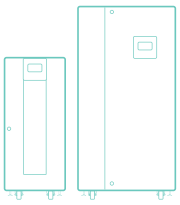


# GE+ vAC ePlus

## Regenerative AC Grid Emulator

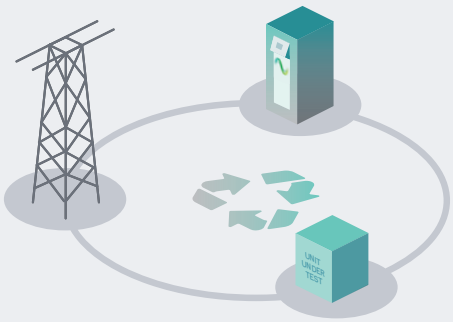
cinergia

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 f ields of: Renewable Energy Sources, Smartgrids, EV and EVSE and, in general, grid connected devices.

### Regenerative Technology

Thanks to our bi-directional topology, the AC Grid Emulator Converter are regenerative, resulting in a reduction of both the consumed energy during the tests and the power required from the electrical installation.

This technology allows us to work in both directions, as power generators or offering a consumption for the realization of all types of tests.




### Main Applications

Electromobility | Smart Grids | IEC Testing | Photovoltaic | Academical & Industrial Test

**Bidirectional and Regenerative**

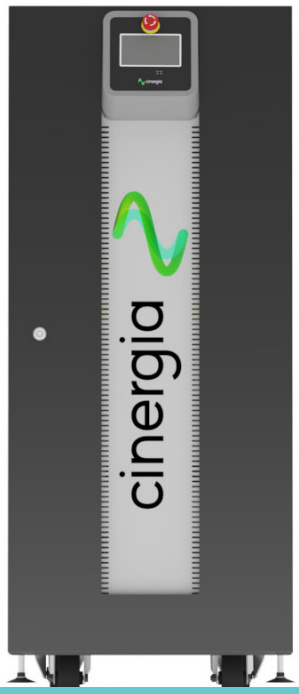
**Clean grid current**
THDi <3% and PF > 0.98

**13 Models**
from 7.5kW to 160kW

**Parallelization of units to increase the power**

**Generation of Worldwide Electrical Grids**
3-phase/ 1-phase/ split phase/ Multichannel

**Independent Phase Configuration of**




CV
AC

**Generation of Disturbances**
harmonics, interharmonics, subharmonics, voltage dips frequency variaton, flicker

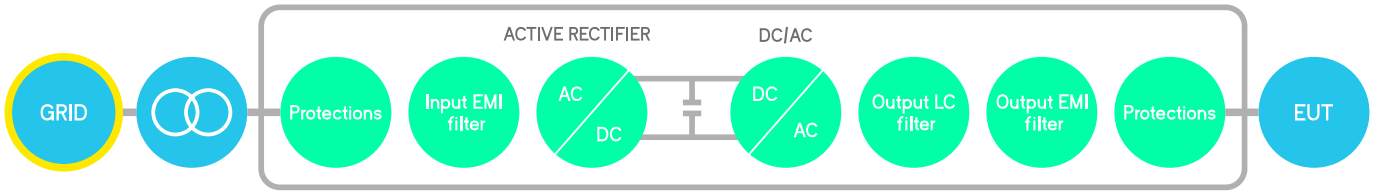
**Disturbance Generation Editor**
compatible with IEC, LVRT, SEMI-F47, CBEMA test standards

**Intuitive User Interface**

**Modbus/Ethernet Open**

ES France - Département Tests & Mesures
127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 45
Fax. 01 47 01 16 22
e-mail : tem@es-france.com
Site Web : www.es-france.com

