

Regenerative High Frequency Electronic Load

Avionics

CINERGIA has developed a line of Regenerative Electronic Load products capable of working in a frequency range of 360 to 900Hz. It was designed to simulate the different loads that can be found in the aircraft.

The testing of aircraft generators with variable frequency is an added difficulty. Since the regulations require a constant value of $\cos \phi$, this implies the need to vary the magnitude of the inductance during the test. Through passive elements, the cost can be very high, and we obtain discrete results.

CINERGIA's electronics loads are the best tools for this type of tests. Their easy-to-use software allows us to control all the parameters and adjust the magnitude of the current required in the test. Its Bidirectional and Regenerative Hardware based on a back-to-back power conversion topology also allows energy and power saving.

Key features

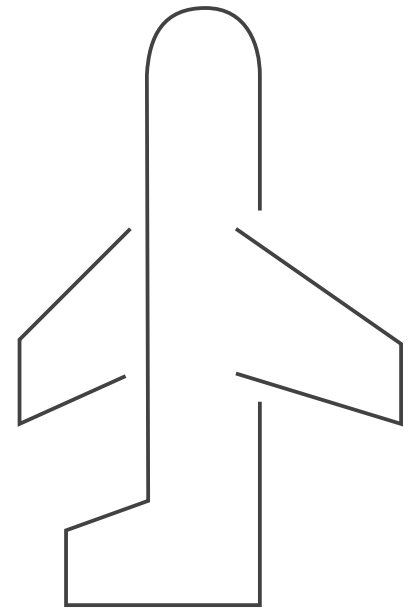
Bidirectional and Regenerative
Clean grid current: THDi < 3% and PF > 0.98
High frequency range 360 - 900 Hz

5 models from 15kW to 50kW
Parallelization of units to increase the power

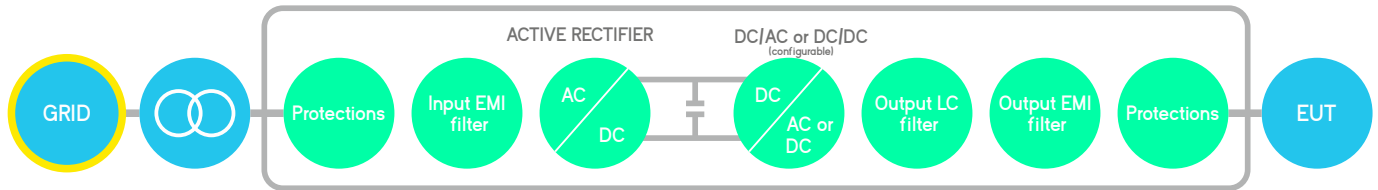
Emulation of grid-connected devices:
Loads absorbing energy from grid.
Generators injecting energy to the grid.
Programmable Active/Reactive consumption
Non-linear currents up to CF of 3

Independent phase configuration of:
rms current, phase angle,
generation of fast transients ("Current Dips")

Intuitive User Interface
Modbus/Ethernet Open protocol, Labview drivers



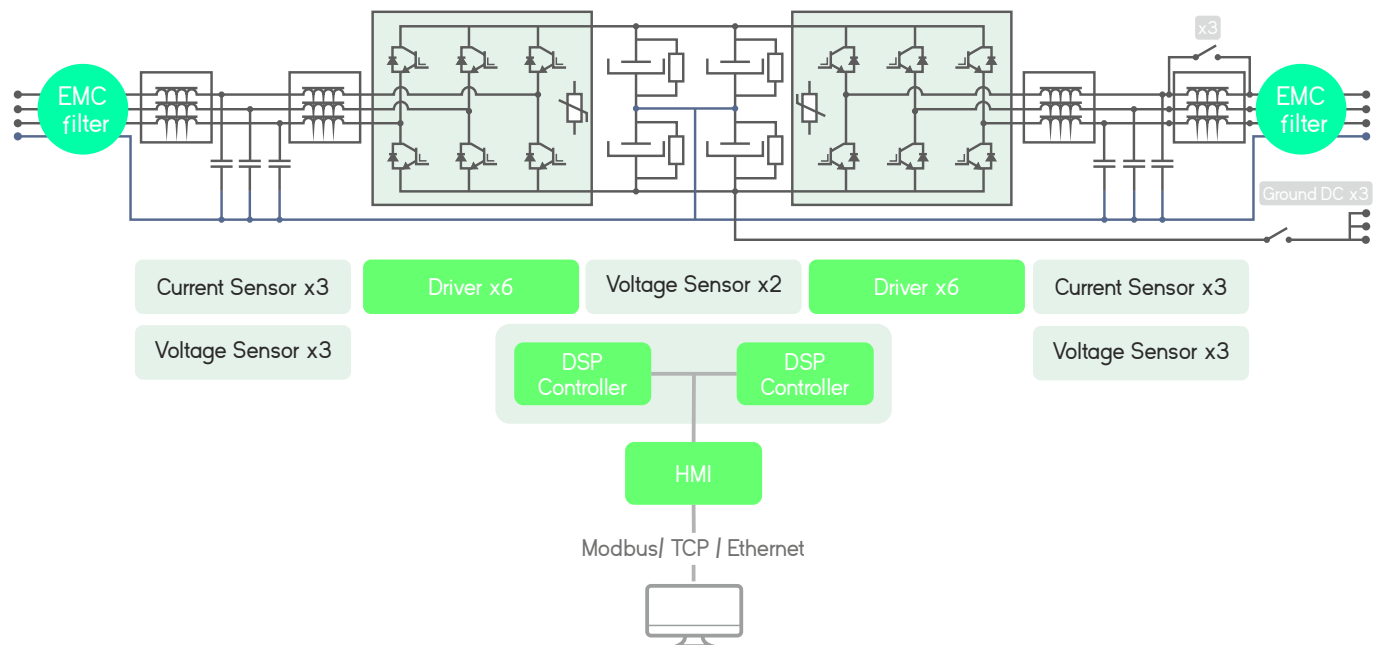
Bidirectional and Regenerative Hardware



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.

