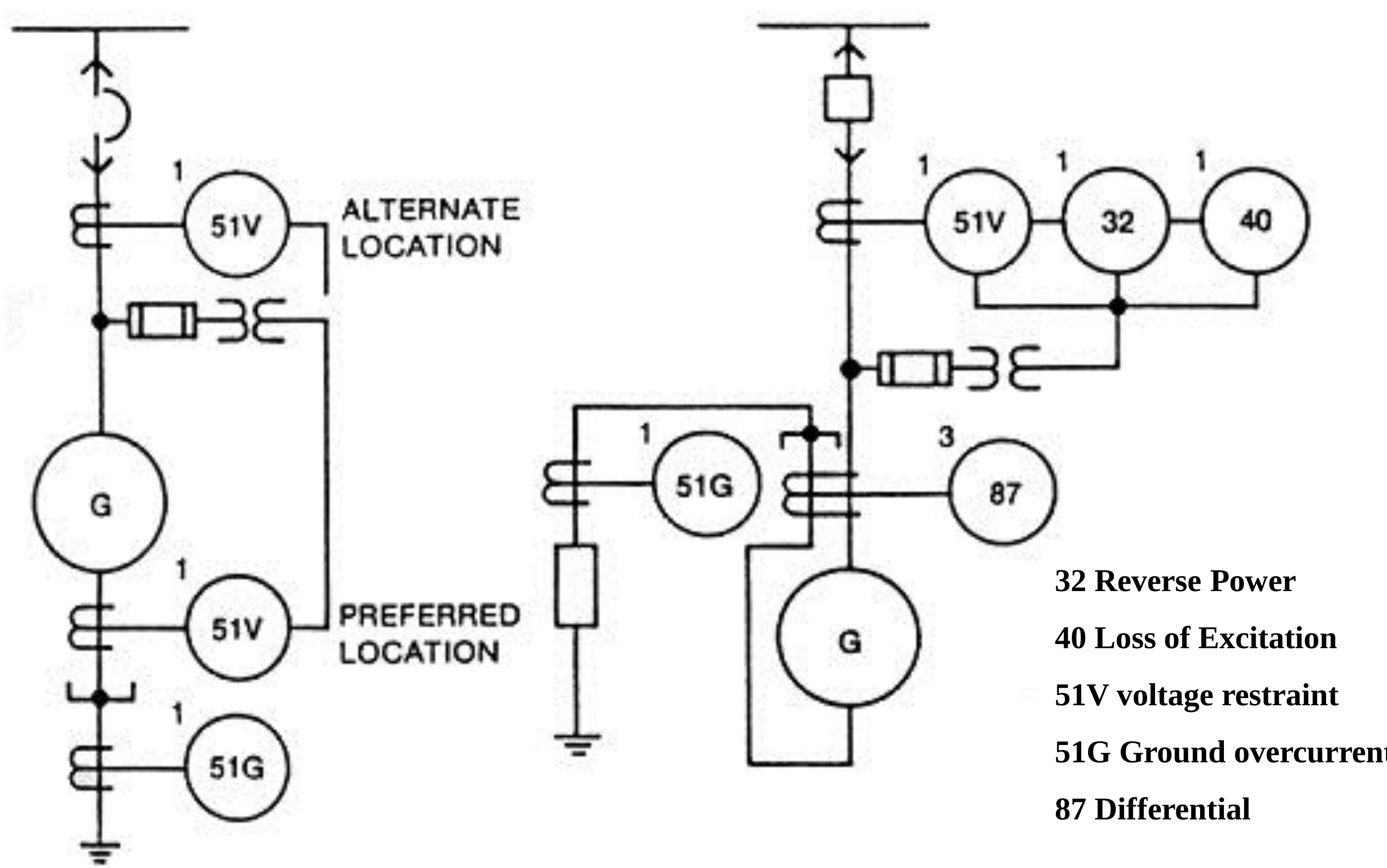
Proteções Geradores Sincronos

2019

Aquiles

Small Machine Protection
IEEE Buff Book



32 Reverse Power

40 Loss of Excitation

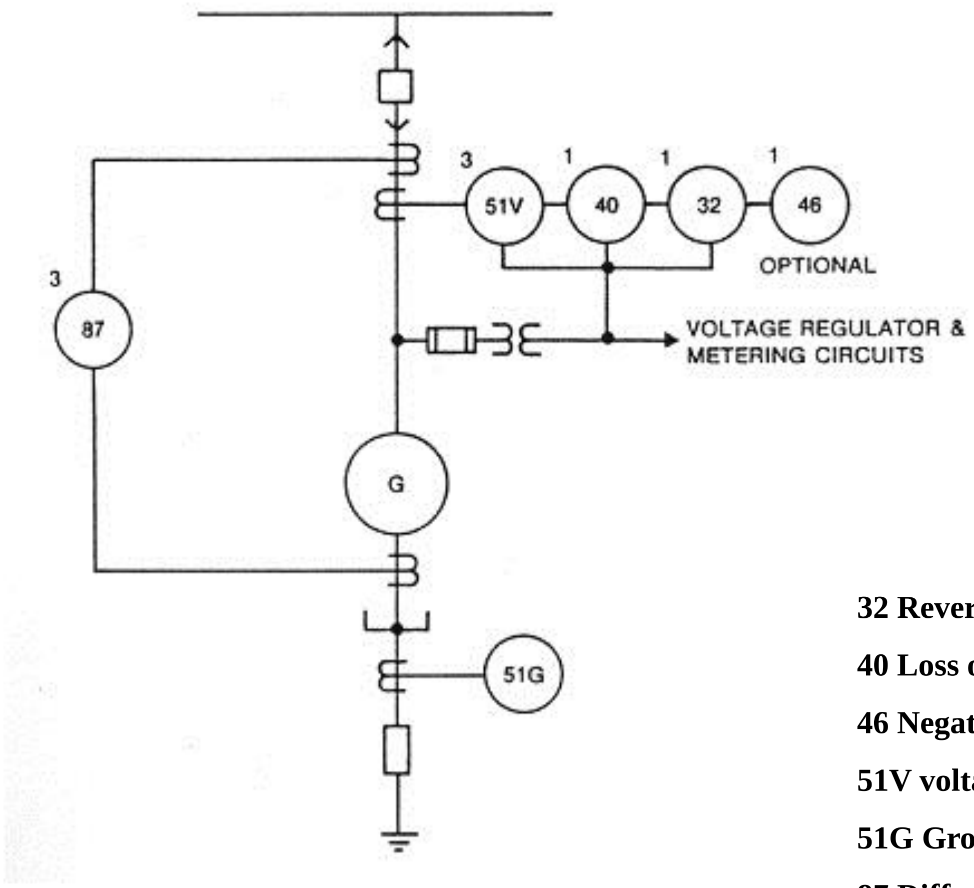
51V voltage restraint

51G Ground overcurrent

87 Differential

- Small – up to 1 MW to 600V, 500 kVA if >600V

Small Machine Protection
IEEE Buff Book



32 Reverse Power

40 Loss of Excitation

46 Negative Sequence

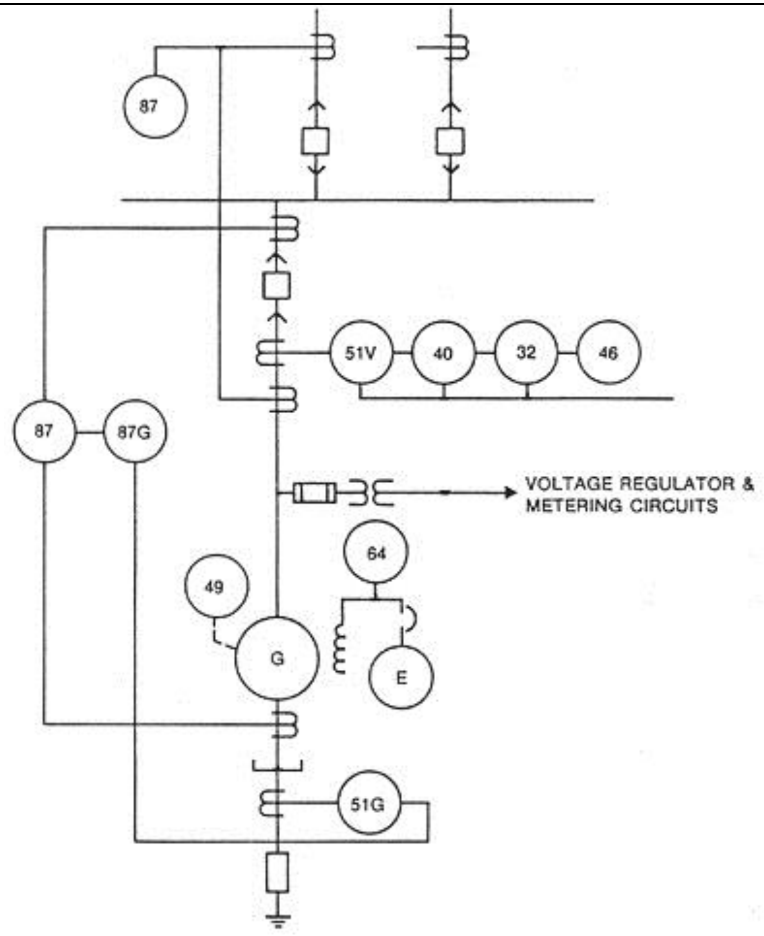