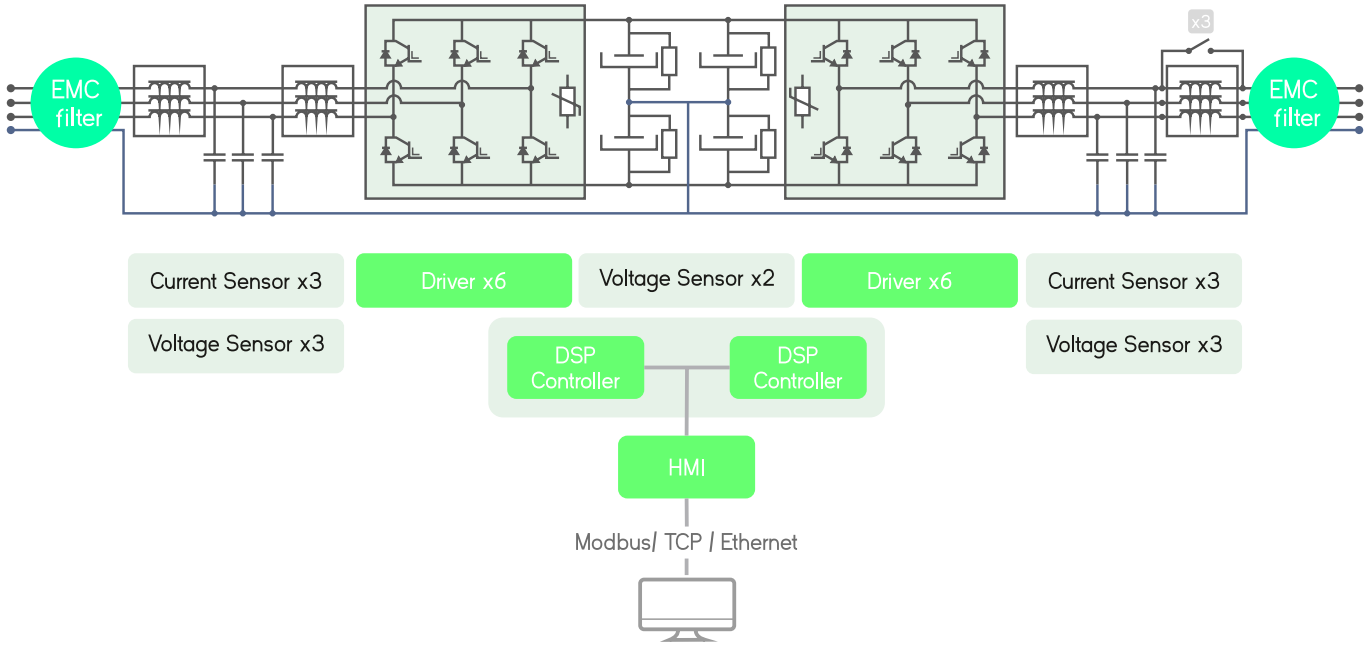
# Bidirectional and Regenerative Hardware




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 conf igured 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 control lers. In DC, the three independent buck-boost bidirectional legs enable the separated control of three different DC voltages or currents.

# Block Diagram




# Local Interface

**Analogue and Digital 10 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

ES France - Département Tests & Mesures
127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 45
Fax. 01 47 01 16 22
e-mail : tem@es-france.com
Site Web : www.es-france.com

# Better than ever,
# the enhanced Plus family

## What's better

**MASTER/SLAVE CONNECTION**
by using a fiber optics link to increase power/voltage capabilities:
GE in AC: can be connected in parallel
EL in AC: can be connected in parallel
B2C: can be connected in parallel, or series or both

