

# 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

#### 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.

#### Hardware

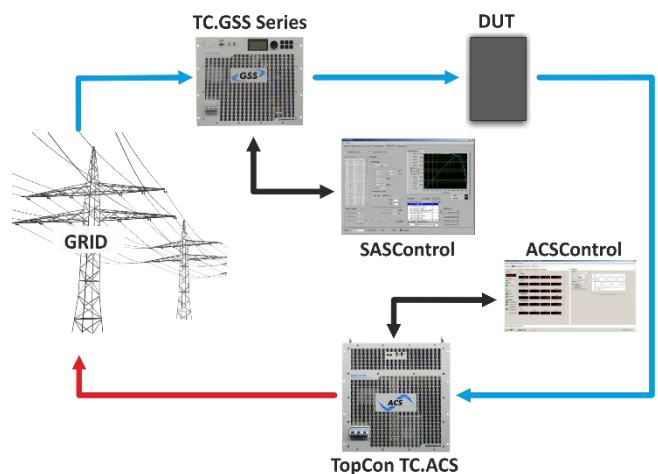
REGATRON grid simulator systems use a state of the art multilevel double inverter technology. The main advantages over existing linear power supplies are a substantial reduction of power losses, full 4-quadrant operation, very compact power units and the modular, cost-effective architecture. This allows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

## Technical Data<sup>1</sup>

### Key Values

|                                            |                                      |
|--------------------------------------------|--------------------------------------|
| Programmable Bidirectional AC Power Source |                                      |
| Power range                                | 0...50 kVA                           |
| Voltage range                              | 3 x 0...305 V <sub>ACrms</sub> (L-N) |
| Current range                              | 3 x 0...72 A <sub>ACrms</sub>        |
| Master-slave / multi-device configuration  | parallel                             |
| Max. number of devices in system           | up to 50                             |
| Case                                       | 19" / 11U                            |

### AC Lineside Ratings (X10)

#### Mains connection

|                                                       |                                                  |
|-------------------------------------------------------|--------------------------------------------------|
| Mains connection type                                 | 3L + PE (no neutral)                             |
| Line voltage                                          | 3 x 360...528 V <sub>ACrms</sub>                 |
| Input current                                         | 3 x 360 V <sub>ACrms</sub> / 90 A <sub>rms</sub> |
|                                                       | 3 x 400 V <sub>ACrms</sub> / 81 A <sub>rms</sub> |
|                                                       | 3 x 440 V <sub>ACrms</sub> / 74 A <sub>rms</sub> |
|                                                       | 3 x 480 V <sub>ACrms</sub> / 68 A <sub>rms</sub> |
| Line frequency                                        | 48...62 Hz                                       |
| Powerfactor @nominal power                            | 1                                                |
| Precharge unit provided. No excessive inrush current. |                                                  |
| THDi @90% P <sub>max</sub>                            | <1%                                              |
| Input filter discharge to <60 V                       | <20 s                                            |
| with option XCD                                       | <1 s                                             |

#### Isolation

|                            |                 |                            |
|----------------------------|-----------------|----------------------------|
| Power to PE (L1 / L2 / L3) | working voltage | 305 V <sub>ACrms</sub>     |
| Power to PE (L1 / L2 / L3) | working voltage | 432 V <sub>DC</sub>        |
| Power to case/logic        | test voltage    | 2120 V <sub>DC</sub> / 1 s |

### Loadside Ratings (X20)

#### Static Accuracy

|                          |          |
|--------------------------|----------|
| Voltage (RMS-controller) | 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 mV <sub>rms</sub> |
| 9 kHz...20 MHz  | 700 mV <sub>p-p</sub> |

#### Overloadability (see Figure 3, 4)

|                        |       |
|------------------------|-------|
| 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°  |

#### Isolation

|                                |                 |                            |
|--------------------------------|-----------------|----------------------------|
| Power to PE (L1 / L2 / L3 / N) | working voltage | 305 V <sub>ACrms</sub>     |
| Power to PE (L1 / L2 / L3 / N) | working voltage | 432 V <sub>DC</sub>        |
| Power to case/logic            | test voltage    | 2120 V <sub>DC</sub> / 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 V <sub>rms</sub> (L-N)            |
| Connection type  | 3L + N + PE                               |
| Current range 3Φ | 3 x 0...72 A <sub>rms</sub> <sup>1)</sup> |

