

TC.ACS.50.528.4WR.S.LC

Programmable Bidirectional AC Power Source



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

- Each phase individually programmable
- Variation of fundamental frequencies up to 1000 Hz
- Variation of phase angles
- Variation of amplitudes
- Step changes of fundamental 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. Depending on the requirements, the ACS functionality may be tailored with various software options. In addition to the Basic Waveform Generator Mode and the Amplifier Mode, which are within the standard scope of delivery, the options Full Waveform Generator Mode with Fourier Synthesis Tool, Current controlled Amplifier Mode and Load Simulation Mode are available.

Features Software

An intuitive application based software with various options allows for manual operation, programming and for automated test runs. With the optional *Full Waveform Generator Mode (GridSim)* a set of predefined voltage shapes – sine, cut sine, square, triangle, sawtooth, user defined – facilitates a quick and easy definition of specific grid situations. This software option also offers freely programmable modulations on each phase for amplitude, frequency and phase angle.

Features Hardware

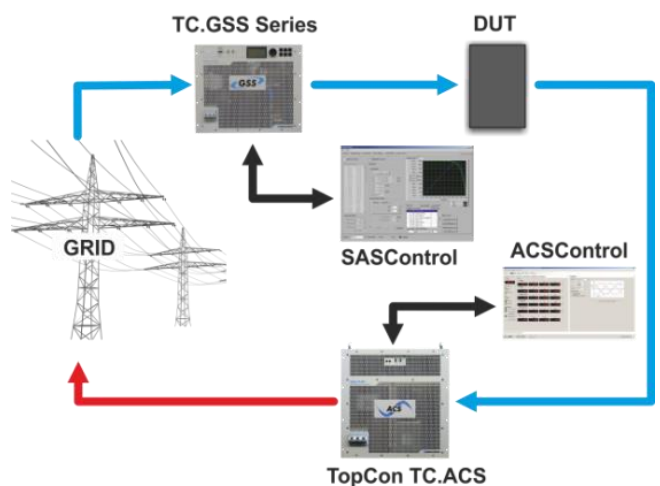
REGATRON grid simulator systems use a state of the art multilevel double inverter technology. The main advantages over existing linear power supplies are a substantial reduction of power losses, full 4-quadrant operation, very compact power units and the modular, cost-effective architecture. This allows 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 30 kVA 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.

Application Example



By the addition of a bidirectional regenerative DC power supply TC.GSS or G5 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 and the G5 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.

AC Lineside Ratings

Line voltage	3 x 360 ... 528 V _{AC}
Line frequency	48 ... 62 Hz
Mains connection type	3L + PE (no neutral)
Input current	3 x 360 V _{AC} / 90 Arms
	3 x 400 V _{AC} / 81 Arms
	3 x 440 V _{AC} / 74 Arms
	3 x 480 V _{AC} / 68 Arms
Powerfactor (At nominal power)	1
Precharge unit provided. No excessive inrush current.	

AC Loadside Ratings

Frequency range (see Fig. 1, 2)	0 ... 1000 Hz
Modulation bandwidth	5.0 kHz
DC offset	≤ 10 mV
Efficiency at nominal power	90 %

Simulation Port: 3L + N (see Fig. 5)

Power range	0 ... 50 kVA
Voltage range	0 ... 305 Vrms (L-N)
Connection type	3L + N + PE
Current range 3Φ	3 x 0 ... 72 A ¹⁾

Simulation Port: 1L + N (see Fig. 6)

Power range	0 ... 20 kVA
Voltage range	0 ... 305 Vrms (L-N)
Connection type	L1//2 + L3//N + PE
Current range 1Φ	0 ... 144 A ¹⁾

Simulation Port: 1Φ3W / split phase (see Fig. 7)

Power range	0 ... 50 kVA
Voltage range	0 ... 610 Vrms (L-L)
Connection type	L1//2 + L3//N + PE
Current range 1Φ	0 ... 144 A ¹⁾

Harmonic distortion at 50 Hz (THD)²⁾

At linear loads	≤ 0.4 %
At non linear loads	≤ 1.6 %

DC Loadside Ratings

Configuration 1: one output (symmetric to PE)

Power range	0 ... ±33 kW
Voltage range	0 ... ±830 VDC
Connection type	L1//2 + L3//N
Current range	0 ... 40 A

Configuration 2: one output (related to PE)

Power range	0 ... ±25 kW
Voltage range	0 ... ±415 VDC
Connection type	L1//2//3 + N
Current range	0 ... 60 A

Configuration 3: two independent outputs

Power range	0 ... ±16 kW
Voltage range	0 ... ±830 VDC
Connection type	L1 + L2
Current range	0 ... ±20 A

