**TC.ACS.50.528.4WR.S.LC**

**Programmable Bidirectional AC Power Source**

### Features

**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 represents 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 characterization

**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 2000+ 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). 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.

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**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.

**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.
## Technical Data

### Key Values

<table>
<thead>
<tr>
<th>Programmable Bidirectional AC Power Source</th>
<th>Power range</th>
<th>0...50 kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage range</td>
<td>3 x 0...305 Vrms (L-N)</td>
<td></td>
</tr>
<tr>
<td>Current range</td>
<td>3 x 0...72 A rms</td>
<td></td>
</tr>
<tr>
<td>Master-slave / multi-device configuration</td>
<td>parallel</td>
<td></td>
</tr>
<tr>
<td>Max. number of devices in system</td>
<td>up to 50</td>
<td></td>
</tr>
</tbody>
</table>

### AC Lineside Ratings (X10)

#### Mains connection
- Mains connection type: 3L + PE (no neutral)
- Line voltage: 3 x 360...528 Vrms
- Input current: 3 x 360 Vrms / 90 A rms
- Phase frequency: 48...62 Hz
- Power factor @ nominal power: 1
- Precharge unit provided: No excessive inrush current.
- THDi @ 90% Pnom: <1%
- Input filter discharge to <60 V: <20 s with option XCD: <1 s

### Isolation
- Power to PE (L1 / L2 / L3): working voltage 305 Vrms
- Power to PE (L1 / L2 / L3): working voltage 432 Vdc
- Power to case/logic: test voltage 2120 Vrms / 1 s

### Loadside Ratings (X20)

#### Static Accuracy
- Voltage (RMS-contoller): 0.05% FS
- Voltage general: <1.5 V
- Frequency: 2 mHz
- Phase Angle: 1°

#### Slew rate (see Figure 5)
- 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 mVpp

#### Overloadability (see Figure 3, 4)
- up to 10 s every 60 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°

### Isolation
- Power to PE (L1 / L2 / L3 / N): working voltage 305 Vrms
- Power to PE (L1 / L2 / L3 / N): working voltage 432 Vdc
- Power to case/logic: test voltage 2120 Vdc / 1 s

### AC Loadside Ratings (X20)

#### Frequency range (see Figure 2, 3)
- 0...1000 Hz

#### Modulation bandwidth
- 5.0 kHz

#### DC offset
- ≤10 mV

#### Efficiency @ nominal power
- 90%

#### Output filter capacitance (L-N)
- 24.7 µF

#### Phase Connection '3L (AC/DC)': 3L + N (see Figure 6)
- 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 rms

#### Phase Connection '1L (AC/DC double current)': 1L + N (see Figure 7)
- Power range: 0...20 kVA
- Voltage range: 0...305 Vrms (L-N)
- Connection type: L1 / L2 + L3 / N + PE
- Current range 1Φ: 0...144 A rms

#### Phase Connection '2L (AC/DC double voltage/current)': 2L (see Figure 8)
- Power range: 0...50 kVA
- Voltage range: 0...610 Vrms (L-L)
- Connection type: L1 / L2 + L3 / N + PE
- Current range 1Φ: 0...144 A rms

#### Harmonic distortion @ 50 Hz (THDi)
- Linear loads: ≤0.4%
- Non linear loads: ≤1.6%

### DC Loadside Ratings (X20)

#### Phase Connection '1L (AC/DC double current)': 1 output (symmetric to PE)
- Power range: 0...±33 kW
- Voltage range: 0...±830 Vdc
- Connection type: L1 / L2 + L3 / N
- Current range: 0...±40 A rms

#### Phase Connection '1L (DC triple current)': 1 output (related to PE)
- Power range: 0...±25 kW
- Voltage range: 0...±415 Vdc
- Connection type: L1 / L2 / L3 + N
- Current range: 0...±60 A rms

#### Phase Connection '3L (AC/DC)': 2 independent outputs
- Power range: 0...±16 kW
- Voltage range: 0...±830 Vdc
- Connection type: L1 + L2
- Current range: 0...±20 A rms
- Power range: 0...±8 kW
- Voltage range: 0...±415 Vdc
- Connection type: L3 + N
- Current range: 0...±20 A rms

#### Phase Connection '3L (AC/DC)': 3 independent outputs (related to PE)
- Power range: 3 x 0...±18 kW
- Voltage range: 3 x 0...±415 Vdc
- Connection type: L1 + N / L2 + N / L3 + N
- Current range: 3 x 0...±20 A rms

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1) Current according to the given power limit of the corresponding units
2) Up to 290 Vrms (L-N)
3) Total current in N is limited to 20 A
4) Power reduction due to internal limitations
Technical Data (continued)

Protection
Built-in Protection
Overvoltage protection programmable
Overcurrent protection programmable

Internal diagnostics
Line input conditions, internal current conditions, temperature conditions, system configuration, system communication, power semiconductor temperatures.

