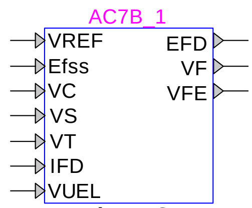
Exciters and Governors: Exciter AC7B



Exciter AC7B

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1 Description

This device is an implementation of the IEEE type AC7B 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 10 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
VT	Input	Terminal voltage of synchronous machine	pu
IFD	input	Field current	pu
VUEL	Input	Under Excitation Limiter signal	pu
EFD	Output	The field voltage signal	pu
VF	Output	The excitation system stabilizer signal	pu
VFE	Output	Signal proportional to exciter field current	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_{PA}**: field current regulator proportional gain
2. **Gain K_{IA}**: field current regulator integral gain

3. **Maximum regulator output V_{Amax}**: maximum field current regulator output
4. **Minimum regulator output V_{Amin}**: minimum field current regulator output
5. **Gain K_{PR}**: voltage regulator proportional gain
6. **Gain K_{IR}**: voltage regulator integral gain
7. **Gain K_{DR}**: voltage regulator derivative gain
8. **Time constant T_{DR}**: lag time constant for derivative channel of PID controller
9. **Maximum regulator output V_{Rmax}**: maximum regulator output
10. **Minimum regulator output V_{Rmin}**: minimum regulator output
11. **Gain K_P**: potential circuit gain coefficient
12. **Gain K_L**: gain related to negative exciter field current capability

1.2.2 Exciter tab

The exciter tab allows to input:

1. **Gain K_E**: exciter gain
2. **Time constant T_E**: exciter time constant
3. **Gain K_{F1}**: excitation control system stabilizer gain
4. **Gain K_{F2}**: excitation control system stabilizer gain
5. **Gain K_{F3}**: excitation control system stabilizer gain
6. **Time constant T_F**: excitation control system stabilizer time constant
7. **Field current limit V_{FEmax}**: exciter field current limit
8. **Voltage V_{Emin}**: minimum of exciter voltage back of commutating reactance
9. **Demagnetizing factor K_D**: demagnetizing factor
10. **Rectifier loading factor K_C**: rectifier loading factor
11. **Field voltage V_{E1}**: The exciter voltage point which is near the exciter ceiling voltage
12. **Field voltage V_{E2}**: The exciter voltage point which is near 75% of V_{E1}
13. **Saturation function output SE_V_{E1}**: The exciter saturation function value at V_{E1}
14. **Saturation function output SE_V_{E2}**: The exciter saturation function value at V_{E2}

The exciter saturation function is defined as

$$S_E = A_{EX} e^{B_{EX} E_{FD}} \quad (1)$$

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:

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

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

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] "IEEE Recommended Practice for Excitation System Models for Power System Models for Power System Stability Studies," IEEE Standard 421.5-2005.

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