Structure of pHs `BJTAMP`

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1 System netlist

line	label	dictionary.component	nodes	parameters
ℓ_1	IN	electronics.source	('A', 'ref')	type voltage
ℓ_2	Cin	electronics.capacitor	('A', 'B')	C ('Cin', 1e-05)
ℓ_3	Rbc	electronics.resistor	('B', 'C')	R ('Rcd', 270000.0)
ℓ_4	BJT	electronics.bjt	('B', 'C', 'ref')	mu ('mu', 1.1) betaF ('betaF', 300) Vt ('Vt', 0.026) betaR ('betaR', 4) Rb ('Rb', 20) Rc ('Rc', 0.1) Is ('Is', 1e-14) Re ('Re', 0.1)
ℓ_5	Rcd	electronics.resistor	('C', 'D')	R ('Rcd', 1000.0)
ℓ_6	VCC	electronics.source	('D', 'ref')	type voltage
ℓ_7	Cout	electronics.capacitor	('C', 'F')	C ('Cout', 1e-05)
ℓ_8	OUT	electronics.source	('F', 'ref')	type current

$\dim(\mathbf{x}) = n_\mathbf{x} = 2$;
$\dim(\mathbf{w}) = n_\mathbf{w} = 7$;

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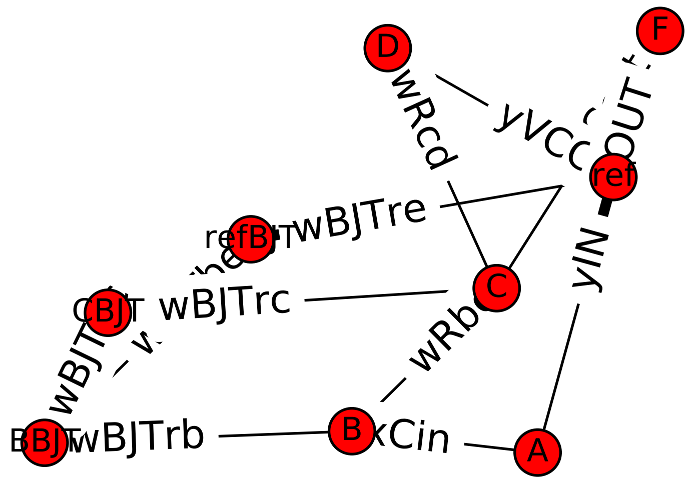

Figure 1: Graph of system `BJTAMP`.

$\dim(\mathbf{y}) = n_{\mathbf{y}} = 3;$
$\dim(\mathbf{p}) = n_{\mathbf{p}} = 0;$

2 System variables

State variable $\mathbf{x} = \begin{pmatrix} x_{\mathrm{Cin}} \\ x_{\mathrm{Cout}} \end{pmatrix};$

Dissipation variable $\mathbf{w} = \begin{pmatrix} w_{\mathrm{Rcd}} \\ w_{\mathrm{BJTbe}} \\ w_{\mathrm{BJTbc}} \\ w_{\mathrm{BJTrc}} \\ w_{\mathrm{BJTre}} \\ w_{\mathrm{BJTrb}} \\ w_{\mathrm{Rbc}} \end{pmatrix};$

Input $\mathbf{u} = \begin{pmatrix} u_{\mathrm{IN}} \\ u_{\mathrm{VCC}} \\ u_{\mathrm{OUT}} \end{pmatrix}$;

Output $\mathbf{y} = \begin{pmatrix} y_{\mathrm{IN}} \\ y_{\mathrm{VCC}} \\ y_{\mathrm{OUT}} \end{pmatrix}$;

3 Constitutive relations

Hamiltonian $\mathtt{H}(\mathbf{x}) = \frac{0.5}{\mathrm{Cout}} \cdot x_{\mathrm{Cout}}^2 + \frac{0.5}{\mathrm{Cin}} \cdot x_{\mathrm{Cin}}^2$;