51V voltage restraint

51G Ground overcurrent

87 Differential

- Medium – up to 12.5 MW

Small Machine Protection
IEEE Buff Book



32 Reverse Power

40 Loss of Excitation

46 Negative Sequence

49 Thermal Overload

51V voltage restraint

51G Ground overcurrent

64 Ground Relay

87 Differential

- Large – up to 50 MW

Large Machine Protection
IEEE C37.102

- Unit Connected,
- High Z Grounded

32 Reverse Power

40 Loss of Excitation

46 Negative Sequence

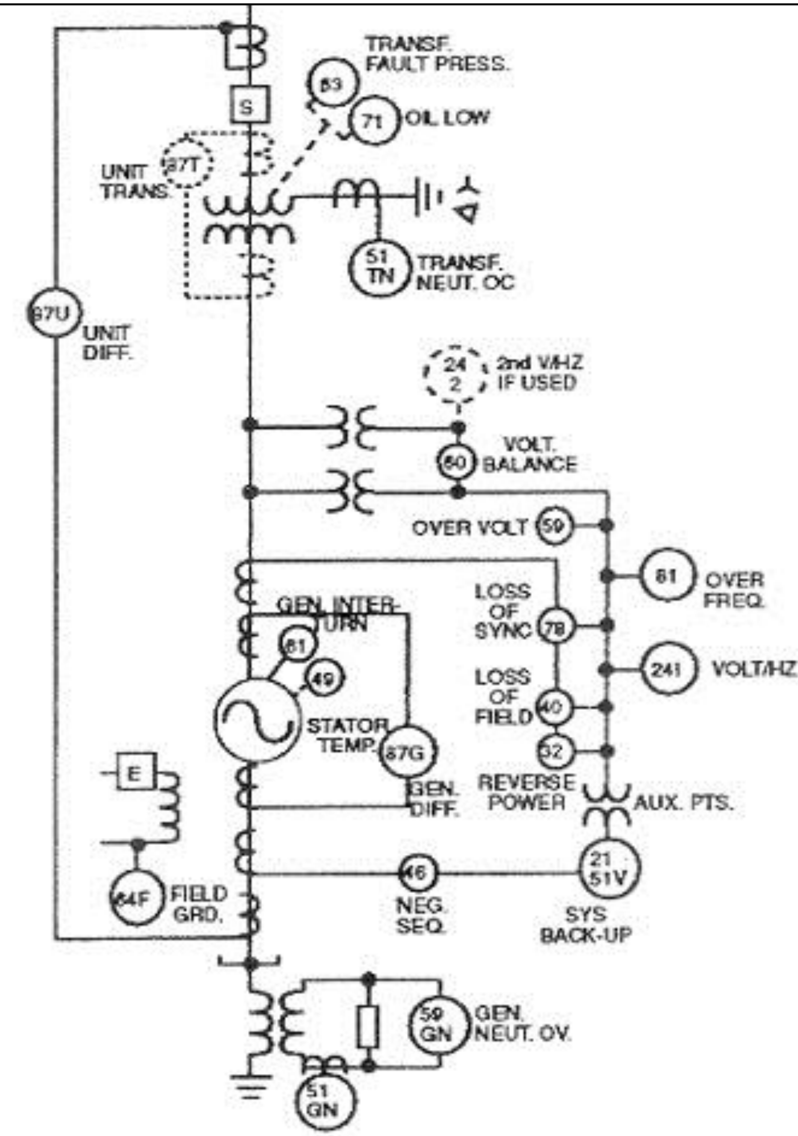
49 Thermal Overload

51V voltage restraint

51G Ground overcurrent

64 Ground Relay

87 Differential



Protection Functions

Generator Stator Differential

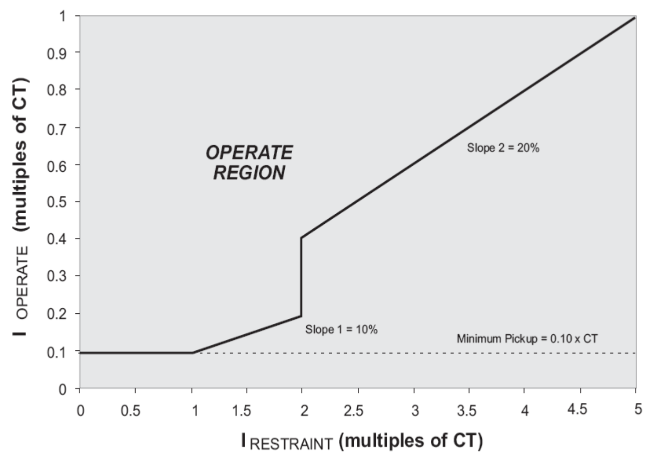
- Stator Phase Differential
- Dual Slope Percent Restraint Operating Characteristic
- Directional Supervision under saturation conditions

Distance Backup Protection

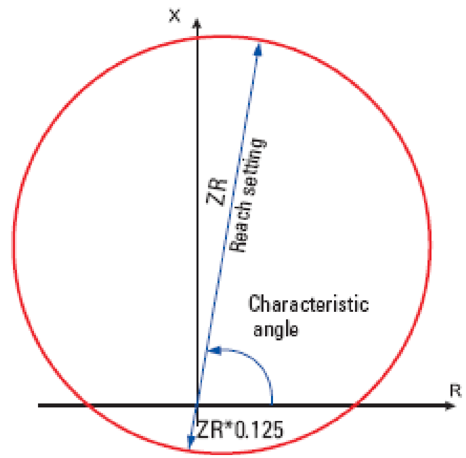
- 2 or 3 Zone Mho Distance Protection
- Backup for primary line protection
- Configurable Reach and Angle Distance Characteristic

100% Stator Ground Protection

- 95% Fundamental OverVoltage
- 15% Third Harmonic UnderVoltage



Dual Slope Phase Differential



Two Zone Distance Backup

Protection Functions

Voltage Protection

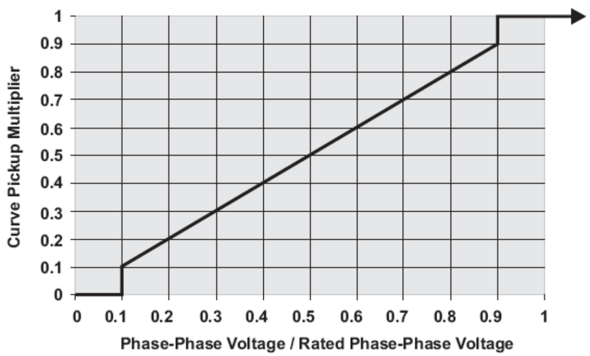
- Phase Overvoltage
- Phase Undervoltage
- Neutral Overvoltage (fundamental)
- Neutral Undervoltage (3^{rd} Harmonic)
- Voltage Phase Reversal

