

EE 211 Lecture 1
Thomas H. Ortmeyer

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Clarkson University

Lecture Outline

- Lab Safety and Performance
- Writing Assignments
- Lab 1– Measurement Error
- Lab 2– Oscilloscopes 1

Lab Safety

- Review the following documents:
 - Lab_Safety_Manual.pdf
 - Basic Safety.pdf
- Basic Rules
 - 2.5 The work area must be kept in neat order.
 - 2.6 Be familiar with the proper operation of all equipment and instrumentation before attempting to use it. Do not drop any equipment.
 - 2.7 Professional conduct must be observed at all times.
 - 2.8 Food and drink may not be present in the work area.

– **3. Proper Attire**

- 3.1 Long hair must be tied or restrained to prevent accidental contact with equipment
- 3.2 Loose or hanging clothing must not be worn. This includes ties, scarves, etc.
- 3.3 Loose jewelry must be avoided.
- 3.4 Shoes must be worn at all times in the lab
- 3.5 A shirt or other top must be worn at all times
- 3.6 Long pants must be worn when soldering, using high voltage equipment, or using machine tools. They are recommended for all other activities in the laboratory

- 2.10 Make circuit connections with all power sources off.
- 2.11 When feasible, activate adjustable power sources at a low level when powering an untested circuit.
- 2.12 Make sure that all components and instrumentation have the proper ratings and are used on the appropriate range.
- 2.13 Determine whether a piece of test equipment uses a grounded lead, and, if so, which lead is grounded. Use equipment accordingly.

4. Equipment malfunctions

4.1 All equipment malfunctions must be reported and the equipment removed from service.

4.2 A blown fuse or circuit breaker is evidence that something is wrong with your circuit.

Determine and rectify the problem prior to re-energizing.

4.3 Inspect all equipment for loose or damaged wiring before use.

MEDIUM VOLTAGES (>40v) HAVE ADDITIONAL RULES!!!

Technical Report Writing

- Reports are designed to convey information efficiently
- They are written to serve a variety of readers
- The EE 211 Report Style Guide is online at <http://people.clarkson.edu/~ortmeyer/ee211/>

Lab 1

- Equipment: Handheld digital voltmeter (DVM). Also measures ohms, amps, etc.



DVM Specification– DC voltage

- This is a 4 ½ digit meter
- It's specification is $\pm(0.25 \% + 2 \text{ digits})$
- 0.25% is percentage of the actual reading
- The 2 digits refers to error in the lowest resolution digit.

Example– on the 20 volt scale,
the reading is 12.37 volts

- The resolution is 1 millivolt
- The maximum percentage error is $0.0025 * (12.37\text{v}) = 0.03\text{v}$
- The digitizing error is 0.02v
- The actual voltage then would be in the range of 12.37 ± 0.05 volts, or between 12.32v and 12.42v (if the meter meets spec.)

In this lab, we will take several sets of measurements, and determine the measured accuracy of meters, power supplies, and resistors. A common question is whether or not a certain lot of devices meets the specification.

Using 6 meters to measure the same 5 volt power supply--

Measurements are:

5.04v

5.17v

5.06v

5.18v

5.15v

6.24v

What do these numbers mean?

Using 1 meter to measure 6 power supplies--

Measurements are:

5.04v

5.17v

5.06v

5.18v

5.15v

0.03v

What do these numbers mean?

Meeting Specifications-- 1

Deterministic–.

For a 5kohm resistor (nominal) resistor with a $\pm 10\%$ specification– the resistor will meet spec. if it is anywhere between 4.5kohm and 5.5kohms.

Meeting specifications– 2

How do you determine if a lot of 100,000 5kohm resistors meets this specification?

Meeting Specifications-- 3

Option 1: Test a sample of the selection, and use statistics:

Calculate the sample mean.

Calculate the sample standard deviation

Use these values to determine if the lot is acceptable.

