

## ME 360: FUNDAMENTALS OF SIGNAL PROCESSING, INSTRUMENTATION AND CONTROL

### Laboratory No. 2 Signal Conditioning and Analog-to-digital Signal Conversion Issues Data Sheet

#### 5.2 SINE WAVE RECONSTRUCTION

##### Qualitative Observations

In the table below, sketch the original and reconstructed waveforms at the frequencies, 200 Hz, 1000 Hz, 1950 Hz, 2000 Hz and 2400 Hz. For each frequency, compare the base tones in the original and reconstructed signals, indicate whether aliasing is occurring, and describe the observed effects that support your finding.

Frequency Regime	Waveform Comparison Sketches	Base Tone Comparisons
200 Hz		
1000 Hz		
1950 Hz		
2000 Hz		
2400 Hz		

### 5.2 SINE WAVE RECONSTRUCTION (CONTINUED)

**Quantitative Data**

f [Hz]	f <sub>s</sub> [Hz]	f <sub>r</sub> [Hz]	s = f <sub>s</sub> / f	S <sub>apparent</sub>	Aliasing? (yes/no)	Max Error [V]
200	2000					
500	2000					
1000	2000					
1950	2000					
2000	2000					
2400	2000					

- f = frequency of original waveform as seen on display of function generator [Hz]
- f<sub>s</sub> = analog-to-digital sampling rate (fixed at 2000 samples per second) [Hz]
- f<sub>r</sub> = frequency of reconstructed waveform as measured by oscilloscope (Channel 2) [Hz]
- s = f<sub>s</sub> / f = actual samples / period of original waveform
- S<sub>apparent</sub> = count of the number of samples / period; *turn off Channel 1 when making this measurement*
- Max Error = worst-case error (absolute value) between original and reconstructed waveform [V]  
 = max [V<sub>original</sub>(t) - V<sub>reconstructed</sub>(t)]  
 = maximum difference between the original and reconstructed waveforms at the same instant of time

### 5.3 QUANTIZATION ERROR IN RAMP OUTPUT

**Ramp Output Measurements**

Scaling	D/A Converter Resolution [mV]					Average	DC Offset [V]
	Step 1	Step 2	Step 3	Step 4	Step 5		
2 mV / div							

**Compare the expected and measured digital-to-analog converter (DAC) resolution.**

**Explain what the Actual Analog Input plot shows.**

**5.4 THERMOCOUPLE TEMPERATURE MEASUREMENT**

Instrument	$T_{\text{ref}}$ [°C]	$V_{\text{TC}}$ [mV]	$T_{\text{meas}}$ [°C]
DMM			

**Calculations:**

Your TA showed you a demonstration of aliasing given a 60Hz interference on a thermocouple signal. What was the problem? What was the solution?