

TC.ACS

Grid Simulator – full digital, full 4-quadrant, full regenerative

Scope of Application

The increasing number of alternative power sources like solar, wind driven or biological energy systems call for consistent and well demanding regulations for energy feed into the utility grid.

Manufacturers of such systems have to test and to prove the compliance of their equipment.

Grid simulators form an electronic equivalent circuit for the grid, but allow to vary all relevant parameters in order to test the behaviour and response of the equipment under test.

TC.ACS-Programmable Parameters

For each phase individually programmable:

- Variation of frequency
- Variation of phase angle
- Variation of amplitude
- Step changes of base frequency
- Voltage drops on either three phase or on each single phase
- Asymmetric three phase voltages
- Micro-ruptures and flicker
- Periodic and single shot under- and over-voltages
- Superimposed harmonic and inter-harmonic voltages up to 3 kHz
- Specialized programs for EMC characterisation

Hardware

REGATRON grid simulator systems use a top-of-the-art multilevel double inverter technology. The main advantages over existing linear systems are a substantial reduction of power losses, full 4-quadrant operation, very compact power units and the modular, cost-effective architecture. This allows the user to choose a system size well fitting his requirements, including the possibility for future power expansions and/or splitting-up of the system into several stand-alone subsystems. The basic triphase power units of 50 kVA may be expanded by simply paralleling further blocks even to big systems reaching 700 kVA. Even higher power levels may be achieved by means of multi-system operation.

With the availability of the active neutral string, any single phase or asymmetric condition can be simulated. Additionally, the neutral can be connected to Protective Earth (PE), if required.

The system will allow for all relevant testing according to the grid-feed-in regulations (CENELEC, DIN, IEC). Both the operation as a grid simulator as also as triphase full 4-quadrant voltage amplifier are possible.

Software

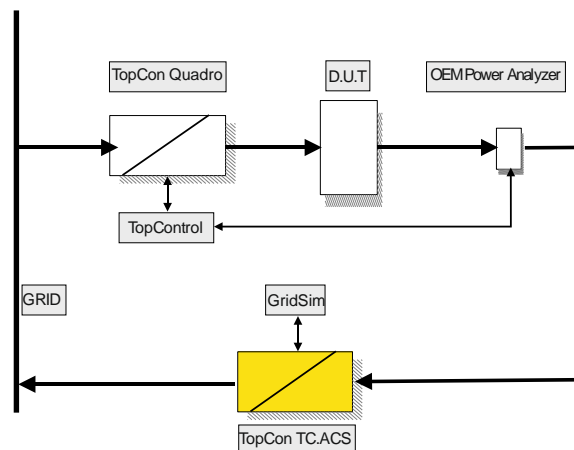
An intuitive, application based software will allow for manual operation, programming and for automated test runs of the system. Provisions are made for data acquisition, storage and visualisation throughout the system. The software also offers the documentation of test results.

The Grid Simulator as a Building Block of a Complete Test Environment

Owing to the full 4-quadrant capability of the TC.ACS system, almost all AC power equipment can be tested with the appropriate test procedures. One of the most interesting application fields today is testing of solar inverter equipment. An integrated test environment for solar inverters is composed of a Solar Array Simulation block (SAS), the device under test (DUT) and the grid simulator system (GRS). While the REGATRON SAS components allow for simulation of a user-defined solar array of any order under arbitrary conditions, the GRS simultaneously defines the different test conditions with respect to the grid connection.

By the addition of the bidirectional DC power supply TC.GSS to such a test environment, even the role of a battery pack within the setup may be experienced.

REGATRON offers complete and modular SAS systems based on the widespread, field-proven TopCon Quadro power supplies on the one hand as well as complete GRS simulation on the other hand. Modern switched-mode technology ensures very compact and reliable systems with high overall efficiency.



Pic. 1 Example of a Solar Inverter test bench with grid simulator

Regatron AG
Kirchstrasse 11
CH-9400 Rorschach
Switzerland

Tel +41 71 846 67 67
Fax +41 71 846 67 77
www.regatron.com
support@regatron.ch

50 kVA / 280 Vrms (L-N) / 72 A

TC.ACS Modular Grid Simulator

Mains Requirements and Specifications

Grid Port

Line voltage 3 x 360 – 440 V_{AC}
Line frequency 48 – 62 Hz
Mains connection type 3L+PE (no neutral)
Input current 3 x 85 Arms
Powerfactor 0 – 1
(At nominal power)

Simulation Port: 3L + active N (4 outputs)

Power range 0 - 50 kVA
Voltage range 0 – 280 Vrms (L-N)
Connection type 3L+N+PE
Current range 3 x 0 – 72 A
Frequency range (fundamental wave) 0 – 1000 Hz
Frequency range (full power) 16 – 1000 Hz
Modulation bandwidth 3 kHz
Resolution frequency 0.001 Hz
Accuracy frequency ± 10 ppm
Stability frequency (-30°... 85°) ± 25 ppm
DC offset ≤1 mV
Bidirectional DC operation allowed
..... with power derating (approx. 25 %)

Operating Modes

- Four quadrant simulator mode
- Four quadrant voltage amplifier mode
- Hardware in the loop mode

Static Accuracy

Load regulation CV < ± 0.3% FS
Line regulation CV < ± 0.1% FS

Overloadability

up to 10 s every 600 s 1.5 p.u
up to 1 s every 60 s 2.0 p.u

General Specifications

Efficiency at nominal power 90 %
Weight approx. 135 kg
Width housing (19") 444 mm
Height housing 11 U
Depth with output terminals 634 mm
Operating orientation upside
Storage, transport orientation upside
Noise level ≤74 dB, at 1 m

Ambient Conditions

Operating temperature 5 – 40 °C
Storage temperature -25 – 70 °C
Relative air humidity (non-condensing) 0 – 95 %

Cooling

External liquid cooling or external air to liquid heat-exchange system using temperature-controlled fans.

Heat exchanger

Material Al
Inlet/outlet on rear side size: G ½"
Liquid temperature 15 – 35 °C
Flow ≥ 5 l/min
Pressure max. ≤ 10 bar

Protection

Built-in Protection

Overvoltage protection programmable
Overcurrent protection programmable
short circuit protection Cont. short circuit allowed
Islandig, grid off, requirements for the connection of micro-generators in public grid according VDE 0126/EN 50438.

Type of Protection (according EN 60529)

Basic construction IP 20
Mounted in cabinet up to IP 53

Conformity CE-Marking

EMC Directive

EMC emission EN 61000-6-4
EMC immunity EN 61000-6-2

Low Voltage Directive

Electronic equipment
for use in power installations EN 50178

Standard Programming Interfaces

Control Port Input Functions

Amplifier mode:
Voltage setting L1: 0 – 100 % -10 – +10 V
Voltage setting L2: 0 – 100 % -10 – +10 V
Voltage setting L3: 0 – 100 % -10 – +10 V

Trigger port

Input 1 (Start) TTL
Input 2 (Stop) TTL
Output (programmable) TTL

Control Port Output Functions

Analogue output configurable

RS232

9 pin D-sub connector, female
Isolation to electronics and earth 125 Vrms

Ethernet

Integrated interface planned

Preliminary