**FASTER**
30kHz control loop frequency

**MORE HARMONICS**
50 per phase with 20 free-harmonics

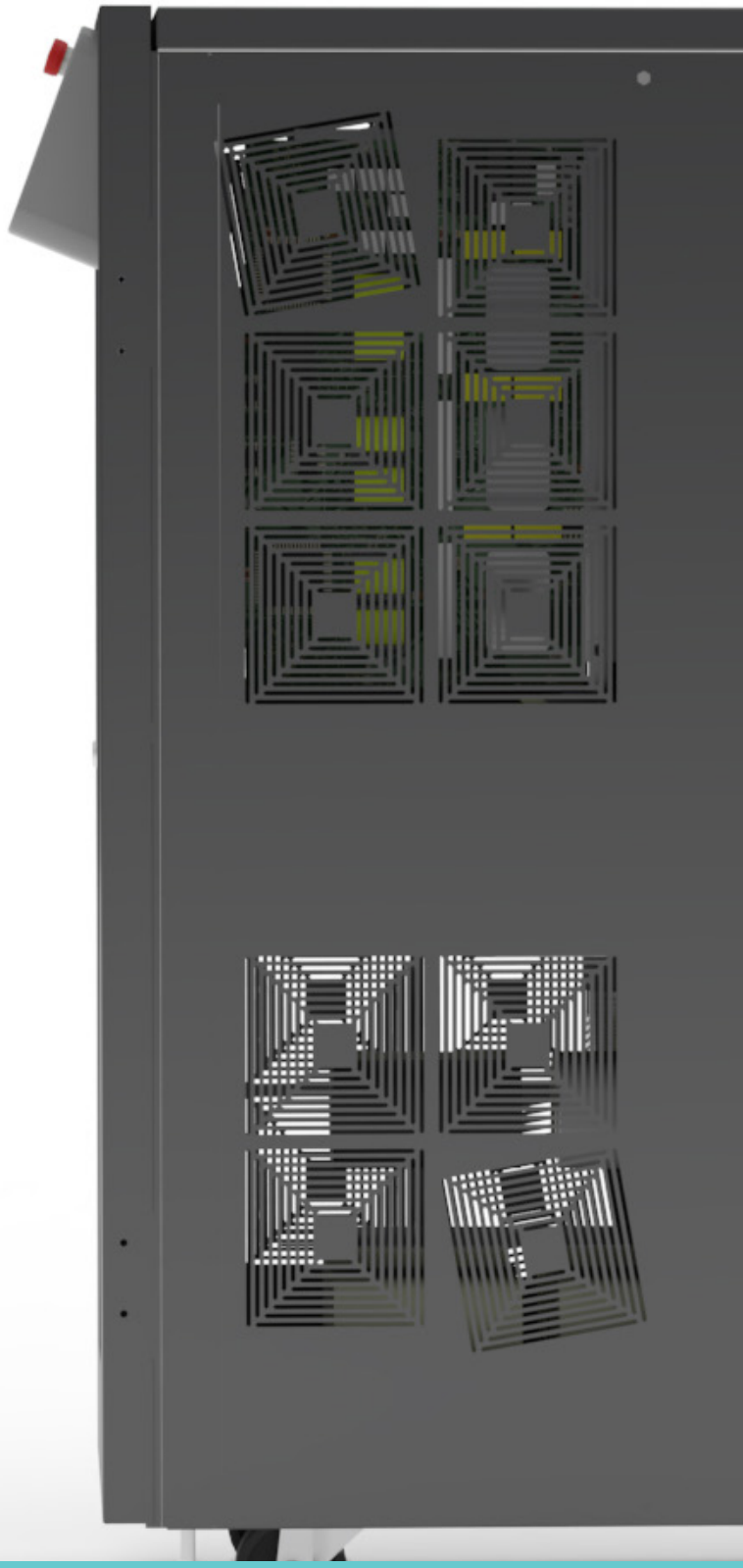
**DELTA LOAD**
for the EL in AC mode

**ADJUSTABLE DC TRANSIENT**
controllers to improve stability of the system

**OPTIMIZED RMS CALCULATION**
for PV inverters anti-islanding test

**SAME ELECTRICAL RATINGS and SAME BANDWIDTH**
because the power platform does not change so robustness and ratings remain the same.

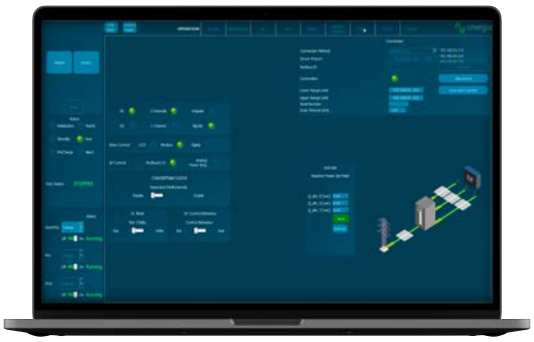
cinergia ePlus

ES France - Département Tests & Mesures
127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 45
Fax. 01 47 01 16 22
e-mail : tem@es-france.com
Site Web : www.es-france.com

# Software

The user interface used by CINERGIA devices has been developed by our R&D team, to offer total control of the device, with a comfortable and intuitive design. This allows us to take full advantage of the capabilities of the device, as well as the programming and execution of standardized or self-created tests.



