

Lesson 17-18 Demo (Optional)

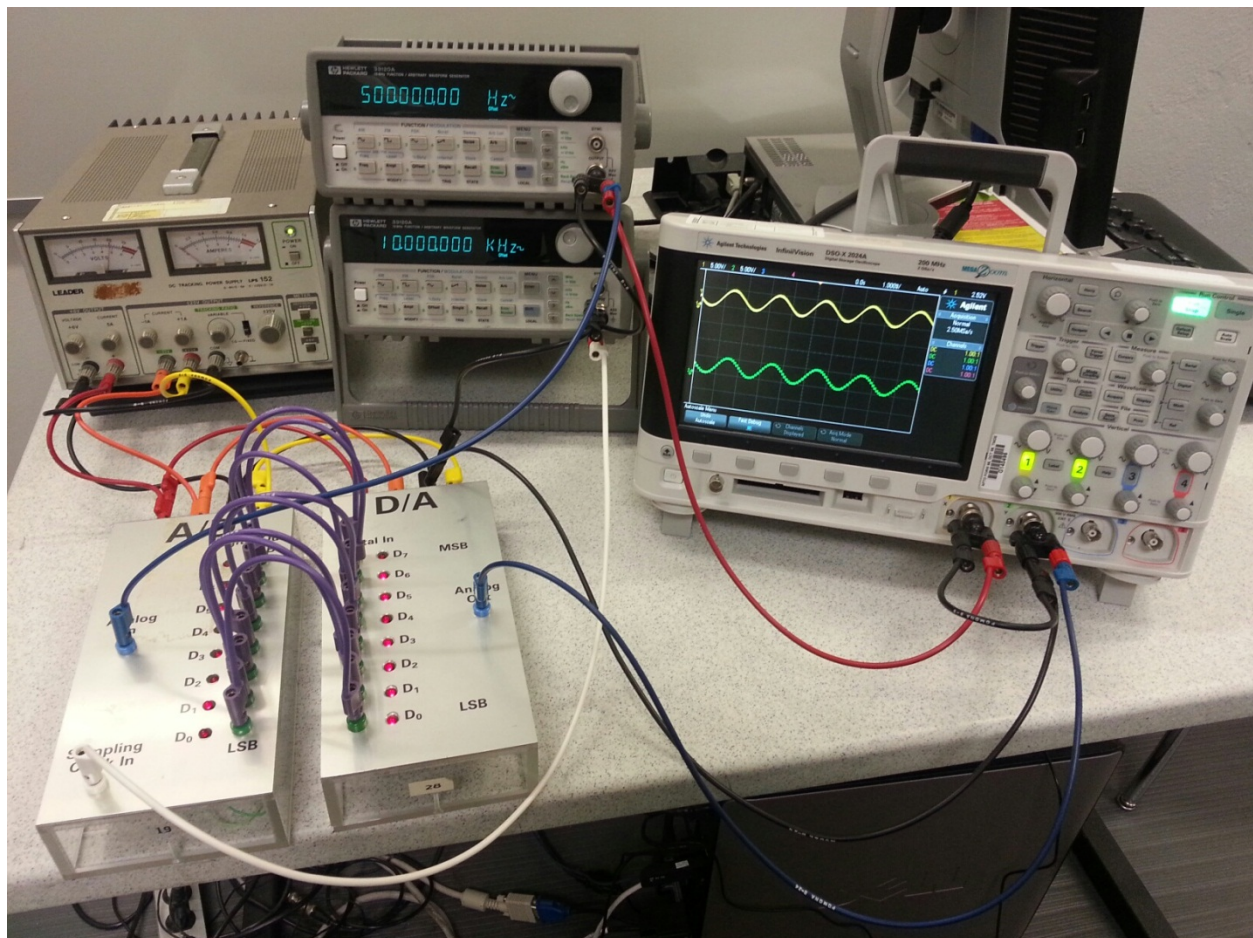
Purpose: To demonstrate a visual representation of Analog to Digital and Digital to Analog concepts including Resolution, Aliasing, Clipping and Smoothing.