#### Phase Connection '1L (AC/DC double current)': 1L + N (see Figure 7)

|                  |                                        |
|------------------|----------------------------------------|
| Power range      | 0...20 kVA <sup>4)</sup>               |
| Voltage range    | 0...305 V <sub>rms</sub> (L-N)         |
| Connection type  | L1//L2 + L3//N + PE                    |
| Current range 1Φ | 0...144 A <sub>rms</sub> <sup>1)</sup> |

#### Phase Connection '2L (AC/DC double voltage/current)': 2L (see Figure 8)

|                  |                                        |
|------------------|----------------------------------------|
| Power range      | 0...50 kVA                             |
| Voltage range    | 0...610 V <sub>rms</sub> (L-L)         |
| Connection type  | L1//L2 + L3//N + PE                    |
| Current range 1Φ | 0...144 A <sub>rms</sub> <sup>1)</sup> |

#### Harmonic distortion @50 Hz (THDu)<sup>2)</sup>

|                  |       |
|------------------|-------|
| 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 V <sub>DC</sub> |
| Connection type | L1//L2 + L3//N           |
| Current range   | 0...±40 A <sub>rms</sub> |

#### Phase Connection '1L (DC triple current)': 1 output (related to PE)

|                 |                          |
|-----------------|--------------------------|
| Power range     | 0...±25 kW               |
| Voltage range   | 0...±415 V <sub>DC</sub> |
| Connection type | L1//L2//L3 + N           |
| Current range   | 0...±60 A <sub>rms</sub> |

#### Phase Connection '3L (AC/DC)': 2 independent outputs

|                 |                                        |
|-----------------|----------------------------------------|
| Power range     | 0...±16 kW                             |
| Voltage range   | 0...±830 V <sub>DC</sub>               |
| Connection type | L1 + L2                                |
| Current range   | 0...±20 A <sub>rms</sub> <sup>3)</sup> |
| Power range     | 0...±8 kW                              |
| Voltage range   | 0...±415 V <sub>DC</sub>               |
| Connection type | L3 + N                                 |
| Current range   | 0...±20 A <sub>rms</sub> <sup>3)</sup> |

#### Phase Connection '3L (AC/DC)': 3 independent outputs (related to PE)

|                 |                                            |
|-----------------|--------------------------------------------|
| Power range     | 3 x 0...±8 kW                              |
| Voltage range   | 3 x 0...±415 V <sub>DC</sub>               |
| Connection type | L1 + N / L2 + N / L3 + N                   |
| Current range   | 3 x 0...±20 A <sub>rms</sub> <sup>3)</sup> |

1) Current according to the given power limit of the corresponding units

2) Up to 290 V<sub>rms</sub> (L-N)

3) Total current in N is limited to 20A

4) Power reduction due to internal limitations

## Technical Data (continued)

### Protection

|                            |              |
|----------------------------|--------------|
| <b>Built-in Protection</b> |              |
| 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 <sup>1)</sup> |

### Safety Interface

#### ISR (integrated safety relay)

|                                                                   |
|-------------------------------------------------------------------|
| 2-channel (2x category 1, PL c according DIN EN ISO 13849-1:2015) |
| read-back circuit with forcibly guided contacts                   |
| PL e possible with 2-channel and external safety relay (optional) |

### I/O 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          | <70 µs               |
| Isolation to electronics and earth  | 125 V <sub>rms</sub> |
| 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 <sub>rms</sub>          |

#### 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 <sub>rms</sub>     |

### Communication Interfaces

#### USB Type B (X607)

|                                                                                        |                      |
|----------------------------------------------------------------------------------------|----------------------|
| Integrated interface for remote control with the operation software<br>ACSCControl/API |                      |
| Isolation to electronics and earth                                                     | 250 V <sub>rms</sub> |

