

12.7 Laboratory Procedure / Summary Sheet

Group: _____ Names: _____

- (1) Calculate the maximum allowable voltage range resulting in a measurement accuracy (quantization size) of 1 mV. The resolution of the USB 6009 is 13 bits in the mode that we will be using.

$$V_{\max} - V_{\min} = \text{_____} \text{ V (round down)}$$

Select a maximum and minimum voltage to be used in the LabView program if a $2\sin(200\pi t)$ V signal is to be measured.

$$V_{\max} = \text{_____} \text{ V} \qquad V_{\min} = \text{_____} \text{ V}$$

- (2) For the following input signal $2\sin(200\pi t)$ V, what is the Nyquist frequency? What is the sampling frequency that ensures the signal changes less than 0.4V (1/10 of V_{p-p}) between samples?

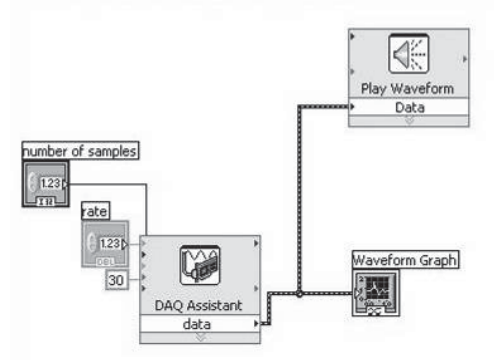
$$\text{Nyquist frequency} = \text{_____} \text{ Hz} \qquad f_s = \text{_____} \text{ Hz}$$

Fill out the following table to display 4 periods of the analog signal. Round up and remember to account for the starting sample (i.e. add 1).

Sampling Rate (Hz)	Number of Samples
90	
150	
175	
200	
500	
1000	
2000	
3000	
4000	

- (3) Follow the procedure from Section 12.6 to create a LabView VI file.
- (4) Use a function generator to create the analog $2\sin(200\pi t)$ and connect the output to the USB 6009. Use the values from parts (1) and (2) as parameters in the LabView program and sketch the resulting waveforms on separate paper.
- (5) In this portion of the lab you will sample music at different sampling rates and listen to the resulting waveform.

Add the *Play Waveform* block to the block diagram which can be found in the Functions palette [Programming, Graphics and Sound, Sound, Output]. Press [OK] when the configuration dialog window appears. Wire the *data* input of the *Play Waveform* block to the data output of the *DAQ Assistant* block. Create a constant for the timeout input of the *DAQ Assistant* (using the same method used to create a control for the rate input) and set it to 30 (the letter icon will need to be selected from the Tools palette). Setting the timeout to 30 allows up to 30 seconds of music to be recorded. The block diagram should now look like the following figure.



Complete the following table in order for 15 seconds of music to be recorded for each sampling rate.

Sampling Rate (samples/sec)	Number of Samples
40,000	
20,000	
15,000	
10,000	
8,000	
6,000	
4,000	
2,000	
1,000	

Connect the two wires from a 3.5mm audio plug to the inputs of the USB 6009 and insert the plug into the output jack of a music player. Play and sample some music starting with a sampling rate of 40,000. At which frequency did the music start to sound bad? The maximum frequency that people can hear is 10-20 kHz, but most of the frequencies in an audio signal are well below this.

