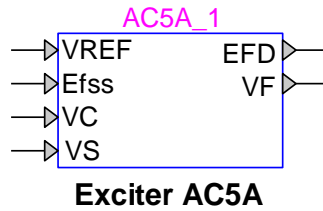


# Exciters and Governors: Exciter AC5A



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## 1 Description

This device is an implementation of the IEEE type AC5A 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 6 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
EFD	Output	The field voltage signal	pu
VF	Output	The excitation system stabilizer 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  $K_A$** : voltage regulator gain
2. **Time constant  $T_A$** : voltage regulator time constant
3. **Maximum regulator output  $V_{Rmax}$** : maximum regulator voltage output
4. **Minimum regulator output  $V_{Rmin}$** : minimum regulator voltage output
5. **Gain  $K_F$** : excitation control system stabilizer gain
6. **Time constant  $T_{F1}$** : excitation control system stabilizer time constant

7. **Time constant  $T_{F2}$** : excitation control system stabilizer time constant
8. **Time constant  $T_{F3}$** : excitation control system stabilizer time constant

## 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. **Voltage  $V_{E1}$** : The exciter voltage point which is near the exciter ceiling voltage
4. **Voltage  $V_{E2}$** : The exciter voltage point which is near 75% of  $V_{E1}$
5. **Saturation function output  $SE_{V_{E1}}$** : The exciter saturation function value at  $V_{E1}$
6. **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  $V_{REF}$  can be manually or automatically set by connecting or not connecting the input signal  $V_{REF}$ , respectively. When  $V_{REF}$  is not connected (the signal is zero), the reference voltage is internally found from the steady-state solution. When  $V_{REF}$  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.