Power range	0 ... ±8 kW
Voltage range	0 ... ±415 VDC
Connection type	L3 + N
Current range	0 ... ±20 A

Configuration 4: three independent outputs (related to PE)

Power range	3 x 0 ... ±8 kW
Voltage range	3 x 0 ... ±415 VDC
Connection type	L1 + N / L2 + N / L3 + N
Current range	3 x 0 ... ±20 A

(total current in N is limited to 20A)

General Data

Static Accuracy

Voltage @ 50/60 Hz (RMS-controller)	0.05 % FS
Voltage general	< 1.5 V
Frequency	2 mHz
Phase Angle	1 °

Slew rate (see Fig. 4)

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

DC ripple + noise

16 Hz ... 200 kHz	230 mVrms
9 kHz ... 20 MHz	700 mVp-p

Overloadability (see Fig. 2, 3)

up to 10 s every 600 s	≤ 150 %
up to 1 s every 60 s	≤ 200 %

Measurement Precision

Voltage	± 0.7 % FS
Current	± 1.4 % FS

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

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 IEC 63000
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- 1) Current according to the given power limit of the corresponding units
- 2) Up to 290 Vrms (L-N)

Ambient

Operating temperature	5 ... 40 °C
Storage temperature	-18 ... 70 °C
Relative air humidity (noncondensing)	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
Emission	
Noise level	≤ 74 dB, at 1 m

Liquid Cooling (LC) Specifications

(aircooling possible with optional TC.LAE)

Material	Al
Inlet/outlet on rear side size	G ½"
Liquid temperature (noncondensing)	15 ... 50 °C
Range of flow rate	4 l / min (15°C) ... 8 l / min (50°C)
Recommended flow rate	5 l/min
Operation pressure max..	4 bar
Pressure drop	70 mbar @ 5 l/min

Use cooling liquid with a 30% share of Antifrogen N® within a closed circuit

Standard Interfaces

Control Port Input Functions (X610 – X612)

Amplifier mode:	
Voltage setting L1: -432 V ... +432 V	-10 ... +10 V
Voltage setting L2: -432 V ... +432 V	-10 ... +10 V
Voltage setting L3: -432 V ... +432 V	-10 ... +10 V
Maximum input voltage	± 30 V
Sampling rate	80 kHz
Time delay input to output	typ. 70 µs
Isolation to electronics and earth	125 Vrms
Input impedance	20.5 kOhm

Control Port Output Functions

Trigger ports BNC

Trigger Input X620 (Start)	TTL
input impedance	10 kOhm
Trigger Output X621 (programmable)	TTL
output impedance	560 Ohm (short-circuit-proof)
Isolation to electronics and earth	250 Vrms

Analog port 12-pin flush-type (X609)

4 Inputs for general usage	± 9.5 V reference voltage
4 Outputs for general usage	± 9.5 V reference voltage
Time delay power output to analogue output:	< 50 µs
Output pins min. load impedance	2 kOhm
Input pins input impedance	330 kOhm
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 / API	
Isolation to electronics and earth	250 Vrms

Ethernet (X605)

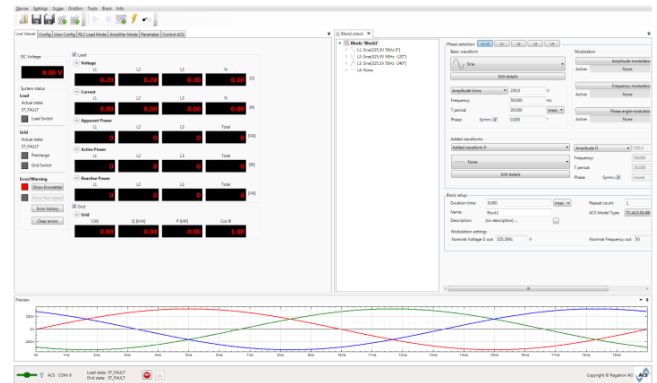
Integrated interface for remote control with the operation software ACSControl / API	
Isolation to electronics and earth	200 Vrms

RS232 (X606)

Service interface	
Isolation to electronics and earth	125 Vrms

All product specifications are subject to change without notification.

