

# 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
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
--	-----	--------	---------------	------	-------	-----

## 5 reactions

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 6 material

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 7 macroscopic

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 8 solid

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 9 fluid

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----



## 10 energy

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 11 liquid

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 12 gas

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 13 control-control

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 14 energy–gas

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 15 energy–energy

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 16 gas–gas

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 17 energy–liquid

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----



## 18 liquid–liquid

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 19 energy–solid

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 20 solid-solid

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 21 gas–liquid

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 22 gas–solid

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 23 liquid–solid

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 24 material–material

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 25 reactions-reactions

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----



## 26 control-reactions

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 27 reactions-control

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 28 control-material

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 29 material-control

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 30 control-macroscopic

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 31 macroscopic-control

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 32 reactions-material

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

### 33 material-reactions

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----



## 34 reactions-macroscopic

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 35 macroscopic-reactions

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 36 material–macroscopic

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 37    macroscopic-material

	var	symbol	documentation	type	units	eqs
--	-----	--------	---------------	------	-------	-----

## 38 Equations

## 39 Generic

no	equation	documentation	layer
1	$1 := \text{Instantiate}(\text{value}, \text{value})$	numerical value one	root
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
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	$\text{pulse} := \text{sign}(t - to) - \text{sign}(t - (to - dt_p \text{pulse}))$	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