are requested to avoid searching for (or asking ChatGPT for) exact solutions to these problems without gaining an understanding of the required processes.

It is recommended that you focus on completing the experiment first and complete this if time permits afterwards or outside of lab hours if necessary.

1 Digital to Analog Converter

1. Consider a 12-bit DAC with a reference voltage of 3.3V. What input code will result in an output of 1.43V?



Handwritten solution for a 12-bit DAC problem:

$$1. \quad N = 12 \text{-bit DAC}$$

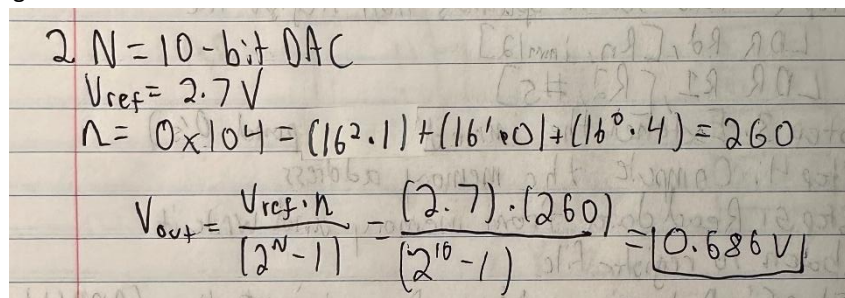
$$V_{\text{ref}} = 3.3 \text{ V}$$

$$V_{\text{out}} = 1.43 \text{ V}$$

$$V_{\text{out}} = \frac{V_{\text{ref}} \cdot n}{(2^N - 1)} = \frac{V_{\text{out}}}{V_{\text{ref}}} \cdot (2^N - 1) = n = \frac{1.43}{3.3} \cdot (2^{12} - 1)$$

$$n = 1774.5 = \lfloor 1775 \rfloor = \boxed{0x6EF}$$

2. Consider a 10-bit DAC with a reference voltage of 2.7V. Given that the input code is 0x104, what is the output voltage?



Handwritten solution for a 10-bit DAC problem:

$$2. \quad N = 10 \text{-bit DAC}$$

$$V_{\text{ref}} = 2.7 \text{ V}$$

$$n = 0x104 = (16^2 \cdot 1) + (16^1 \cdot 0) + (16^0 \cdot 4) = 260$$

$$V_{\text{out}} = \frac{V_{\text{ref}} \cdot n}{(2^N - 1)} = \frac{(2.7) \cdot (260)}{(2^{10} - 1)} = \boxed{0.686 \text{ V}}$$

2 Analog to Digital Converter

3. Consider a 12-bit ADC with a reference voltage of 3.3V. Given an input voltage of 0.92V, what will the output code be?

3. $N = 12$ -bit ADC
 $V_{ref} = 3.3V$
 $V_{in} = 0.92V$
 $n = ?$

$$n = \frac{V_{in}}{V_{ref}} \cdot (2^N - 1)$$

$$n = \frac{0.92V}{3.3V} \cdot (2^{12} - 1) = 1141.64$$

$$\text{or } \lfloor 1142 \rfloor = 0x476$$

4. Consider an 8-bit ADC with a reference voltage of 2.7V. What input voltage range will lead to an output code of 0x34?

4. $N = 8$ -bit ADC
 $V_{ref} = 2.7V$
 $V_{in} = ?$

Step size = $\frac{V_{ref}}{2^N} = \frac{2.7V}{2^8} = 10.55mV$
 (0.01055V)

$n_{out} = 0x34 = 52$ $V_{min} = 52 \cdot 10.55mV = 0.548V$

$V_{max} = 53 \cdot 10.55mV = 0.559V$

Input voltage range $0.548V \leq V_{in} < 0.559V$