TopCon TC.ACS

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

Full 4-quadrant Grid Simulator

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.
REGATRON TC.ACS represent the newest generation of fully programmable, full 4-quadrant grid simulation systems. Modular architecture and additional operation modes make them an ideal choice for test and R+D laboratories.

TC.ACS-Programmable Parameters

- For each phase individually programmable:
- Variation of frequency up to 1000Hz
- Variation of phase angle
- Variation of amplitude
- Step changes of base frequency
- Voltage drops either three phase or 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 5 kHz
- Specialized software for EMC characterisation

Software

An intuitive application based software allows for manual operation, programming and for automated test runs. A set of predefined voltage shapes – Sine, Clipped Sine, Sine divers, Square, multifunctional Ramp, Triangle, Sawtooth, user definable slope - facilitates a quick and easy definition of specific grid situations. The software offers also data acquisition, storage and documentation throughout the system.

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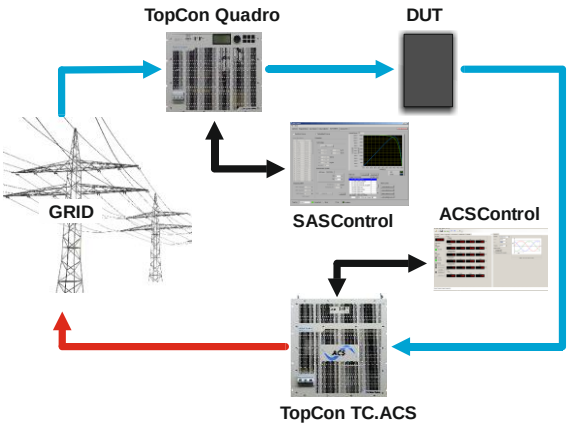
Hardware

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 1 MVA.
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). Note the operation as a grid simulator, as fast triphase full 4-quadrant voltage amplifier and as a programmable electronic load are possible.

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



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

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. 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 precise 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 an energy storage 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 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.

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 (At nominal power) 1
Precharge unit provided. No inrush current.

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 ..... 0 – 1000 Hz [1) 2)]
Modulation bandwidth ..... 5.0 kHz
DC offset ..... ≤10 mV
Bidirectional DC operation ..... 0 – 800V
..... 3 x 20A (per phase)

Slew rate

Voltage slew rate ..... ≤ 4 V / µs
10% … 90% step of full scale ..... ≤ 100 µs [4)]

Harmonic distortion at 50 Hz

Linear ..... ≤ 0.1%
Non linear ..... ≤ 0.8%

Overloadability

up to 10 s every 600 s ..... ≤ 150 % [2) 3)]
up to 1 s every 60 s ..... ≤ 200 % [2) 3)]

Operating Modes

Four quadrant mode ..... AC, DC, AC + DC

Static Accuracy

Voltage ..... < 1.5 V
Frequency ..... 1 mHz
Phase Angle ..... 1°

Setpoint Resolution

Voltage ..... 0.25 V
Frequency ..... 1 mHz
Phase ..... 1°

Measurement Precision

Voltage ..... ± 0.7 %
Current ..... ± 1.4 %

General Specifications

Efficiency at nominal power ..... 90 %
Weight ..... approx. 150 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 ..... -18 – 70 °C
Relative air humidity (non-condensing) ..... 0 – 95 %

Liquid Cooling (LC) Characteristics

Internal heat sink material ..... Al
Inlet/outlet on rear side size: ..... G ½''
Liquid temperature ..... 15 – 35 °C
Flow ..... ≥ 5 l/min
Pressure max. ..... ≤ 4 bar

External Heat exchanger TC.LAE (Option)

The external liquid to air heat-exchange system using temperature-controlled fans

Input voltage options ..... 24 V_{DC}; 230 V_{AC}; 400 V_{AC}
Material ..... Stainless steel
Inlet/outlet on rear side size: ..... G ½''
Liquid temperature ..... 15 – 40 °C
Flow ..... ≥ 10 l/min
Pressure max. ..... ≤ 1.5 bar
Pressure drop 250mbar

Protection

Built-in Protection

Overvoltage protection ..... programmable
Overcurrent protection ..... programmable
short circuit protection ..... Cont. short circuit allowed

Internal diagnostics

line input conditions, internal current conditions, temperature conditions, processor idle time, system configuration, system communication, sensor signals, power semiconductor temperatures.

