GE+ vAC

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
- 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:
  - 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
- Intuitive User Interface
  - Modbus/Ethernet Open protocol, Labview drivers

Highlights

- Efficiency and Flexibility
- Harmonics Generation
- AC only
- Smooth Integration
- High-Resolution and Dynamics

Applications

- Electrical Vehicles and EVSE
- PV Inverter Testing
- Applications for Industry and Education
- Smartgrids and ESS
- IEC Testing
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. 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 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.
Software Interface in GE+ mode

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

IEC Testing (option)
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

## Input side
### (GRID side)
- **AC Voltage**
  - Rated: 3x400Vrms + Neutral + Earth
  - Range: +15% / -20%
  - Depends on model (see Wiring Manual)
- **Frequency**
  - 48-62Hz
- **Current Harmonic Distortion**
  - $\text{THDI} < 3\%$ at rated power
- **Current Power factor**
  - $\text{PF} > 0.98$ at rated power
- **Efficiency**
  - $\geq 89\%$ (7.5 & 10), $\geq 91\%$ (15 to 30), $\geq 92\%$ (40 to 200)

## Output side
### in AC
#### (EUT side)
- **Terminals**
  - Number: 4 (3 phases + 1 neutral)
- **Configuration of Channels**
  - Independent: 4Q, independent setpoints per phase
  - Parallel: 4Q, global setpoints for all phases
  - 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° to 277Vrms phase-neutral (295Vrms with HV option)
  - 0° 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: $< 0.05\%$ of FS
  - Setpoint Accuracy: $< 0.1\%$ of FS
  - Transient Time: $< 1.5\text{ms}$ (10% to 90% at a step to $V_{\text{rated}}$)
  - Ripple (peak-peak): $< 0.55\%$ of FS
- **Harmonics**
  - Range: up to 50th (at 50/60 Hz fundamental)
  - 15 independent harmonics per phase:
    - 14 fixed frequency multiple of $f_0$: 2,3,4,5,6,7,8,9,10,11,12,13,14,15
    - 1 free programmable frequency from 0.1 to 50 times $f_0$
  - Harmonics content: $V_f < 46000$ (with current derating)
  - Setpoint Accuracy: same as voltage accuracy
  - Small Signal Bandwidth: up to 5000Hz
  - Transient Time: $< 2\text{ms}$ (10% to 90% at a step change)
- **Frequency**
  - Fundamental Frequency Range: 10 to 100Hz (up to 400Hz option)
  - Small Signal Bandwidth: up to 5000Hz
  - Resolution: 1mHz
- **Phase Angle**
  - Range: 0° to 360°
  - Resolution: 0.01°
**Operation Modes**

**AC**

Programmable Voltage (CV)

Steps

Optional IEC 61000

**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 for Windows 7/10

LabView drivers and open Labview interface example

**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

**Measurements**

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

**Ambient**

Operating temperature (°C): 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)

