0.0.1 Voltage-Controlled Current Source — G

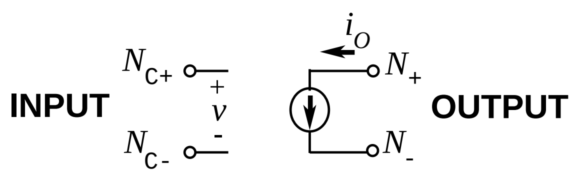

Figure 1: G — voltage-controlled current source element.

Form:

`Gname` N_+ N_- N_{C+} N_{C-} *Transconductance*

`Gname` N_+ N_- `POLY( D )` N_{C+} N_{C-} *PolynomialCoefficients*

N_+	is the positive voltage source node.
N_-	is the negative voltage source node.
N_{C+}	is the positive controlling node.
N_{C-}	is the negative controlling node.
Transconductance	is the transconductance.
`POLY`	is the identifier for the polynomial form of the element.
D	is the degree of the polynomial. The number of pairs of controlling nodes must be equal to *Degree*.
N_{Ci+}	the positive node of the i th controlling node pair.
N_{Ci-}	the negative node of the i th controlling node pair.
PolynomialCoefficients	is the set of polynomial coefficients which must be specified in the standard polynomial coefficient format discussed in the description.
`VALUE`	is the identifier for the value form of the element.
Expression	This is an expression of the form discussed in the description.
`TABLE`	is the identifier for the table form of the element.
TableInput	This is the independent input of the table. See the `TABLE` parameter above.
TableInput	This is the dependent output of the table. See the `TABLE` parameter above.
`LAPLACE`	is the identifier for the laplace form of the element.
TransformExpression	
`FREQ`	is the identifier for the frequency form of the element.
Frequency	
Magnitude	
Phase	
`CHEBYSHEV`	is the identifier for the chebyshev form of the element.
Type	
CutoffFrequency	
Phase	

Example:

```
G1 2 3 14 1 2.0
```

Description:
Polynomial expressions can be used with the controlled source elements (`E`, `F`, `G` and `H`) to realize nonlinear controlled sources. The specification of the polynomial must be at the end of the input line and has two forms. The polynomial format for a voltage-controlled current source (the `G` element) is

`POLY(`N`)` `(`N_{C1+}`,`N_{C1-}`)` ... `(`N_{CN+}`,` N_{CN-}`)` C_0 C_1 C_2 C_3 ...

where

`POLY`	is the keyword indicating that a polynomial description follows.
N	is the degree of the polynomial.
N_{C1+}, N_{C1-}	The voltage at the node N_{C1+} with respect to the voltage at the node N_{C1-} is the controlling voltage V_1.
N_{CN+}, N_{CN-}	The voltage at the node N_{CN+} with respect to the voltage at the node N_{CN-} is the controlling voltage V_N.
C_0 C_1 ...	are the polynomial coefficients. Not all of the coefficients need be specified as the trailing coefficients that are not specified are treated as if they are zero.

Note that in spice parentheses, "(" and ")", and commas, ",", are treated as if they are spaces. The use of parentheses and commas serves only to make the netlist more easily read. **The exception to this is their use in expressions.**

For voltage-controlled elements the output is calculated as

$$
\begin{aligned}
\text{OUTPUT} = \; & C_0 \\
& + C_1 V_1 + \ldots + C_N V_N \\
& + C_{N+1} V_1 V_1 + C_{N+2} V_1 V_2 + \ldots + C_{N+N} V_1 V_N \\
& + C_{2N+1} V_2 V_2 + C_{2N+2} V_2 V_3 + \ldots + C_{2N+N-1} V_2 V_N \\
& \vdots \\
& + C_{N!/(2(N-2)!)+2N} V_N V_N \\
& + C_{N!/(2(N-2)!)+2N+1} V_1 V_1 V_1 + C_{N!/(2(N-2)!)+2N+2} V_1 V_1 V_2 \\
& \qquad + \ldots + C_{N!/(2(N-2)!)+2N+N-1} V_1 V_1 V_N \\
& + C_{N!/(2(N-2)!)+3N} V_1 V_2 V_2 + \ldots + C_{N!/(2(N-2)!)+3N+N-2} V_1 V_2 V_N \\
& \vdots
\end{aligned}
$$

A one dimensional polynomial (with only one pair of controlling nodes) is evaluated as

$$\text{OUTPUT} = C_0 + C_1 V_1 + C_2 V_1^2 + C_3 V_1^3 + \ldots C_N V_1^N$$

An example of a voltage-controlled current source is

```
G1 2 3 POLY(4) (10,0) (12,2) (11,0) (13,0) 0.5 1 1 1 1 0.2 0.3 0.2
```

Several form of the voltage-controlled voltage source element are supported in addition to the Linear Transconductance form which is the default. The other forms are selected based on the the identifier `POLY`, `VALUE`, `TABLE`, `LAPLACE`, `FREQ` or `CHEBYSHEV`.

Linear Transconductance Instance

`G`*name* N_+ N_- N_{C+} N_{C-} *Transconductance*

The value of the voltage generator is linearly proportional to the controlling voltage:

$$v_o = Transconductance\, v_c \tag{1}$$

`POLY`nomial Instance

`G`*name* N_+ N_- `POLY(` D `)` `(`N_{C1+} N_{C1-}`)` ... `(`N_{CD+} N_{CD-}`)` *PolynomialCoefficients*

The value of the voltage generator is a polynomial function of the controlling voltages:

$$v_o = f(v_{c1}, ..., v_{ci}, ...v_{cD}) \tag{2}$$

where the number of controlling voltages is D — the degree of the polynomial specified on the element line. v_{ci} is the ith controlling voltage and is the voltage of the n_{ci+} node with respect to the n_{ci+} node.

`VALUE` Instance — PSpice92 only

`G`*name* N_+ N_- `VALUE=` { *Expression* }

The value of the voltage generator is the resultant of an expression evaluation.

$$v_o = f(v_c) \tag{3}$$

`TABLE` Instance — PSpice92 only

`G`*name* N_+ N_- `TABLE` { *Expression* }`=(` *TableInput* `,` *TableOutput* `)` ...

$$v_o = f(v_c) \tag{4}$$

`LAPLACE` Instance — PSpice92 only

`G`*name* N_+ N_- `LAPLACE` { *Expression* }`={` *TransformExpression* }

$$v_o = f(v_c) \tag{5}$$

<u>`FREQ`</u> — PSpice92 only

`G`*name* N_+ N_- `FREQ` { *Expression* }`=(` *Frequency*`,` *Magnitude*`,` *Phase* `)` ...

$$v_o = f(v_c) \tag{6}$$

<u>`CHEBYSHEV`</u> — PSpice92 only

`G`*name* N_+ N_- `CHEBYSHEV` { *Expression* }`=` *Type*`,` *CutoffFrequency* ... `,` *Phase* ...

Notes:
The actual element in *f*REEDA™is the `G` element. See `G` for full documentation.

Credits:

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