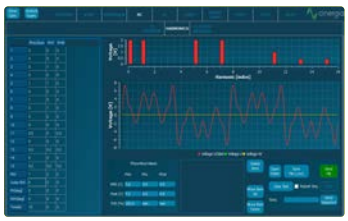
## GE Modes

### AC Operation

From this panel, the user can set all AC parameters. Each phase can be independently configured: RMS current 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

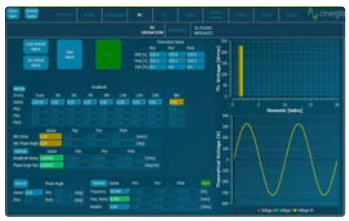
The device can control simultaneosly the magnitude of the first 15 harmonics and one free harmonic per phase. The free one allows the generation of sub-harmonics, inter-harmonics and high frequency harmonics up to the 50th, setting both the magnitude and phase delay.



### Parallel Mode

The device can be controlled in parallel 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.

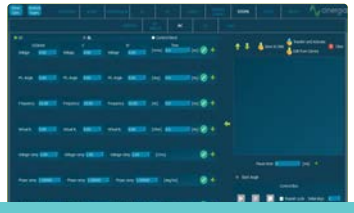
*For this connection contact us.



## AC

### Steps Mode

One of the most remarkable novelties of the new software is the steps funcionality. 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 flicker. Specific profiles can be saved in .csv files, modified, and reused by importing an existing one.

### IEC Testing

Optional

The last version of software includes a library supporting IEC standard for pre-compliance tests. The profiles def ined 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

*It is mainly intended for pre-compliance testing. Contact us for futher information.

ES France - Département Tests & Mesures
127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 45
Fax. 01 47 01 16 22
e-mail : tem@es-france.com
Site Web : www.es-france.com

# GE+ vAC/DC Range & Specifications

## 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)

## 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)

## Output side in GE-AC

**Voltage Mode (CV)**
Peak: ± 400V phase-neutral
Range: 0[1] to 277Vrms phase-neutral (295Vrms with HV option)
0[1] 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[2]: < 0.05% of FS[3]
Setpoint Accuracy[4]: < ± 0.1% of FS[3]
Transient Time[5]: < 1.5ms (10% to 90% at a step to $V_{rated}$)
Ripple[7] (peak-peak): < 0.55% of FS[3]

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·f < 46000 (with current derating)
Setpoint Accuracy[4]: same as voltage accuracy
Small Signal Bandwidth: up to 5000Hz[9]
Transient Time[5]: < 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[9]
Resolution: 1mHz

**Phase Angle**
Range: 0 to 360°
Resolution: 0.01°

## Operation Modes

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

ES France - Département Tests & Mesures
127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 45
Fax. 01 47 01 16 22
e-mail : tem@es-france.com
Site Web : www.es-france.com

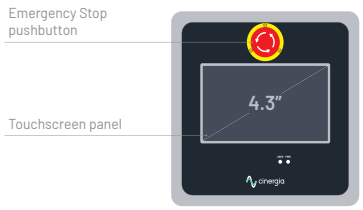
## Overload/ Overcurrent

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

## 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 far Windows 7/10
LabView drivers and open Labview interface example