Alternatives

100% testing on the loading dock

Pre-qualifying of vendors

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Analysis

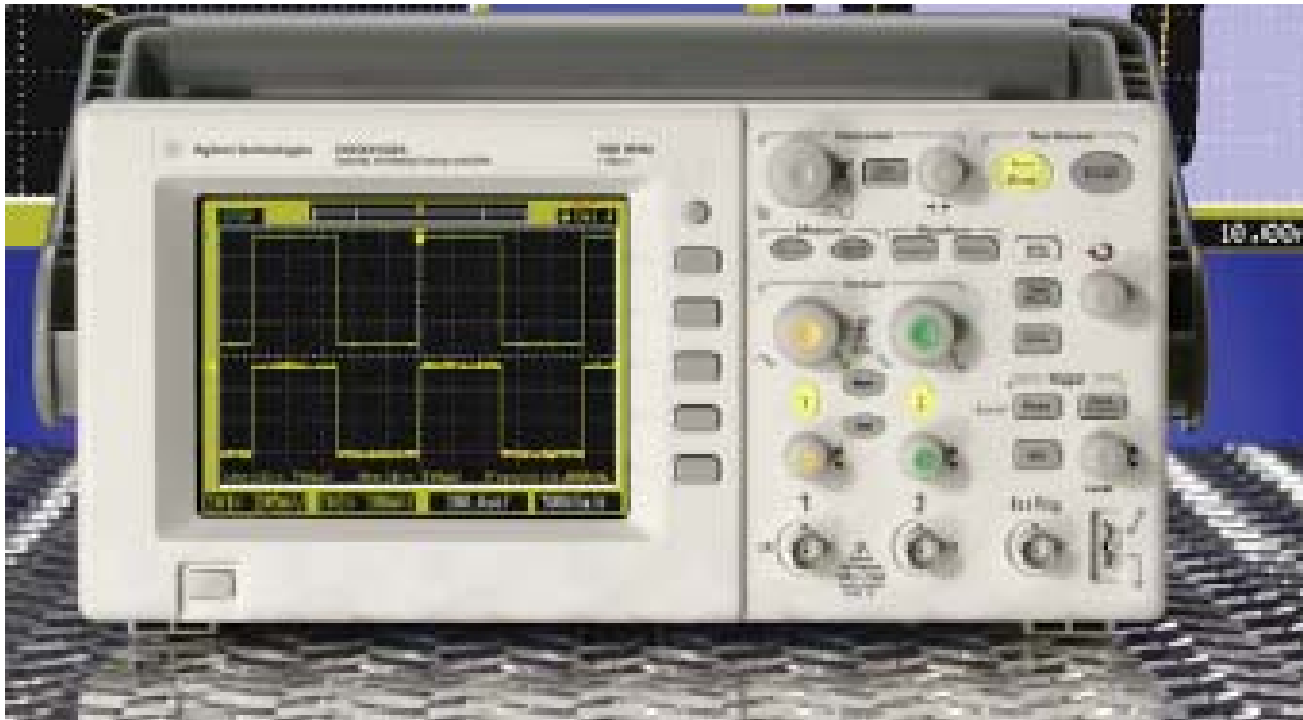
- Enter your measurements in an excel spread sheet
- Go to Tools>Data Analysis>Descriptive Statistics
- Select Summary statistics, and 95% confidence level for computation.

You will be asked to record your results on the handout which is provided in the lab. You will be asked to write a conclusion. Your group should discuss this conclusion, and agree on what to submit.

This conclusion needs to include the following elements:

- A brief statement on the purpose of the lab.
- A summary of the key measurements, which includes a comparison with expected results.
- A summary and/or conclusions, which could include comments on the quality of the results, the meaning of the results, etc.

Lab #2 Oscilloscopes



Web resources

<http://www.facstaff.bucknell.edu/mastascu/eLessonsHTML/EEIndex.html>

http://physics.mtsu.edu/~phys2020/Lectures/L12-L16/L16/Basic_Controls/basic_controls.html

Things to know about scopes

- Input channels are often grounded
- Triggering is a common frustration
- The most common use is a sweep of voltage vs. time— the oscilloscope will trace a plot of voltage vs. time across the screen, beginning at the trigger point.
- It is important to understand what you are seeing on the scope trace.

