GE+ vHiL

Regenerative AC/DC Grid Emulator

The GE+ vHiL is CINERGIA's Voltage Source optimized in performance and price for Power Hardware in the Loop applications. This version keeps the software and functionalities of CINERGIA's GE+ vAC and it includes Power Amplifier functions to interface with Real Time Control Systems.

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 variaton, flicker

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

Intuitive User Interface
Modbus/Ethernet Open protocol, Labview drivers

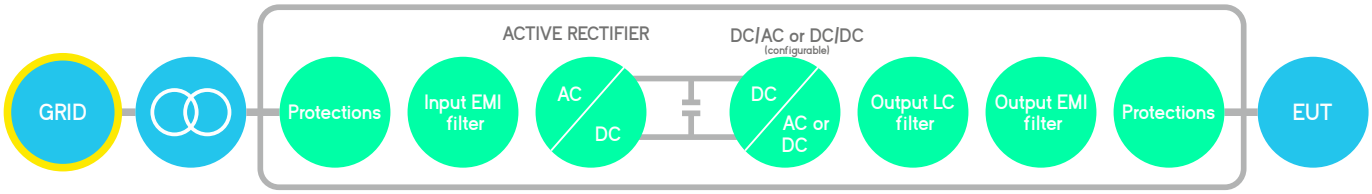
Highlights

- Efficiency and Flexibility
- Harmonics Generation
- Optimized version for PHiL
- Power Amplifier
- High-Resolution and Dynamics

Applications

- Electrical Vehicles and EVSE
- Power HIL
- PV Inverter Emulation and PV Inverter Testing
- Battery Testing and Emulation
- Smartgrids and ESS
- IEC Testing

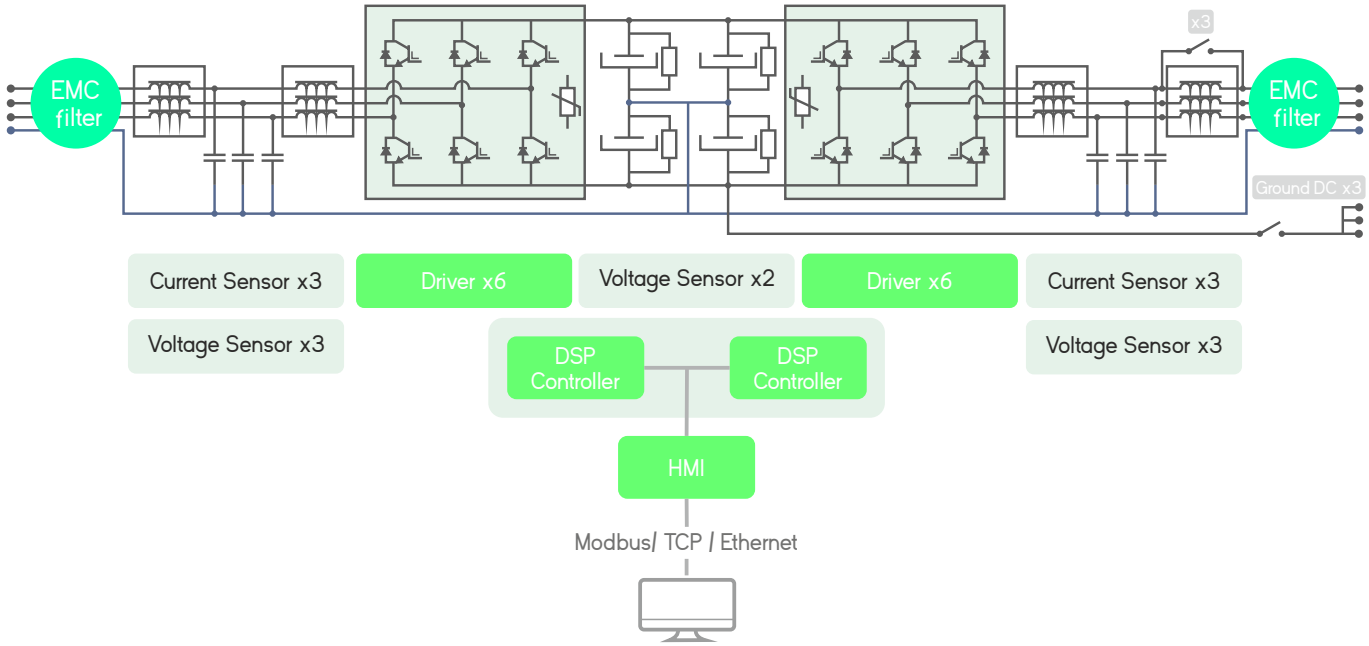
Bidirectional and Regenerative Hardware



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).

