ECE 3254 PreLab 1 notes

Edited 08-14-2009

Pspice 9.1 Student Edition

Pspice is a tool for testing a circuit design - via a simulation program that models the behavior of an electrical circuit in DC, AC, and/or transient conditions. A library of standard parts is included in the installation package. Models for specialized parts are often available from the internet and/or the part's manufacturer.

To run a Pspice simulation, you will

- Draw a basic schematic of the circuit.
- Adjust the component and source values to match your desired circuit values.
- Add voltage and current probes and/or markers where you wish to perform measurements.
- Set up the analysis.
- Run the simulation

Pspice can do several types of circuit analyses, including:

- Non-linear DC analysis: calculates the DC transfer curve.
- Non-linear transient analysis: calculates the voltage and current as a function of time when a large signal is applied.
- Linear AC Analysis: calculates the output as a function of frequency. A bode plot is generated.
- Noise analysis
- Sensitivity analysis
- Distortion analysis
- Fourier analysis: calculates and plots the frequency spectrum.
- Monte Carlo Analysis

All analyses can be done at different temperatures. The default temperature is 300K.

The circuit can contain the following components:

- Independent and dependent voltage and current sources
- Resistors
- Capacitors
- Inductors
- Mutual inductors
- Transmission lines
- Operational amplifiers
- Switches
- Diodes
- Bipolar transistors
- MOS transistors
- JFET
- MESFET
- Digital gates (PSpice, version 5.4 and up)

Pspice Voltage and Current Conventions:

1. Voltage probes may be placed at any wiring point on the circuit diagram. A single ended voltage probe will be referenced to 0V ground. A differential probe (dual probe) will measure the voltage between the two probes with the negative (–) probe as the reference voltage.

2. Current probes must be placed at a part connection (where the part terminal begins), and positive current is flowing out of that pin or wire away the part. Negative current would flow into the connection pin and toward the part.

NOTE: Do not attempt to use Pspice as a primary design tool (where you keep changing the component values in an attempt to get the result you want). Think of Pspice as a software breadboard that you use to verify a design/calculation that you have already completed on paper.

Lab 1 will go more quickly if you take some time to begin entering the schematic(s) into Pspice at home. Follow the instructions in the Lab 1 Handout to create a simple Pspice simulation.

Lab Computers

The lab computers use Windows XP and Labview software to control the instruments, capture data, and store the data to a floppy disk or USB stick. All printing is done from the computer on the front desk.

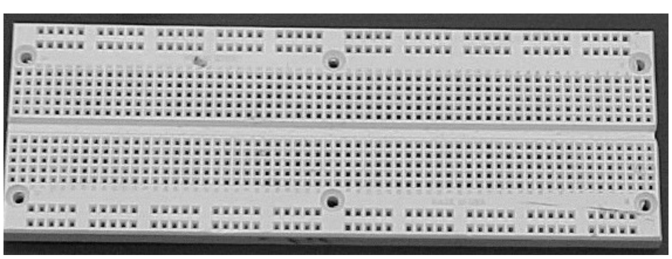
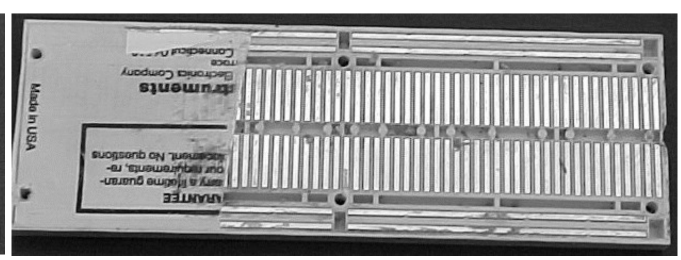
The data is printed as jpeg image captures of the data plots. If you wish to preserve the actual data values, you should transfer the txt files to a floppy/USB stick using windows explorer or the buffer save file option.

Labview Menus

- Waveform – controls function generator output
- Oscilloscope – captures waveforms
- AC Sweep – measures frequency response Vo vs. input frequency
- DC Sweep – measures DC voltage response Vo vs Vin
- Buffer – graphically displays data captured, uses cursors to measure parameters, saves data plots as jpeg image file, can load and/or save raw data files

