

# GE+ vAC ePLUS

## Regenerative AC Grid Emulator

GE+ vAC is a 4Q programmable AC Voltage Source designed to create both stable and distorted AC grids, adding now a predefined IEC testing software. This cost-competitive solution is specially suitable to perform AC testing in the fields of: Renewable Energy Sources, Smartgrids, EV and EVSE and, in general, grid connected devices.

### Key features



Bidirectional and Regenerative  
Clean grid current: THDi < 3% and PF > 0.98

**Generation of Worldwide electrical grids:**  
3-phase/ 1-phase/ split phase/ Multichannel

**Independent phase configuration of:**  
voltage rms, phase angle, frequency and harmonics

**Generation of disturbances:**  
harmonics, interharmonics, subharmonics, voltage dips  
frequency variation, flicker

Disturbance Generation Editor compatible with IEC,  
LVRT, SEMI-F47, CBEMA test standards

Modbus/Ethernet Open protocol, Labview drivers

### What's new

**MASTER/SLAVE CONNECTION**  
up to 8 units using a fiber optics link to increase  
power/voltage capabilities:  
GE mode: can be connected in parallel

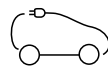
**IMPROVED CONTROL**  
30kHz closed control loop frequency with 300kHz  
oversampling technique

**MORE HARMONICS**  
50 per phase with 20 free-harmonics, in AC models

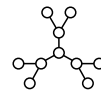


ePLUS keeps the robustness, ratings  
and all the functionalities of the PLUS  
platform and adds the new features  
described in this datasheet