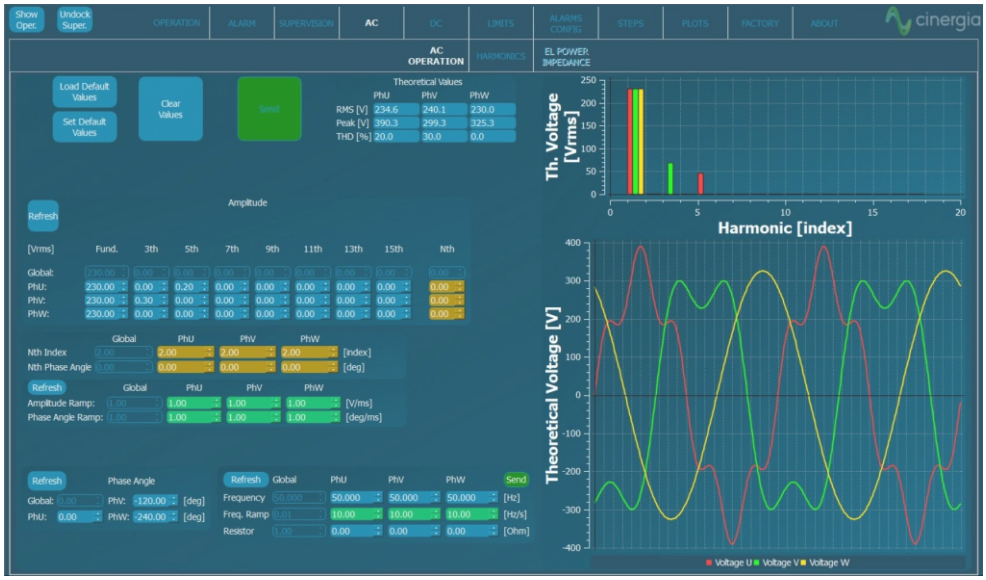
4.3" Touchscreen

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

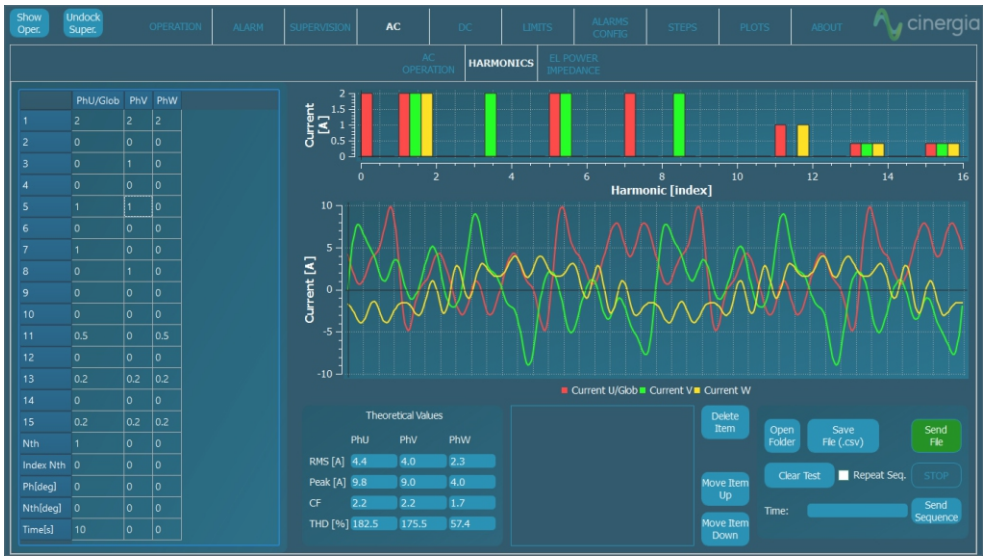
The units integrate a local Emergency Stop pushbutton and two signals (input + output) to be connected to the laboratory interlock system. Additionally, the digital outputs can be interfaced to safety tower lights.