Type of Protection (according EN 60529)

Basic construction ..... IP 20
Mounted in cabinet ..... up to IP 54

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
Time delay input to output ..... typ 25 µs

Trigger port

Input 1 (Start) .....TTL
Output (programmable) .....TTL

Control Port Output Functions

Analogue outputs ……..configurable for any
..... phase voltage or current

USB

USB-Type B connector
Isolation to electronics and earth .....125 Vrms

Ethernet

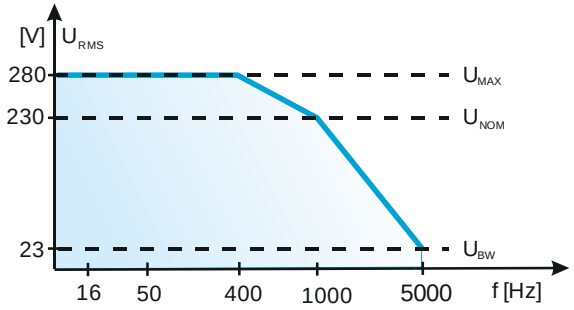
Integrated interface..... planned

Safety interface

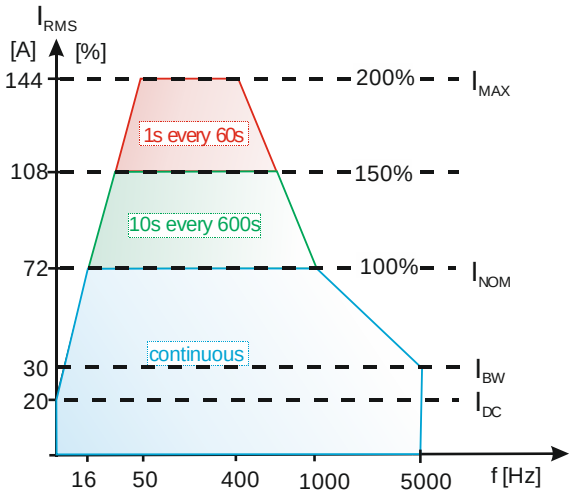
The energy transmission between the line side and the load side will be disconnected via integrated safety relays. The interface provides a connection to an external safety circuit.

Further description details

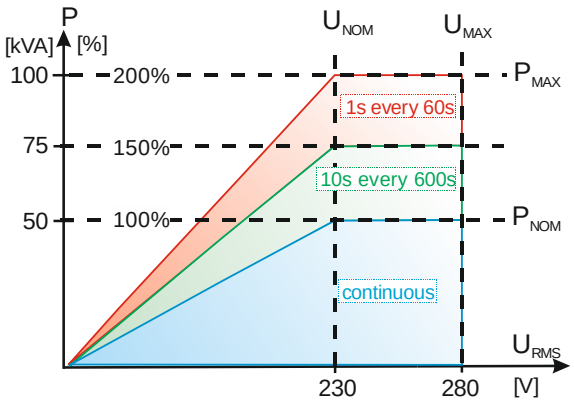
1) Output voltage versus frequency



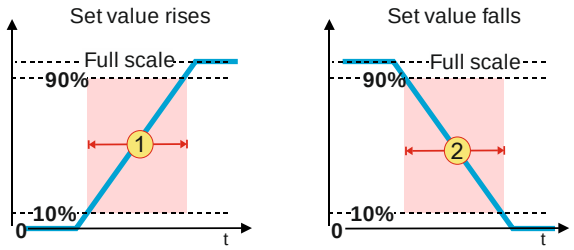
2) Overloadability versus frequency



3) Overloadability versus voltage



4) Slew rate at a resistive load



-1- rise time 100 µs;
-2- fall time 100 µs