Voltage-Controlled Voltage Source   vcvs

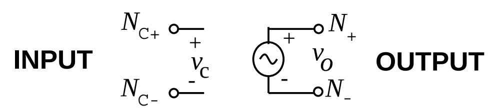

Figure 1: Voltage-controlled voltage source element.

Form:
`e:`⟨`instance name`⟩ n_1 n_2 $\cdots$ ⟨`parameter list`⟩
n_1, n_2 $\cdots$ are the element nodes.
Parameters:

Parameter	Type	Default value	Required?
k: gain	DOUBLE	1	no
ri: Input resistance value(Ohms)	DOUBLE	0	no
ro: Output resistance value(Ohms)	DOUBLE	0	no
$\mathrm{poly}_{\mathrm{coeff}}$: Coefficients of polynomial	DOUBLE VECTOR	See source file.	no
polydimension: Dimension of polynomial	INTEGER	1	no

Example (when called in spice mode):
```
E1 5 0 POLY(1) 3 2 1 2.5
```

Description:
The voltage controlled voltage source is either a linear or nonlinear function of controlling node voltages, depending on whether the polynomial is used or not.
Polynomial Functions:
The controlled element statement allows the definition of the controlled voltage source as a polynomial function of one or more voltages. Three polynomial equations can be used through the POLY(N) parameter. POLY(1) one-dimensional equation, POLY(2) two-dimensional equation, POLY(3) three-dimensional equation. The POLY(1) polynomial equation specifies a polynomial equation as a function of one controlling variable, POLY(2) as a function of two controlling variables, and POLY(3) as a function of three controlling variables. Along with each polynomial equation are polynomial coefficient parameters $(P_0, P_1 \cdots P_n)$ that can be set to explicitly define the equation.
One-Dimensional Function:
If the function is one-dimensional (a function of one node voltage), the function value FV is determined by the following expression:

$$FV = P_0 + (P_1.FA) + (P_2.FA^2) + (P_3.FA^3) + (P_4.FA^4) + (P_5.FA^5) + \cdots \tag{1}$$

FV   controlled voltage from the controlled source,

$P_0 \cdots P_n$ coefficients of polynomial equation,

FA   controlling nodal voltage.

If the polynomial is one-dimensional and exactly one coefficient is specified, *f*REEDA™assumes it to be $P_1 (P_0 = 0.0)$ to facilitate the input of linear controlled sources.
One-Dimensional Example:
The example given above is a one-dimensional function. The above voltage-controlled voltage source is connected to nodes 5 and 0. The single dimension polynomial function parameter, POLY(1), means that E1 is a function of the difference of one nodal voltage pair, in this the voltage difference between nodes 3 and

2, hence $FA = V(3,2)$. The dependent source statement then specifies that P0=1 and P1=2.5. From the one-dimensional polynomial equation above, the defining equation for V(5,0) is $V(5,0) = 1 + 2.5 * V(3,2)$.

Two-Dimensional Function:

Where the function is two-dimensional (a function of two node voltages), FV is determined by the following expression:

$$\begin{aligned} FV = {} & P_0 + (P_1.FA) + (P_2.FB) + (P_3.FA^2) + (P_4.FA.FB) + \\ & (P_5.FB^2) + (P_6.FA^3) + (P_7.FA^2.FB) + (P_8.FA.FB^2) + (P_9.FB^3) + \cdots \end{aligned} \tag{2}$$

For a two-dimensional polynomial, the controlled voltage source is a function of two nodal voltages. To specify a two-dimensional polynomial, set POLY(2) in the controlled source statement.

Three-Dimensional Function:

For a three-dimensional polynomial function with arguments FA, FB, and FC, the function value FV is determined by the following expression:

$$\begin{aligned} FV = {} & P_0 + (P_1.FA) + (P_2.FB) + (P_3.FC) + (P_4.FA^2) + \\ & (P_5.FA.FB) + (P_6.FA.FC) + (P_7.FB^2) + (P_8.FB.FC) + (P_9.FC^2) + \\ & (P_{10}.FA^3) + (P_{11}.FA^2.FB) + (P_{12}.FA^2.FC) + (P_{13}.FA.FB^2) + \\ & (P_{14}.FA.FB.FC) + (P_{15}.FA.FC^2) + (P_{16}.FB^3) + (P_{17}.FB^2.FC) + \\ & (P_{18}.FB.FC^2) + (P_{19}.FC^3) + (P_{20}.FA^4) + \cdots \end{aligned} \tag{3}$$

Notes:

This is the `E` element in the SPICE compatible netlist.

Version:

2002.05.01

Credits:

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