CS150 Lab Lecture 4: Using Test Equipment

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Fall 2001

Test Equipment

- HP E3630A Triple-Output Power Supply
- Fluke 8010A Digital Multimeter
- HP 8112A Pulse Generator
- HP 54645D 100 MHz Mixed Signal Oscilloscope

Overview

- Test Equipment Introduction
- Lab Hints

HP E3630A

- Power Supply
- 3 output voltages
- +6V, +20V, –20V

Past Labs

- Load circuits onto Xilinx and everything works
- What if there are problems?
- Time for debugging/test equipment!

HP E3630A

Press '**meter**' buttons for voltages

Set **Tracking Ratio** to right
Use knobs to set voltage

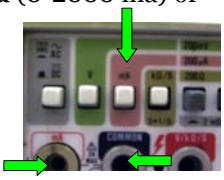
Use leads with **COM**
And the correct voltage

HP E3630A

- Don't directly connect COM to voltage
- Large current will flow
- $P = I^2R$ means resistors and wires will fry
- As a safety feature, current is limited

Measuring Current

- Press **mA** button
- Connect black lead to **Common**
- Connect red lead to **ma** (0-2000 ma) or **10A** (0-10A)
- Connect in series to measure current

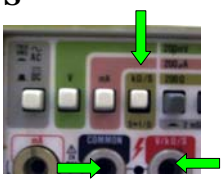


Fluke 8010A Digital Multimeter

- Measures AC/DC Voltage, Current, and Resistance
- More accurate than the power supply display

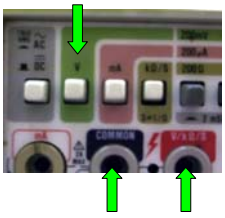
Measuring Resistance

- Press **kΩ/S** button
- Connect black lead to **Common**
- Connect red lead to **V/kΩ/S**
- Device must be removed from circuit before measurement



Measuring Voltage

- Press **V** button
- Connect **Common** to ground, and **V/kΩ/S** to voltage to measure
- Connect probes in parallel



Adjust Measurement Scale

- Adjust the scale based on the range of values you expect

HP 8112A Pulse Generator

- Generate single or period square waveforms
- Can vary voltages, periods, duty cycles, pulse widths, and slew rates

Oscilloscopes

- Can show analog signals and digital signals from Xilinx pins
- Valuable Resource
- Useful on project
- Use soft menus to navigate

Changing Values

Set **Mode** to Norm
CTRL to nothing
Use **PER** for period

DTY is duty cycle
WID is pulse width
HIL set high voltage
LOL sets low voltage

Analog Inputs

- Two analog inputs
- **Volts/Div** knobs sets Y axis
- **Auto-scale** (white button) does a lot of work for you

- Can get exact measurements for voltage, time, etc
- Use buttons, then follow menus

Adjusting Values

- Use **Vernier** to change value of each digit
- **Range** changes magnitude
- Make sure **disable** is off

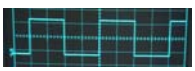
- Use shown probe
- Has two leads

Triggering

- Triggering determines when to catch and display signals
- Trigger menus for manual adjustment

Bad Triggering ➡

Good Triggering ➡



Digital Inputs

- 16 inputs
- Input knob selects pin
- Main method of seeing
- Xilinx signals
- Careful when attaching pins
- Don't bend pins



Lab 4

- Measure Power Supply Voltage
- Observe Pulse Generator with Scope
- Both basic operations described earlier

Digital Triggering

- Pattern matching
- Check signal for High, Low, Positive Edge, Negative Edge, or don't care
- For project, useful to label pins so easier to identify


Rest of Lab

- Download two ROM circuits
- First circuit repeatedly outputs 3 16 bit outputs
- Use trigger and storage to capture information
- 1 output is known, so it can be used as a reference to determine exact contents of other two outputs

Save/Recall

- Store sweeps of data
- **Single** gets one sweep
- **Run/Stop** freezes current output
- **Auto-store** stores on triggers

Rest of Lab

- Second circuit used to measure propagation delay
- Logic analyzer used to measure worst-case delay
- Use triggers to mark when worst case transition occurs
- Delay can be measured off analyzer