Max Schrader

2/10/2021

# HW 1

## Problem 1

#### DAQ Code:

function y = daq(v\_ref\_high, v\_ref\_low, n\_bits, signal\_v)

v\_ref\_high = v\_ref\_high - v\_ref\_low;

resolution = 2^n\_bits;

delta = v\_ref\_high / resolution;

binary = zeros(resolution, 1);

signal\_v = signal\_v - v\_ref\_low;

for i=1:resolution

comparator = v\_ref\_high - (i - 1) \* delta;

bit = signal\_v >= comparator;

binary(i) = bit \* comparator;

if bit

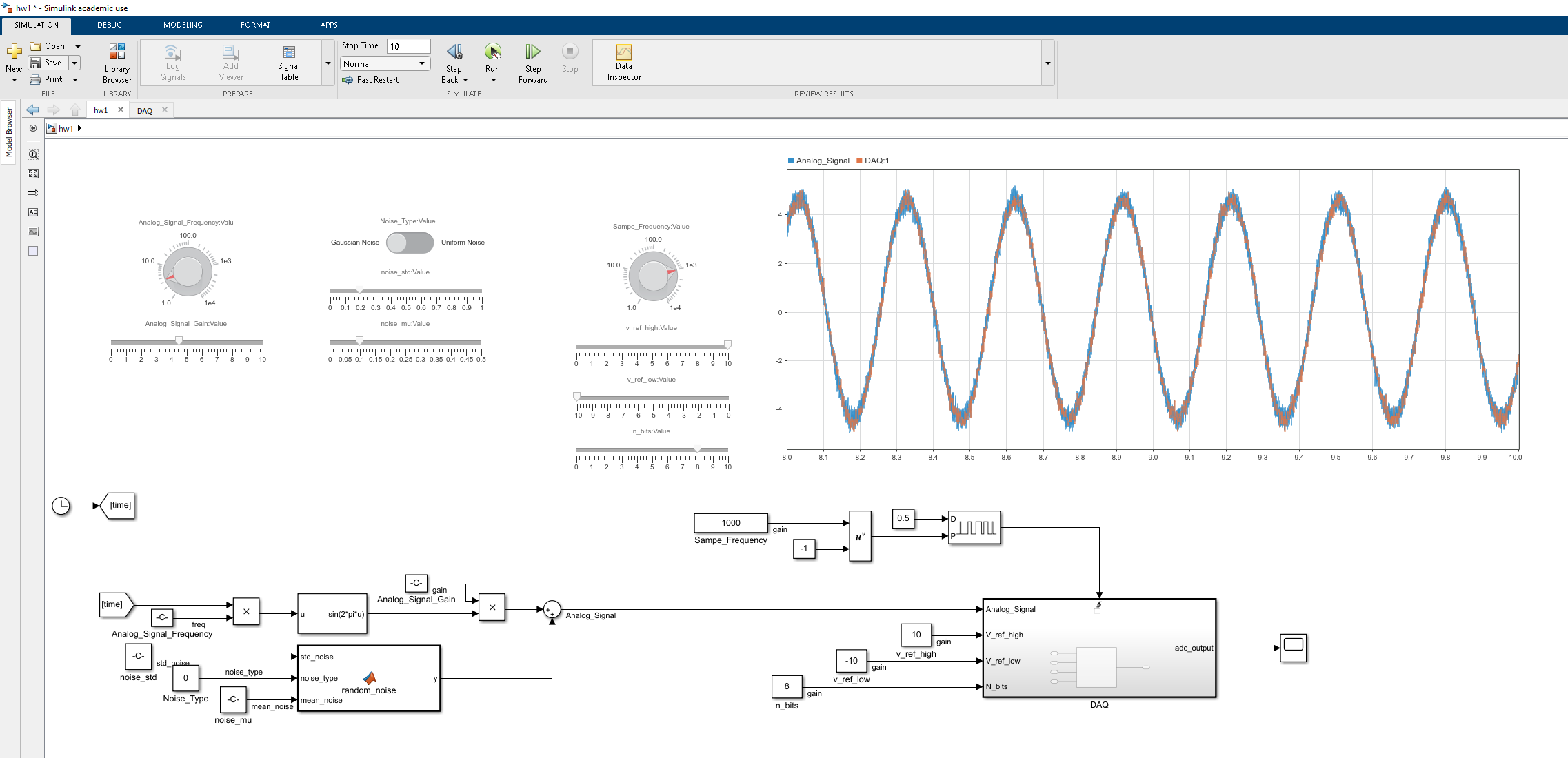
signal\_v = signal\_v - comparator;

