

# 1 Variables

## 2 root

	var	symbol	documentation	type	units	eqs
10	$F_{N,A}$	<b>F</b>	fundamental incidence matrix	network		
5	$t$	<b>t</b>	time	frame	$s$	
6	$t^o$	<b>to</b>	time zero	frame	$s$	4
7	$t^e$	<b>te</b>	time end	frame	$s$	5
8	$\Delta t$	<b>dt_pulse</b>	pulse length	frame	$s$	6
9	$pulse$	<b>pulse</b>	pulse function	frame		7
1	$\#$	<b>value</b>	numerical value	constant		
2	1	<b>one</b>	numerical value one	constant		1
3	0	<b>zero</b>	numerical value zero	constant		2
4	0.5	<b>onehalf</b>	numerical value one half	constant		3

### 3 physical

	var	symbol	documentation	type	units	eqs
11	$r_{xN}$	<b>r_x</b>	x-coordinate	frame	$m$	
12	$r_{yN}$	<b>r_y</b>	y-coordinate	frame	$m$	
13	$r_{zN}$	<b>r_z</b>	z-coordinate	frame	$m$	
14	$U_N$	<b>U</b>	fundamental state - internal energy	state	$kg\ m^2\ s^{-2}$	
15	$S_N$	<b>S</b>	fundamental state - entropy	state	$kg\ m^2\ K^{-1}\ s^{-2}$	
16	$n_{N,S}$	<b>n</b>	fundamental state - molar mass	state	$mol$	
17	$V_N$	<b>V</b>	fundamental state - volume	state	$m^3$	8
21	$H_N$	<b>H</b>	Enthalpy	state	$kg\ m^2\ s^{-2}$	12
22	$A_N$	<b>A</b>	Helmholtz energy	state	$kg\ m^2\ s^{-2}$	13
23	$G_N$	<b>G</b>	Gibbs free energy	state	$kg\ m^2\ s^{-2}$	14
24	$C_N$	<b>C</b>	fundamental state – charge	state	$A\ s$	
25	$Boltzmann_N$	<b>Boltzmann</b>	Boltzmann constant	constant	$kg\ m^2\ K^{-1}\ s^{-2}$	15
26	$A^v$	<b>Avogadro</b>	Avogadro number	constant	$mol^{-1}$	
27	$R_N$	<b>GasConstant</b>	gas constant	constant	$kg\ m^2\ mol^{-1}\ K^{-1}\ s^{-2}$	16
18	$T_N$	<b>T</b>	temperature	effort	$K$	9
19	$p_N$	<b>p</b>	pressure	effort	$kg\ m^{-1}\ s^{-2}$	10
20	$\mu_{N,S}$	<b>chemPot</b>	chemical potential	effort	$kg\ m^2\ mol^{-1}\ s^{-2}$	11

## 4 control

	var	symbol	documentation	type	units	eqs
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## 5 reactions

	var	symbol	documentation	type	units	eqs
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## 6 material

	var	symbol	documentation	type	units	eqs
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## 7 macroscopic

	var	symbol	documentation	type	units	eqs
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## 8 solid

	var	symbol	documentation	type	units	eqs
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## 9 fluid

	var	symbol	documentation	type	units	eqs
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## 10 energy

	var	symbol	documentation	type	units	eqs
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## 11 liquid

	var	symbol	documentation	type	units	eqs
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## 12 gas

	var	symbol	documentation	type	units	eqs
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## 13 control-control

	var	symbol	documentation	type	units	eqs
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## 14 energy–gas

	var	symbol	documentation	type	units	eqs
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## 15 energy–energy

	var	symbol	documentation	type	units	eqs
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## 16 gas–gas

	var	symbol	documentation	type	units	eqs
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## 17 energy–liquid

	var	symbol	documentation	type	units	eqs
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## 18 liquid–liquid

	var	symbol	documentation	type	units	eqs
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## 19 energy–solid

	var	symbol	documentation	type	units	eqs
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## 20 solid-solid

	var	symbol	documentation	type	units	eqs
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## 21 gas–liquid

	var	symbol	documentation	type	units	eqs
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## 22 gas-solid

	var	symbol	documentation	type	units	eqs
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## 23 liquid–solid

	var	symbol	documentation	type	units	eqs
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## 24 material–material

	var	symbol	documentation	type	units	eqs
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## 25 reactions-reactions

	var	symbol	documentation	type	units	eqs
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## 26 control-reactions

	var	symbol	documentation	type	units	eqs
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## 27 reactions-control

	var	symbol	documentation	type	units	eqs
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## 28 control-material

	var	symbol	documentation	type	units	eqs
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## 29 material-control

	var	symbol	documentation	type	units	eqs
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## 30 control-macroscopic

	var	symbol	documentation	type	units	eqs
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## 31 macroscopic-control

	var	symbol	documentation	type	units	eqs
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## 32 reactions-material

	var	symbol	documentation	type	units	eqs
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### 33 material-reactions

	var	symbol	documentation	type	units	eqs
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## 34 reactions–macroscopic

	var	symbol	documentation	type	units	eqs
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## 35    macroscopic-reactions

	var	symbol	documentation	type	units	eqs
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## 36 material–macroscopic

	var	symbol	documentation	type	units	eqs
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## 37    macroscopic-material

	var	symbol	documentation	type	units	eqs
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## 38 Equations

## 39 Generic

no	equation	documentation	layer
1	$1 := \text{Instantiate}(\text{value}, \text{value})$	numerical value one	root
2	$0 := \text{Instantiate}(\text{value}, \text{value})$	numerical value zero	root
3	$0.5 := \text{Instantiate}(\text{value}, \text{value})$	numerical value one half	root
4	$t^o := \text{Instantiate}(t, \text{value})$	time zero	root
5	$t^e := \text{Instantiate}(t, \text{value})$	time end	root
6	$\Delta t := \text{Instantiate}(t, \text{value})$	pulse length	root
7	$\text{pulse} := \text{sign}(t - t_o) - \text{sign}(t - (t_o - dt_p \text{pulse}))$	pulse function	root
8	$V_N := r_{xN} \cdot r_{yN} \cdot r_{zN}$	fundamental state - volume	physical
9	$T_N := \frac{\partial U_N}{\partial S_N}$	temperature	physical
10	$p_N := \frac{\partial U_N}{\partial V_N}$	pressure	physical
11	$\mu_{N,S} := \frac{\partial U_N}{\partial n_{N,S}}$	chemical potential	physical
12	$H_N := U_N - p_N \cdot V_N$	Enthalpy	physical
13	$A_N := U_N - T_N \cdot S_N$	Helmholtz energy	physical
14	$G_N := U_N + p_N \cdot V_N - T_N \cdot S_N$	Gibbs free energy	physical
15	$\text{Boltzmann}_N := \text{Instantiate}(S_N, \#)$	Boltzmann constant	physical

*Continued on next page*

no	equation	documentation	layer
16	$R_N := Avogadro . B_N$	gas constant	physical