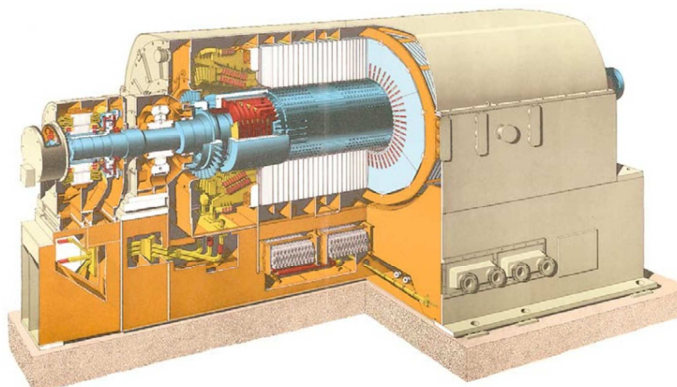


# THE EXCITER FOR TURBOGENERATOR

## Introduction

Kazakhstan is the country of great electric-power industry in which the generated power of power plants is constantly increasing not only due to the commissioning of new power units, but also due to the modernization and reconstruction of existing capacities. Commissioning of the new power units and modernization inevitably entails the implementation of more modern excitation systems for turbo- and hydro generators.



In Kazakhstan, for this purpose excitation systems are mainly used and produced by enterprises of Russia, Ukraine and a number of foreign companies, such as **ABB**.

At the present time Kazakh Company **“RVSA” Ltd.** can offer exciters for generators of its own design and manufacture under the brand **“Made in Kazakhstan”**.

**“RVSA” Ltd.** has experience in implementation, adjustment, repair and technical maintenance of excitation systems at several power plants of Kazakhstan: Karaganda TPP-TBS JSC “Arcelor Mittal Temirtau”, Topar State District Power Plant “Kazakhmys Energy” Ltd.; Petropavlovsk TPP-2 JSC “SevKazEnergo”; Rudny TPP JSC “SSGPO”; Balkhash TPP «Kazakhmys Energy».

The exciter for synchronous generator of **“RVSA” Ltd.** has the grading **CRV-STG-AAA/BBB** on currents (AAA) 800-1000-1250-1600-2000 A, and voltage (BBB) for the specific generator according to the customer’s request as indicated in the questionnaire.

The exciter satisfies GOST 21558-2000 requirements, the best technical solutions, applied to the exciters of other manufactures are considered in it, also the work experience, gained over recent years during adjustment and implementation of excitation system is used.

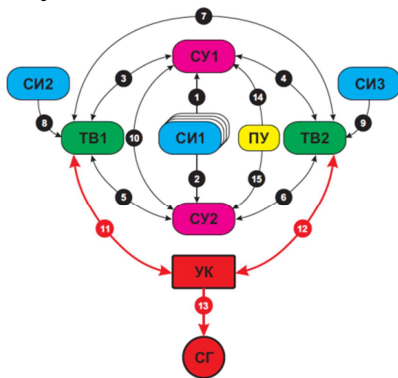
## Exciter description

The exciter CRV-STG is designed to supply the excitation winding of the synchronous generator with an adjustable current of DC voltage in normal and emergency modes.

The device relates to the class of one group exciters with parallel self-excitation, its energy source is the stator voltage of the excited synchronous machine.

Main functional units (Automatic excitation regulator, measuring device of electrical parameters and control system of thyristor rectifier, protection units and so on) are made, with the using of the microprocessor technology. Power supply of the elements for this device is realized from a few (up to three) independent sources of voltage.

To carry out adjustment work, testing, characterization of idling and short circuit, the device is switched to the independent excitation mode, receiving power from the built-in power supply, which is not connected with voltage of this synchronous machine.



All main units of the system are redundant and operate on the principle **"each with each"** due to cross-connections between devices.

Excitation control from Main control Board is realized by means of the pulpit, equipped with switching and visualization bodies as operator's panel and signal fixtures. The connection between pulpit and exciter is possible not only on fiber optic cable - channel of remote control but also on control cable – distance control. The type of the connection in each case is determined by the customer in accordance with the questionnaire.



The compact design of the exciter meets the requirements of serviceability, adjustment, installation and dismantling of separate assembly units.

During the modernization and reconstruction the exciter can be mounted in the power control rooms with limited working area, for example, in the existing power control room of the field breaking switch.

Safety requirements in the operation of electrical installation are observed.



## Technical specification:

Supply voltage of auxiliaries:

AC [V]	3x380 <sup>+10</sup> / <sub>-15%</sub>
DC [V]	220 <sup>±10%</sup>
The ratio of current forcing, [r.u]	2.0
The ratio of voltage forcing, [r.u]	2.5
Forcing interval, [sec]	20
The rate of voltage rise, [ r.u/ sec]	4
Performance when the forcing does not exceed as follows (in the presence of voltage on the stator ≥80%), [sec]	0.06
The voltage of the stator measuring circuits, [V]	3x100
The current of the stator measuring circuits, [A]	5
Climatic modification:	4
- the ambient air temperature	from 5 to 40°C

- environment is not explosive and does not contain dust at concentrations reducing the isolation level. .

