GE+ Series

Regenerative AC/DC Grid Emulators

CINERGIA's Grid Emulators are programmable Voltage Sources designed to create stable AC grids as well as electrical disturbances. Based on a Regenerative and Bidirectional power hardware it is a key device for testing Renewable Energy Sources (PV, WT, CHP) and grid connected devices.

Key features

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

13 models from 6.75kW to 160kW
Parallelization of units to increase the power

4 versions:
    AC only: the essential unit for AC applications
    DC only: (see B2C+ datasheet)
    AC/DC: the most flexible, AC and DC in one unit
    AC/DC Lite: for Power Hardware In the Loop

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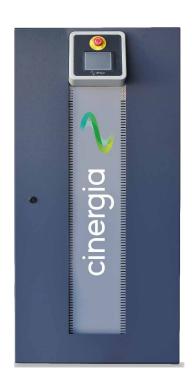   3-phase/ 1-phase/ split phase / Multichannel

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 Software
Modbus/Ethernet Open protocol, Labview drivers

Highlights

Efficiency and Flexibility

GE+ units efficiently converts AC to AC with Regenerative capability. The system has been specially designed to bring a high level of flexibility to testing featuring independent configuration of each output phase: magnitude, phase, frequency, harmonics, ramps, voltage dip rise/fall along with a comprehensive set of alarms and limits for EUT protection.

Harmonics Generation

The PLUS series comes with an improved control of harmonics based on ressonant controllers. The fundamental frequency is individually set on each phase and the user can control, for each phase, the multiple harmonics up to the 15th and one free harmonic to create sub/inter/high frequency harmonics up to the 50th.

High-Resolution and Dynamics

The fully-digital DSP-based control system is based on a 300kHz oversampling of the currents and voltages. This data is processed to provide high-resolution and low-noise measurements enabling the Proportional-Resonant Controllers to produce accurate outputs and fast transients.

Smooth Integration

All models integrate the electrical protections, terminal blocks, local touchscreen, analogue and digital I/O, local emergency stop pushbutton as well as input&output emergency signals for the general interlock system. Interfacing remotely a unit is simple by using the Modbus Ethernet connection (open protocol), User Interface Software and Labview drivers supplied.

Range and 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 (EUT side in AC mode[#])

Terminals
Number: 4 (3 phases + 1 neutral)

Configuration
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)

Voltage
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]: < 1ms (10% to 90% at a step to Vrated)

Ripple[6] (peak-peak): < 0.55% of FS[3]

Phase Angle
Range: 0 to 360°

Resolution: 0.01°

Frequency
Fundamental Frequency Range: 10 to 100Hz (up to 400Hz as option)

Small Signal Bandwidth: up to 5000Hz[7]

Resolution: 10mHz (1mHz upon request)

Harmonics
Range: up to 50th

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[4]: same as voltage accuracy

Transient Time[5]: < 2ms (10% to 90% at a step change)

Modes of operation

Version AC-only
CV: AC-only Programmable Voltage Source

Version Power Amplifier
CV: AC or DC Programmable Voltage Source

Power Amplifier

Optional: DC current/power/resistance, BatTest, BatEmu, PVEmu

Version AC/DC
CV: AC or DC Programmable Voltage Source

Power Amplifier

DC current/power/resistance, Battery Test

Optional: Battery Emulation, PV Panel Emulation

All versions: AC Disturbance Generation Mode, Automated testing
from .csv file

Protections
Overvoltage (peak, rms), Overcurrent[11,12] (peak, rms), Overload[10]
Shortcircuit, Emergency Stop, Watchdog, Heart
Beat, Output Contactor

Alarms and Limits are user configurable and can be saved in a
password protected EEPROM

Measurements(8)
Grid Voltage (rms), Current (rms), Power (P,Q) and Frequency

Output Voltage (rms), Current (rms), Power (P,Q) and Frequency

Heatsink Temperatures (x2) and DC Link Voltage

Datalogging available through FTP connection

User Interface
Local Control (4.3" Touchscreen panel)

　Isolated Digital IO port: 6 inputs, 4 outputs

　Isolated Analogue IO port: 6 inputs, 6 outputs

　Interlock IO port: 1 input, 1 output

　Emergency Stop pushbutton

Remote Control port:

　LAN Ethernet with Open Modbus-TCP protocol

　RS485, RS232, CANbus (optionals)

Software:

　Graphical User Interface for Windows 7/10

　LabView drivers and basic Labview interface example

Ambient
Operating temperature[9]: 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: EN-50178