Equipment List

- Bench Instruments— oscilloscope, function generator, and bnc-bnc connector.
- FG basics—
 - You will use amplitude, frequency, and offset controls, which are set by pushbuttons.
 - When one of these is selected, you can adjust the value by using either the knob or the pushbuttons (arrows) Use the arrow buttons for large changes.

Taking measurements with oscilloscopes

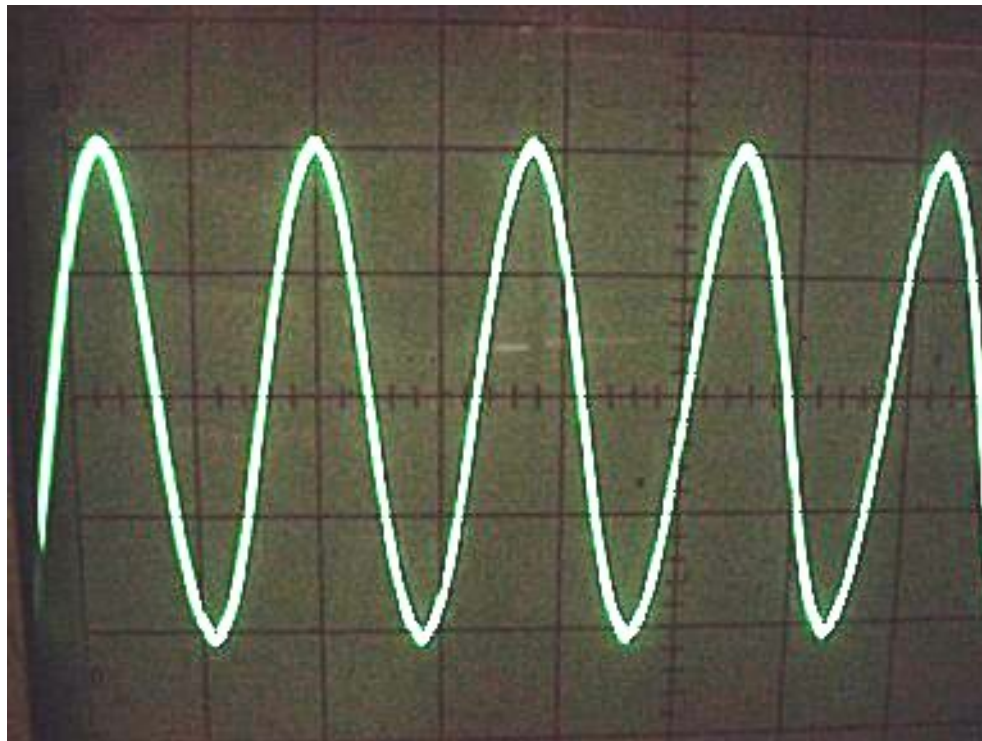
- The oscilloscope has horizontal and vertical amplifiers which drive the trace across the face of the screen.
- The horizontal and vertical gains are adjusted in order to provide a stable trace which provides good resolution.

Example: The vertical setting on a scope is 2 volts/div, and the horizontal gain is 0.5 milliseconds per division.

What is the peak-peak amplitude of this voltage wave?

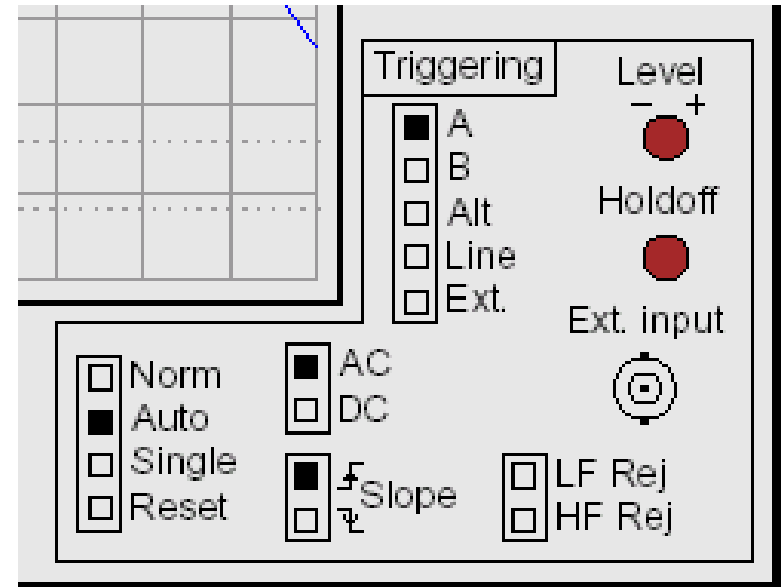
What is the period of this wave?