Software Interface in GE+ mode



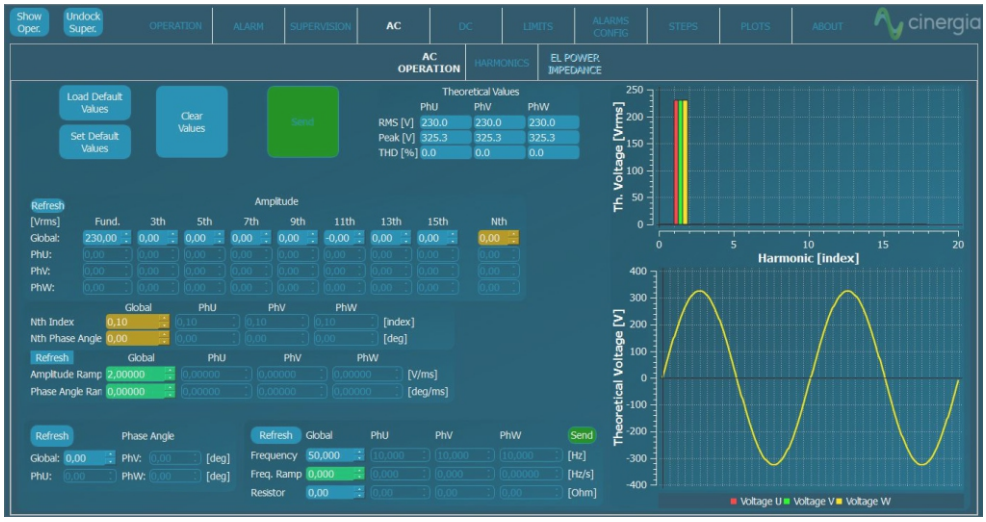
AC Operation

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 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.



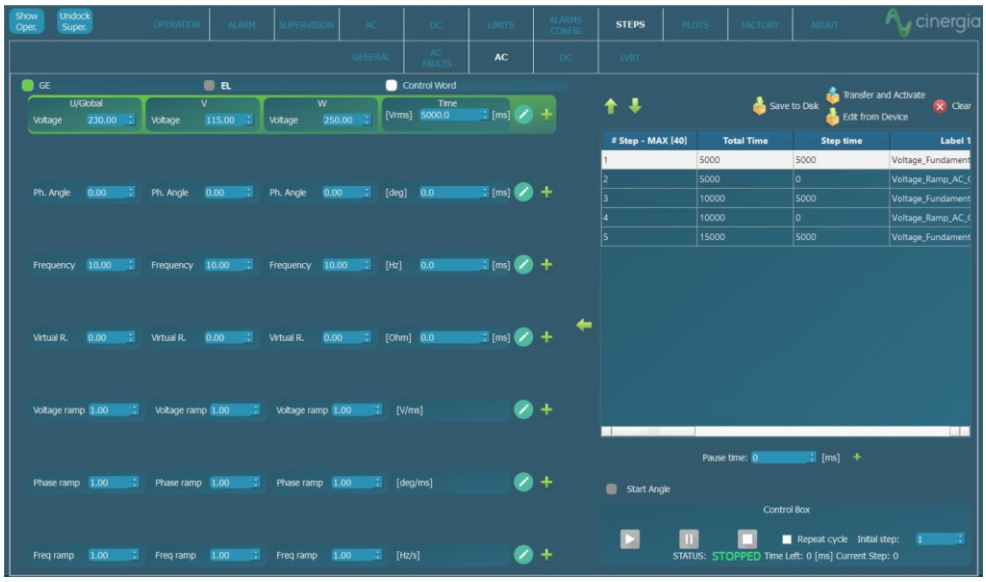
Parallel Mode

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.