### Main Applications



ELECTROMOBILITY



SMARTGRIDS



PHOTOVOLTAIC



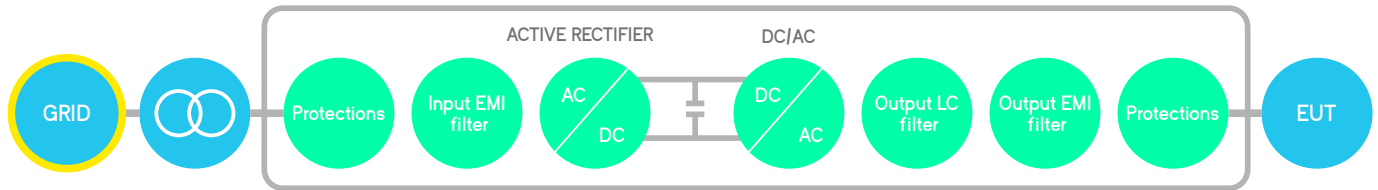
IEC TESTING



ACADEMIC &  
INDUSTRIAL TEST

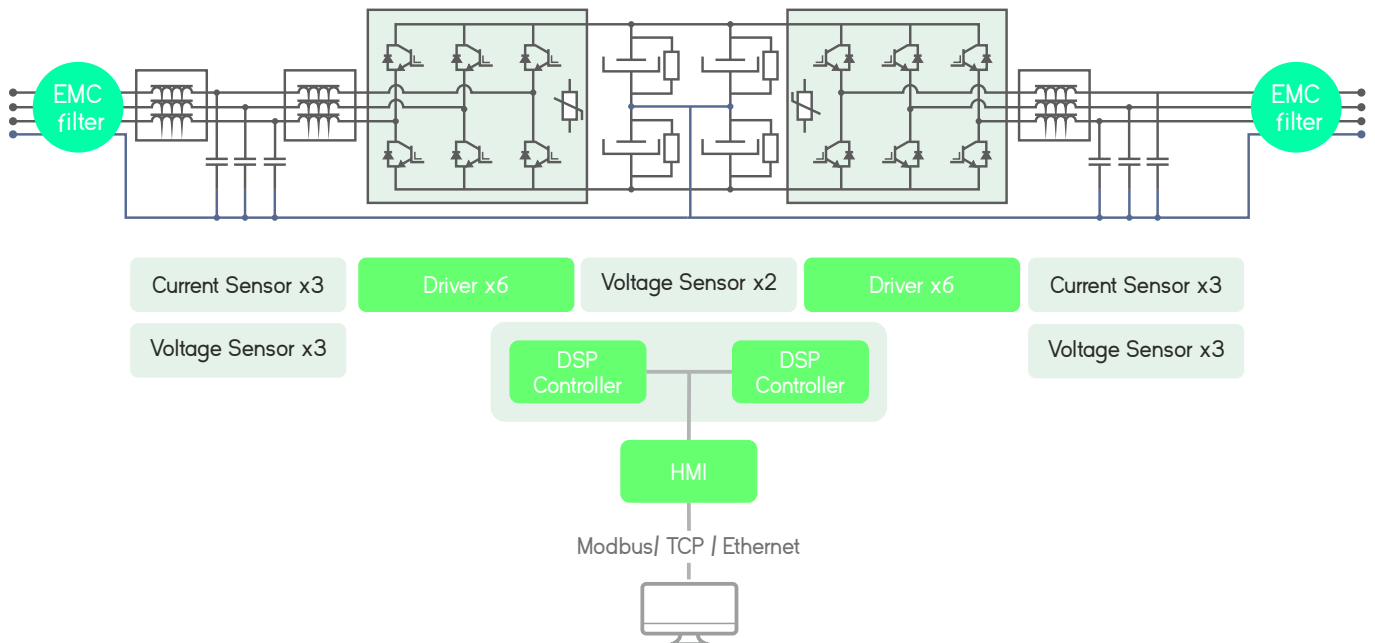


# Bidirectional and Regenerative Hardware



The hardware platform is based on a Back-to-Back power conversion topology, formed by two IGBT-based power stages. The grid side stage is an Active Rectifier which produces clean sinusoidal currents with very low harmonic distortion and power factor close to one.

The EUT side stage can be configured for AC voltage source or AC current source or DC output. In AC, voltage/current are controlled by using state of the art digital Proportional-Resonant controllers.



## Local Interface

### Analogue and Digital IO ports

The isolated digital and analogue inputs/outputs permit the connection of the unit to External Controllers and Power Hardware in the Loop systems (option).

### 4.3" Touchscreen

Allows the local parameterization and command of the device, configuration of the communications link, plots the main signals and enables the local datalogging.

### Safety First

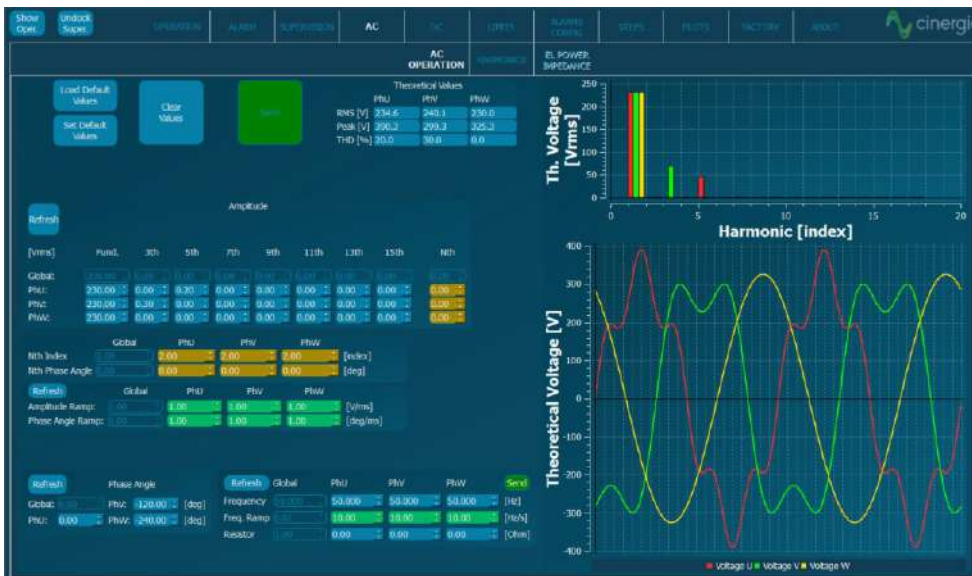
The units integrate a local Emergency Stop pushbutton and two signals (input + output) to be connected to the laboratory interlock system. Additionally, the digital outputs can be interfaced to safety tower lights.

### Master/Slave

ePLUS is a modular platform enabling the master/slave connection of units with equal power.



