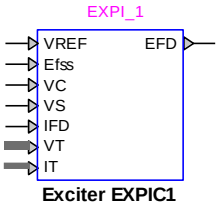
Exciters and Governors: Exciter EXPIC1



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1 Description

This device is an implementation of the Proportional/Integral Excitation System model. This device is implemented as described in [1]. Implementation details can be viewed by inspecting the subcircuit of this device.

1.1 Pins

This device has 8 pins:

Pin name	Type	Description	Units
VREF	Input	Reference voltage of the stator terminal voltage	pu
Efss	Input	Steady-state field voltage at t = 0, for initialization	pu
VC	Input	Terminal voltage of synchronous machine, transducer output	pu
VS	Input	Power system stabilizer signal	pu
IFD	Input	Field current signal	pu
VT	Input, bundle	Terminal voltage (phasor) of synchronous machine (magnitude and phase)	pu
IT	Input, bundle	Current (phasor) of synchronous machine (magnitude and phase)	pu
EFD	Output	Field voltage signal	pu

1.2 Parameters

The default set of parameters can be found in [1].

1.2.1 Data tab

The parameters on the Data tab are:

1. **Gain K_A**: PI controller gain
2. **Time constant T_{A1}**: PI controller time constant
3. **Voltage V_{R1}**: maximum PI controller output
4. **Voltage V_{R2}**: minimum PI controller output

5. **Time constant T_{A2}**: voltage regulator time constant
6. **Time constant T_{A3}**: voltage regulator time constant
7. **Time constant T_{A4}**: voltage regulator time constant
8. **Voltage V_{Rmax}**: maximum voltage regulator output
9. **Voltage V_{Rmin}**: minimum voltage regulator output
10. **Gain K_F**: rate feedback gain
11. **Time constant T_{F1}**: rate feedback time constant
12. **Time constant T_{F2}**: rate feedback time constant

1.2.2 Exciter tab

The parameters on the Exciter tab are:

1. **Constant K_E**: exciter field proportional constant
2. **Time constant T_E**: exciter field time constant
3. **Voltage E_{FDmax}**: maximum exciter field voltage
4. **Voltage E_{FDmin}**: minimum exciter field voltage
5. **Gain K_P**: potential circuit gain coefficient
6. **Gain K_I**: potential circuit (current) gain coefficient
7. **Gain K_C**: rectifier loading factor proportional to commutating reactance
8. **Field voltage V_{E1}**: exciter voltage point which is near the exciter ceiling voltage
9. **Field voltage V_{E2}**: exciter voltage point which is near 75% of V_{E1}
10. **Saturation function output SE_V_{E1}**: exciter saturation function value at V_{E1}
11. **Saturation function output SE_V_{E2}**: exciter saturation function value at V_{E2}

The exciter saturation function is defined as

$$S_E = A_{EX} e^{B_{EX} E_{FD}} \tag{1}$$

which gives the approximation saturation for any E_{FD} (exciter output voltage). According to [2] (see pages 562 and 563), the coefficients A_{EX} and B_{EX} can be found from:

$$A_{EX} = \frac{S_{V_{E2}}^4}{S_{V_{E1}}^3} \tag{2}$$

$$B_{EX} = \frac{4}{V_{E1}} \ln\left(\frac{S_{V_{E1}}}{S_{V_{E2}}}\right) \tag{3}$$

In the literature [2] $V_{E1} = V_{E_{max}}$ and $V_{E2} = V_{E_{0.75max}}$.

2 Initial conditions

The reference voltage VREF can be manually or automatically set by connecting or not connecting the input signal VREF, respectively. When VREF is not connected (the signal is zero), the reference voltage is internally found from the steady-state solution. When VREF is connected, its initial value must match the per unit steady-state voltage of the stator terminal voltage, since otherwise the generator voltage will not start at the actual steady-state.

3 References

[1] PSS®E MODEL LIBRARY PSS®E 32.0.5, Siemens Energy, Inc.

[2] P. M. Anderson and A. A. Fouad, “Power system control and stability”, second edition, IEEE Press, Wiley Interscience, 2003.