Equipment:

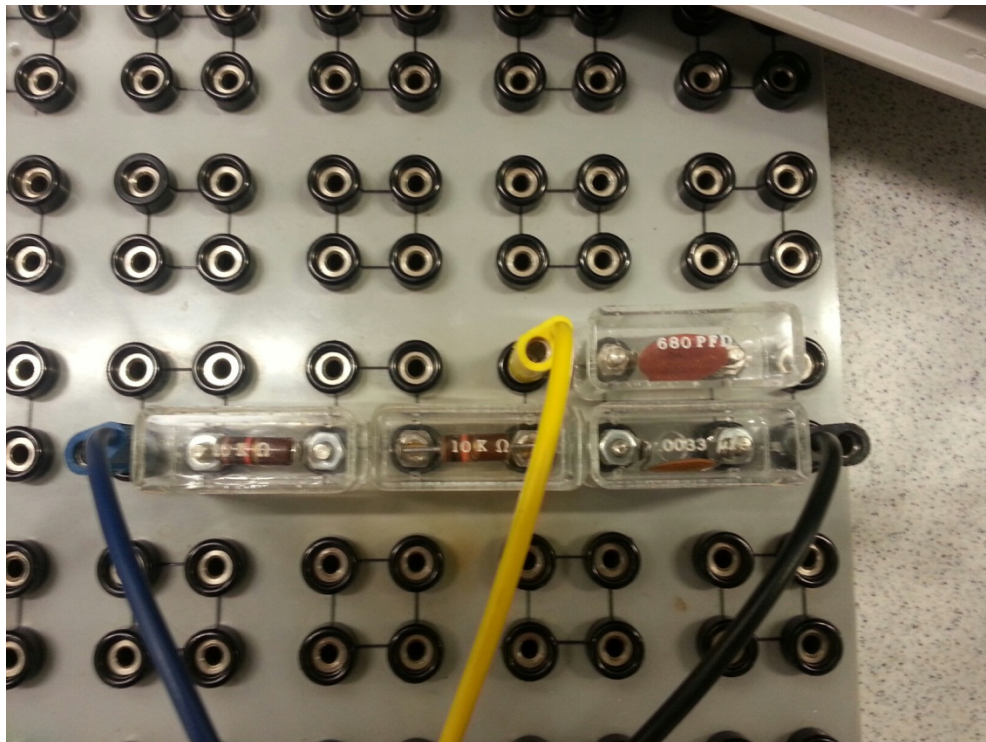
Power Supply, 2 Function Generators, Oscilloscope
ADC and DAC boxes
Numerous wires of different colors/lengths (see pictures)
Plugboard with 2 x 10k Ω resistors and 2 capacitors (I used a .0033 μ f and 680pf)