Protoboard

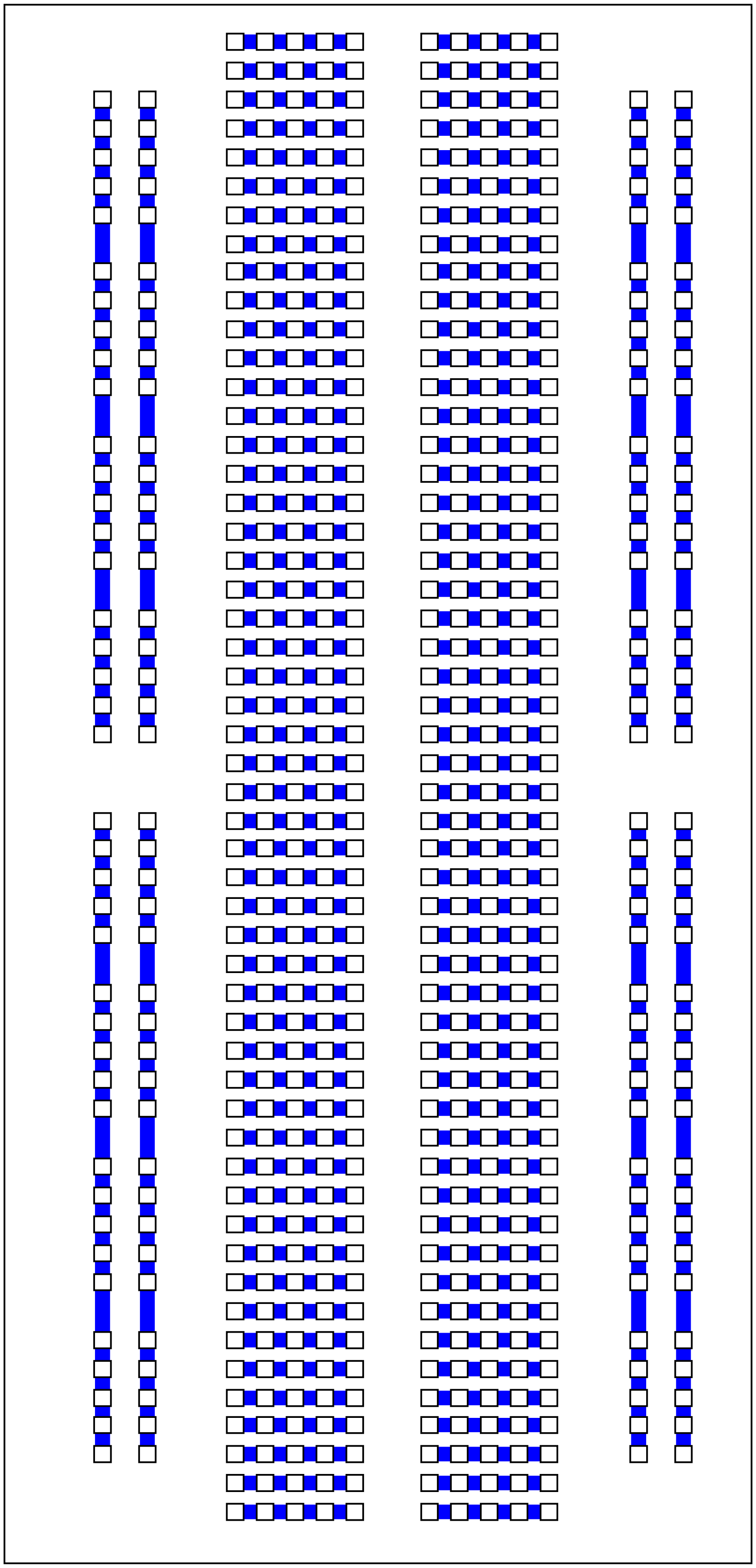
Internally the protoboard consists of conductive metal strips separated by plastic insulation.

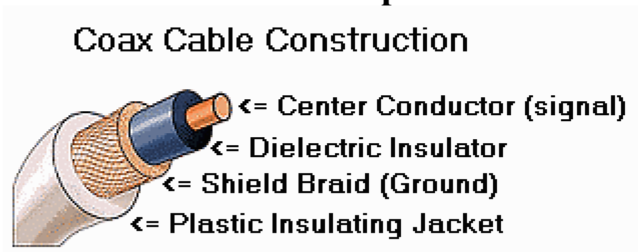
The protoboard is arranged so that each section of five vertical holes is one strip.
The two horizontal rows at the top and bottom of the protoboard are each connected as a bus. The bus does not cross the center of the board. See the backless protoboard in the desk drawer for clarity.

The protoboard has an upper usable frequency limit of 4 MHz due to strip inductance and the capacitance between strips.

Protoboard Bus Layout – blue is metal conductor that connects the holes



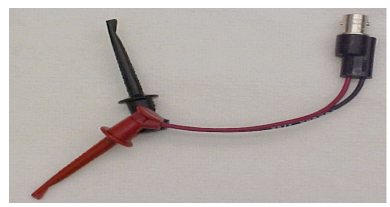
Coax Cable and Coax Adapters



The RG-58 Coax cables in this lab have a BNC connector on each end.

