

**Programmable Bidirectional
Regenerative AC Power Source**



TC.ACS Series unit
Full 4-Quadrant Grid Simulation System

Scope of Application

TC.ACS Series (wide range)

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.

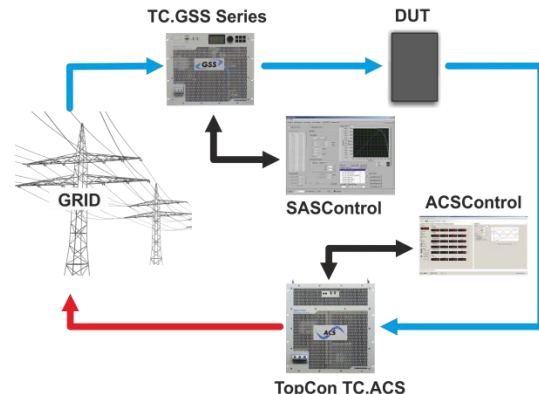
TC.ACS - Programmable Parameters

- 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

The Grid Simulation System 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. 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 (ACS). While the REGATRON SAS components allow for precise simulation of a user-defined solar array of any order under arbitrary conditions, the ACS simultaneously defines the different test conditions with respect to the grid connection.

Application example



By the addition of the bidirectional regenerative 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 grid simulation on the other hand. Modern switched-mode technology ensures very compact and reliable systems with high overall efficiency.

Features

Software

An intuitive application based software allows for manual operation, programming and for automated test runs. A set of predefined voltage shapes – sine, cut sine, square, triangle, sawtooth, user defined - facilitates a quick and easy definition of specific grid situations. The software also offers freely programmable modulations on each phase for amplitude, frequency and phase angle.

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 30kVA or 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.

Technical Data

AC lineside ratings

Grid Port

Line voltage.....	3 x 360 – 528 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.	

AC loadside ratings

Simulation Port: 3L + N

Power range.....	0 - 50 kVA
Voltage range.....	0 – 305 Vrms (L-N)
Connection type.....	3L + N + PE
Current range.....	3 x 0 – 72 A
Frequency range.....	0 – 1000 Hz (see fig. 1,2)
Modulation bandwidth.....	5.0 kHz
DC offset.....	≤ 10 mV
Efficiency at nominal power.....	90 %

DC loadside ratings

Simulation Port: 3L + N

Configuration 1: two independent outputs	
.....	1 x 0 - 800 V _{DC} , ± 20 A, ± 16 kW (L1 - L2)
.....	1 x 0 - 400 V _{DC} , ± 20 A, ± 8 kW (L3 - N)
Configuration 2: three independent outputs	
.....	3 x 0 - 400 V _{DC} , ± 20 A, ± 8 kW (L1 - N, L2 - N, L3 - N)
.....	(total current in N is limited to 20A)

Static Accuracy

Voltage @ 50/60 Hz.....	0.05 %
Voltage general.....	< 1.5 V
Frequency.....	1 mHz
Phase Angle.....	1 °

Slew rate

Voltage slew rate.....	≤ 4 V / μs
10% ... 90% step of full scale.....	≤ 100 μs (see fig. 4)

Harmonic distortion at 50 Hz

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

Overloadability

up to 10 s every 600 s.....	≤ 150 % (see fig. 2,3)
up to 1 s every 60 s.....	≤ 200 % (see fig. 2,3)

Measurement Precision

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

Setpoint Resolution

Voltage.....	0.1 V
Frequency.....	1 mHz
Phase.....	0,1 °

Operating Modes

Full 4 quadrant Grid Simulation mode.....	
Full 4 quadrant Load Simulation mode.....	
Full 4 quadrant Amplifier mode CV / CC.....	

Technical Data

Protection

Built-in Protection

Overvoltage protection.....	programmable
Overcurrent protection.....	programmable

Internal diagnostics

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

Type of Protection (according EN 60529)

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

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.

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
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RoHS Directive 2011/65/EU

Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances..... EN 50581

Ambient conditions

Operation

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

Storage

Storage temperature.....	-18 – 70 °C
Relative air humidity (non-condensing).....	0 – 95 %

Installation altitude..... 0 – 1000 m above sea level
 Operating orientation..... upside
 Storage, transport orientation..... upside

Utilization category

Protection class.....	I
Overvoltage category.....	III
Degree of pollution.....	2

Liquid Cooling (LC)

Internal heat exchanger

(aircooling possible with optional TC.LAE)

Material.....	Al
Inlet/outlet on rear side size.....	G ½"
Liquid temperature.....	15 – 50 °C
Flow.....	4 l / min (15°C) – 8 l / min (50°C)
Pressure max.....	8 bar

Standard Interfaces

Control Port Input Functions (X610 – X612)

Amplifier mode:
 Voltage setting L1: -100 % – +100 %..... -10 – +10 V
 Voltage setting L2: -100 % – +100 %..... -10 – +10 V
 Voltage setting L3: -100 % – +100 %..... -10 – +10 V
 Sampling rate 80 kHz
 Time delay input to output..... typ 25 µs
 Isolation to electronics and earth..... 125 Vrms

Control Port Output Functions

Trigger ports BNC

Trigger Input X620 (Start)..... TTL
 Trigger Output X621 (programmable) TTL
 Isolation to electronics and earth..... 250 Vrms

Analog port 12-pin flush-type (X609)