# Software Interface in GE+



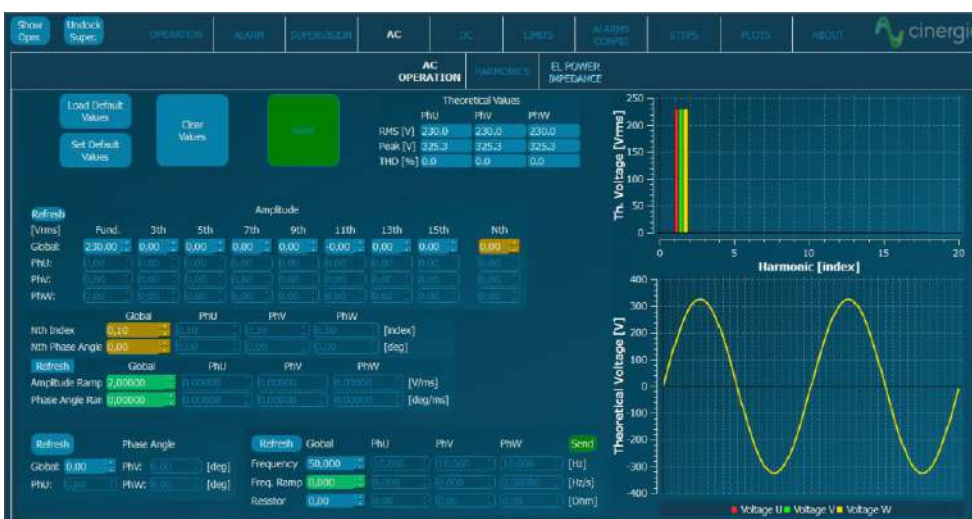
## AC Operation

From this panel, the user can set all AC parameters. Each phase can be independently configured: RMS voltage (GE+) or current (EL+) magnitude, phase delay, harmonics content, free-frequency harmonic and transition ramps. A plot shows the expected real-time waveform, the FFT representation and the numeric data: RMS, peak, CF and THD.



## Harmonics

The device can control simultaneously the magnitude of the first 50 harmonics and 20 free harmonic per phase. These free ones allows the generation of sub-harmonics, inter-harmonics and high frequency harmonics up to the 50th, setting both the magnitude and phase delay.



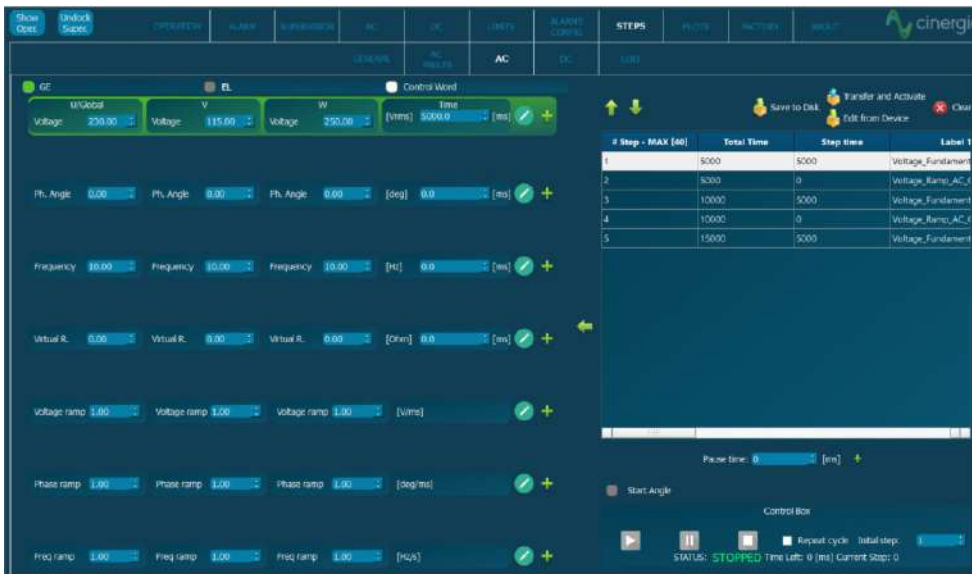
## 1-channel Mode/Parallel

The device can be controlled in 1-channel mode where all phases are short-circuited internally. This mode it's suitable for single-phase applications.