What is the frequency of this wave?

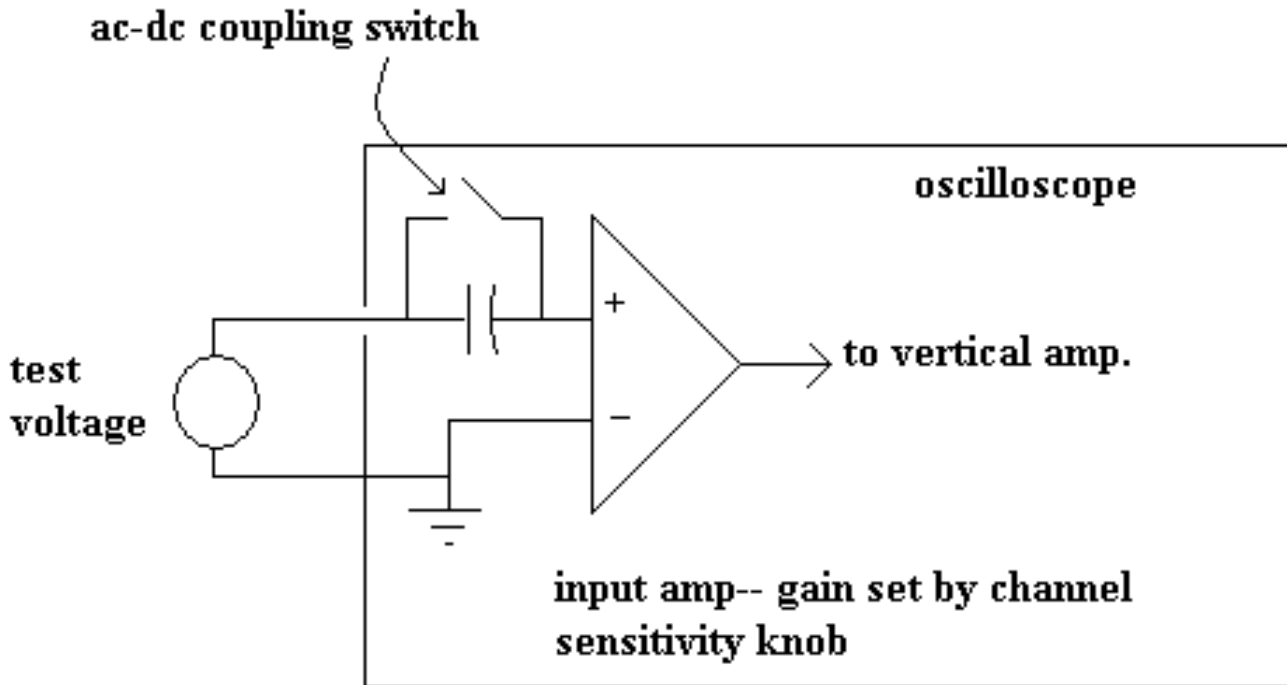


Triggering tricks

Lack of triggering can result from triggering off the wrong channel, having the trigger level set wrong, or have the coupling set wrong.



“dc” and “ac” coupling switch



Lab Performance

We will measure a variety of waves in this lab, and also investigate several different modes of operation of the oscilloscope.

Please review the definitions of peak, peak-peak, and rms amplitude. Also review the definitions of period, frequency (hertz) and angular frequency (radians per second).