ENGR-325
HW #3 - Part A

Homework #3 is divided into two parts. Part A is due Monday, Jan. 25. Part B will be due Wednesday.

This part of the homework deals with A/D converter characteristics and specifications. In Monday's lecture I introduced some of these but there is more to explore.

0) Read sections 7.4 and 7.5 in the text if you have not already done so. Pay particular attention to pages 285-289. Key terms and concepts related to A/D converters that you need to understand are: Resolution, Quantization Error, Saturation Error, Conversion Error.

   Related terms are E_{FSR} (effective full scale range, also called the voltage input span for an A/D converter), SNR (signal to noise ratio), MSB (most significant bit), LSB (least significant bit), Sign bit.

1) Assume you find a 11-bit A/D converter and wish to use it and you need to know how good the data measured may be. You find a specification sheet with this information: E_{FSR} = 5v with relative accuracy of 0.03% FS (full-scale). What is the total possible error (i.e. worst case) expressed in volts? What value would be a nominal value of uncertainty (express in volts and also %)?

2) A load cell with an analog output is being used to measure force in an experiment. The output voltage of 3.150V is measured with an 8-bit successive approximation A/D converter whose input voltage range is 0 - 5V. List the sequence of register and comparator values used by the A/D converter to obtain the final quantized value. Find the final register value and the measured voltage it represents. (See table 7.3 for example).

See next page

In class we briefly looked at a couple different A/D products. Below is information about two different A/D products.

3) For the DATAQ DI-145 A/D product determine the following:
   a) Input resolution in volts
   b) The uncertainty of a single measurement made with a 5.0000Vdc as input.
   c) The highest frequency signal that could be sampled and then a fourier transform done.

10 bit converter

Max sample throughput rate:	240 Hz
Min sample throughput rate:	0.44 samples per minute
Sample rate timing accuracy:	50 ppm

$29.00

Signal Inputs

Analog Inputs

Number of Channels:	4
Configuration:	Differential
Full Scale Range:	±10VFS
Input impedance:	1 MΩ, each input to ground
Isolation:	none
Accuracy:	±0.25% of FSR
Overall inaccuracy:	±64mV (at 25°C)
DC common mode rejection:	40db (at 25°C)
Max input without damage:	±75 V peak, continuous ±150 V peak, one minute or less
Max common mode voltage:	±10V
Analog frequency response:	-3db @ 100 Hz

4) For an Omega OME-PCI-1002L A/D board, determine the following:
   a) Input resolution in volts. Assume a gain of one.
   b) The uncertainty of a single measurement made when Vin is 5.0000Vdc
   c) The highest frequency signal that could be sampled and then a fourier transform done.

$419.00

Specifications

ANALOG INPUT SPECIFICATIONS

Channels: OME-PCI-1002H, OME-PCI-1002L: 32 single-ended/16 differential
Resolution: 12-bits
Maximum Conversion Rate:
  OME-PCI-1002H: 40 KS/s
  OME-PCI-1002L: 110 KS/s
Input Impedance: 10,000 MΩ/6pF
Overvoltage Protection: ±35V
Accuracy: 0.01% of reading ±1-bit
Linearity: ±1-bit

OME-PCI-1002L Input Ranges (Low Gain)

Gain	Bipolar	Sampling Rate (Maximum)
1	±10V	110 KS/s
2	±5V	110 KS/s
4	±2.5V	110 KS/s
8	±1.25V	110 KS/s