Safety: EN-60950-1, EN-62040-1-2

EMC: EN-62040-2

All specifications are subject to change without notice.
(#) Refer to B2C+ datasheet for the specifications in DC mode for versions AC/DC Full and Lite
(1) The recommended minimum setpoint for long-term use is 20Vrms
(2) Effective resolution measured with a 400ms window
(3) FS Range of voltage is 800V
　FS Range of current is 2| 3 · Irated | (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) Consult us for lower voltage/current ripple requirements
(7) The maximum output voltage depends on frequency following V·f < 46000
(8) 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)

Models

GE+ AC only version

Model	Version	AC Power Rated [9]	DC Power Rated [9]	AC Current Rated [10] RMS Per phase / Parallel	DC Current Rated [11] DC Per phase / Parallel	Operation Modes All models
GE+7.5	**vAC**	7.5 kW	-	11A / 33A	-	
GE+10	**vAC**	10 kW	-	15A / 45A	-	
GE+15	**vAC**	15 kW	-	22A / 66A	-	
GE+20	**vAC**	20 kW	-	29A / 87A	-	
GE+30	**vAC**	27 kW	-	40A / 120A	-	
GE+40	**vAC**	40 kW	-	58A / 174A	-	Programmable Voltage (CV)
GE+50	**vAC**	50 kW	-	73A / 219A	-	Automatic Sequence (csv file)
GE+60	**vAC**	54 kW	-	80A / 240A	-	Disturbance Generator
GE+80	**vAC**	80 kW	-	116A / 348A	-	
GE+100	**vAC**	100 kW	-	145A / 435A	-	
GE+120	**vAC**	108 kW	-	157A / 471A	-	
GE+160	**vAC**	145 kW	-	211A / 633A	-	
GE+200	**vAC**	160 kW	-	232A / 696A	-	

All specifications are subject to change without notice.

GE+ AC/DC Full version

Model	Version	AC Power Rated [9]	DC Power Rated [9]	AC Current Rated [10] RMS Per phase / Parallel	DC Current Rated [11] DC Per phase / Parallel	Operation Modes All models
GE+7.5	**vAC/DC**	7.5 kW	7.5 kW	11A / 33A	±10A / ±30A	AC Modes:
GE+10	**vAC/DC**	10 kW	10 kW	15A / 45A	±15A / ±45A	Programmable Voltage (CV)
GE+15	**vAC/DC**	15 kW	15 kW	22A / 66A	±20A / ±60A	Power Amplifier (for Power HIL)
GE+20	**vAC/DC**	20 kW	20 kW	29A / 87A	±25A / ±75A	Automatic Sequence (csv file)
GE+30	**vAC/DC**	27 kW	27 kW	40A / 120A	±30A / ±90A	Disturbance Generator
GE+40	**vAC/DC**	40 kW	40 kW	58A / 174A	±40A / ±120A	DC Modes:
GE+50	**vAC/DC**	50 kW	50 kW	73A / 219A	±50A / ±150A	Programmable Voltage (CV)
GE+60	**vAC/DC**	54 kW	54 kW	80A / 240A	±57A / ±171A	Programmable Current (CC)
GE+80	**vAC/DC**	80 kW	80 kW	116A / 348A	±105A / ±315A	Programmable Power (CP)
GE+100	**vAC/DC**	100 kW	100 kW	145A / 435A	±130A / ±390A	Programmable Resistance (CR)
GE+120	**vAC/DC**	108 kW	108 kW	157A / 471A	±130A / ±390A	Power Amplifier (for Power HIL)
GE+160	**vAC/DC**	145 kW	145 kW	211A / 633A	±155A / ±465A	Automatic Sequence (csv file)
GE+200	**vAC/DC**	160 kW	160 kW	232A / 696A	±185A / ±555A	Optional (software):

Operation Modes (continued):
Optional (software):
  Battery Test / Cycler
  Battery Emulation
  PV Panel Emulation

All specifications are subject to change without notice.

(9) Rated power figures are given at 20°C. See (9) for admissible Overloads
(10) Admissible overloads are the following: 125% of rated value during 10 minutes, 150% of rated value during 1 minute, 200% of rated value during 2s
    Overload levels can be configured by the user (to values below the factory ones) and saved in a EEPROM (password protected)
    The user can configure different admissible overload levels for power sourcing and power absorbing
(11) Admissible AC Overcurrents are the following: 125% during 10 minutes, 150% during 1 minute, 200% during 2s
    Admissible Peak Overcurrent is 3 times the rated current (to allow a crest factor of 3)
    Overload levels can be configured by the user (to values below the factory ones) and saved in a EEPROM (password protected)
(12) Admissible DC Overcurrent is the following: 110% during 1 minute

Models

GE+ AC/DC Lite version (Power Hardware In the Loop)