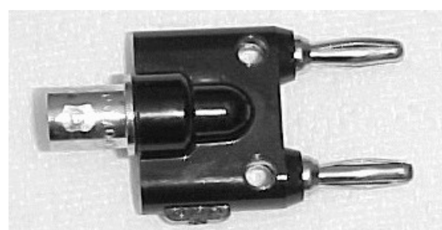
- RG-58 is a transmission line with a 50 Ω characteristic impedance and a 2GHz frequency limit.
- BNC Shell is ground (connected to the shield braid)
- BNC Center connector is connected to the signal conductor
- Under certain conditions a coax cable (two conductors separated by a dielectric insulator) acts as a capacitor!
- FWIW: BNC stands for **B**ayonet (connection type) **N**eil-**C**oncelman (the inventors)

BNC to Clip (Mini-grabber) adapter



- 3 in box on each bench
- Black Grabber = Shield = ground
- Red Grabber = signal
- Do not connect a Red Grabber of one cable to a Black Grabber of another cable – this produces a short circuit through the coax shield.

BNC to Banana adapter



↑ Tab (or Foot) = Ground

- 3 in box on each bench
- Used to connect BNC cables to power supplies, meters, protoboards, etc.
- May be used to connect power supplies, decade resistance boxes, meters, and isolation transformers to your circuit.

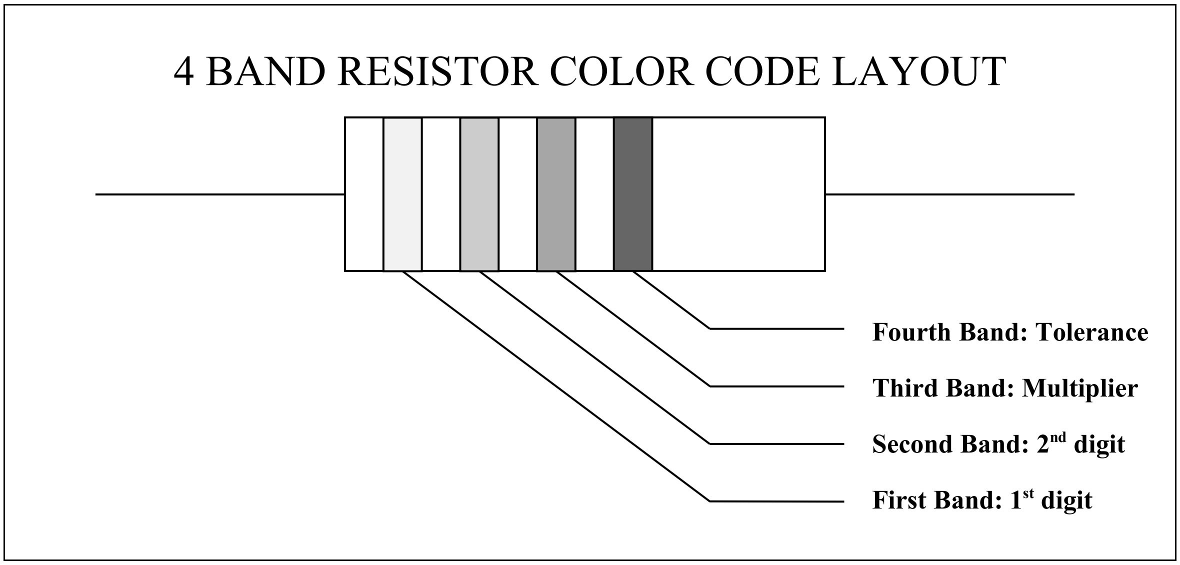
BNC T

- 3 in box on each bench
- Use to connect two cables to one BNC connector (i.e. One "input signal" cable from Function Gen to scope and one "input signal" cable to your circuit)

Voltage, Current, and Resistance

Except for special superconductors, every conductor resists the flow of electrical current. This resistance to current flow produces a voltage drop across the material through which the current is flowing.

George Ohm defined the relationship between voltage (V) and current (I) as resistance (R).
1 Ampere flowing through a 1 Ohm (Ω) resistance produces 1 Volt. Voltage, current, and resistance are related by Ohm's law which states that V = I*R.



COLOR	1ST DIGIT	2ND DIGIT	MULTIPLIER	TOLERENCE
Black	0	0	1	± 20%
Brown	1	1	10	± 1%
Red	2	2	100	± 2%
Orange	3	3	1000	± 3%
Yellow	4	4	10000	± 4%
Green	5	5	100000	NA
Blue	6	6	1000000	NA
Violet	7	7	10000000	NA
Gray	8	8	100000000	NA
White	9	9	1000000000	NA
Gold	NA	NA	0.1	± 5%
Silver	NA	NA	0.01	± 10%

COLOR BAND VALUES