

Problem 1: 10 points

I have configured the A/D converter to produce 12-bit measurements. Vref is set to 2.7 volts. For each of the readings below, provide the corresponding input voltage to the nearest mV.

$$2^{12} = 4096. \text{ ADC equation: output} = (V_{in}/V_{ref}) * 4096$$

$$(\text{output}/4096) * V_{ref} = V_{in}$$

Reading Voltage

Reading	Voltage (mV)
0x000	$(0/4096) * 2.7 = \mathbf{0}$
0x600	$(1536/4096) * 2.7 * 1000 = \mathbf{1013}$
0x70A	$(1802/4096) * 2.7 * 1000 \approx \mathbf{1188}$
0x70B	$(1803/4096) * 2.7 * 1000 \approx \mathbf{1189}$
0xFFE	$(4094/4096) * 2.7 * 1000 \approx \mathbf{2699}$

Problem 2: 10 points

I have configured the A/D converter to produce 12-bit measurements. Vref is set to 3.000 volts. The signal I am measuring has approximately 40-45 mV of noise.

How many bits of the A/D measurement should I reject as being too noisy? Explain why?

$$\text{ADC equation: output} = (V_{in}/V_{ref}) * 4096$$

$$(.04/3) * 4096 = 54.6133333 \approx 55$$

$$(.045/3) * 4096 = 61.44 \approx 61$$

55 and 61 are less than 64 ( $2^6$ ) so you should reject the 6 least significant bits because those are the bits that are made up by the noise.

Problem 3: 10 points

I am going to program my LED strip to turn on 3 LEDs. I send it the following 32-bit words:

0x00000000

0xf0f0f0f0

0xf0f00000

0xf00000f0

0xffffffff

What will the first 3 LEDS look like?

Nearest to connector: dim white/light gray at 50% LED brightness

Second from connector: blue at 50% LED brightness

Third from connector: red at 50% LED brightness