Current Protection

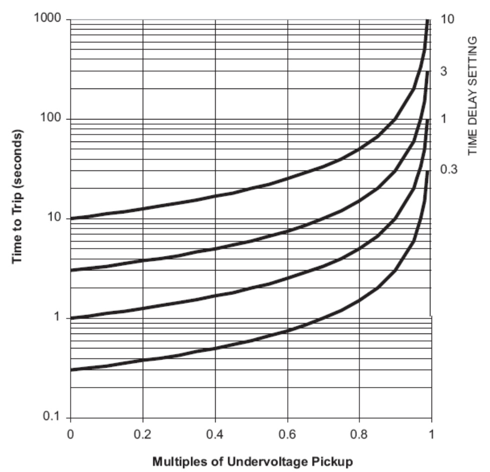
- Phase, Ground and Negative Sequence Overcurrent Tripping
- IEC, ANSI , IAC and Customizable Overcurrent Curves
- Voltage Restraint increasing sensitivity under low voltage conditions

Frequency Protection

- Overfrequency
- Underfrequency



Voltage Restraint Overcurrent



Undervoltage Trip Curves

Protection Functions

Thermal Protection

- Generator Thermal Model
- RTD Alarming and Tripping
- RTD Biased Thermal Model

Inadvertent Energization

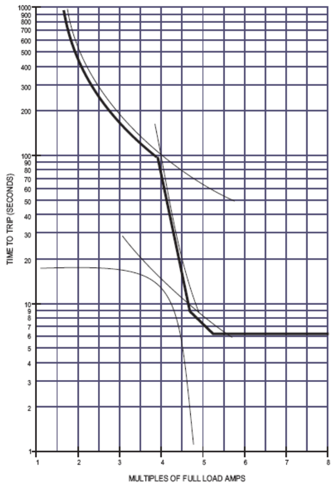
- Prevents Accidentally Closing a Stopped Generator onto a Live Line
- Armed when Generator is Offline and Voltage is below a pre-set level

Loss of Excitation (show Training CD)

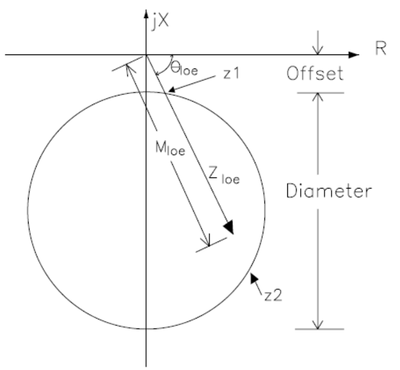
- Uses Impedance Circle for loss of excitation detection
- 2 Zones for fault detection and control

Volt/Hertz (Overexcitation)

- Detects changes in the Volts/Hertz ratio of the generator or associated transformer