#### Ethernet (X605)

|                                                                                     |                      |
|-------------------------------------------------------------------------------------|----------------------|
| Integrated interface for remote control with the operation software ACSCControl/API |                      |
| Isolation to electronics and earth                                                  | 200 V <sub>rms</sub> |

#### RS232 (X606)

|                                    |                      |
|------------------------------------|----------------------|
| Service interface                  |                      |
| Isolation to electronics and earth | 125 V <sub>rms</sub> |

## General Data

### Weight & Dimension (see Figure 1)

|                             |                  |
|-----------------------------|------------------|
| Weight                      | approx. 150 kg   |
| Width housing               | 444 mm / 17 1/2" |
| Height housing              | 489 mm / 19 1/4" |
| Depth with output terminals | 635 mm / 25"     |

### Terminals

|                                                  |           |
|--------------------------------------------------|-----------|
| Screw terminals for 6...35 mm <sup>2</sup> 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 <sup>2)</sup> |
| Installation                           | in 19" switch cabinet                    |
|                                        | IEC 60721-3-3 indoor, air-conditioned    |
| Vibration                              | IEC 60068-2-6 Test Fc                    |
| 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 size                                               | G 1/2"           |
| 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 |                                                    |
|                                  | EN 62477-1:2012 + A11 :2014 + A1 :2017 + A12 :2021 |
| 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

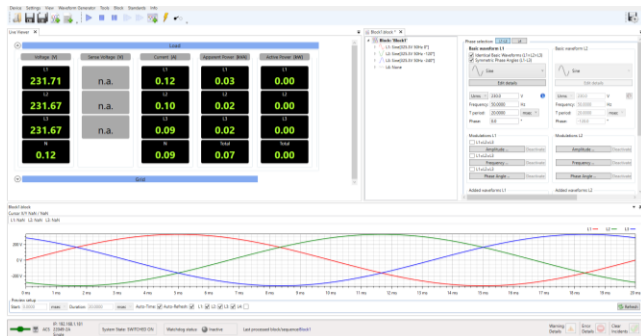
|                                                                                                                    |                                                       |
|--------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Electrical Equipment (Safety) Regulations 2016                                                                     |                                                       |
|                                                                                                                    | BS EN 62477-1:2012 + A11 :2014 + A1 :2017 + A12 :2021 |
| 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

## User Software

### Application Software ACSControl



## Software Options

### ACSControl integrated

|                                                              |                      |
|--------------------------------------------------------------|----------------------|
| Full Waveform Generator Mode<br>(Phase Connections included) | GridSim              |
| AC Load Simulation Mode                                      | RLC-Load Mode        |
| Current Controlled Mode                                      | Current Control Mode |
| Phase Connections (available in CV Mode only):               | Phase Connections    |
| 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 61000-4-11 |
| IEC/EN 61000-3-3  | IEC/EN 61000-4-13 |
| IEC/EN 61000-3-11 | IEC/EN 61000-4-14 |
| IEC/EN 61000-3-12 | 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

#### 1500V type, maximum input voltages:

|                 |                                             |
|-----------------|---------------------------------------------|
| L-L, L-N, L-PE: | 1000 V <sub>rms</sub> , 1500 V <sub>p</sub> |
| N-PE:           | 500 V <sub>rms</sub> , 750 V <sub>p</sub>   |

#### 750 V type, maximum input voltages:

|       |                                            |
|-------|--------------------------------------------|
| L-L:  | 860 V <sub>rms</sub> , 1290 V <sub>p</sub> |
| L-N:  | 500 V <sub>rms</sub> , 750 V <sub>p</sub>  |
| N-PE: | 500 V <sub>rms</sub> , 750 V <sub>p</sub>  |

#### 500 V type, maximum input voltages:

|       |                                           |
|-------|-------------------------------------------|
| L-L:  | 570 V <sub>rms</sub> , 860 V <sub>p</sub> |
| L-N:  | 330 V <sub>rms</sub> , 500 V <sub>p</sub> |
| N-PE: | 500 V <sub>rms</sub> , 750 V <sub>p</sub> |