Advanced AC Software Applications



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

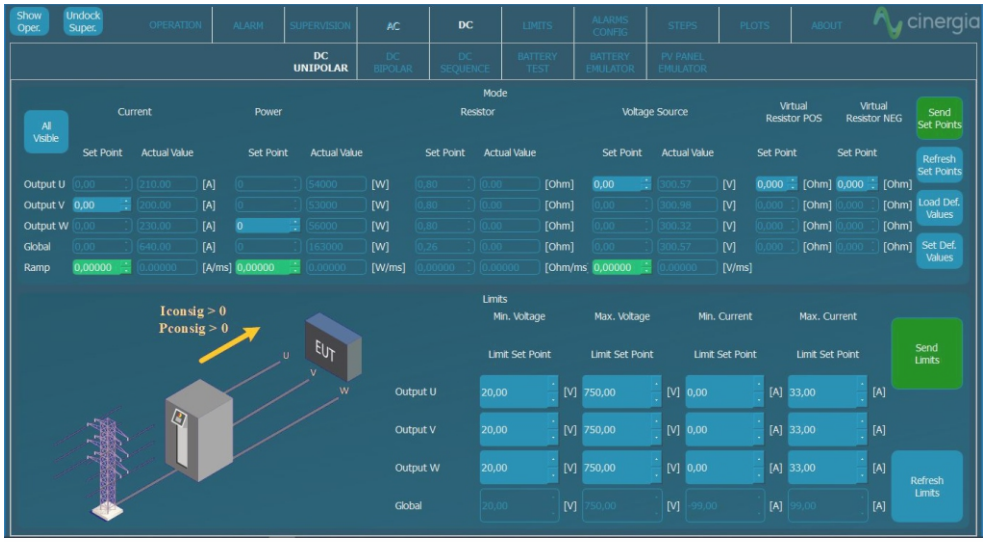
The steps mode includes predefined easy-to-use test panels. The AC faults panel is a powerful yet intuitive editor which allows generating and configuring voltage dips, frequency variation, flicker and LVRT. Specific profiles can be saved in .csv files, modified, and reused by importing an existing one.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

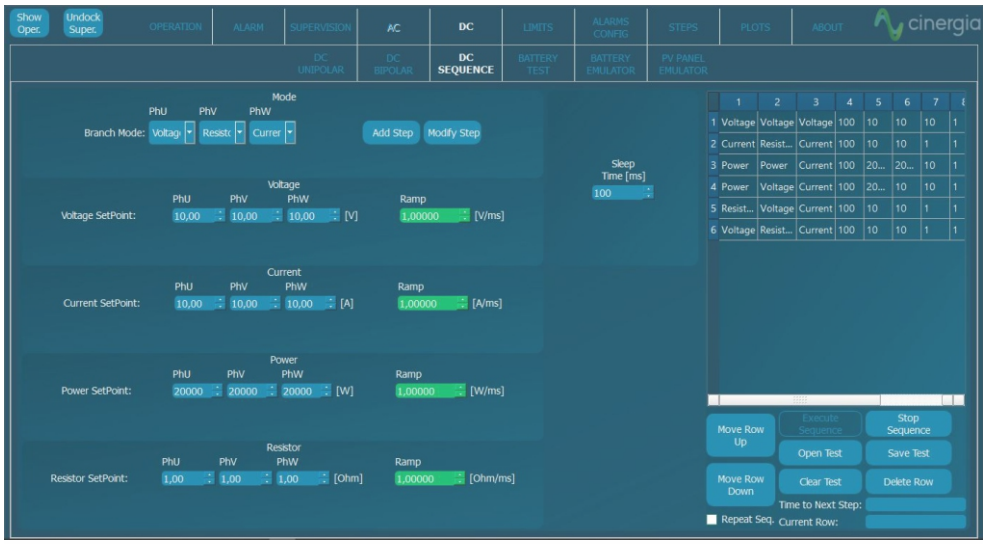
- IEC61000-4/11
- IEC61000-4/13
- IEC61000-4/14
- IEC61000-4/28