end

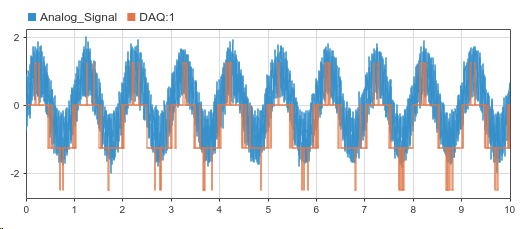
end

y = sum(binary) + v\_ref\_low;

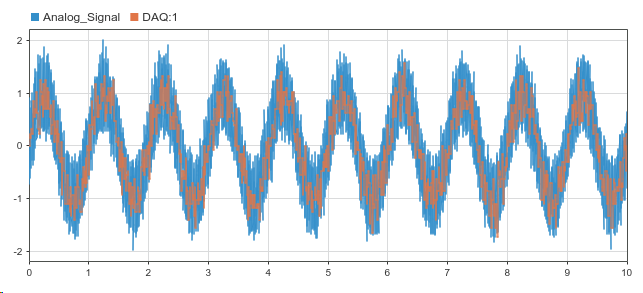
#### Simulink Model:



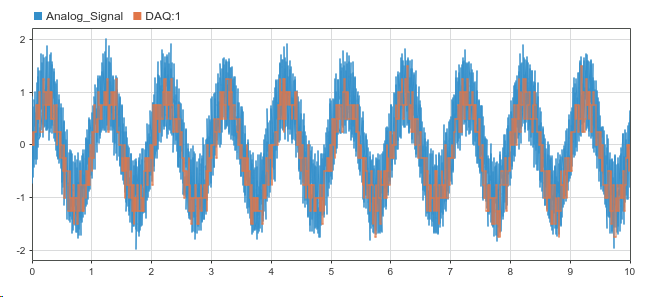
#### 4 Bit, -10V to 10V @100Hz Sampling Frequency



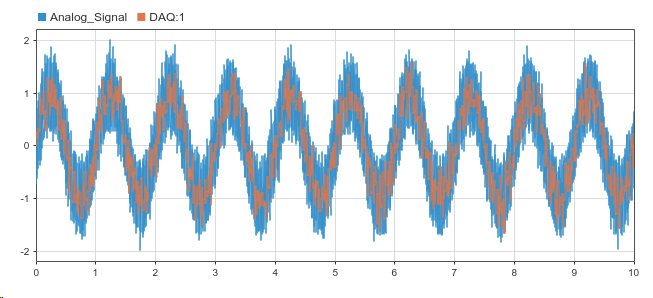
#### 8 Bit, -10V to10V @100Hz Sampling Frequency