### Digital I/O Interface

|                 |                     |
|-----------------|---------------------|
| 8 x Digital IN  | 24 V <sub>DC</sub>  |
| 8 x Digital OUT | 24 V <sub>DC</sub>  |
| 4 x Relays      | potential free SPDT |

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

|                |                      |
|----------------|----------------------|
| 4 x Analog IN  | ±9.5 V <sub>DC</sub> |
| 4 x Analog OUT | ±9.5 V <sub>DC</sub> |

### TC.ACS.CANmp Interface

|                                |                    |
|--------------------------------|--------------------|
| 2 x D-Sub 9 pin male connector | CAN interface      |
| 8 x Digital IN                 | 24 V <sub>DC</sub> |
| 8 x Digital OUT                | 24 V <sub>DC</sub> |

### Air Cooling

#### External Liquid to Air Heat Exchanger (TC.LAE)<sup>1)</sup>

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

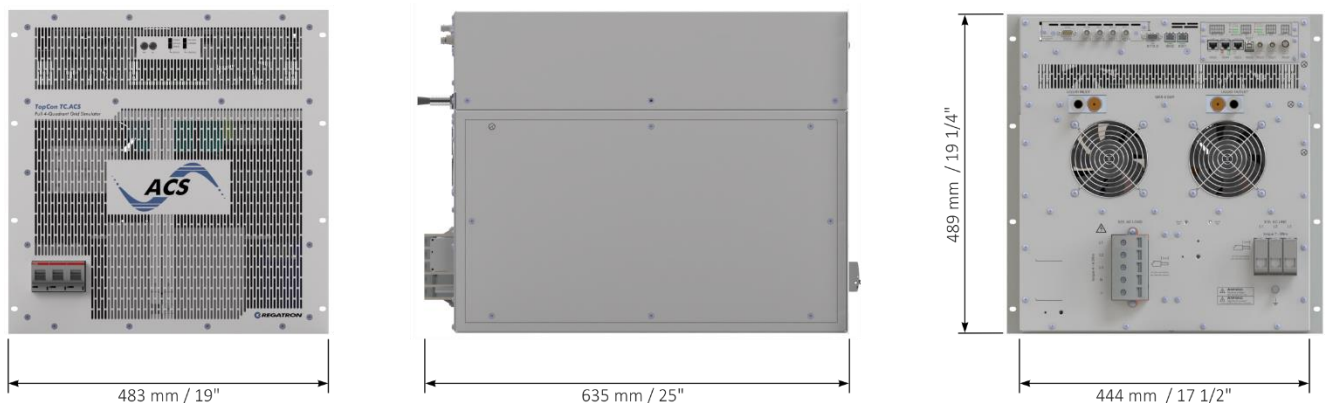


Figure 1: Front, right hand side and rear view. 19-inch module with 11 units in height.

