Overview

- Test Equipment Introduction
- Lab Hints
Past Labs

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

Test Equipment

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

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

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

**Fluke 8010A Digital Multimeter**

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

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

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
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

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

Changing Values

- Set **Mode** to Norm
- Set **CTRL** to nothing
- Use **PER** for period
- **DTY** is duty cycle
- **WID** is pulse width
- **HIL** set high voltage
- **LOL** sets low voltage
Adjusting Values

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

- Use shown probe
- Has two leads

Oscilloscopes

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

**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

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
Save/Recall

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

Lab 4

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

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