

Lab 3 – Analog Signals – Prelab Report

Sunday, February 8<sup>th</sup>, 2025

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As a future member of the engineering profession, the student is responsible for performing the required work in an honest manner, without plagiarism and cheating. Submitting this work with my name and student number is a statement and understanding that this work is our own and adheres to the Academic Integrity Policy of McMaster University and the Code of Conduct of the Professional Engineers of Ontario.

1. What method of analog to digital conversion does the MSP432E401Y ARM microcontroller use for its ADC? How many bits? [3 marks]

The MSP432E401Y ARM microcontroller uses a Successive Approximation Register (SAR) ADC for analog-to-digital conversion. The ADC has a 12-bit resolution.

2. Converting an analog signal to digital will result in quantization error - show the calculations and explain the MSP432E401Y's maximum quantization error. [3 marks]

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

$$V_{REFN} = 0\text{V}$$

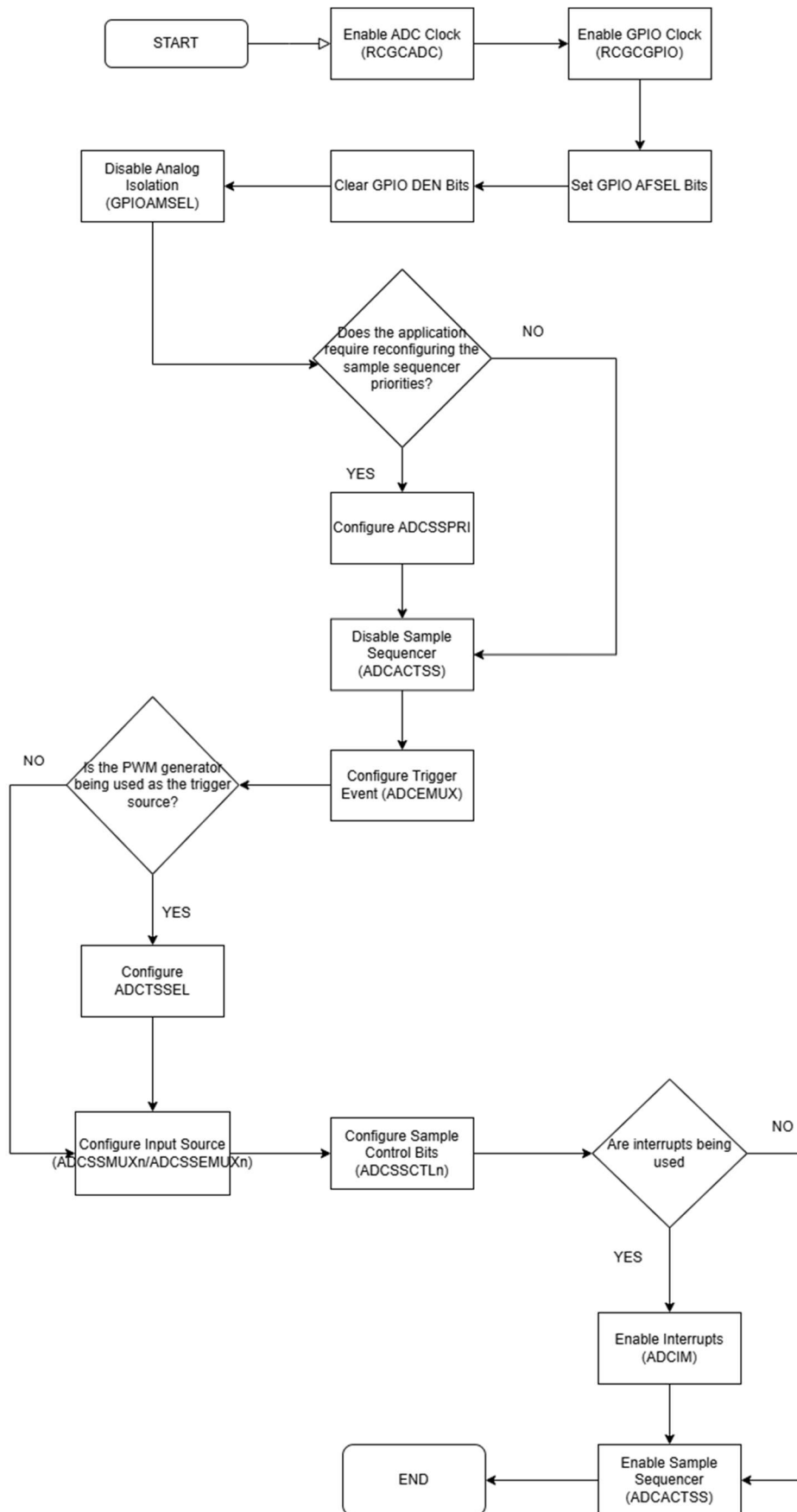
$$\text{Max Error} = \frac{2 \times (V_{REFP} - V_{REFN})}{2 \times 4096} V_{REFP}$$

$$\text{Max Error} = \pm 0.8057\text{mV}$$

The MSP432E401Y microcontroller uses a 12-bit ADC, meaning it divides the input voltage range into  $2^{12} = 4096$  discrete levels. This introduces quantization error, which is the difference between the actual analog signal and its closest digital representation.

3. Draw a flowchart outlining the steps to configure the ADC on the MSP432E401Y. Hint: there are 13 steps. [13 marks]

(See next page)



4. Complete the table below assuming a 12-bit ADC (same as MSP432E401Y's ADC), assuming a full-scale voltage of 3.3V [11 marks]:

Analog Voltage ( $V_H$ )	x-bit ADC (hex)
0.00	0
0.33	19A
0.66	333
1.00	4D9
1.33	673
1.66	80C
2.00	9B2
2.33	B4C
2.66	CE6
3.00	E8B
3.30	1000