A highly reliable modern microprocessor units and power components from leading manufacturers of electrical products: **SIEMENS**, **ABB**, **Schneider Electric** and others are used in the exciter.

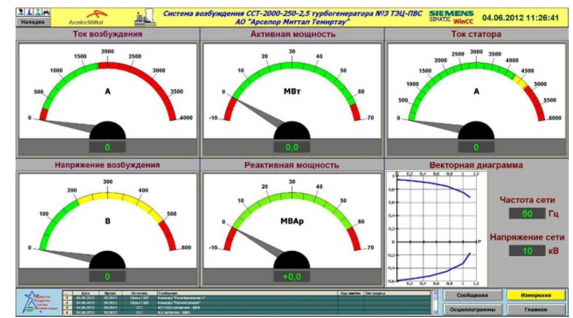
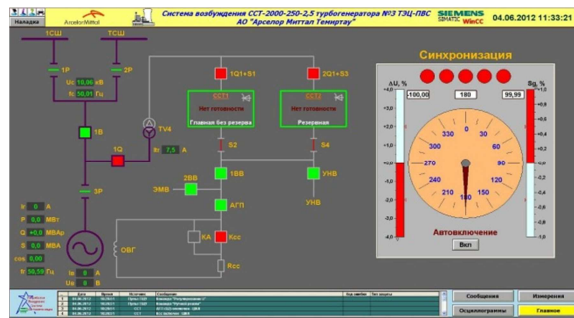
Devices and elements of the general purposes, mass-produced are used to the maximum. It permits to change components of other modifications or to the similar products of other manufactures if it is necessary.

In general the exciter contains **SIEMENS** equipment, such as: thyristor rectifiers **SINAMICS DCM**, master controllers **SIMATIC S7**, measuring devices of electrical parameters **SENTRON PAC 3200**, protection units **SICROWBAR DC**, visualization and diagnostics equipment and protection terminals.

The reliability and efficiency of this equipment is confirmed by long-term experience of its operation in various industries including the energy sector.

A pulpit, which is integrated into the overall **SCADA** system, a power transformer, the cabinet of generator protections with units **SIPROTEC**, made by **SIEMENS** in combination with the exciter are supplied optionally.

Integrated visualization system allows monitoring current parameters as schedules, tables and diagrams, conditions of all system units, not only in real-time mode but also on data from the archive for any period of time, it permits detect and analyze failures in the power grid and generator quickly.



Automatic excitation regulator system provides work of the exciter in manual and automatic modes with controlling of stator voltage, reactive power and power factor. The exciter has a system stabilizer PSS, which suppresses oscillations of the rotor and the generator electrical parameters during disturbances in the electric power system.

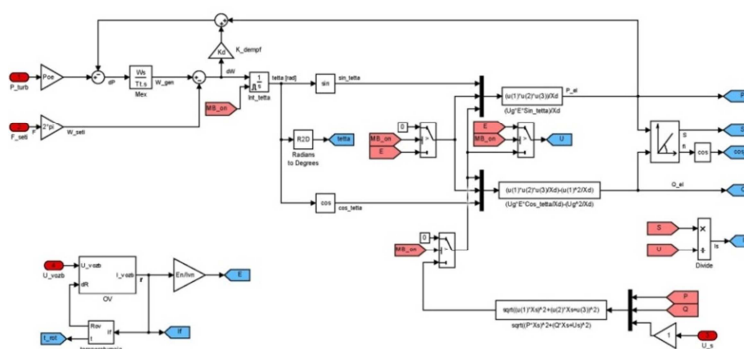
Control of electrical parameters is made on a combined principle with the PI and PID adaptive controllers (with variable coefficients) thus high accuracy and performance during maintaining of marginal stability achieve.

All basic operations: field injection, cutting into mains, networking, unloading and transfer to work from the external backup excitation can be carried out in automatic mode; it eliminates errors connected with human factor.

Interlocks and protection units against switching overvoltage, limitation of operating parameters, built-in protection of the converter from the critical situations, the indirect calculations of the rotor temperature protect the converter and the associated generator from damages.

The exciter is equipped with automatic characteristic measuring of idling and short circuit, using an auxiliary supply of power bridge voltage at disconnected converter transformer.

Switching of the exciter to auxiliary power supply allows testing the equipment, when the turbine is stopped.



The mathematical model of the generator is built in the control program, it allowed to obtain a combined (math + physical) model of the excitation system in combination with the real exciter and thereby to test control system and converter,

loaded on equivalent load or the generator rotor. Operation of all regulators, limiters, PSS operation, thyristor converter, power circuit, measuring characteristic program of idling and short circuit are verified during the testing in real-time.

Using this model, it is possible to provide training of the operating staff during the work and maintenance of the excitation system.

Excitation system passes a thorough and comprehensive test after assembly and its long-term operation is guaranteed.

**“RVSA” Ltd.** realizes supervising installation and adjustment, holds technical consultations on exciter operation and carries out post-warranty service of the excitation system, if it is necessary.