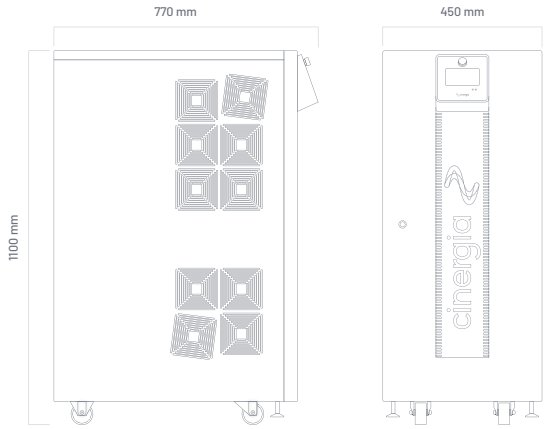
Enhanced **Master/Slave Operation**

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


## Size and Weight

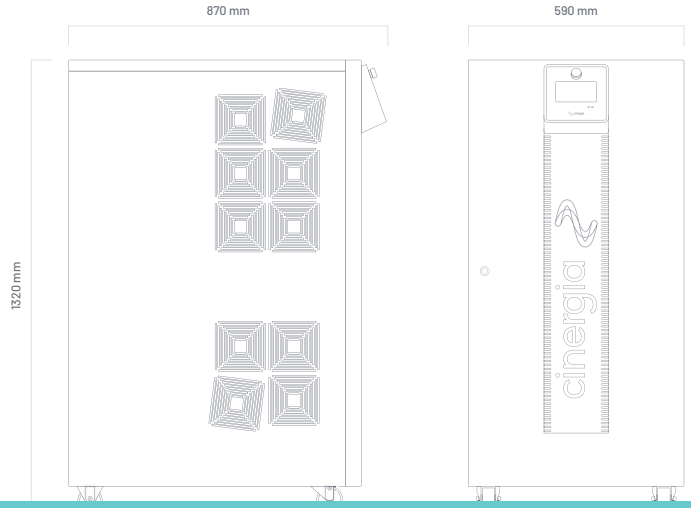
### Models 7.5 to 60 kW

**Height**
1100 mm
**Width**
450 mm
**Depth**
770 mm
**Weight**
200 kg




### Models 80 to 120 kW

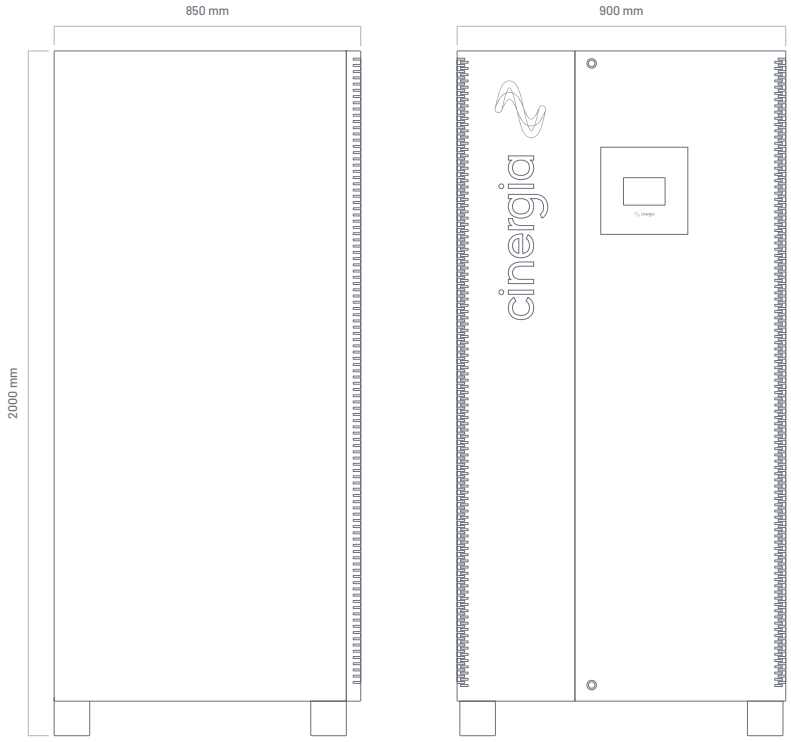
**Height**
1320 mm
**Width**
590 mm
**Depth**
870 mm
**Weight**
320 kg



