

Electronic Devices and Circuits

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1 Circuit Analysis

1.1 Spice Elements

The passive and active circuit elements introduced in the previous section are all available in SPICE modeling; however, the manner of node specification and the voltage and current sense or direction are clarified for each element by Figure 1.1. The universal ground node is assigned the number 0. Otherwise, the node numbers n_1 (positive node) and n_2 (negative node) are positive integers selected to uniquely define each node in the network. The assumed direction of positive current flow is from the node n_1 to node n_2 . The four controlled sources—voltage-controlled voltage source (VCVS), current-controlled voltage source (CCVS), voltage-controlled current source (VCCS), and current-controlled current source (CCCS)—have the associated controlling element also shown with its nodes indicated by cn_1 (positive) and cn_2 (negative). Each element is described by an *element specification statement* in the SPICE netlist code. Table 1.1 presents the basic format for the element specification statement for each of the elements in Figure 1.1. The first letter of the element name specifies the device and the remaining characters must assure a unique name.

Example 1.1. Use SPICE methods to determine the Thévenin equivalent circuit looking to the left through terminals 3,0 for the circuit of Figure 1.1. In SPICE independent source models, an ideal voltage source of 0V acts as a short circuit and an ideal current source of 0 A acts as an infinite impedance or open circuit. Advantage will be taken of these two features to solve the problem.

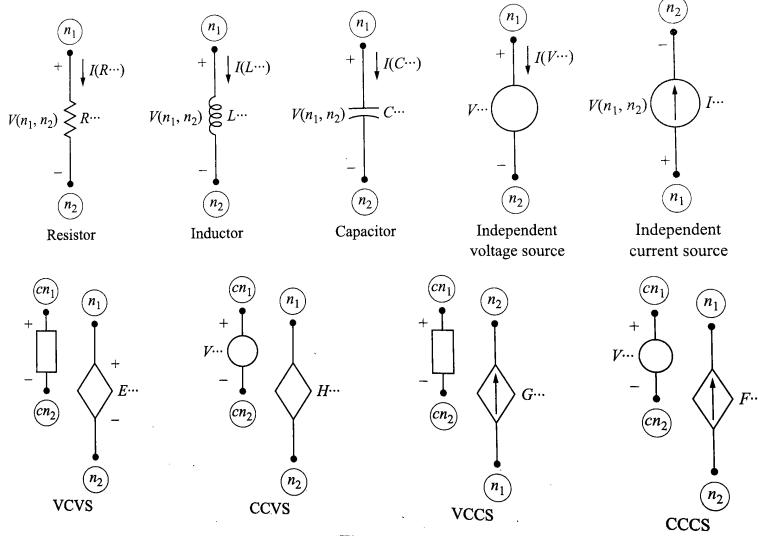


Fig. 1-2

Element	Name	Signal Type	Control Source	Value
Resistor	R...			Ω
Inductor	L...			H
Capacitor	C...			F
Voltage source	V...	AC or DC ^a		V ^b
Current source	I...	AC or DC ^a		A ^b
VCVS	E...		(cn ₁ , cn ₂)	V/V
CCVS	H...		V...	V/A
VCCS	G...		(cn ₁ , cn ₂)	A/V
CCCS	F...		V...	A/A

a. Time-varying signal types (SIN, PULSE, EXP, PWL, SFFM) also available.
b. AC signal types may specify phase angle as well as magnitude.

Load resistor R_L of Figure 1.1(a) is replaced by the driving point current source I_{dp} of Figure 1.1(b). The netlist code that follows forms a SPICE description of the resulting circuit. The code is set up with parameter-assigned values for V_1 , I_2 , and I_{dp} .

If both V_1 and I_2 are deactivated by setting $V1value=I2value=0$, current $I_{dp}=1$ A must flow through the Thévening equivalent impedance $Z_{Th} = R_{Th}$ so that $v_3 = I_{dp}R_{Th} = R_{Th}$.

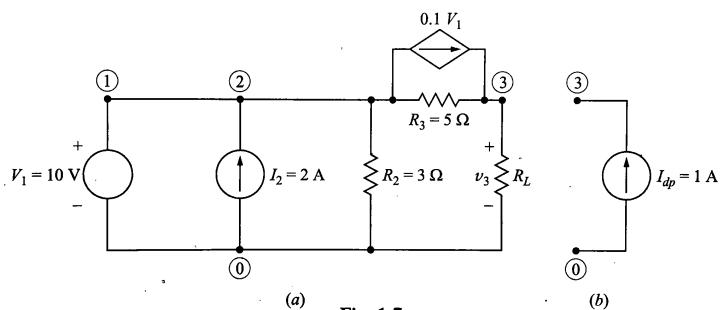


Fig. 1-7