Model	Version	AC Power Rated [9]	DC Power Rated [9]	AC Current Rated [10] RMS Per phase / Parallel	DC Current Rated [11] DC Per phase / Parallel	Operation Modes All models
GE+7.5	vHIL	7.5 kW	3.75 kW	11A / 33A	5A / 15A	**AC Modes:**
GE+10	vHIL	10 kW	5 kW	15A / 45A	7.5A / 22.5A	Programmable Voltage (CV)
GE+15	vHIL	15 kW	7.5 kW	22A / 66A	10A / 30A	Power Amplifier (for Power HIL)
GE+20	vHIL	20 kW	10 kW	29A / 87A	12.5A / 37.5A	Automatic Sequence (csv file)
GE+30	vHIL	27 kW	13.5 kW	40A / 120A	15A / 45A	Disturbance Generator
GE+40	vHIL	40 kW	20 kW	58A / 174A	20A / 60A	**DC Modes:**
GE+50	vHIL	50 kW	25 kW	73A / 219A	25A / 75A	Programmable Voltage (CV)
GE+60	vHIL	54 kW	27 kW	80A / 240A	28.5A / 85.5A	Power Amplifier (for Power HIL)
GE+80	vHIL	80 kW	40 kW	116A / 348A	52.5A / 157.5A	Automatic Sequence (csv file)
GE+100	vHIL	100 kW	50 kW	145A / 435A	65A / 195A	**Optional (software):**
GE+120	vHIL	108 kW	54 kW	157A / 471A	65A / 195A	Programmable Current (CC)
GE+160	vHIL	145 kW	72.5 kW	211A / 633A	77.5A / 232.5	Programmable Power (CP)
GE+200	vHIL	160 kW	80 kW	232A / 696A	92.5A / 277.5A	Programmable Resistance (CR)
						Battery Test / Cycler
						Battery Emulation
						PV Panel Emulation

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Mechanical

Model	WEIGHT kg	DIMENSIONS DxWxH (mm)
GE+7.5	155 kg	770x450x1100 mm
GE+10	155 kg	770x450x1100 mm
GE+15	155 kg	770x450x1100 mm
GE+20	155 kg	770x450x1100 mm
GE+30	155 kg	770x450x1100 mm
GE+40	190 kg	770x450x1100 mm
GE+50	190 kg	770x450x1100 mm
GE+60	190 kg	770x450x1100 mm
GE+80	270 kg	880x590x1320 mm
GE+100	295 kg	880x590x1320 mm
GE+120	295 kg	880x590x1320 mm
GE+160	545 kg	850x900x2000 mm
GE+200	555 kg	850x900x2000 mm

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Galvanic Isolation (optional)

Model	Circuit Breaker Recommended	WEIGHT kg	DIMENSIONS DxWxH (mm)
IT7.5i	Type C - 25A	145 kg	Inside the cabinet
IT10i	Type C - 25A	145 kg	Inside the cabinet
IT15i	Type C - 32A	145 kg	Inside the cabinet
IT20i	Type C - 40A	145 kg	Inside the cabinet
IT30i	Type C - 50A	195 kg	Inside the cabinet
IT30e	Type D - 80A	174 kg	595x415x708
IT40e	Type D - 100A	217 kg	789x490x865
IT50e	Type D - 125A	280 kg	789x490x865
IT60e	Type D - 160A	381 kg	789x490x865
IT80e	Type D - 200A	435 kg	964x684x1252
IT100e	Type D - 250A	458 kg	964x684x1252
IT120e	Type D - 315A	514 kg	964x684x1252
IT160e	Type D - 400A	612 kg	964x684x1252
IT200e	Type D - 500A	753 kg	1192x744x1430

Note: 'i' stands for internal transformer, 'e' stands for external transformer (delivered in a stand-alone cabinet IP23)
All specifications are subject to change without notice.

Options

Galvanic Isolation: recommended for EV and EVSE test platforms, provides isolated output via low frequency transformer
Multichannel: allows separated on/off/alarm status and a different operation mode for each channel. It is an option for units
  ≥ 80kW (included in all models from 7.5 to 60)
30kHz Switching Frequency: only available for models GE+15, 20 and 30. Power is derated to 7.5kW, 7.5kW and 10kW respectively.
Low Ripple Capacitance: reduce the output voltage ripple at requested value (bandwidth of the unit may vary)
Isolation monitor / Anti-islanding monitor: commercial isolation and/or anti-islanding relays can be installed for safety
High Voltage (HV): the high voltage option allows a maximum voltage of 295Vrms p-n
Communications: RS485, RS232, CAN

Álava Ingenieros
GRUPO ÁLAVA

CINERGIA, Regenerative Power Electronics Solutions
- Grid Emulators AC, DC, AC/DC
- Electronic Loads AC, DC, AC/DC, HF (360-900Hz)
- Bidirectional DC, Battery Emulators, PV Panel Emulators

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