Software Interface in DC



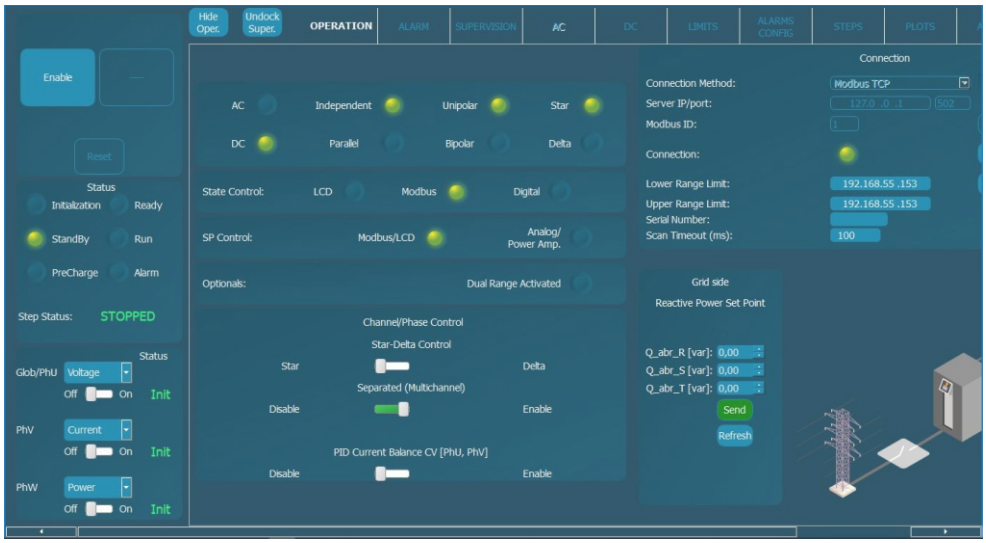
DC Operation

This panel allows the user to access all DC setpoints and limits. Thanks to the unique Multichannel feature, each phase can have a different Operation Mode: voltage, current, power, resistance and advanced DC applications. Transition ramps, voltage and current limits can be modified. The limits for sink and source operation are different for safer testing, specially in battery applications.



Sequence

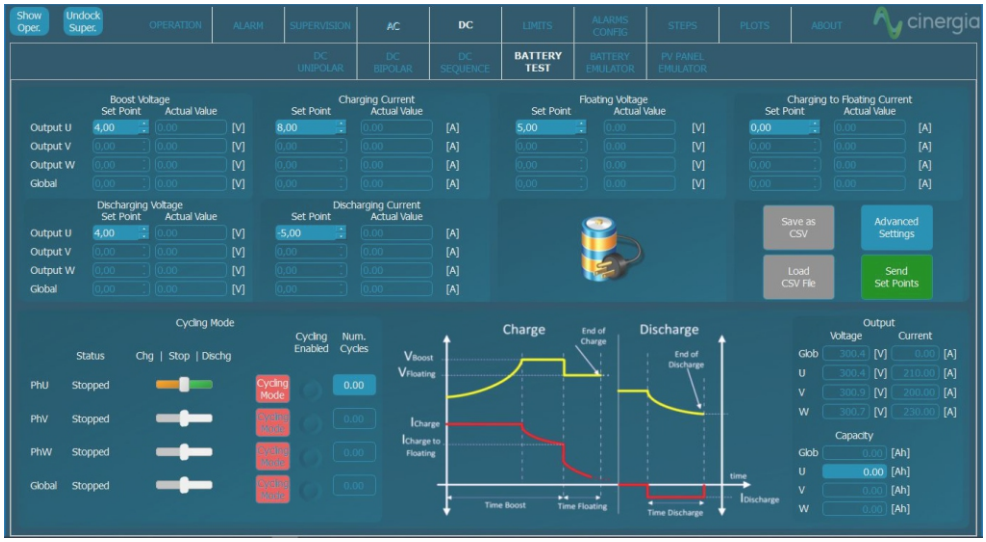
The User Interface Software integrates a Sequence Editor to create automatic test sequences, save them for future use and import them in .csv files.
A smart datalogger can be activated from the LCD of the unit to record automatically the resulting voltage and current measurements with a time resolution of 400 ms.