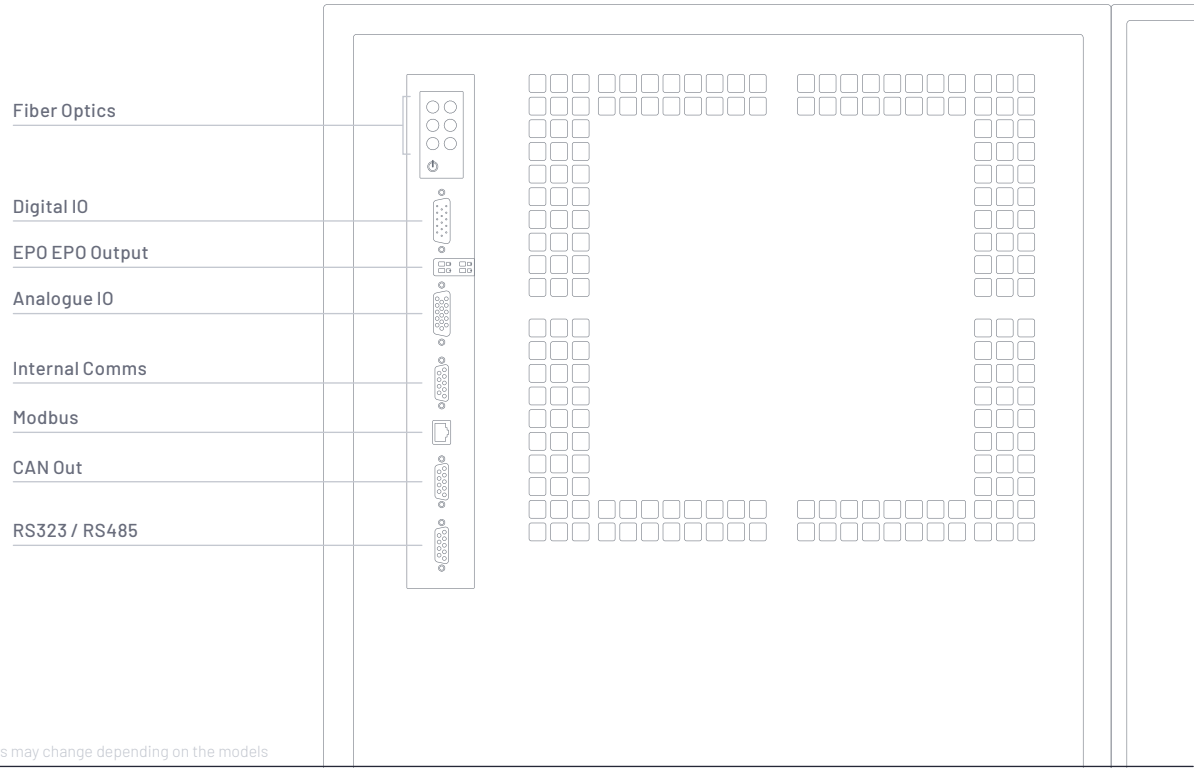

ES France - Département Tests & Mesures
127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 45
Fax. 01 47 01 16 22
e-mail : tem@es-france.com
Site Web : www.es-france.com

## Models 160 & 200 kW

**Height**
2000 mm
**Width**
900 mm
**Depth**
850 mm
**Weight**
680 kg

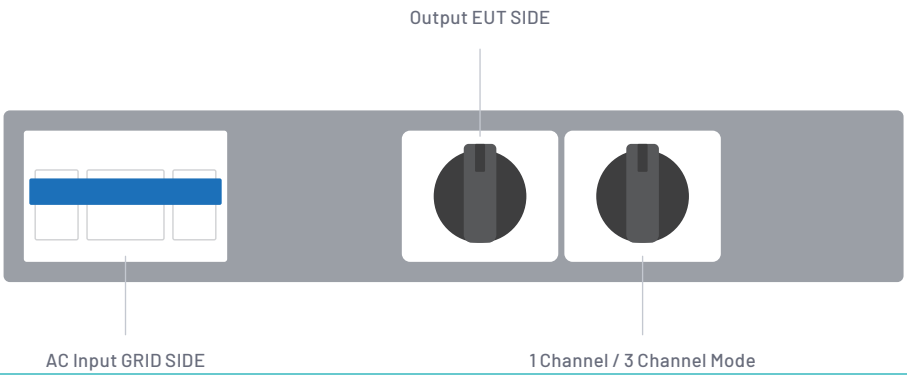



## Connections




The distribution of the connectors may change depending on the models

## Selectors




ES France - Département Tests & Mesures
127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 45
Fax. 01 47 01 16 22
e-mail : tem@es-france.com
Site Web : www.es-france.com

## Protections

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

## Mesurements (6)

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

## Ambient

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

## Standards

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

All specifications are subject to change without notice.

## Options

Choose your options:

- Galvanic Isolation
- Three channel 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 far 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)

All specifications are subject to change without notice.