Hamiltonian gradient $\nabla\mathtt{H}(\mathbf{x}) = \begin{pmatrix} \frac{1.0}{\mathrm{Cin}} \cdot x_{\mathrm{Cin}} \\ \frac{1.0}{\mathrm{Cout}} \cdot x_{\mathrm{Cout}} \end{pmatrix}$;

Dissipation function $\mathbf{z}(\mathbf{w}) = \begin{pmatrix} \frac{w_{\mathrm{Rcd}}}{\mathrm{Rcd}} \\ -\mathrm{Is} \cdot \left(e^{\frac{w_{\mathrm{BJTbc}}}{\mathrm{Vt \cdot mu}}} - 1\right) - 1.0 \cdot 10^{-9} \cdot w_{\mathrm{BJTbc}} + \frac{1}{\mathrm{betaF}} \cdot (\mathrm{betaF} + 1) \cdot \left(\mathrm{Is} \cdot \left(e^{\frac{w_{\mathrm{BJTbe}}}{\mathrm{Vt \cdot mu}}} - \right.\right. \\ -\mathrm{Is} \cdot \left(e^{\frac{w_{\mathrm{BJTbe}}}{\mathrm{Vt \cdot mu}}} - 1\right) - 1.0 \cdot 10^{-9} \cdot w_{\mathrm{BJTbe}} + \frac{1}{\mathrm{betaR}} \cdot (\mathrm{betaR} + 1) \cdot \left(\mathrm{Is} \cdot \left(e^{\frac{w_{\mathrm{BJTbc}}}{\mathrm{Vt \cdot mu}}} - \right.\right. \\ \mathrm{Rc} \cdot w_{\mathrm{BJTrc}} \\ \mathrm{Re} \cdot w_{\mathrm{BJTre}} \\ \mathrm{Rb} \cdot w_{\mathrm{BJTrb}} \\ \mathrm{Rcd} \cdot w_{\mathrm{Rbc}} \end{pmatrix}$

Jacobian of dissipation function $\mathcal{J}_{\mathbf{z}}(\mathbf{w}) = \begin{pmatrix} \frac{1}{\mathrm{Rcd}} & 0 & \\ 0 & \frac{1}{\mathrm{betaF}} \cdot (\mathrm{betaF} + 1) \cdot \left(\frac{\mathrm{Is} \cdot e^{\frac{w_{\mathrm{BJTbe}}}{\mathrm{Vt \cdot mu}}}}{\mathrm{Vt \cdot mu}} + 1.0 \cdot 10^{-9}\right) & - \\ 0 & -\frac{\mathrm{Is} \cdot e^{\frac{w_{\mathrm{BJTbe}}}{\mathrm{Vt \cdot mu}}}}{\mathrm{Vt \cdot mu}} - 1.0 \cdot 10^{-9} & \frac{1}{\mathrm{betaR}} \cdot (\mathrm{betal} \\ 0 & 0 & \\ 0 & 0 & \\ 0 & 0 & \\ 0 & 0 & \end{pmatrix}$

4 System parameters

4.1 Constant

parameter	value (SI)
betaF :	300
betaR :	4
Rb :	20
Rcd :	1000.0
Re :	0.1
Vt :	0.026
Cin :	1e-05
mu :	1.1
Is :	1e-14
Cout :	1e-05
Rc :	0.1

$$\mathbf{J} = \begin{pmatrix} 0 & 0 & 1.0 & 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 \\ -1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1.0 & 1.0 & -1.0 & 0 \\ -1.0 & 0 & 0 & 0 & 0 & 0 & 1.0 & -1.0 & 0 & 1.0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & -1.0 & 1.0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1.0 & 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1.0 & 0 & -1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 \\ 0 & 0 & -1.0 & -1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1.0 \\ 0 & 0 & 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1.0 & -1.0 & 0 & 0 & 0 & 0 & 0 & 0 & -1.0 & 1.0 & 0 & 0 \end{pmatrix};$$