Type of Protection (according EN 60529)
Basic construction IP 20
Mounted in cabinet up to IP 54

Safety Interface
ISR (integrated safety relay)
2-channel (2x category 1, PLC according DIN EN ISO 13849-1:2015)
Read-back circuit with forcibly guided contacts
Possible with 2-channel and external safety relay (optional)

I/O Interfaces
Control Port Input Functions (X610 – X612)
Amplifier model:
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 ≤70 µs
Isolation to electronics and earth 125 V.mm
Input impedance 20.5 kOhm

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 V.mm

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 V.mm

Communication Interfaces
USB Type B (X607)
Integrated interface for remote control with the operation software ACSControl/API
Isolation to electronics and earth 250 V.mm

Ethernet (X605)
Integrated interface for remote control with the operation software ACSControl/API
Isolation to electronics and earth 200 V.mm

RS232 (X606)
Service interface
Isolation to electronics and earth 125 V.mm

General Data

Weight & Dimension (see Figure 1)
Weight approx. 150 kg
Width housing 444 mm / 17 ¼"
Height housing 489 mm / 11 1/16" / 19 3/8"
Depth with output terminals 635 mm / 25 1/8"

Terminals
Screw terminals for 6…35mm² wires d ≤8.5 mm
AC lineside terminals 3L + PE
AC loadside terminals 3LN + PE

Ambient
Operating temperature 5...40 °C
Storage temperature -18...70 °C
Relative air humidity (non-condensing) 0...95 %
Installation altitude 0...2000 m above sea level

Installation IEC 60721-3-3 indoor, air-conditioned
Vibration IEC 60068-2-6 Test F
Operating orientation upside
Storage, transport orientation upside
Acoustic noise level ≤74 dB, @1 m

Liquid Cooling (LC) Specifications
(Air-cooling possible with optional TC LAE)
Material Al
Inlet/outlet on rear side G ¾"/G 1½"
Liquid temperature inlet (non-condensing) 15...50 °C
Minimum flow rate 2.5 l/min
Recommended flow rate 5 l/min
Maximum inlet temperature 25 °C @2.5 l/min
40 °C @5 l/min
50 °C @8 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

Standards
Protection class I
Overvoltage category III
Degree of pollution 2
Area of application industrial

Approval CE
Low Voltage Directive 2014/35/EU
EMC Directive 2014/30/EU
EMC immunity (industrial) EN 61000-6-2:2005
EMC emission (industrial) EN 61000-6-4:2007 + A1:2011
RoHS Directive 2011/65/EU EN IEC 63000:2018

Approval UKCA
Electrical Equipment (Safety) Regulations 2016
Electromagnetic Compatibility Regulations 2016
EMC immunity (industrial) BS EN 61000-6-2:2005
EMC emission (industrial) BS EN 61000-6-4:2007 + A1:2011
The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
BS EN IEC 63000:2018

1) slight temperature derating possible depending on ambient temperature inside cabinet.
2) above 1000 m, slight temperature derating possible
Datasheet

User Software

Application Software ACSControl

Software Options

ACSControl integrated

Full Waveform Generator Mode
(Phase Connections included)

Current Controlled Mode

GridSim

RLC-Load Mode

Phase Connections (available in CV Mode only):

1L (AC/DC double current)
2L (AC/DC double voltage/current)
1L (DC triple current)

EMC Test Sequences, preprogrammed:

IEC/EN 61000-3-2
IEC/EN 61000-4-3
IEC/EN 61000-3-11
IEC/EN 61000-4-12
IEC/EN 61000-4-27
IEC/EN 61000-4-28
IEC/EN 61000-4-34

Hardware Options

Senseboard for RMS voltage drop compensation
with programmable transformer ratio

1 500 V type, maximum input voltages:

L-L, L-N, L-PE: 1000 V\text{rms}, 1500 V\text{p-p}
N-PE: 500 V\text{rms}, 750 V\text{p-p}

7 500 V type, maximum input voltages:

L-L: 860 V\text{rms}, 1290 V\text{p-p}
L-N: 500 V\text{rms}, 750 V\text{p-p}
N-PE: 500 V\text{rms}, 750 V\text{p-p}

500 V type, maximum input voltages:

L-L: 570 V\text{rms}, 860 V\text{p-p}
L-N: 330 V\text{rms}, 500 V\text{p-p}
N-PE: 500 V\text{rms}, 750 V\text{p-p}

Digital I/O Interface

TC.ACS X609 Adapter (Analog I/O Adapter)

4 x Analog IN ±9.5 V\text{DC}
4 x Analog OUT ±9.5 V\text{DC}

TC.ACS.CANmp Interface

2 x D-Sub 9 pin male connector

8 x Digital IN 24 V\text{DC}
8 x Digital OUT 24 V\text{DC}

Air Cooling

External Liquid to Air Heat Exchanger (TC.LAE)\textsuperscript{1}
In addition to the internal Liquid Cooling (LC)

Max. Power @40 °C ambient temperature 35 kVA
Max. Power @35 °C ambient temperature 45 kVA
Max. Power @32 °C ambient temperature 50 kVA

Dimensions

Figure 1: Front, right hand side and rear view. 19-inch module with 11 units in height.

1) Derating of Power depending on the ambient temperature so that the coolant inlet temperature <50 °C.
Further Description Details

Figure 2: Output voltage versus frequency

Figure 3: Overloadability versus frequency

Figure 4: Overloadability versus voltage

Figure 5: Slew rate with resistive load

Figure 6: any independent phase angle possible, including split phase

Figure 7: 1L+N (single phase, N related to PE)

Figure 8: 2L (single phase symmetric to PE)

This product is developed, produced and tested according to ISO 9001 by REGATRON.

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

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All product specifications and information contained herein are subject to change without notice.

Filename: DS_TC.ACS.50.528.4WR.SLC_EN.230414
Class: Project-specific-use-only