Application Software ACSControl (with options)



Optional EMC Test Sequences, preprogrammed

- 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 Generator Mode	(GridSim)
Load Simulation Mode	(RLC load)
Current Controlled Amplifier Mode	(Current Control)

Hardware

Senseboard with programmable transformer ratio

for RMS voltage drop compensation	
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	24 VDC
8 x Digital OUT	24 VDC
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

Further Description Details

Fig. 1) Output voltage versus frequency

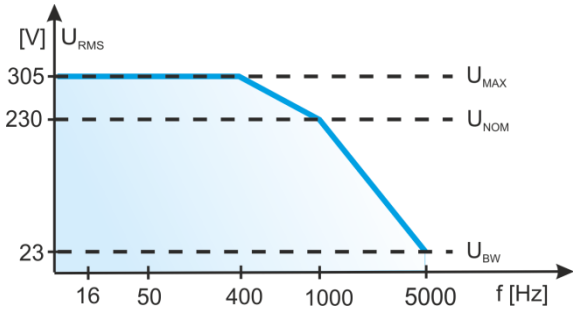


Fig. 2) Overloadability versus frequency

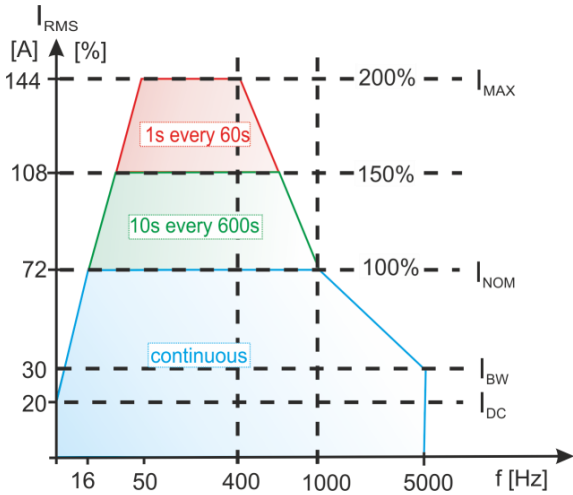


Fig. 3) Overloadability versus voltage

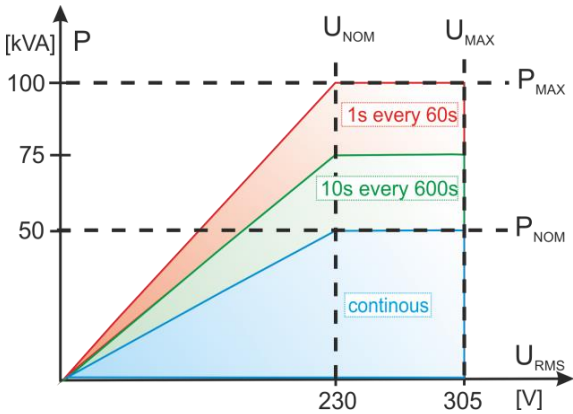
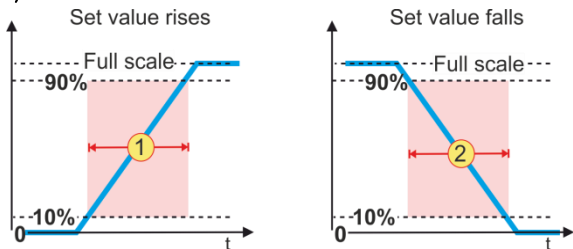


Fig. 4) Slew rate at a resistive load



-1- rise time 100 μ s;

-2- fall time 100 μ s

Fig. 5) 3L +N

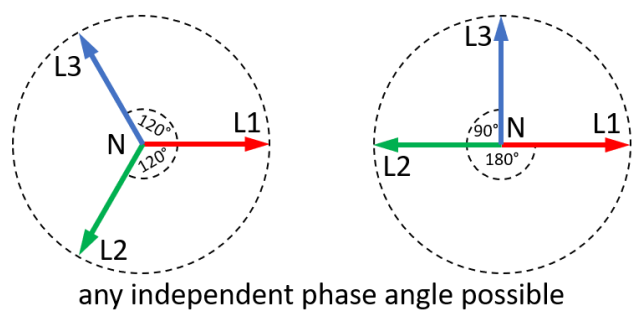


Fig. 6) 1L +N

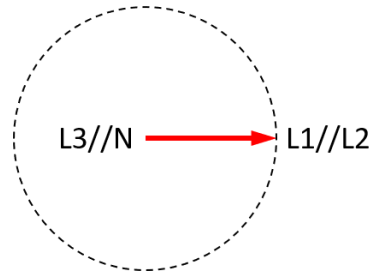
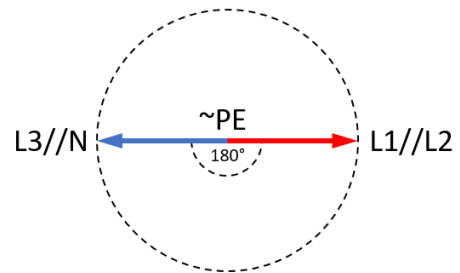


Fig. 7) 1 Φ 3W / split phase



For detailed technical information, contact your local sales partner or REGATRON.

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