Voltage-Controlled Current Source — vccs

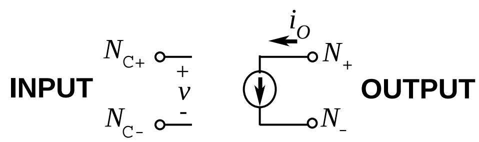

Figure 1: Voltage-controlled current source element.

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

Parameter	Type	Default value	Required?
g: Transconductance (Siemens)	DOUBLE	n/a	yes
ri: Input resistance value(Ohms)	DOUBLE	0	no
ro: Output resistance value(Ohms)	DOUBLE	0	no
$\text{poly}_{\text{coeff}}$: Coefficients of polynomial	DOUBLE VECTOR	See source file.	no
polydimension: Dimension of polynomial	INTEGER	1	no

Example:

```
G1 5 0 POLY(1) 3 2 1 2.5
vccs:g1 1 2 0 0 g=1e-3 ri=1e3 ro=2e3
```

Description:
The voltage controlled current 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 current 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 current from the controlled source,

$P_0 \cdots P_n$ coefficients of polynomial equation,

FA controlling node 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 current source is connected between nodes 5 and 0. The single dimension polynomial function parameter, POLY(1), means

that G1 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 I(5,0) is $I(5,0) = 1 + 2.5 * V(3,2)$.

Two-Dimensional Function:

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

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

For a two-dimensional polynomial, the controlled current 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:

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

Notes:

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

Version:

2002.05.01

Credits:

Name	Affiliation	Date	Links
Satish Uppathil	NC State University	May 2002	NC STATE UNIVERSITY
svuppath@eos.ncsu.edu			www.ncsu.edu