To increase the total power of the solution, the device can be connected in parallel\* with multiple devices.

\*For this connection contact us.

# Advanced AC Software Applications



## Steps Mode

One of the most remarkable novelties of the new software is the steps functionality.

Step test files are saved and executed by the DSP allowing deterministic timing with a resolution of 66µs.

The user gains access to all registers of the device to create complex test sequences which run directly in the converter without the need of an external computer.



## Disturbance Generation

The steps mode includes predefined easy-to-use test panels. The AC faults panel is a powerful yet intuitive editor which allows generating and configuring voltage dips, frequency variation, flicker and LVRT. Specific profiles can be saved in .csv files, modified, and reused by importing an existing one. The LVRT page have predetermined profiles for different countries.



## Option IEC Testing

The last version of software includes a library supporting IEC compatible tests. The profiles defined in the standards are preloaded in the software for a user friendly execution and edition. Currently the following standards are available:

- IEC61000-4/11
- IEC61000-4/13
- IEC61000-4/14
- IEC61000-4/28



# GE+ vAC Range & Specifications

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## Input side (GRID side)

### AC Voltage

Rated: 3x400Vrms + Neutral + Earth  
Range: +15% / -20%

### Rated AC Current

Depends on model (see Wiring Manual)

### Frequency

48-62Hz

### Current Harmonic Distortion

THDi < 3% at rated power

### Current Power factor

PF > 0.98 at rated power

### Efficiency

≥ 89% (7.5 & 10), ≥ 91% (15 to 30), ≥ 92% (40 to 200)

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## Output side in AC (EUT side)

### Terminals

Number: 4 (3 phases + 1 neutral)

### Configuration of Channels

3-channels: 4Q, independent setpoints per phase  
1-channel: 4Q, global setpoints for all phases (only in GE+)  
Multichannel: 4Q, independent start/stop, alarm status and setpoints per phase (note: multichannel is an option for ≥ 80kVA)

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## Output side in GE-AC

### Voltage Mode (CV)

Peak: ± 400V phase-neutral  
Range: 0<sup>(1)</sup> to 277Vrms phase-neutral (295Vrms with HV option)  
0<sup>(1)</sup> to 480Vrms phase-phase (510Vrms with HV option)  
THDv: < 0.1% rated linear load at 230Vrms, 50/60Hz  
< 0.9% rated non linear load CF=3 at 230Vrms, 50/60Hz  
Setpoint Resolution: 10mVrms  
Effective Resolution<sup>(2)</sup>: < 0.05% of FS<sup>(3)</sup>  
Setpoint Accuracy<sup>(4)</sup>: < ± 0.1% of FS<sup>(3)</sup>  
Transient Time<sup>(5)</sup>: < 1.5ms (10% to 90% at a step to Vrated)  
Ripple<sup>(7)</sup>(peak-peak): < 0.55% of FS<sup>(3)</sup>

### Enhanced Harmonics

Range: up to 50th (at 50/60 Hz fundamental)  
50 independent harmonics per phase:  
20 free programmable frequency and phase from 0.1 to 50 times  $f_0$   
30 fixed frequency  
Harmonics content:  $V \cdot f < 46000$  (with current derating)  
Setpoint Accuracy<sup>(4)</sup>: same as voltage accuracy  
Small Signal Bandwidth: up to 5000Hz<sup>(9)</sup>  
Transient Time<sup>(6)</sup>: < 2ms (10% to 90% at a step change)

### Frequency

Fundamental Frequency Range: 10 to 100Hz (up to 400Hz option)  
Small Signal Bandwidth: up to 5000Hz<sup>(9)</sup>  
Resolution: 1mHz

### Phase Angle

Range: 0 to 360°  
Resolution: 0.01°

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## Operation Modes

AC  
Programmable Voltage (CV)  
Steps  
**Optional** LVRT, IEC 61000 -4-11, 4-13, 4-14, 4-28

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## Overload/Overcurrent

Admissible AC overcurrent: 125% of rated value during 10 minutes,  
150% during 1 minute, 200% during 2 seconds  
Admissible overloads: 125% of rated value during 10 minutes,  
150% during 1 minute, 200% during 2 seconds