Thermal Model – Voltage Dependant Overload Curves

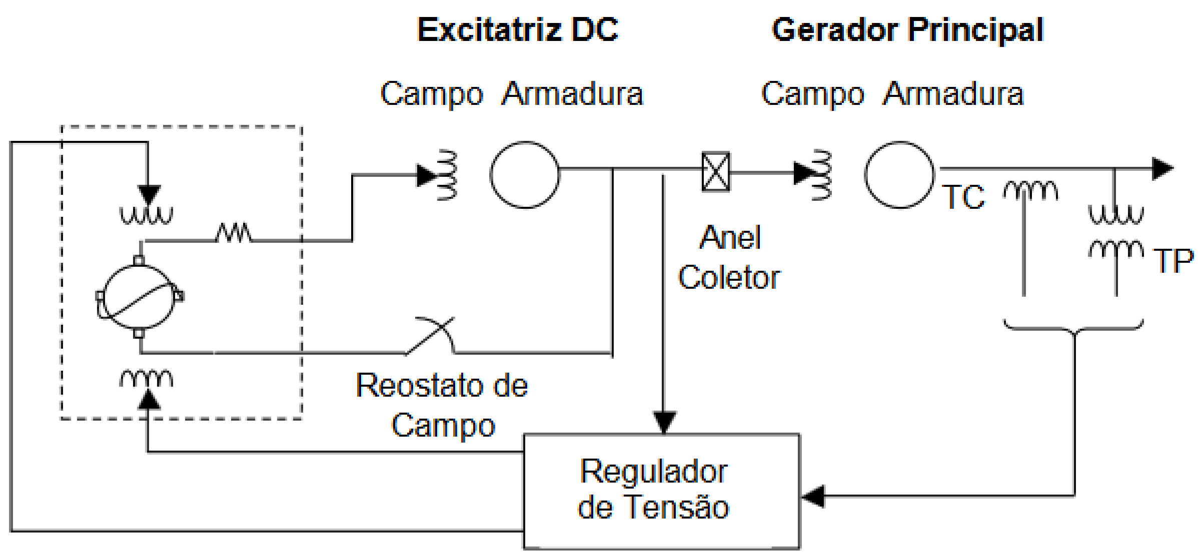


Loss of Excitation

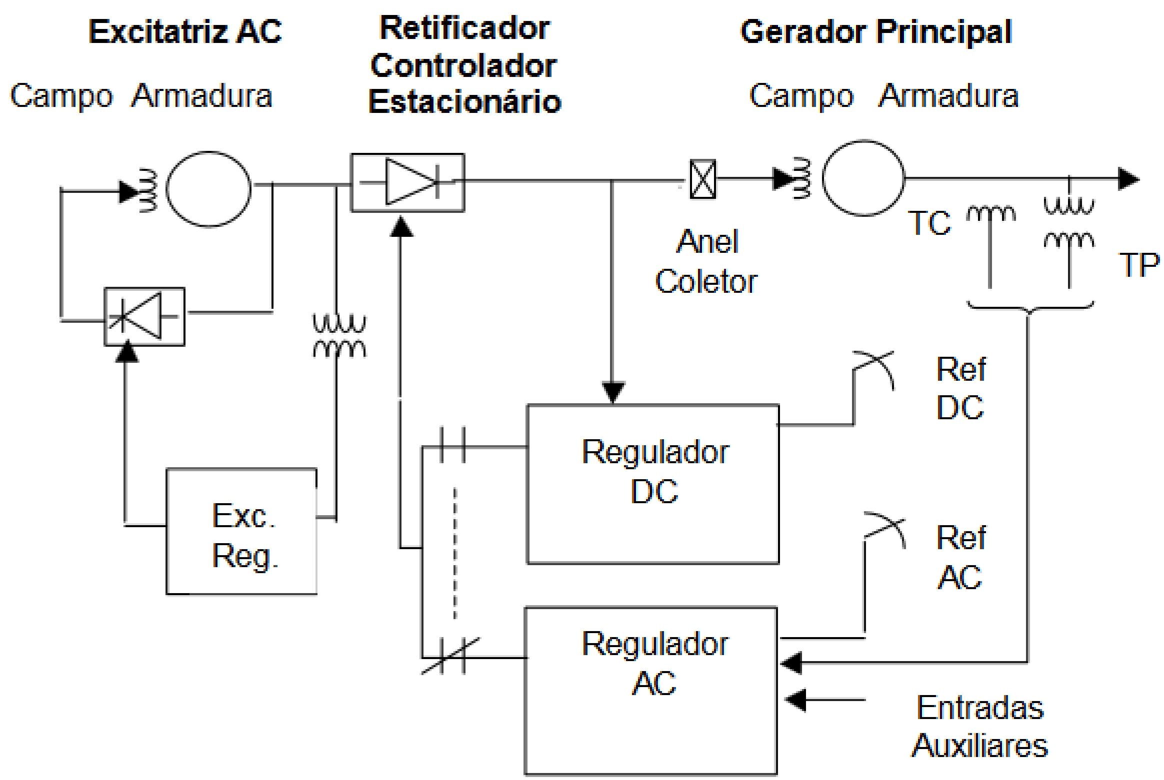
Sistemas de excitação – Reguladores de Tensão

- sistemas de excitação DC (Direct Current);
- sistemas de excitação AC (Alternating Current);
- sistemas de excitação estáticos