EL+ vHF/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 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
Multichannel: 4Q, independent start/stop, alarm status and setpoints per phase

Output side in EL-HF

Admissible Voltage

Connection: 1-phase or 3-phase star (consult us for 3-phase delta)

Maximum: $\pm 400\text{V}$ peak

Range: 360-900Hz

35⁽¹⁾ to 277Vrms phase-neutral (295Vrms with HV option)

35⁽¹⁾ to 480Vrms phase-phase (510Vrms with HV option)

Frequency: 360 to 900Hz

Current Mode (CC)

Range: from 0 to $\pm 200\%$ ⁽⁶⁾ of Irated (see models table)

Setpoint Resolution: 10mA_{rms}

Effective Resolution⁽²⁾: $< 0.05\%$ of FS⁽³⁾ ($< 0.1\%$ models 7.5 & 10)

Setpoint Accuracy⁽⁴⁾: $\pm 0.2\%$ of FS⁽³⁾

Transient Time⁽⁵⁾: $< 1.5\text{ms}$ (10% to 90% at a step transient)

Ripple⁽⁷⁾ (peak-peak): $< 0.7\%$ of FS⁽³⁾ (with Low Ripple Inductor option)¹⁾

Phase Angle ($\cos \phi$)

Range: -90 to 90° in Sink / Source

Resolution: 0.01°

Harmonics

Open-loop generation of harmonics (consult us)

Power Mode (CP / CS)

Range: from 0 to $\pm 200\%$ ⁽⁶⁾ of Prated (see models table)

Derived current setpoint: calculated from |S| and $\Phi(S)$

Setpoint Resolution: 1W, 1VA

Effective Resolution⁽²⁾: $< 0.1\%$ of FS⁽³⁾ ($< 0.25\%$ models 7.5 & 10)

Setpoint Accuracy⁽⁴⁾: $\pm 0.4\%$ of FS⁽³⁾

Transient Time⁽⁵⁾: $< 2.5\text{ms}$ (10% to 90% at a step to Prated)

Impedance Mode (CZ)

Range: from 0.8 to 1000 Ohm, 0.1 to 2000mH, 0 to 3.7mF

Derived current/phase setpoint: calculated from |Z| and $\Phi(Z)$

Setpoint Resolution: 0.01 Ohm/mH/mF

Setpoint Accuracy⁽⁴⁾: see current accuracy

Transient Time⁽⁵⁾: $< 2.5\text{ms}$ (10% to 90% at a step to Rrated)

Operation Modes

DC

Programmable Voltage (CV)

Programmable Current (CC)

Programmable Power (CP)

Programmable Resistance (CR)

Power Amplifier (HiL)

Steps

Optional Battery Testing (BTest) (charge/discharge/cycling)

Optional Battery Emulation (Bemu)

Optional PV Panel Emulation (PVEmu)

HF

Programmable Current (CC)

Programmable Power (CP / CS)

Programmable Impedance (CZ)

Steps

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 $\pm 0.1\%$ of FS for rms voltage, $\pm 0.2\%$ of FS for rms current,

$\pm 0.4\%$ 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

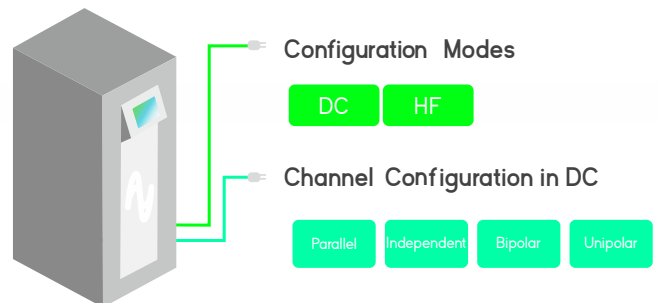
EL+ vHF/DC

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)
EL+15 vHF/DC	15kW	15kW	20A / 60A	±20A / ±60A	155 kg	770x450x1100 mm
EL+20 vHF/DC	20kW	20kW	26A / 78A	±25A / ±75A	155 kg	770x450x1100 mm
EL+30 vHF/DC	27kW	27kW	40A / 120A	±30A / ±90A	155 kg	770x450x1100 mm
EL+40 vHF/DC	40kW	40kW	52A / 156A	±40A / ±120A	190kg	770x450x1100 mm
EL+50 vHF/DC	50kW	50kW	65A / 195A	±50A / ±150A	190kg	770x450x1100 mm

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Galvanic Isolation (optional)

	Circuit Breaker Recommended	Weight (kg)	Dimensions DxWxH (mm)
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 40i	Type D - 80A	195 kg	Inside the cabinet
IT 50i	Type D - 100A	195 kg	Inside the cabinet
IT 30e	Type D - 125A	174 kg	595x415x708 mm
IT 40e	Type D - 160A	217 kg	789x490x865 mm
IT 50e	Type D - 200A	280 kg	789x490x865 mm



Options

Choose your options

- Galvanic Isolation
- Multichannel mode: allows different operation mode, start/stop/reset per channel
- 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)
- 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



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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