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## User Interface

**Local Control (4.3" Touchscreen panel)**  
Isolated Digital port: 6 inputs, 4 outputs  
Isolated Analogue port: 6 inputs (rms setpoints or power amplifier),  
6 outputs (rms readback or real-time readback)  
Interlock port: 1 NC Input, 1 NO Output  
Emergency Stop pushbutton

### Remote Control Port

LAN Ethernet with Open Modbus-TCP protocol  
RS485 (option), CAN and RS232 (using external gateway)

### Software

Graphical User Interface for Windows 7/10  
LabView drivers and open Labview interface example

**Enhanced** **Master/Slave operation**

Connection: fiber optics link (x6)  
Configuration: from software user interface/MODBUS  
up to 8 units:  
AC: parallel



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## Protections

Overvoltage (peak, rms), Overcurrent (peak, rms), Overload  
Shortcircuit, Emergency Stop, Watchdog, Heart Beat, Output  
Contactor, Wrong Configuration  
Alarms and Limits are user configurable and can be saved in a  
password protected EEPROM

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## Mesurements<sup>(6)</sup>

Grid Voltage (rms), Current (rms), Power (P,Q) and Frequency  
Output Voltage (rms, avg), Current (rms, avg), Power (P,Q) and  
Frequency  
Heatsink Temperatures (x2) and DC Link Voltage  
Datalogging available through FTP connection

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## Ambient

Operating temperature<sup>(8)</sup>: 5-40°C  
Relative Humidity: up to 95%, non-condensing  
Cooling: Forced air  
Acoustic noise at 1m: < 52dB(A)(7.5 to 60), < 65dB(A)(80 to 120), < 70dB(A)(160 and 200)

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## Standards

CE Marking  
Operation and Safety: EN-50178, EN-62040-1  
EMC: EN-62040-2  
RoHS

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All specifications are subject to change without notice.

# Options

Choose your options

- Galvanic Isolation
- Multichannel mode: allows different operation mode, start/stop/reset per channel (included in all models from 7.5 to 60, both included)
- 30kHz Switching Frequency: only available for models 15 (derated to 7.5kW), 20 (derated to 7.5kW) and 30 (derated to 10kW)
- Isolation monitor (advised for IT systems)
- Low voltage ripple capacitance
- High Frequency 360 - 900 Hz
- Anti-islanding monitor (only advised in net injection to the grid and following local regulations)
- High Voltage (HV): voltage up to 295Vrms phase-neutral in AC up to 800V in DC
- RS485
- Predefined Tests: LVRT, IEC 61000-4-11, 4-13, 4-14, 4-28 (consult us for specific Test)
- External gateway for RS232, CAN and others (consult us for specific gateway)

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(1) Minimum voltage setpoint is 0V in DC. The recommended minimum setpoint for long-term use is 20Vrms in AC and 20V in DC.

(2) Effective resolution measured with a 400ms window

(3) FS Range of voltage is 800V (with High Voltage option)

FS Range of current is 2|3 · I<sub>rated</sub> | (see models table)

FS Range of power is 2|200% · Prated | (see models table)

(4) Accuracies are valid for settings above 10% of FS

(5) Measured with the rated resistive load and high-dynamics controllers configuration

(6) Accuracy of measurements is ±0.1% of FS for rms voltage, ±0.2% of FS for rms current, ±0.4% of FS for active power (valid only above 10% of FS)

(7) Consult us for lower voltage/current ripple requirements

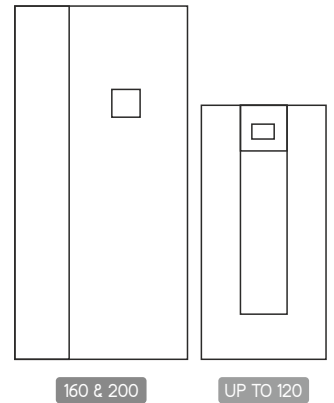
(8) Rated power figures are given at 20°C

(9) The maximum output voltage depends on frequency following  $V \cdot f < 46000$