Multichannel

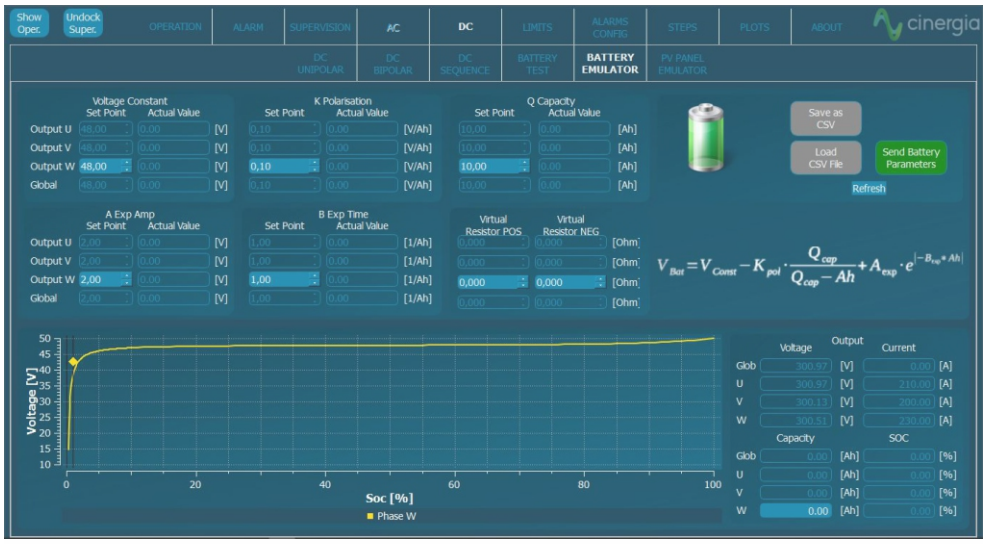
Enabling the Separated Channel Control converts the device in three functionally independent DC Bidirectional Power Supplies, sharing the common negative rail. Each channel can have a different status (ON, OFF, Warning, Alarm), Operation Mode (see Range and Specifications table), Setpoint, Ramp and Limits.

Advanced DC Applications



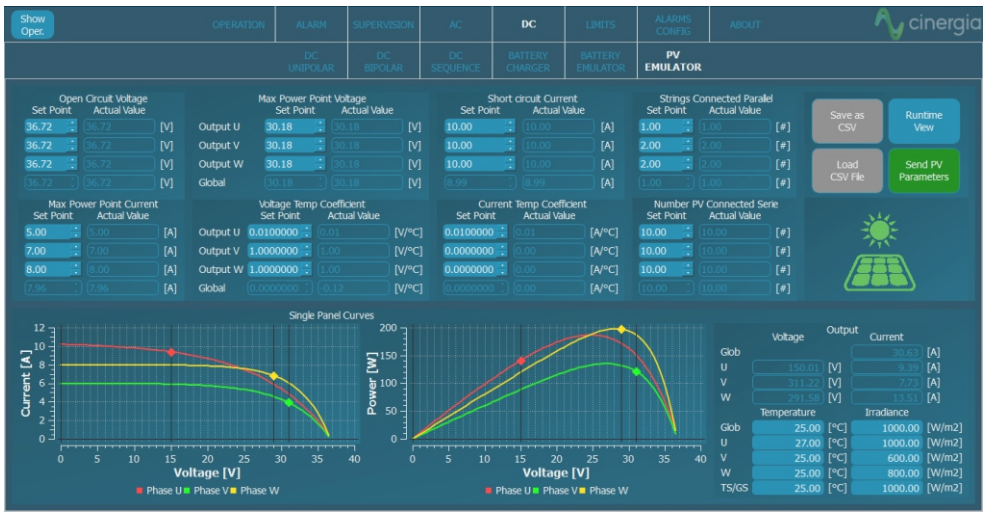
Battery Pack Testing

This functionality enables the user to precisely control the charge, discharge and cycling of a Battery. Basic parameters include the charge/discharge current, fast charge and floating voltages while Advanced parameters add Energy (Ah) and Time as transition conditions. Profiles for each Battery technology can be saved and imported in .CSV files.



Battery Emulation

The B2C+ integrates a mathematical model to emulate the voltage behaviour of a real battery pack. The output voltage will change as a function of the SOC and Current. By configuring the provided parameters, the voltage profile can be adjusted to match different technologies: LiIon, NiMH, NiCd, Pb, Flux, etc...



PV Panel Emulation

The PV Panel model is based on the single-diode equivalent circuit of a PV cell and the series-parallel connection of cells to form a panel. A Runtime functionality allows the simulation of a complete day by launching different irradiance and temperature setpoints from a .csv file, enabling the user burn-in and functional tests of PV Inverters.