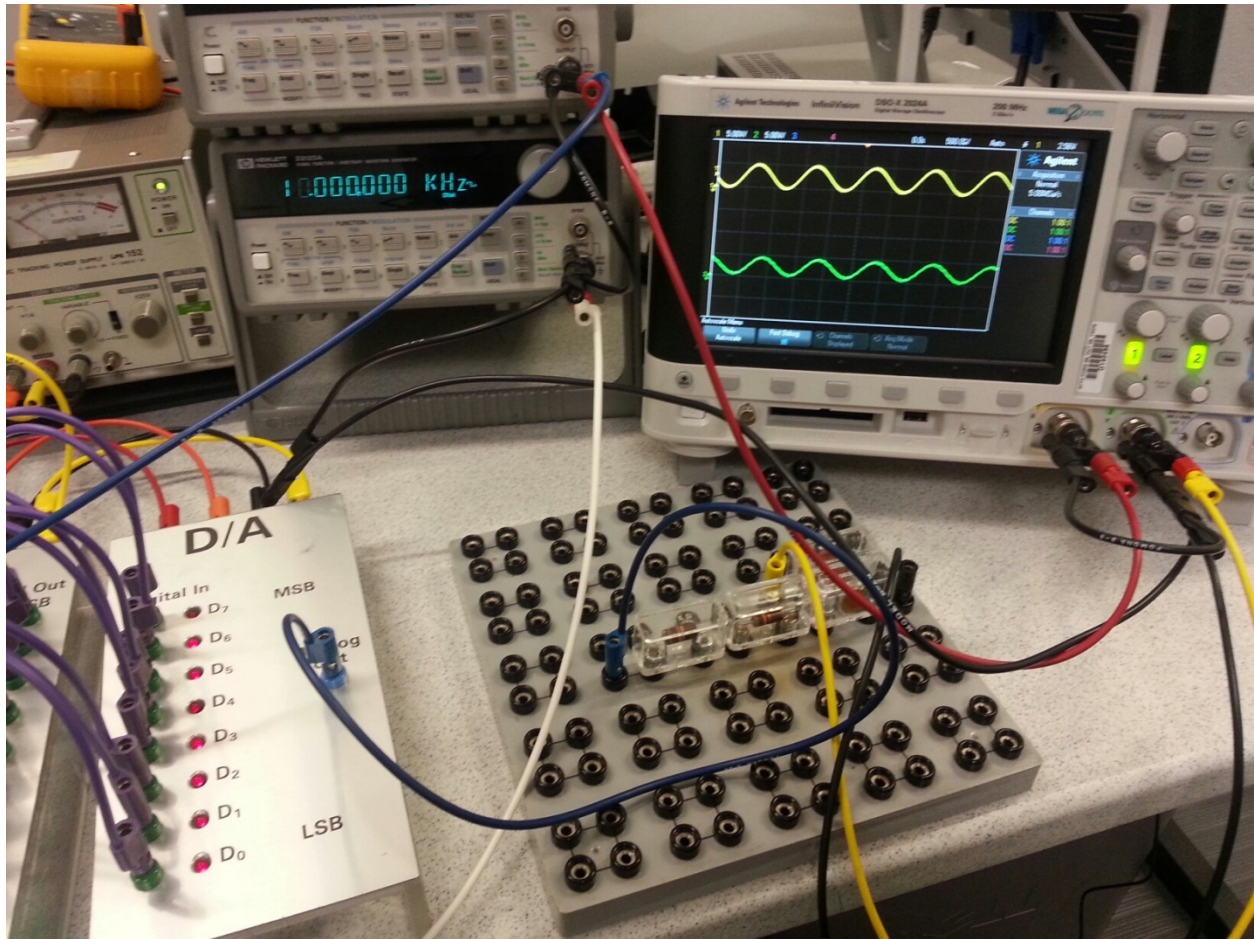
Procedure:

1. Set equipment up as shown in picture below, with the following settings:
 - a. Set first Funct Gen to make a 'clock' signal of 0-5 Vpp (5 Vpp with 2.5 V offset) @ 10 kHz
 - b. Set second Funct Gen to make a sinusoid of 0-5 Vpp (5 Vpp with 2.5 V offset) @ 500 Hz
2. Pressing the 'Auto Scale' button on the O-scope should give a good comparison of the original signal compared to the 'DC' stepped output of the DAC. Zoom in for a better look.



3. Show that less samples gives a less accurate picture. You can show this by changing the input signal frequency to 1 kHz. This effectively reduces the samples per cycle... meaning it should look less accurate.
4. Show Aliasing. I did this by changing the input signal frequency to 8 kHz. Now the 10 kHz clock frequency is not fast enough and does not meet Nyquist requirements. The DAC output should look different than the input signal, demonstrating the aliasing.
5. Show Clipping. Raising the input signal voltage to 10 Vpp should show a clipping of the top and bottom of the output signal from the DAC. Notice that the input will also become distorted while hooked up, so make a point of showing the input by itself by unplugging the DAC output first. Then hook up the DAC output to show the real comparison.
 - a. You can also try to show what happens when you have an input that is too small. This can be a bit tricky, but when I put the input signal voltage to 100 mVpp it definitely showed a very small range on the output. You may also notice when doing this that only a few of the LEDs on the ADC and DAC boxes will light up.
6. (Optional idea). If you have a smaller group, it may be cool to slow the sampling way down to show the lights changing on the boxes. This really does not do much other than show that the levels are changing, but it would look cool. I did this by slowing the clock down to 40 Hz.
7. Show Smoothing. To do this you will need to hook up a rough Low Pass Filter such as shown in the pictures below:





- a. You can show the smoothing very clearly by showing a zoomed in view of the output from the DAC without the filter, and then replacing it with the output from the filter.