Circuit Modeling Overview

Introduction

The Venable software contains a built-in circuit-modeling program. This program is similar to SPICE in that it works from a net list. It is a relatively simple program. There are no libraries of parts and only AC analysis is performed. The advantage of this program is that it is very quick and easy to create and analyze models. It is easy to create accurate models of actual circuits since it is so easy to compare the model results with actual test results and also easy to change the model to make the model data match the test data.

We recognize that keying in a few lines of circuit description is not as glamorous as entering data with a schematic entry program, but we think you will find this method quicker and easier once you get used to it.

The following components are available:

V	Voltage source (volts)
I	Current source (amps)
R	Resistor (ohms)
L	Inductor (henries)
C	Capacitor (farads)
G	Conductance (mhos)

You can add annotation after any component designator. V, V213, or Vemf all will be interpreted as a voltage source.

The following abbreviations can be used for multipliers:

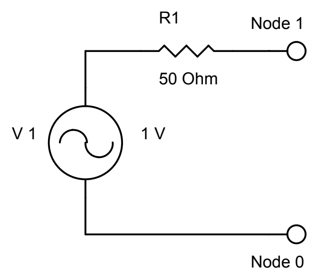
p or P	multiplied by 1E-12
n or N	multiplied by 1E-9
u or U	multiplied by 1E-6
m	multiplied by 1E-3
k or K	multiplied by 1E+3
M	multiplied by 1E+6
g or G	multiplied by 1E+9

The format of a source is:

Type of source	*positive control node*	*negative control node*	*value or gain*
Resistance	*positive connection node*	*negative connection node*	*value*

A special case is using 0 for both control nodes; this indicates a fixed source.

Spaces or commas separate entries.

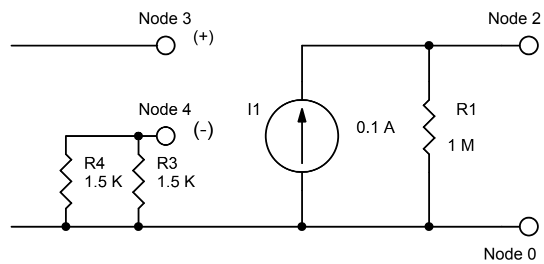


Example 1: Voltage Source

V 0 0 1

R 1 0 50

This is a fixed 1-volt source with an impedance of 50 ohms, connected in the circuit from node 1 (positive node) to node 0 (negative node). Node 0 is always circuit common.



Example 2: Current Source

I 3 4 0.1

R 2 0 1M

This is a current source controlled by the voltage from node 3 to node 4. It has a gain of 0.1, which means 1 volt from node 3 to node 4 will produce 0.1 amp from this source. It is connected in the circuit from node 2 to node 0, and is paralleled by a 1 mega-ohm resistor. Node 2 is in phase with node 3.

The format of a component is:

Component type	*connection node*	*connection node*	*value*

Example 3: Component (in this case, a capacitor)

C13 4 3 10U

This is a capacitor connected from node 4 to node 3 with a value of 10 microfarads. The order of the connection nodes is not significant. The number "13" after the C is any desired notation to identify the component, usually the reference designator.

Notes on model file creation:

Model files are ordinary ASCII text files. They can be created with any ASCII editing program such as Notepad in Windows.

Model files can have any extension, but if they have no extension a .CKT extension will be added when the circuit is saved.

Comment lines can be added at the beginning of a file by beginning each line with an asterisk.

Comments can be added at the end of any line. It is not necessary to begin a comment with an asterisk. The program will ignore anything on a line after reading the required four entries.

Blank lines are ignored.

Circuit node numbers must be sequential. They do not have to be entered in sequence, but all nodes from 0 to the highest number node must be present. A missing node number will generate an error.

Example 4: Circuit file for a low-pass filter

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*Low-pass R-C filter

V1  0  0  1

R1  1  0  1

R2  1  2  1K

C1  2  0  0.1U
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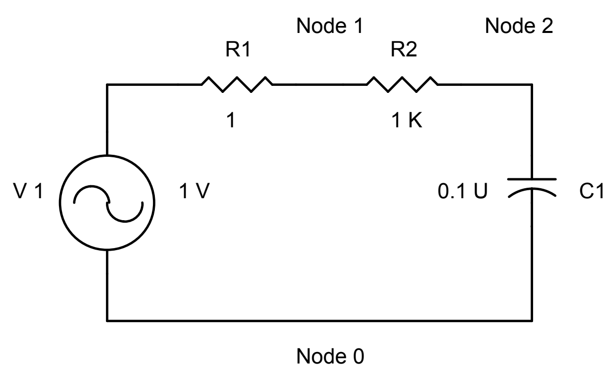
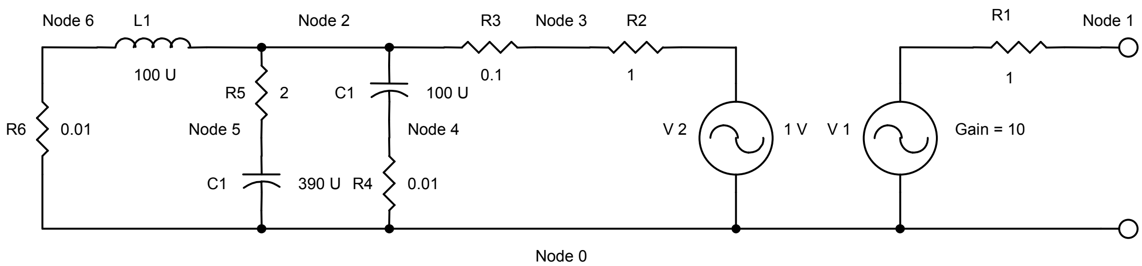


This circuit file represents a fixed one-volt source with a source impedance of 1 ohm driving a low-pass filter consisting of a 1,000 ohm resistor in series with a 0.1 microfarad capacitor to ground. When analyzed and plotted as the transfer function (Bode plot) from node 1 to node 2, the result will be a classic low-pass filter response. Since the result is plotted as the ratio of the voltage on node 2 divided by the voltage on node 1, the impedance of the source (1 ohm) does not enter into the calculation and the result will be the same no matter what the value of the source resistance.

Example 5: Measuring the output impedance of an input filter

*Model of input filter output impedance

V1 3 2 10	Controlled source translates current to ground reference. Gain=1/R3.
R1 1 0 1	Resistance of controlled source (value not significant)
V2 0 0 1	Fixed one volt source driving output of filter
R2 3 0 1	Impedance of test source (value not significant)
R3 3 2 0.1	Resistor to measure current. Different value changes gain of V1.
C1 2 4 100U	Output capacitance of L-C filter
R4 4 0 0.01	ESR of filter output capacitor
R5 2 5 2	Damping resistor
C2 5 0 390U	Capacitor to block DC current through damping resistor
L1 2 6 100U	Input inductance of L-C filter
R6 6 0 0.01	Resistance of input inductor



Normally R3 would be 1 ohm to simplify the calculation, and V1 would have a gain of 1. The values used in this example show the flexibility of the technique.

R6 is connected to ground to represent zero AC impedance of the power source.

In this example, filter impedance is measured as Node 2 over Node 1.

Note that the Venable system, unlike older Spice-type modeling programs, actually plots the ratio of the output to the input. Many older modeling programs require a one-volt source as an input and then plot absolute value of the output and pretend it is the ratio of output to input. This works when the input is exactly one volt, but the technique falls apart when the input is not one volt. When measuring gain by plotting the ratio of voltages on each side of an injection resistor, the capability to plot voltage ratios is essential.