GE+ vAC/DC Lite 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 DC (EUT side)

Terminals
Number: 6 (3 positive + 3 negative)
Configuration of Channels
Unipolar Independent: 2Q, independent setpoints per channel
Unipolar Parallel: 2Q, one global setpoint for all channels
Multichannel: 2Q, independent start/stop, operation mode and setpoints per channel (note: multichannel is an option for ≥ 80kVA)
Bipolar (4Q two independent setpoints)
Voltage Mode (CV)
Range: 2Q: 20[1] to 750V (800V with High Voltage option)
4Q: 0 to +350V / 0 to -350 (+ rail / 0 / - rail, Bipolar configuration)
Setpoint Resolution: 10mV
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[7] (peak-peak): < 0.55% of FS[3]
Current Mode (CC)
Range: from 0 to ± 110% of Irated (see models table)
Setpoint Resolution: 10mA
Effective Resolution[2]: < 0.05% of FS[3] (< 0.1% models 7.5 & 10)
Setpoint Accuracy[4]: ± 0.2% of FS[3]
Transient Time[5]: < 1ms (10% to 90% at a step to Irated)
Ripple[7] (peak-peak): < 0.7% of FS[3]
Power Mode (CP)
Range: from 0 to ± 200%[8] of Prated (see models table)
Derived current setpoint: Psetpoint / Vmeasured
Setpoint Resolution: 1W
Effective Resolution[2]: < 0.1% of FS[3] (< 0.25% models 7.5 & 10)
Setpoint Accuracy[4]: ± 0.4% of FS[3]
Transient Time[5]: < 2.5ms (10% to 90% at a step to Prated)
Resistance Mode (CR)
Range: from 0.1 to 1000 Ohm
Derived current: Vmeasured / Rsetpoint
Setpoint Resolution: 0.01 Ohm
Setpoint Accuracy[4]: ± 0.2% of FS[3]
Transient Time[5]: < 2ms (10% to 90% at a step to Rrated))

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[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 Vrated)
- Ripple[7] (peak-peak): < 0.55% of FS[3]

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[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

DC
- Programmable Voltage (CV)
- Power Amplifier (HiL)
- Steps
- Optional Programmable Current (CC)
- Optional Programmable Power (CP)
- Optional Programmable Resistance (CR)
- Optional Battery Testing (BTest) (charge/discharge/cycling)
- Optional Battery Emulation (BEmu)
- Optional PV Panel Emulation (PVEmu)

AC
- Programmable Voltage (CV)
- Power Amplifier (HiL)
- Steps
- Optional IEC 61000

Overload/ Overcurrent

Admissible DC overcurrent is: 110% of rated value during 1 minute
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

Mesurements[6]