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

## Further Description Details

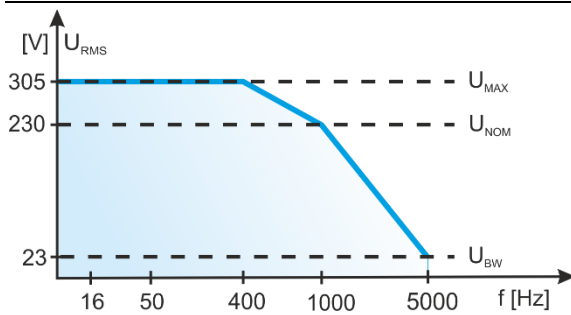


Figure 2: Output voltage versus frequency

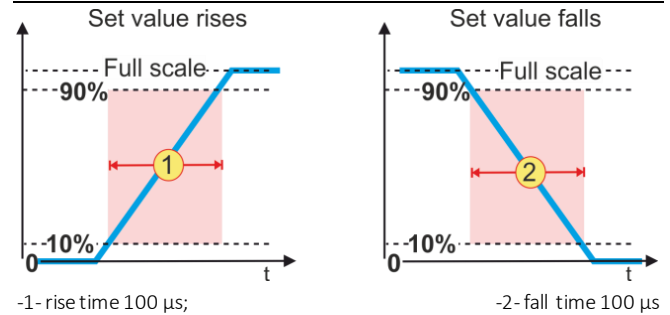


Figure 5: Slew rate with resistive load

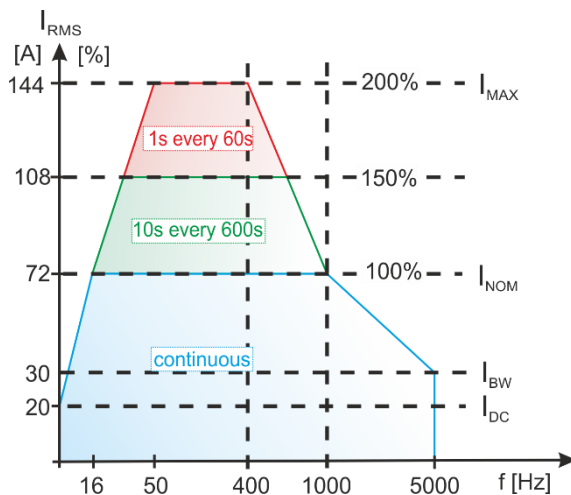
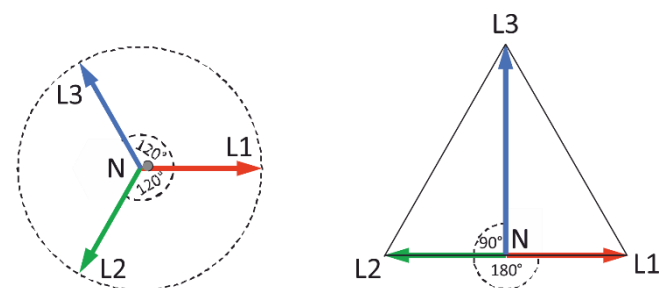


Figure 3: Overloadability versus frequency



any independent phase angle possible, including split phase

Figure 6: 3L + N

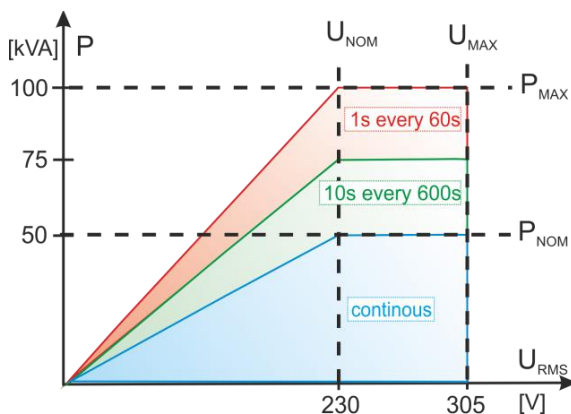


Figure 4: Overloadability versus voltage

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

For detailed technical information, contact your local sales partner:

**HEIDEN**  
COMPETENCE IN POWER

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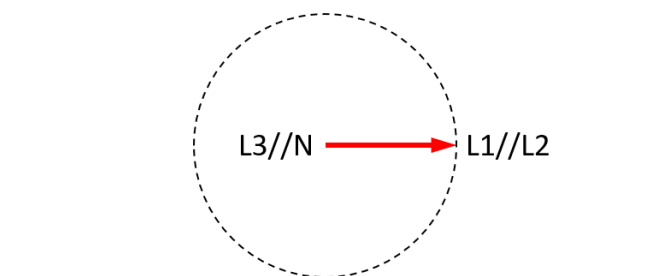


Figure 7: 1L + N (single phase, N related to PE)

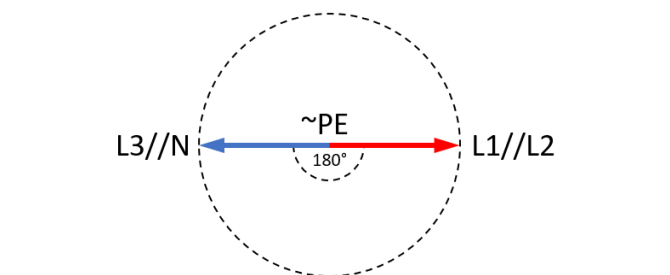


Figure 8: 2L (single phase symmetric to PE)