4 Inputs for general usage, ± 10V reference voltage.
 4 Outputs for general usage, ± 10V reference voltage.
 Sampling rate 80 kHz
 Isolation to electronics and earth..... 250 Vrms

USB Type B (X607)

Integrated interface for remote control with the operation software ACSControl..... 250 Vrms
 Isolation to electronics and earth..... 250 Vrms

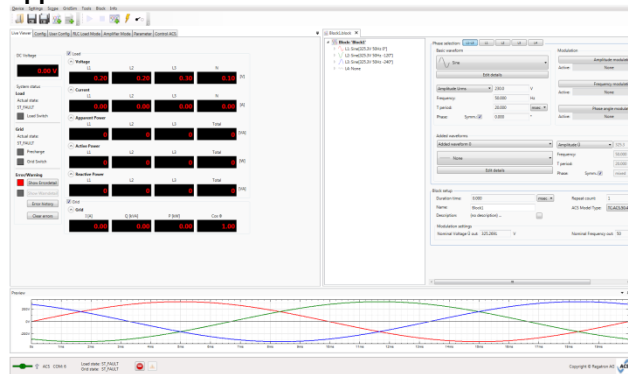
Ethernet (X605)

Integrated interface for remote control with the operation software ACSControl..... 200 Vrms
 Isolation to electronics and earth..... 200 Vrms

RS232 (X606)

Service interface
 Isolation to electronics and earth..... 125 Vrms

Application Software ACSControl



Possible Test Sequences

- IEC 61000-4-11
- IEC 61000-4-13
- IEC 61000-4-14
- IEC 61000-4-27
- IEC 61000-4-28
- IEC 61000-4-34

Options

Software

Full waveform generation mode..... (GridSim)
 Load Simulation mode (RLC load)
 Amplifier mode CC..... (Current Control)

Hardware

Senseboard with programmable transformer ratio
 for RMS voltage drop compensation @ 50/60 Hz
 maximum input voltages
 L-L: 1000 VRMS, 1500 Vp
 L-N: 1000 VRMS, 1500 Vp
 N-PE: 500 VRMS, 750 Vp

Digital I/O Interface

8 x Digital IN 24V
 8 x Digital OUT 24V
 4 x Relays, potential free SPDT

External Liquid to Air Heat Exchanger (TC.LAE)

In addition to the internal Liquid Cooling (LC)

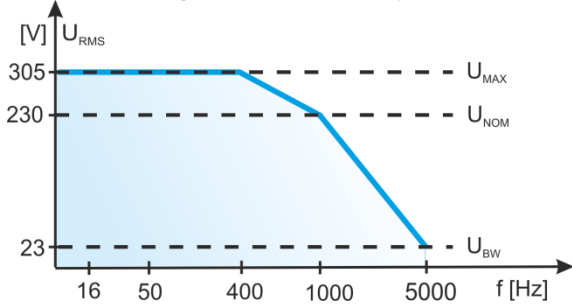
General Data

Weight & Dimension

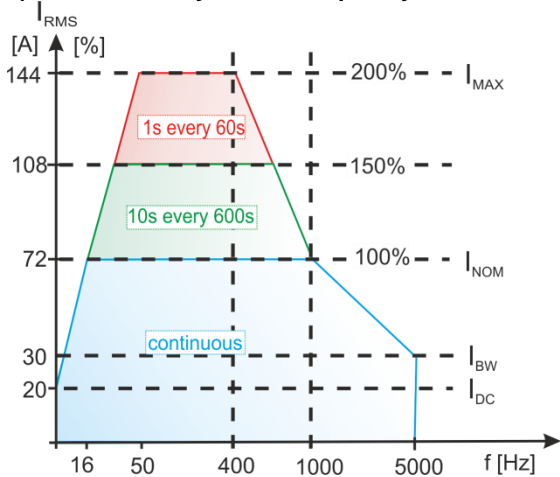
Weight approx. 150 kg
 Width housing (19") 444 mm
 Height housing 11 U
 Depth with output terminals 634 mm
 Noise level ≤ 74 dB, at 1 m

Further description details

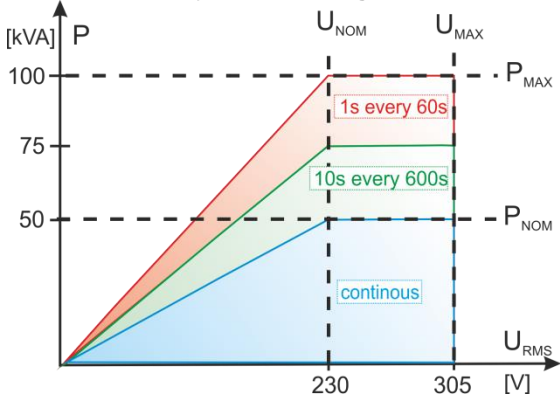
1) Output voltage versus frequency



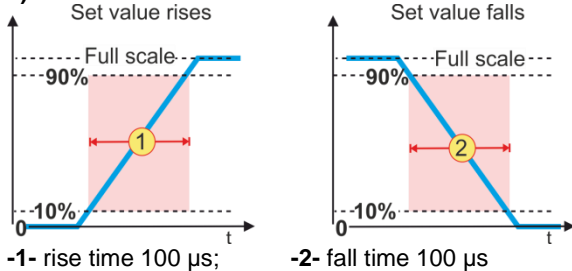
2) Overloadability versus frequency



3) Overloadability versus voltage



4) Slew rate at a resistive load



All product specifications are subject to change without notification.

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