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

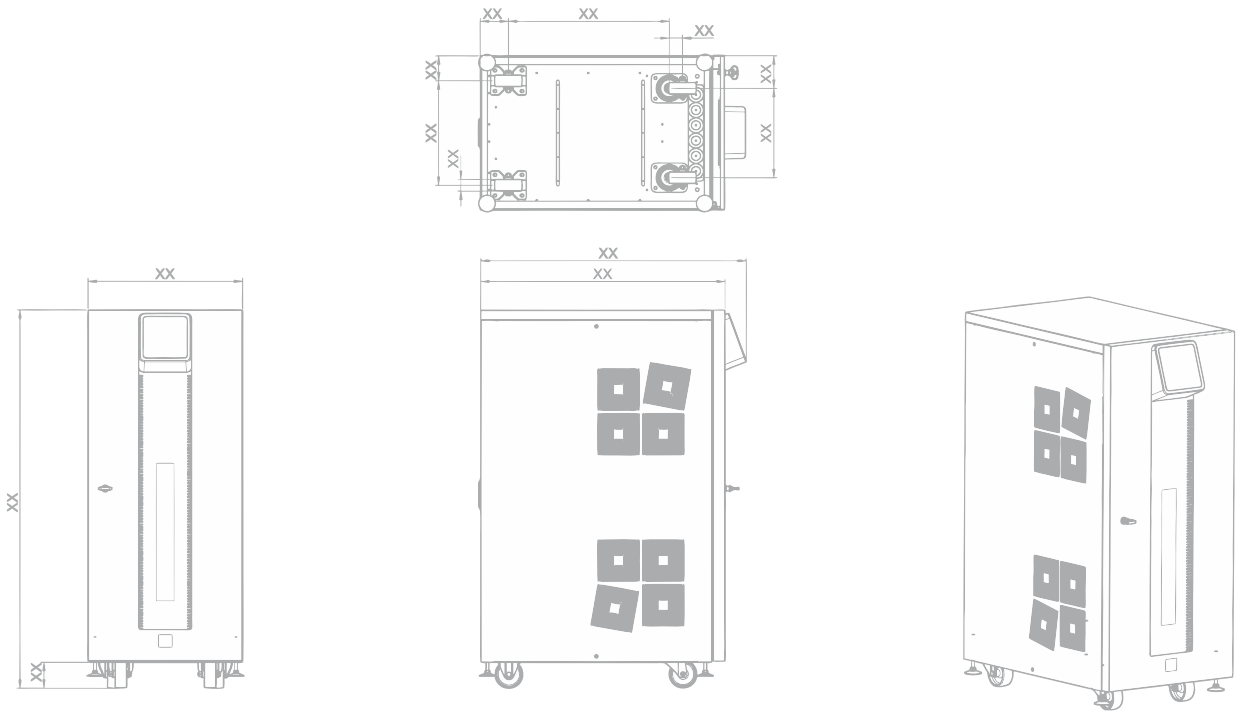
Ambient

Operating temperature[8]: 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.



All specifications are subject to change without notice.
(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·| 110% to Irated (see models table)
FS Range of power is 2·| 200% to 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·f < 46000

Models

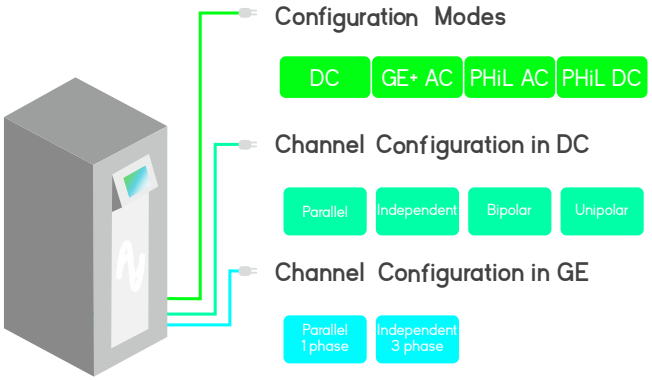
GE+ vHiL

Reference	AC Power Rated [9]	DC Power Rated [9]	AC Current Rated [9] RMS Per phase / Parallel	DC Current Rated [9] RMS Per phase / Parallel	Weight (kg)	Dimensions DxWxH (mm)
GE+7.5 vHiL	7.5kW	3.75kW	11A / 33A	±5A / ±15A	155 kg	770x450x1100 mm
GE+10 vHiL	10kW	5kW	15A / 45A	±7.5A / ±22.5A	155 kg	770x450x1100 mm
GE+15 vHiL	15kW	7.5kW	22A / 66A	±10A / ±30A	155 kg	770x450x1100 mm
GE+20 vHiL	20kW	10kW	29A / 87A	±12.5A / ±37.5A	155 kg	770x450x1100 mm
GE+30 vHiL	27kW	13.5kW	40A / 120A	±15A / ±45A	155 kg	770x450x1100 mm
GE+40 vHiL	40kW	20kW	58A / 174A	±20A / ±60A	190kg	770x450x1100 mm
GE+50 vHiL	50kW	25kW	73A / 219A	±25A / ±75A	190kg	770x450x1100 mm
GE+60 vHiL	54kW	27kW	80A / 240A	±28.5A / ±85.5A	190kg	770x450x1100 mm
GE+80 vHiL	80kW	40kW	116A / 348A	±52.5A / ±157.5A	270kg	880x590x1320 mm
GE+100 vHiL	100kW	50kW	145A / 435A	±65A / ±195A	295kg	880x590x1320 mm
GE+120 vHiL	108kW	54kW	157A / 471A	±65A / ±195A	295kg	880x590x1320 mm
GE+160 vHiL	145kW	72.5kW	211A / 633A	±77.5A / ±232.5A	545kg	850x900x2000 mm
GE+200 vHiL	160kW	80kW	232A / 696A	±92.5A / ±277.5A	555kg	850x900x2000 mm

All specifications are subject to change without notice.

Galvanic Isolation (optional)

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



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
- 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
- Battery Emulation
- Battery Test
- PV Panel Emulation
- CC
- CP
- CR
- Predefined Tests: IEC 61000-4-11, 4-13, 4-14, 4-28,... (consult us for specific Test)

CINERGIA, Regenerative Power Electronics Solutions

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

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