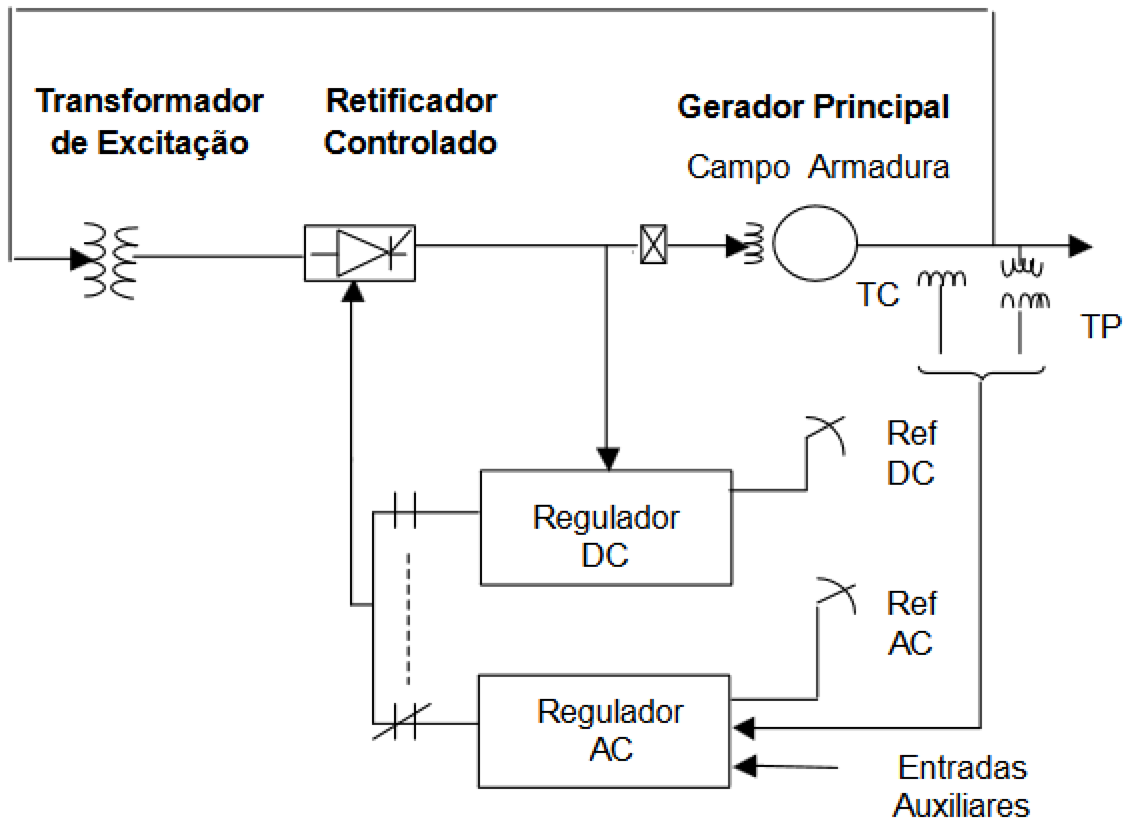
Sistemas de excitação DC



Sistemas de excitação AC com Retificação Estacionária



Sistemas de excitação estáticos



Standard IEEE Models

- IEEE has standardized 12 model structures for representing the wide variety of excitation systems currently in use (see IEEE Standard 421.5-1992):
  - these models are intended for use in transient and small-signal stability studies
  - Figures 8.40 to 8.43 show four examples

1. *Type DC1A Exciter model*

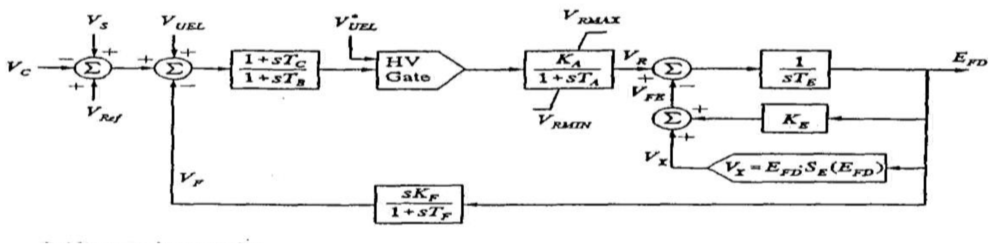


Figure 8.40: IEEE type DC1A excitation system model. ©IEEE 1991[8]

2. *Type AC1A Exciter model*

The type DC1A exciter model represents field controlled dc communtator exciters, with continuously acting voltage regulators. The exciter may be separately excited or self excited, the latter type being more common. When self excited, K_E is selected so that initially V_R=0, representing operator action of tracking the voltage regulator by periodically trimming the shunt field rheostat set point.

