Now, disable the Channel 2 view in the oscilloscope. Though you cannot see the waveform, the oscilloscope is still triggering on Channel 2. If you change the Sine's amplitude in Channel 1, you will see that the oscilloscope stays triggered for all values (the top-left says Trig'd) unlike before.

Beginning the Experiment

Change the mode of the function generator from Sine to Triangle to Square. Note each of these waveforms. The actual voltage levels of a waveform can be measured by double-clicking in the waveform window and using the cursor (double-click again to turn this off). To measure the peak-to-peak voltage (Vpp), add the Peak2Peak measurement to the Measurements window as previously described for the RMS voltage measurement.

In this lab, you will be comparing RMS voltage measurements between the AD2's voltmeter and oscilloscope. Note that the behavior you observe here is analogous to the behavior you would observe between a laboratory DMM[2] and oscilloscope.

Take the following measurements for each frequency and waveform type. Use Vpp = 5 V for all functions (NOTE: You are not setting 5 V as the amplitude!). You may use either triggering method covered thus far. (One way is easier than the other!)

WORK SHEET HERE: (100 Hz)

Wave Form	Oscilloscope Measured V_{rms}	DMM Measured V_{rms}	Calculated Theoretical V_{rms}	$\frac{\lvert Theoretical\ V_{rms} - DMM\ V_{rms} \rvert}{Theoretical\ V_{rms}}$ (%)
Sine:	1.77V	1.774V	1.768V	.34%
Triangle:	1.46 V	1.449V	1.443V	.42%
Square:	2.51V	2.489V	2.5V	.44%

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2 The DMM reports TRUE RMS and AC RMS. TRUE RMS is equivalent to DC RMS as described in the oscilloscope bonus.

WORK SHEET HERE: (3.7 kHz)

Wave Form	Oscilloscope Measured V_{rms}	DMM Measured V_{rms}	Calculated Theoretical V_{rms}	$\frac{\lvert Theoretical\ V_{rms} - DMM\ V_{rms}\rvert}{Theoretical\ V_{rms}}$ (%)
Sine:	1.79V	1.248V	1.768V $\left(\frac{2.5}{\sqrt{2}}\right)$	29%
Triangle:	1.45V	1.01V	1.443V $\left(\frac{2.5}{\sqrt{3}}\right)$	30%
Square:	2.51V	1.6V	2.5V	36%

WORK SHEET HERE: (25 kHz)

Wave Form	Oscilloscope Measured V_{rms}	DMM Measured V_{rms}	Calculated Theoretical V_{rms}	$\frac{\lvert Theoretical\ V_{rms} - DMM\ V_{rms}\rvert}{Theoretical\ V_{rms}}$ (%)
Sine:	1.78V	30mV	1.768V	98.3%
Triangle:	1.45V	24mV	1.443V	98.3%
Square:	2.5V	41mV	2.5V	98.4%

What's your observation regarding the voltmeter/DMM reading's accuracy over different frequencies within the same waveform? Can you guess why that's the case?

When the frequency increases, the accuracy decreases tremendously. There is much higher error at 25kHz than at 100Hz.

I predict that the voltmeter is better with AC current than DC current. Also, the high frequency throws it off.

ANSWER HERE:

Check bottom of previous page sorry

Does the voltmeter/DMM perform poorer when measuring square or triangular waves over sine waves? Can you guess why that's the case?

ANSWER HERE:

Both square and triangle waves give poorer readings than sine waves. Square waves are slightly poorer than triangle waves. This is because sine waves are continuously differentiable. This offers smoother readings as there are no corners or sharp edges.

Take these questions as a cautionary exercise in knowing what limits your measuring devices have. Here you've seen that DMMs are not suited for use at high frequencies!

Spectrum Analyzer – Knowing how your input signals are constructed

In this part of the lab you'll be learning how to display and analyze your input signal in the frequency domain, as well as learning how other types of periodic signals (e.g. square waves) are formed from sinusoids with different frequencies.

Setting up your Oscilloscope for Spectrum Analyzing

1. Start the Scope and Wavegen applications as done previously. For this section, only connect Channel 1 of the oscilloscope and function generator.

WORK SHEET HERE (SQUARE WAVE ANALYSIS)		
N^{th} Harmonic	Measured value in dB scale: $20 * log\left(\frac{V_{Nth\ harm.}}{V_{1st\ harm.}}\right)$	Theoretical value in dB scale: $20 * log\ (1/n)$, n=odd; $-\infty$, n=even.
1	0	0
2	-80	$-\infty$
3	-9.2	-9.54
4	-80	$-\infty$
5	-14.4	-13.98
6	-80	$-\infty$
7	-16.6	-16.9
8	-80	$-\infty$
9	-20.2	-19.08
10	-80	$-\infty$

End of Lab 2.