

1 Variables

2 root

	var	symbol	documentation	type	units	eqs
10	$F_{N,A}$	F	basic directed graph incidence matrix	network		
4	t	t	time	frame	s	
5	t^o	to	time zero	frame	s	3
6	t^e	te	time end	frame	s	4
7	Δt	t_interval	time interval	frame	s	5
9	Δ	pulse	pulse of length time interval	frame		7
1	$\#$	value	numerical value	constant		
2	1	one	numerical one	constant		1
3	0	zero	numerical value zero	constant		2
8	0.5	onehalf	numerical one half	constant		6

3 physical

	var	symbol	documentation	type	units	eqs
11	l_N	l	length	frame	m	
12	r_{xN}	r_x	x-direction	frame	m	8
13	r_{yN}	r_y	y-direction	frame	m	9
14	r_{zN}	r_z	z-direction	frame	m	10
15	V_N	v	fundamental state - volume	state	m^3	11
16	U_N	U	fundamental state - internal energy	state	$kg\ m^2\ s^{-2}$	
17	S	S	fundamental state - entropy	state	$kg\ m^2\ K^{-1}\ s^{-2}$	
18	$n_{N,S}$	n	fundamental state - molar mass	state	mol	
19	T_N	T	temperature	effort	K	12
20	p_N	p	pressure	effort	$kg\ m^{-1}\ s^{-2}$	13
21	$\mu_{N,S}$	chemPot		effort	$kg\ m^2\ mol^{-1}\ s^{-2}$	14

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	$1 := \text{Instantiate}(\#, \#)$	numerical one	root
2	$0 := \text{Instantiate}(\#, \#)$	numerical value zero	root
3	$t^o := \text{Instantiate}(t, 0)$	time zero	root
4	$t^e := \text{Instantiate}(t, \#)$	time end	root
5	$\Delta t := \text{Instantiate}(t, \#)$	time interval	root
6	$0.5 := \text{Instantiate}(\#, \#)$	numerical one half	root
7	$\Delta := \text{sign}(t - t^o) - \text{sign}(t - (t^o - \Delta t))$	pulse of length time interval	root
8	$r_{xN} := \text{Instantiate}(l_N, \#)$	x-direction	physical
9	$r_{yN} := \text{Instantiate}(l_N, \#)$	y-direction	physical
10	$r_{zN} := \text{Instantiate}(l_N, \#)$	z-direction	physical
11	$V_N := r_{xN} \cdot r_{yN} \cdot r_{zN}$	volume	physical
12	$T_N := \frac{\partial U_N}{\partial S}$	temperature - thermodynamic	physical
13	$p_N := \frac{\partial U_N}{\partial V_N}$	pressure	physical
14	$\mu_{N,S} := \frac{\partial U_N}{\partial n_{N,S}}$		physical