# Models

## GE+ vAC

| Reference |     | AC Power<br>Rated <sup>(9)</sup> | AC Current<br>Rated <sup>(9)</sup> RMS<br>3 channels / 1 channel | Weight<br>(kg) | Dimensions<br>DxWxH (mm) |
|-----------|-----|----------------------------------|--|----------------|--------------------------|
| GE+7.5    | vAC | 7.5kW                            | 11A / 33A  | 155 kg         | 770x450x1100 mm          |
| GE+10     | vAC | 10kW                             | 15A / 45A  | 155 kg         | 770x450x1100 mm          |
| GE+15     | vAC | 15kW                             | 22A / 66A  | 155 kg         | 770x450x1100 mm          |
| GE+20     | vAC | 20kW                             | 29A / 87A  | 155 kg         | 770x450x1100 mm          |
| GE+30     | vAC | 27kW                             | 40A / 120A   | 155 kg         | 770x450x1100 mm          |
| GE+40     | vAC | 40kW                             | 58A / 174A   | 200 kg         | 770x450x1100 mm          |
| GE+50     | vAC | 50kW                             | 73A / 219A   | 200 kg         | 770x450x1100 mm          |
| GE+60     | vAC | 54kW                             | 80A / 240A   | 200 kg         | 770x450x1100 mm          |
| GE+80     | vAC | 80kW                             | 116A / -   | 320 kg         | 880x590x1320 mm          |
| GE+100    | vAC | 100kW                            | 145A / -   | 320 kg         | 880x590x1320 mm          |
| GE+120    | vAC | 108kW                            | 157A / -   | 320 kg         | 880x590x1320 mm          |
| GE+160    | vAC | 145kW                            | 211A / -   | 680 kg         | 850x900x2000 mm          |
| GE+200    | vAC | 160kW                            | 232A / -   | 680 kg         | 850x900x2000 mm          |



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## Galvanic Isolation (optional)

|                          | Circuit Breaker<br>Recommended | Weight<br>(kg) | Circuit Breaker<br>Recommended | Weight<br>(kg) | Dimensions<br>DxWxH (mm) |        |                  |
|--------------------------|--------------------------------|----------------|--------------------------------|----------------|--------------------------|--------|------------------|
| INSIDE THE CABINET       | IT 7.5i                        | Type C - 25A   | 145 kg                         | IT 30e         | Type D - 80A             | 174 kg | 595x415x708 mm   |
|                          | IT 10i                         | Type C - 25A   | 145 kg                         | IT 40e         | Type D - 100A            | 217 kg | 710x525x775 mm   |
|                          | IT 15i                         | Type C - 32A   | 145 kg                         | IT 50e         | Type D - 125A            | 280 kg | 710x525x775 mm   |
|                          | IT 20i                         | Type C - 40A   | 145 kg                         | IT 60e         | Type D - 160A            | 381 kg | 875x600x900 mm   |
|                          | IT 30i                         | Type C - 50A   | 195 kg                         | IT 80e         | Type D - 200A            | 435 kg | 875x600x900 mm   |
|                          | * IT 40i                       | Type C - 63A   | 195 kg                         | IT 100e        | Type D - 250A            | 458 kg | 875x600x900 mm   |
|                          | * IT 50i                       | Type C - 83A   | 195 kg                         | IT 120e        | Type D - 315A            | 514 kg | 875x600x900 mm   |
| IN EXTERNAL CABINET IP20 |                                |                |                                | IT 160e        | Type D - 400A            | 612 kg | 964x684x1252 mm  |
|                          |                                |                |                                | IT 200e        | Type D - 500A            | 753 kg | 1210x750x1430 mm |

\* In the IT40i and IT50i models the size of the cabinet increases to a total of 770x835x1100mm. The others keep the original size.

### Configuration Modes

GE+ AC

### Master/Slave

Parallel in AC modes



### Channel Configuration in GE

3 channels 1 channel

1-channel mode available in standard units up to 60kVA. Consult us for parallel mode above 60kVA.

## CINERGIA, Regenerative Power Electronics Solutions

- Grid Emulators AC, DC, AC/DC
- Electronic Loads, AC, DC, AC/DC, HF (360-900Hz)
- Bidireccional DC, Battery Emulators, PV Panel Emulators

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