**Standards**

CE Marking

Operation and Safety: EN-50178, EN-62040-1

EMC: EN-62040-2

RoHS

All specifications are subject to change without notice.
### Models

**GE+ vAC**

<table>
<thead>
<tr>
<th>Reference</th>
<th>AC Power</th>
<th>AC Current</th>
<th>Weight</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>GE+7.5 vAC</td>
<td>7.5kW</td>
<td>11A / 33A</td>
<td>155 kg</td>
<td>770x450x1100 mm</td>
</tr>
<tr>
<td>GE+10 vAC</td>
<td>10kW</td>
<td>15A / 45A</td>
<td>155 kg</td>
<td>770x450x1100 mm</td>
</tr>
<tr>
<td>GE+15 vAC</td>
<td>15kW</td>
<td>22A / 66A</td>
<td>155 kg</td>
<td>770x450x1100 mm</td>
</tr>
<tr>
<td>GE+20 vAC</td>
<td>20kW</td>
<td>29A / 87A</td>
<td>155 kg</td>
<td>770x450x1100 mm</td>
</tr>
<tr>
<td>GE+30 vAC</td>
<td>27kW</td>
<td>40A / 120A</td>
<td>155 kg</td>
<td>770x450x1100 mm</td>
</tr>
<tr>
<td>GE+40 vAC</td>
<td>40kW</td>
<td>58A / 174A</td>
<td>190 kg</td>
<td>770x450x1100 mm</td>
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<tr>
<td>GE+50 vAC</td>
<td>50kW</td>
<td>73A / 219A</td>
<td>190 kg</td>
<td>770x450x1100 mm</td>
</tr>
<tr>
<td>GE+60 vAC</td>
<td>54kW</td>
<td>80A / 240A</td>
<td>190 kg</td>
<td>770x450x1100 mm</td>
</tr>
<tr>
<td>GE+80 vAC</td>
<td>80kW</td>
<td>116A / 348A</td>
<td>270 kg</td>
<td>880x590x1320 mm</td>
</tr>
<tr>
<td>GE+100 vAC</td>
<td>100kW</td>
<td>145A / 435A</td>
<td>295 kg</td>
<td>880x590x1320 mm</td>
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<tr>
<td>GE+120 vAC</td>
<td>108kW</td>
<td>157A / 471A</td>
<td>295 kg</td>
<td>880x590x1320 mm</td>
</tr>
<tr>
<td>GE+160 vAC</td>
<td>145kW</td>
<td>211A / 633A</td>
<td>545 kg</td>
<td>850x900x2000 mm</td>
</tr>
<tr>
<td>GE+200 vAC</td>
<td>160kW</td>
<td>232A / 696A</td>
<td>555 kg</td>
<td>850x900x2000 mm</td>
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</table>

Galvanic Isolation (optional)

<table>
<thead>
<tr>
<th>Circuit Breaker</th>
<th>Weight</th>
<th>Dimensions DxWxH (mm)</th>
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</thead>
<tbody>
<tr>
<td>IT 7.5i Type C - 25A</td>
<td>145 kg</td>
<td>Inside the cabinet</td>
</tr>
<tr>
<td>IT 10i Type C - 25A</td>
<td>145 kg</td>
<td>Inside the cabinet</td>
</tr>
<tr>
<td>IT 15i Type C - 32A</td>
<td>145 kg</td>
<td>Inside the cabinet</td>
</tr>
<tr>
<td>IT 20i Type C - 40A</td>
<td>145 kg</td>
<td>Inside the cabinet</td>
</tr>
<tr>
<td>IT 30i Type C - 50A</td>
<td>195 kg</td>
<td>Inside the cabinet</td>
</tr>
<tr>
<td>IT 30e Type D - 80A</td>
<td>174 kg</td>
<td>595x415x708 mm</td>
</tr>
<tr>
<td>IT 40e Type D - 100A</td>
<td>217 kg</td>
<td>789x490x865 mm</td>
</tr>
<tr>
<td>IT 50e Type D - 125A</td>
<td>280 kg</td>
<td>789x490x865 mm</td>
</tr>
<tr>
<td>IT 60e Type D - 160A</td>
<td>381 kg</td>
<td>789x490x865 mm</td>
</tr>
<tr>
<td>IT 80e Type D - 200A</td>
<td>435 kg</td>
<td>964x684x1252 mm</td>
</tr>
<tr>
<td>IT 100e Type D - 250A</td>
<td>458 kg</td>
<td>964x684x1252 mm</td>
</tr>
<tr>
<td>IT 120e Type D - 315A</td>
<td>514 kg</td>
<td>964x684x1252 mm</td>
</tr>
<tr>
<td>IT 160e Type D - 400A</td>
<td>612 kg</td>
<td>964x684x1252 mm</td>
</tr>
<tr>
<td>IT 200e Type D - 500A</td>
<td>753 kg</td>
<td>1192x744x1430 mm</td>
</tr>
</tbody>
</table>

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**
- **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**: IEC 61000-4-11, 4-13, 4-14, 4-28, ..., (consult us for specific Test)