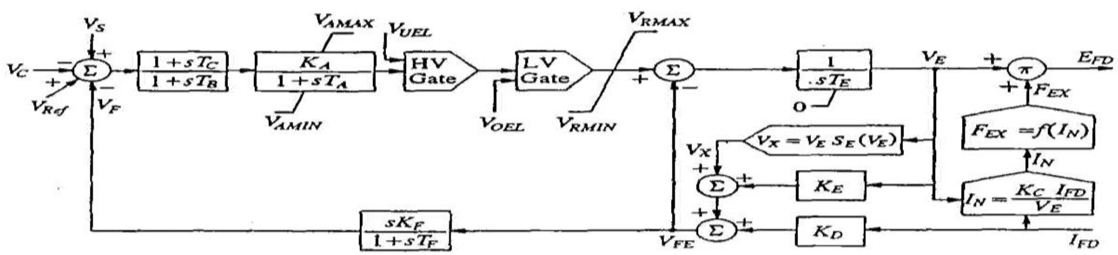


Figure 8.41: IEEE type AC1A excitation system model. ©IEEE 1991[8]

The type AC1A exciter model represents a field controlled alternator excitation system with non-controlled rectifiers, applicable to a brushless excitation system. The diode rectifier characteristic imposes a lower limit of zero on the exciter output voltage. The exciter field supplied by a pilot exciter, and the voltage regulator power supply is not affected by external transients.

3. *Type AC4A exciter model*

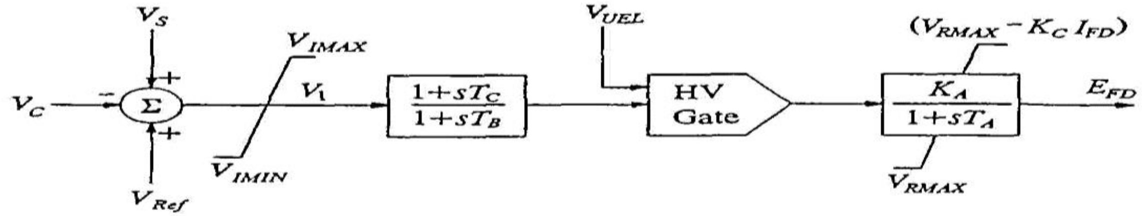


Figure 8.42: IEEE type AC4A excitation system model © IEEE 1991 [8]

The type AC4A exciter model represents an alternator supplied controlled rectifier excitation system - a high initial response excitation system utilizing full wave thyristor bridge circuit. Excitation system stabilization is usually provided in the form of a series lag-lead network (transient gain reduction). The time constant associated with the regulator and firing of thyristors is represented by T_A. The overall gain is represented by K_A. The rectifier operation is confined to mode 1 region. Rectifier regulation effects on exciter output limits are accounted for by constant K_C.

4. *Type ST1A exc*

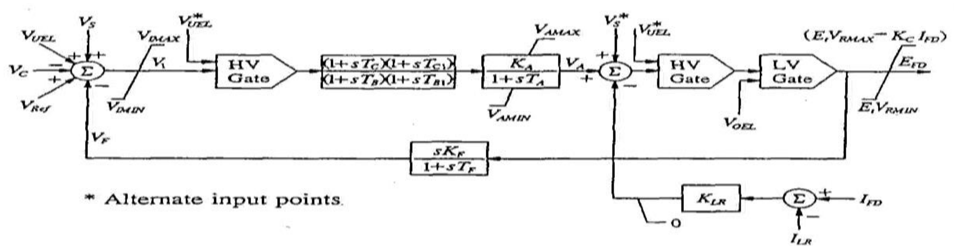


Figure 8.43: IEEE type ST1A excitation system model © IEEE 1991 [8]

The type ST1A exciter model represents potential-source controlled-rectifier systems. The excitation power is supplied through a transformer from generator terminals; therefore, the exciter ceiling voltage is directly proportional to generator terminal voltage. The effect of rectifier regulation on ceiling voltage is represented by K_C. The model provides flexibility to represent series lag-lead or rate feedback stabilization. Because of very high field forcing capability of the system, a field current limiter is sometimes employed; the limit is defined by I_{LR} and the gain by K_{LR}.

Bibliografia

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- Excitation Course - Kundur