1. Minimum voltage setpoint is 0V in DC. The recommended mínimum setpoint far 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 2·13 · Irated I (see models table)
   FS Range of power is 2·1200% · Prated I (see models table)
5. Measured with the rated resistive load and high-dynamics controllers configuration.
6. Accuracy of measurements is ±0.1% of FS far rms voltage, ±0.2% of FS far rms current, ±0.4% of FS far active power(valid only above 10% of FS)
7. Consult us far lower voltage/current ripple requirements
8. Rated power figures are given at 20°C

ES France - Département Tests & Mesures
127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 45
Fax. 01 47 01 16 22
e-mail : tem@es-france.com
Site Web : www.es-france.com

# Models

## GE+ vAC

| Reference | AC Power Rated[9] | AC Current Rated[9] RMS 3 channels / 1 channel | DC Power Rated[9] | DC Current Rated[9] RMS 3 channels / 1 channel | Weight (kg) | Dimensions DxWxH (mm) |
|---|---|---|---|---|---|---|
| GE+ 7.5 vAC | 7.5 kW | 11 A / 33A | - | - | 155 kg | 770 x 450 x 1100 mm |
| GE+ 10 vAC | 10 kW | 15 A / 45 A | - | - | 155 kg | 770 x 450 x 1100 mm |
| GE+ 15 vAC | 15 kW | 22 A / 66 A | - | - | 155 kg | 770 x 450 x 1100 mm |
| GE+ 20 vAC | 20 kW | 29 A / 87 A | - | - | 155 kg | 770 x 450 x 1100 mm |
| GE+ 30 vAC | 27 kW | 40 A / 120 A | - | - | 155 kg | 770 x 450 x 1100 mm |
| GE+ 40 vAC | 40 kW | 58 A / 174 A | - | - | 200 kg | 770 x 450 x 1100 mm |
| GE+ 50 vAC | 50 kW | 73 A / 219 A | - | - | 200 kg | 770 x 450 x 1100 mm |
| GE+ 60 vAC | 54 kW | 80 A / 240 A | - | - | 200 kg | 770 x 450 x 1100 mm |
| GE+ 80 vAC | 80 kW | 116 A / - | - | - | 320 kg | 870 x 590 x 1320 mm |
| GE+ 100 vAC | 100 kW | 145 A / - | - | - | 320 kg | 870 x 590 x 1320 mm |
| GE+ 120 vAC | 108 kW | 157 A / - | - | - | 320 kg | 870 x 590 x 1320 mm |
| GE+ 160 vAC | 145 kW | 211 A / - | - | - | 680 kg | 850 x 900 x 2000 mm |
| GE+ 200 vAC | 160 kW | 232 A / - | - | - | 680 kg | 850 x 900 x 2000 mm |

All specifications are subject to change without notice.

## Galvanic Isolation (optional)

| | | Circuit Breaker Recommended | Weight |
|---|---|---|---|
| Inside the cabinet | IT 7.5i | Type C - 25 A | 145 kg |
| | IT 10i | Type C - 25 A | 145 kg |
| | IT 15i | Type C - 32 A | 145 kg |
| | IT 20i | Type C - 40 A | 145 kg |
| | IT 30i | Type C - 50 A | 195 kg |
| | IT 40i* | Type C - 63 A | 195 kg |
| | IT 50i* | Type C - 83 A | 195 kg |

*In the **IT 40i** and **IT 50i** models the size of the cabinet increases to a total of 770 x 835 x 1100 mm. The others keep the original size.

| | | Circuit Breaker Recommended | Weight | Dimensions D x W x H |
|---|---|---|---|---|
| In external cabinet IP20 | IT 30e | Type D - 80 A | 174 kg | 595 x 415 x 708 mm |
| | IT 40e | Type D - 100 A | 217 kg | 725 x 525 x 773 mm |
| | IT 50e | Type D - 125 A | 280 kg | 725 x 525 x 773 mm |
| | IT 60e | Type D - 160 A | 381 kg | 875 x 600 x 900 mm |
| | IT 80e | Type D - 200 A | 435 kg | 875 x 600 x 900 mm |
| | IT 100e | Type D - 250 A | 458 kg | 875 x 600 x 900 mm |
| | IT 120e | Type D - 315 A | 514 kg | 875 x 600 x 900 mm |
| | IT 160e | Type D - 400 A | 612 kg | 964 x 648 x 1252 mm |
| | IT 200e | Type D - 500 A | 753 kg | 1192 x 744 x 1430 mm |

## Configuration Modes

GE+ AC

## Master / Slave

Parallel — in AC modes (GE & EL)

## 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.

**Regenerative Power Electronic**

cinergia
Can Baletes 7, Nau A
08310 Argentona
Barcelona (Spain)
+34 934 864 358
info@cinergia.coop