

## Static Excitation Systems for Synchronous Machines

Automatic Voltage Regulators and Static Excitation Systems provides high performance control of all kinds of synchronous machines. The microprocessor-based voltage regulator uses the latest available technology. The development is based on more than 40 years experience with semiconductors and more than 15 years experience with microprocessor technology.

### Product range

System is available as

- **Automatic Voltage Regulator (AVR)** for 50 Hz supply using thyristor converter
- **Static Excitation System (SES)** for 50 Hz supply using thyristor converter.

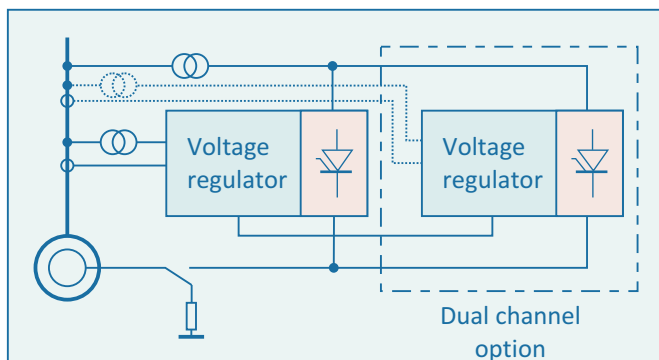


Fig 1. Static excitation system block diagram

Basic components

- Excitation transformer
- Thyristor power converter
- Automatic voltage regulator
- Field discharge equipment

A wide selection of power components and software functions is available to provide a system which meets the most demanding technical requirements.

### Digital control

A microprocessor-based system provides high control accuracy (min.  $\pm 0.5\%$ ) and high initial response (approx. 20 ms). Its well-structured software offers a wide range of functions covering standard (e.g. limiters) and optional (e.g. PSS and Electric Breaking System ) functions.

### Local operation

System includes a control panel for local operation and monitoring. With this panel it is also possible to modify system parameters and to make changes to the application programs on-line.

### System configurations

AVR and SES are available in the following configurations (Fig 2.):

- Single automatic channel system (**SACS**) with one excitation module including one power converter and one controller for both AUTO and MAN control modes
- Dual automatic channel system (**DACS**) with two identical excitation modules each with power converter and controller. Each channel can operate in AUTO or MAN mode. A follow-up control ensures a smooth change-over from one mode or one channel to another.

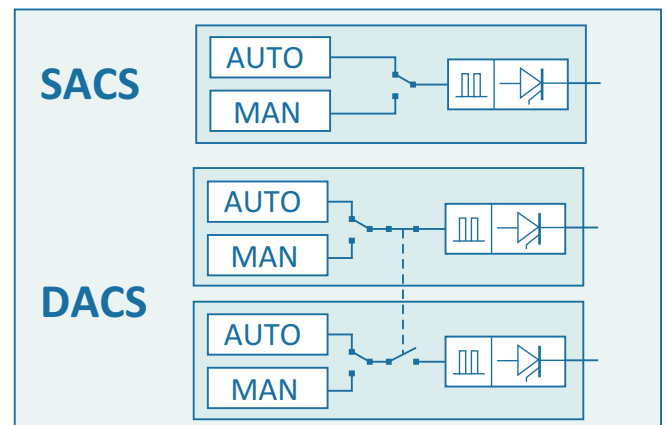


Fig 2. Main configurations

## Regulator highlights

### Additional regulator redundancy

- Dual-channel system

### Digital input processing

- Three-phase voltage measurement
- Three-phase current measurement
- Digital processing of the input values with a signal processor

### Independent current regulator

Separate device with power supply, measurement and gate control circuits can be used. Because of the follow-up control for all the inactive regulators, in the case of failure of the active regulator a smooth switch-over to a ready-to-operate regulator channel is guaranteed.



### Power section highlights

#### Power converter redundancy

- Power converter redundancy of parallel power converters are possible
- Power converter redundancy is completely independent of the regulator configuration

#### Intelligent power converter electronics

- 2-quadrant operation (negative excitation current is possible)
- Fan control and monitoring
- Monitoring of fuses, power converter temperature and cooling-air flow
- Bridge current display.

### Functionality of the standard Program

This comprises the following excitation specific functions:

#### Regulator functions

- Voltage regulator with PID filter (AUTO operating mode)
- Field current regulator with PI filter (MAN operating mode)
- Reactive load and/or active load droop/compensation
- Limiters for
  - maximum and minimum field current
  - maximum stator current (lead / lag)
  - P/Q underexcitation
- Follow-up control
  - CHANNEL 1 ↔ CHANNEL 2 (for dual automatic channel systems)
  - operating mode AUTO ↔ MAN
- MANUAL restrict
- Power system stabilizer (option)
- Electric breaking system (option)

### Protection and monitoring functions

- Field flashing time
- Overcurrent protection (instantaneous / inverse time)
- Loss of excitation protection
- Power converter fuses monitoring
- Power converter fans monitoring
- Instantaneous excitation trip for protection purposes.

### Control functions

All standard excitation sequences and interlocks are software-based with fixed pre-programmed function blocks. They can be extended with freely programmable function blocks by the user.

### Additional Software Functions

The characteristics of the excitation system can be adapted by both extending the application program and with optional software functions, in order to optimally match the system to the customer's requirements.

#### Application function blocks

In addition to the standard software functions, further universally applicable function blocks of various kinds are available for the application program.

#### Power System Stabilizer (PSS)

The purpose of the power system stabilizer is to improve the stability of the generator and the transmission system as a whole by using the excitation to damp load oscillations.

#### Electric Breaking System

Electric breaking system is used for faster stopping of hydro power unit by making use of electromagnetizing counter-moment of short-circuited generator



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