#### 4 Bit, -2V to 2V @100Hz Sampling Frequency



#### 8 Bit, -2V to 2V @100Hz Sampling Frequency

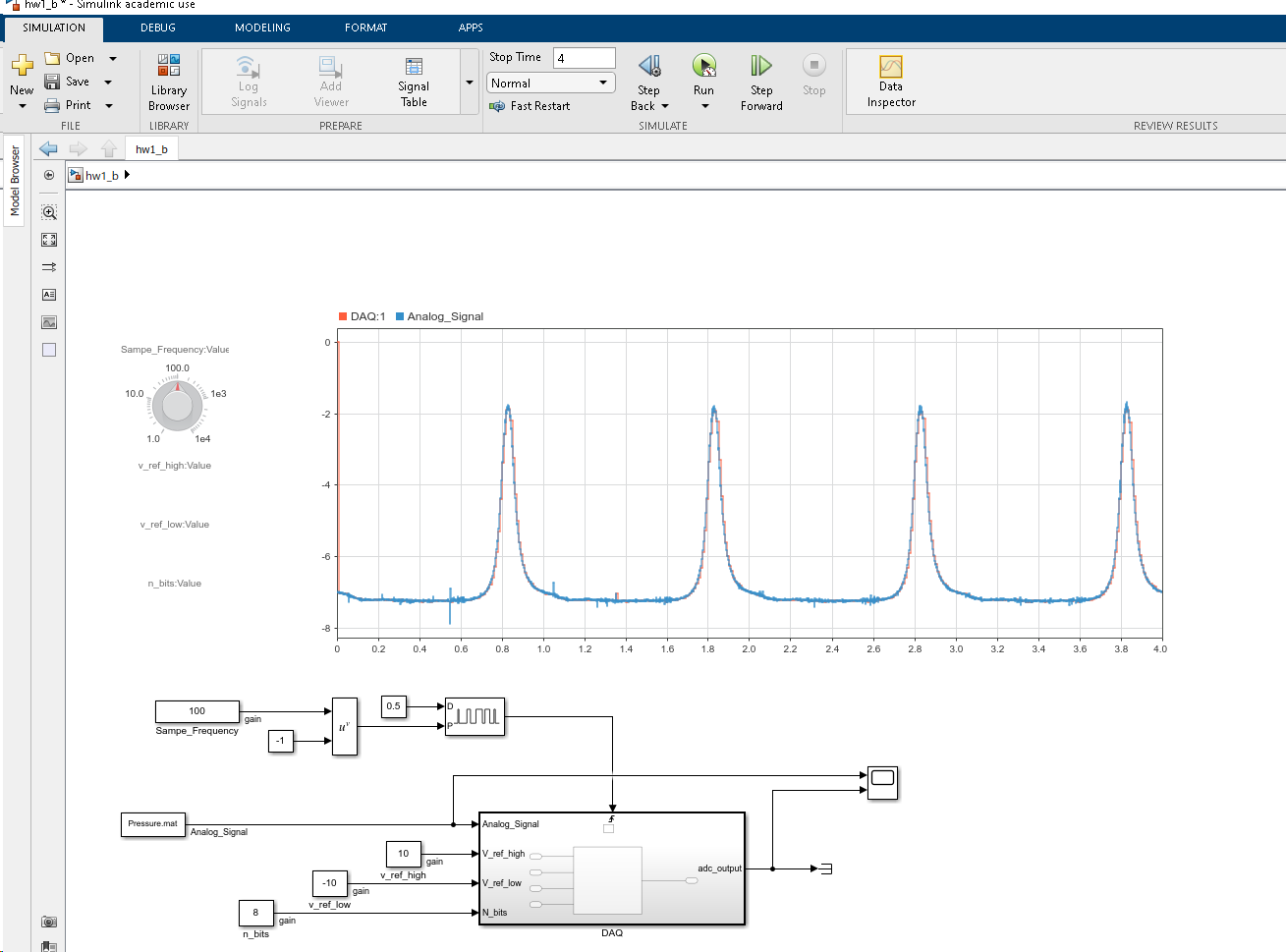


## Problem 2

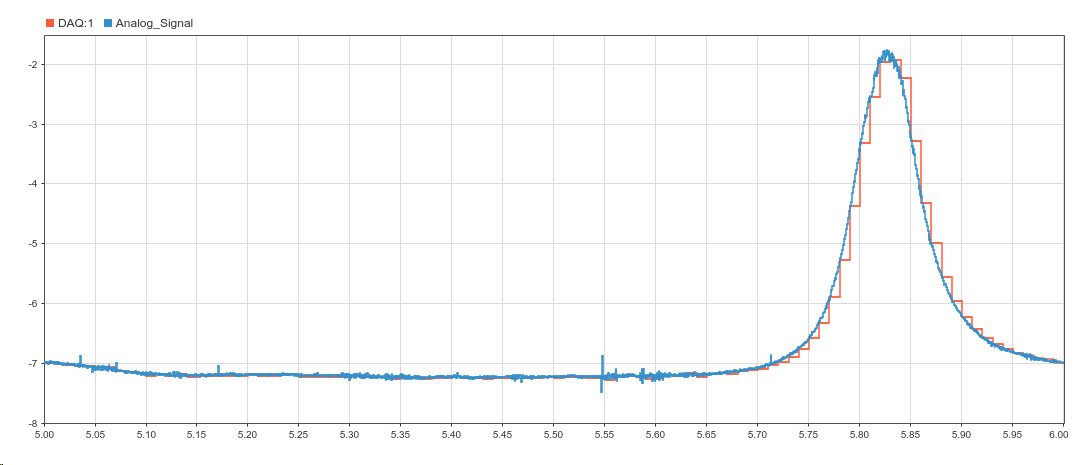
See problem 3

## Problem 3

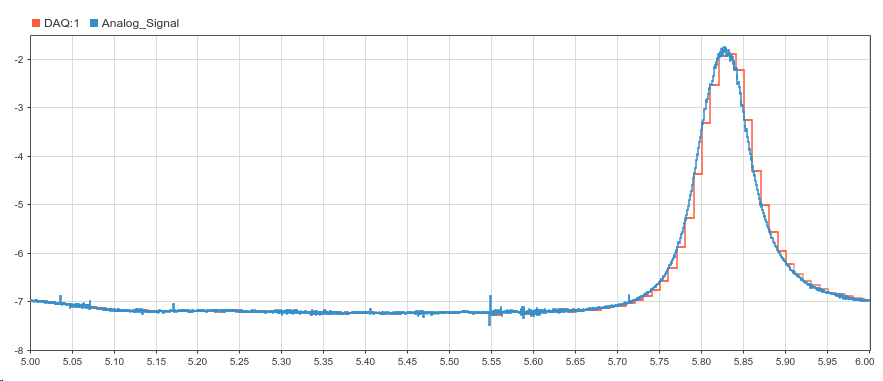
#### Simulink Model



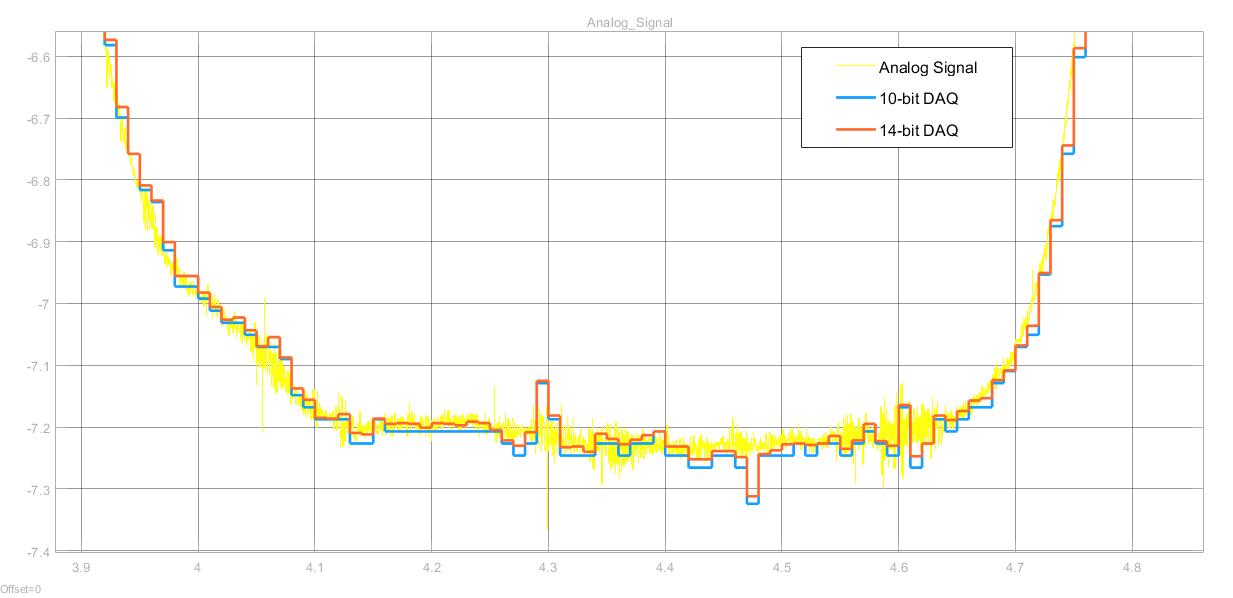
#### 10 bit, -10V to 10V @100Hz Sampling Frequency



#### 14 bit, -10V to 10V @1000Hz Sampling Frequency



#### Difference between 10 & 14 bit resolution



## Problem 4

To calculate the bit resolution of the In-Cylinder Pressure measurement, the minimum (non-zero) from one reading to another was calculated. I shifted the array by 1 and subtracted it from itself. Then,