# 1 Variables

# 2 root

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

# 3 physical

| | var | symbol | documentation | type | units | eqs |
|---|---|---|---|---|---|---|
| 14 | $r_{zN}$ | r_z | z-direction | frame | $m$ | 10 |
| 11 | $\ell_N$ | l | length | frame | $m$ | |
| 12 | $r_{xN}$ | r_x | x-direction | frame | $m$ | 8 |
| 13 | $r_{yN}$ | r_y | y-direction | frame | $m$ | 9 |
| 15 | $V_N$ | V | fundamental state - volume | state | $m^3$ | 11 |
| 23 | $A_N$ | A | Helmholts energy | state | $kg\,m^2\,s^{-2}$ | 17 |
| 18 | $n_{N,S}$ | n | fundamental state - molar mass | state | $mol$ | |
| 25 | $C_N$ | C | fundamental state - charge | state | $A\,s$ | |
| 24 | $G_N$ | G | Gibbs free energy | state | $kg\,m^2\,s^{-2}$ | 18 |
| 22 | $H_N$ | H | Enthalpy | state | $kg\,m^2\,s^{-2}$ | 15 |
| 17 | $S_N$ | S | fundamental state - entropy | state | $kg\,m^2\,K^{-1}\,s^{-2}$ | |
| 16 | $U_N$ | U | fundamental state - internal energy | state | $kg\,m^2\,s^{-2}$ | |
| 21 | $\mu_{N,S}$ | chemPot | chemical potential | effort | $kg\,m^2\,mol^{-1}\,s^{-2}$ | 14 |
| 19 | $T_N$ | T | temperature | effort | $K$ | 16 |
| 20 | $p_N$ | p | pressure | effort | $kg\,m^{-1}\,s^{-2}$ | 13 |
| 29 | $v_{zN}$ | v_z | velocity in z-direction | secondaryState | $ms^{-1}$ | 21 |
| 28 | $v_{yN}$ | v_y | velocity in y-direction | secondaryState | $ms^{-1}$ | 20 |
| 27 | $v_{xN}$ | v_x | velocity in x-direction | secondaryState | $ms^{-1}$ | 19 |

# 4    material–macroscopic

| | var | symbol | documentation | type | units | eqs |
|---|---|---|---|---|---|---|
| 30 | $\_\lambda_S$ | _Mm | link variable Mm to interface material »> macroscopic | get | $kg\,mol^{-1}$ | 22 |

# 5 Equations

# 6 Generic

| no | equation | documentation | layer |
|---|---|---|---|
| 1 | $1 := \mathrm{Instantiate}(\#, \#)$ | numerical one | root |
| 2 | $0 := \mathrm{Instantiate}(\#, \#)$ | numerical value zero | root |
| 3 | $t^o := \mathrm{Instantiate}(t, 0)$ | time zero | root |
| 4 | $t^e := \mathrm{Instantiate}(t, \#)$ | time end | root |
| 5 | $\Delta t := \mathrm{Instantiate}(t, \#)$ | time interval | root |
| 6 | $0.5 := \mathrm{Instantiate}(\#, \#)$ | numerical one half | root |
| 7 | $\Delta := \mathrm{sign}\,(t - t^o) - \mathrm{sign}\,(t - (t^o - \Delta t))$ | pulse of length time interval | root |
| 8 | $r_{xN} := \mathrm{Instantiate}(\ell_N, \#)$ | x-direction | physical |
| 9 | $r_{yN} := \mathrm{Instantiate}(\ell_N, \#)$ | y-direction | physical |
| 10 | $r_{zN} := \mathrm{Instantiate}(\ell_N, \#)$ | z-direction | physical |
| 11 | $V_N := r_{xN} \cdot r_{yN} \cdot r_{zN}$ | volume | physical |
| 13 | $p_N := \frac{\partial U_N}{\partial V_N}$ | pressure | physical |
| 14 | $\mu_{N,S} := \frac{\partial U_N}{\partial n_{N,S}}$ | chemical potential | physical |
| 15 | $H_N := U_N - p_N \cdot V_N$ | Enthalpy | physical |
| 16 | $T_N := \frac{\partial U_N}{\partial S_N}$ | temperature | physical |
| 17 | $A_N := U_N - T_N \cdot S_N$ | Helmholts energy | physical |

| no | equation | documentation | layer |
|---|---|---|---|
| 18 | $G_N := U_N + p_N \cdot V_N - T_N \cdot S_N$ | Gibbs free energy | physical |
| 19 | $v_{xN} := (t)^{-1} \cdot r_{xN}$ | velocity in x-direction | physical |
| 20 | $v_{yN} := (t)^{-1} \cdot r_{yN}$ | velocity in y-direction | physical |
| 21 | $v_{zN} := (t)^{-1} \cdot r_{zN}$ | velocity in z-direction | physical |

# 7    Interface Link Equation

| no | equation | documentation | layer |
|----|----------|---------------|-------|
| 22 | $\_\lambda_S := \lambda_S$ | interface equation | material −> macroscopic |