0.0.1 Current-Controlled Current Source **F**

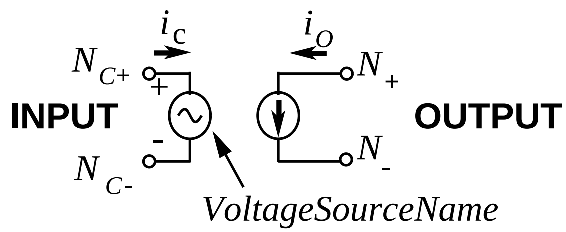

Figure 1: F — current-controlled current source element.

Form:
`Fname` N_+ N_- *VoltageSourceName Gain*
`Fname` N_+ N_- `POLY( D )` *VoltageSourceName* $_1$ ... *VoltageSourceName*$_D$ *PolynomialCoefficients*

N_+	is the positive voltage source node.
N_-	is the negative voltage source node.
VoltageSourceName	is the name of the voltage source the current through which is the controlling current. The voltage source must be a `V` element.
Gain	is the current gain.
`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*.
VoltageSourceName$_i$	is the name of the voltage source the current through which is the ith controlling current. The voltage source must be a `V` element.
PolynomialCoefficients	is the set of polynomial coefficients which must be specified in the standard polynomial coefficient format discussed in the description.

Example:
```
F1 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 format for a current-controlled current source (the `F` element) is

`POLY(`N`)` *VoltageSourceName*$_1$ ... *VoltageSourceName*$_N$ C_0 C_1 C_2 C_3 ...

where

`POLY`	is the keyword indicating that that a polynomial description follows.
N	is the degree of the polynomial.
$VoltageSourceName_1$	is the name of the voltage source the current through which is control current I_1.
$VoltageSourceName_N$	is the name of the voltage source the current through which is control current I_N.
$C_0\ C_1\ \ldots$	are the polynomial coefficients.

For these elements the output is calculated as

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

An example of a current-controlled current source is:

F1 2 3 POLY(4) VIN V2 (11,0) (13,0) 0.5 1 1 1 1 0.2 0.3 0.2.

Linear Gain Instance

`F`*name* $N_+\ N_-\ N_{C+}\ N_{C-}\ Gain$

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

$$v_o = Gain\, v_c. \tag{3}$$

`POLY`nomial Instance

`F`*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:

$$v_o = f(i_{c1}, ..., i_{ci}, ...i_{cD}) \tag{4}$$

where the number of controlling currents is D — the degree of the polynomial specified on the element line. i_{ci} is the ith controlling current and is the current flowing from the +

terminal to the − terminal in the ith voltage source of name *VoltageSourceName*.

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

Credits:

Name	Affiliation	Date	Links
Satish Uppathil	NC State University	Sept 2000	NC STATE UNIVERSITY
svuppath@eos.ncsu.edu			www.ncsu.edu