1 Variables

2 root

	var	symbol	documentation	type	units	eqs
8	$F_{N,A}$	`F_N_A`	fudamental incidence matrix	network		
5	t	`t`	time	frame	s	
6	t^o	`to`	starting time	frame	s	4
7	t^e	`te`	end time	frame	s	5
1	#	`value`	numerical value	constant		
2	1	`one`	numerical value one	constant		1
3	0	`zero`	numerical value zero	constant		2
4	0.5	`onehalf`	numerical value one half	constant		3

3 physical

	var	symbol	documentation	type	units	eqs
9	$P_{N,A}$	`P_N_A`	projection from node to arc for arc properties	projection		
10	r_{xN}	`r_x`	x-coordinate	frame	m	
11	r_{yN}	`r_y`	y-coordinate	frame	m	
12	r_{zN}	`r_z`	z coordinate	frame	m	
13	U_N	`U`	fundamental state – internal energy	state	$kg\,m^2\,s^{-2}$	
14	S_N	`S`	fundamental state – entropy	state	$kg\,m^2\,K^{-1}\,s^{-2}$	
15	V_N	`V`	fundamental state – volume	state	m^3	
16	n_{NS}	`n`	fundamental state – molar mass	state	mol	
20	H_N	`H`	enthalpy	state	$kg\,m^2\,s^{-2}$	9
21	A_N	`A`	Helmholtz energy	state	$kg\,m^2\,s^{-2}$	10
22	G_N	`G`	Gibbs free energy	state	$kg\,m^2\,s^{-2}$	11
23	C_N	`charge`	fundamental state – charge	state	$A\,s$	
24	A^v	`Avogadro`	Avogadro number	constant	mol^{-1}	
25	${k^B}_N$	`Boltzmann`	Boltzmann constant	constant	$kg\,m^2\,K^{-1}\,s^{-2}$	12
26	R_N	`GasConstant`	gas constant	constant	$kg\,m^2\,mol^{-1}\,K^{-1}\,s^{-2}$	13
17	p_N	`p`	thermodynamic pressure	effort	$kg\,m^{-1}\,s^{-2}$	6
18	T_N	`T`	temperature	effort	K	7
19	μ_{NS}	`chemPot`	chemical potential	effort	$kg\,m^2\,mol^{-1}\,s^{-2}$	8
27	UC_N	`UC`	electrical potential – voltage	effort	$kg\,m^2\,A^{-1}s^{-3}$	14
28	v_{xN}	`v_x`	velocitiy in x-direction	secondaryState	ms^{-1}	15
29	v_{yN}	`v_y`	velocity in y-direction	secondaryState	ms^{-1}	16
30	v_{zN}	`v_z`	velocity in z-direction	secondaryState	ms^{-1}	17

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 liquid

	var	symbol	documentation	type	units	eqs

11 gas

	var	symbol	documentation	type	units	eqs

12 control–control

	var	symbol	documentation	type	units	eqs

13 gas–liquid

	var	symbol	documentation	type	units	eqs

14 gas–gas

	var	symbol	documentation	type	units	eqs

15 liquid–liquid

	var	symbol	documentation	type	units	eqs

16 gas–solid

	var	symbol	documentation	type	units	eqs

17 solid–solid

	var	symbol	documentation	type	units	eqs

18 liquid–solid

	var	symbol	documentation	type	units	eqs

19 material–material

	var	symbol	documentation	type	units	eqs

20 reactions–reactions

	var	symbol	documentation	type	units	eqs

21 control–reactions

	var	symbol	documentation	type	units	eqs

22 reactions–control

	var	symbol	documentation	type	units	eqs

23 control–material

	var	symbol	documentation	type	units	eqs

24 material–control

	var	symbol	documentation	type	units	eqs

25 control–macroscopic

	var	symbol	documentation	type	units	eqs

26 macroscopic–control

	var	symbol	documentation	type	units	eqs

27 reactions–material

	var	symbol	documentation	type	units	eqs

28 material–reactions

	var	symbol	documentation	type	units	eqs

29 reactions–macroscopic

	var	symbol	documentation	type	units	eqs

30 macroscopic–reactions

	var	symbol	documentation	type	units	eqs

31 material–macroscopic

	var	symbol	documentation	type	units	eqs

32 macroscopic–material

	var	symbol	documentation	type	units	eqs

33 Equations

34 Generic

no	equation	documentation	layer
1	$1 := \text{Instantiate}(\#, \#)$	numerical value 1	root
2	$0 := \text{Instantiate}(\#, \#)$	numerical value zero	root
3	$0.5 := \text{Instantiate}(\#, \#)$	numerical value one half	root
4	$t^o := \text{Instantiate}(t, \#)$	starting time	root
5	$t^e := \text{Instantiate}(t, \#)$	end time	root
6	$p_N := \left(-\frac{\partial U_N}{\partial V_N}\right)$	thermodynamic pressure	physical
7	$T_N := \frac{\partial U_N}{\partial S_N}$	temperature	physical
8	$\mu_{NS} := \frac{\partial U_N}{\partial n_{NS}}$	chemical potential	physical
9	$H_N := U_N - p_N \,.\, V_N$	enthalpy	physical
10	$A_N := U_N - T_N \,.\, S_N$	Helmholtz energy	physical
11	$G_N := U_N + p_N \,.\, V_N - T_N \,.\, S_N$	Gibbs free energy	physical
12	${k^B}_N := \text{Instantiate}(S_N, \#)$	Boltzmann constant	physical
13	$R_N := A^v \,.\, {k^B}_N$	gas constant	physical
14	$UC_N := (C_N)^{-1} \,.\, U_N$	electrical potential – voltage	physical
15	$v_{xN} := \frac{\partial r_{xN}}{\partial t}$	velocitiy in x-direction	physical
16	$v_{yN} := \frac{\partial r_{yN}}{\partial t}$	velocity in y direction	physical

Continued on next page

no	equation	documentation	layer
17	$v_{zN} := \frac{\partial r_{zN}}{\partial t}$	velocity in z-direction	physical