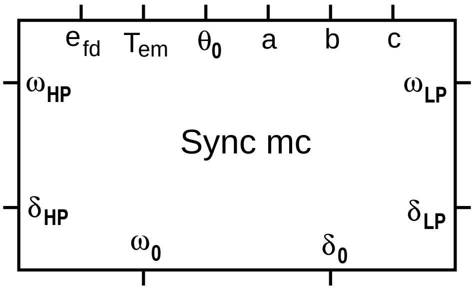
syncmc_delta.gme



Attributes

```
mainnodes_anlg: a b c
main_var:
+  omega
+  tem
+  efd
+  theta
+  delta
+  delta_lp
+  delta_hp
+  omega_lp
+  omega_hp
aux_var:
+  t1
iparms:
+  i_compute_strt=1
+  i_flag_network=1
rparms:
+  xd=1.79
+  xq=1.71
+  xdp=0.169
+  xqp=0.228
+  xdpp=0.135
+  xqpp=0.2
+  ra=0.001
+  td0p=4.3
+  tq0p=0.85
+  td0pp=0.032
+  tq0pp=0.05
+  h0=0.05
+  d0=0.3
+  fb=50
+  f0=50
```

```
+  vg0=1.0
+  thetag0_deg=30
+  e_src=1.0
+  xl=0.5
+  r_parallel=100
+  ka_static=100
+  xc=0.4
+  r_line=0.01
+  k_hi=19.303
+  k_ila=34.929
+  k_lab=52.038
+  k_lbg=70.858
+  k_ge=2.82
+  d_hi=0.01
+  d_ila=0.01
+  d_lab=0.01
+  d_lbg=0.01
+  d_ge=0.01
+  d_h=0.2
+  d_i=0.2
+  d_la=0.2
+  d_lb=0.2
+  d_e=0.2
outvar_anlg:
+  ia=ia_of_sm1
+  ib=ib_of_sm1
+  ic=ic_of_sm1
+  id=id_of_sm1
+  iq=iq_of_sm1
+  vd=vd_of_sm1
+  vq=vq_of_sm1
+  psid=psid_of_sm1
+  psiq=psiq_of_sm1
+  psif=psif_of_sm1
+  psih=psih_of_sm1
+  psig=psig_of_sm1
+  psik=psik_of_sm1
+  t1=var_of_t1
```

Description

`syncmc_delta.gme` is a synchronous machine model with terminals `a`, `b`, `c`.

The following model equations are used.

$$
\begin{aligned}
i_a &= -(k_d\, i_d\, \cos\theta_1 + k_q\, i_q\, \sin\theta_1)\,, \\
i_b &= -(k_d\, i_d\, \cos\theta_2 + k_q\, i_q\, \sin\theta_2)\,, \\
i_c &= -(k_d\, i_d\, \cos\theta_3 + k_q\, i_q\, \sin\theta_3)\,, \\
v_d &= k_1\,[v_a\, \cos\theta_1 + v_b\, \cos\theta_2 + v_c\, \cos\theta_3]\,, \\
v_q &= k_2\,[v_a\, \sin\theta_1 + v_b\, \sin\theta_2 + v_c\, \sin\theta_3]\,, \\
\psi_d &= x''_d\, i_d + a_{1d}\, \psi_h + a_{2d}\, \psi_f\,, \\
\psi_q &= x''_q\, i_q + a_{1q}\, \psi_k + a_{2q}\, \psi_g\,, \\
T_{\mathrm{em}} &= \psi_d\, i_q - \psi_q\, i_d\,, \\
\frac{d\psi_d}{dt} &= -\omega\omega_B\, \psi_q - \omega_B(r_a i_d + v_d)\,, \\
\frac{d\psi_q}{dt} &= \omega\omega_B\, \psi_d - \omega_B(r_a i_q + v_q)\,, \\
\frac{d\psi_f}{dt} &= -\frac{\psi_f}{\tau'_d} + \frac{\psi_d}{\tau'_d} + c_{1d} e_{fd}\,, \\
\frac{d\psi_h}{dt} &= -\frac{\psi_h}{\tau''_d} + \frac{\psi_d}{\tau''_d}\,, \\
\frac{d\psi_g}{dt} &= -\frac{\psi_g}{\tau'_q} + \frac{\psi_q}{\tau'_q} + c_{1d} e_{fd}\,, \\
\frac{d\psi_k}{dt} &= -\frac{\psi_k}{\tau''_q} + \frac{\psi_q}{\tau''_q}\,, \\
\frac{d\theta}{dt} &= \omega\omega_B\,, \\
\frac{d\omega}{dt} &= -e_2\omega + e_4\,(T_{\mathrm{mech}} - T_{\mathrm{em}})\,.
\end{aligned}
$$

In the above equations,

$\theta_1 = \theta$, $\theta_2 = \theta - 2\pi/3$, $\theta_3 = \theta + 2\pi/3$,

$k_1 = k_d = \sqrt{2/3}$, $k_2 = k_q = \sqrt{2/3}$, $k_3 = k_0 = \sqrt{1/3}$,

$a_{1d} = \dfrac{x'_d - x''_d}{x'_d}$,

$a_{1q} = \dfrac{x'_q - x''_q}{x'_q}$,

$a_{2d} = \dfrac{x_d - x'_d}{x_d}\,\dfrac{x''_d}{x'_d}$,

$a_{2q} = \dfrac{x_q - x'_q}{x_q}\,\dfrac{x''_q}{x'_q}$,

$\omega_B = 2\pi f_B$,

$a_0 = 2\,h_0,\ e_2 = d_0/a_0,\ e_4 = 1/a_0$.

In addition, the following equations, which are useful in coupling the synchronous machine to other components, are implemented:

$$\frac{d\delta}{dt} = \omega\,\omega_B - \omega_0\,,$$

$$T + K_{LP}\,(\delta - \delta_{LP}) + K_{HP}\,(\delta - \delta_{HP}) + D_{LP}\,(\omega - \omega_{LP}) + D_{HP}\,(\omega - \omega_{HP}) = 0\,.$$

Circuits involving a synchronous machine generally require the values of certain state variables to be computed and imposed before a transient simulation is carried out. If that is not done, the machine may never get started (i.e., ω (p.u.) may remain stuck at 0). Computation of these state variables is performed internally in `syncmc_1.ece` (which is called by `syncmc_delta.gme`).

The integer parameters `i_compute_strt` and `i_flag_network` are related to computation of the initial values of the state variables, and they are described in the documentation for `syncmc_1.ece`.

AC behaviour is not implemented.