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Regenerative Power Converter

Converters for energy saving and power optimization in Research and Testing

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Converters for energy saving and power optimization in Research and Testing

- Flexible hardware platform to build most testtools for smartgrid applications
- Cost reduction is also possible within R&D and industrial testing with regenerative solutions

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- Build-up converter
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- Typical application for the hardware:
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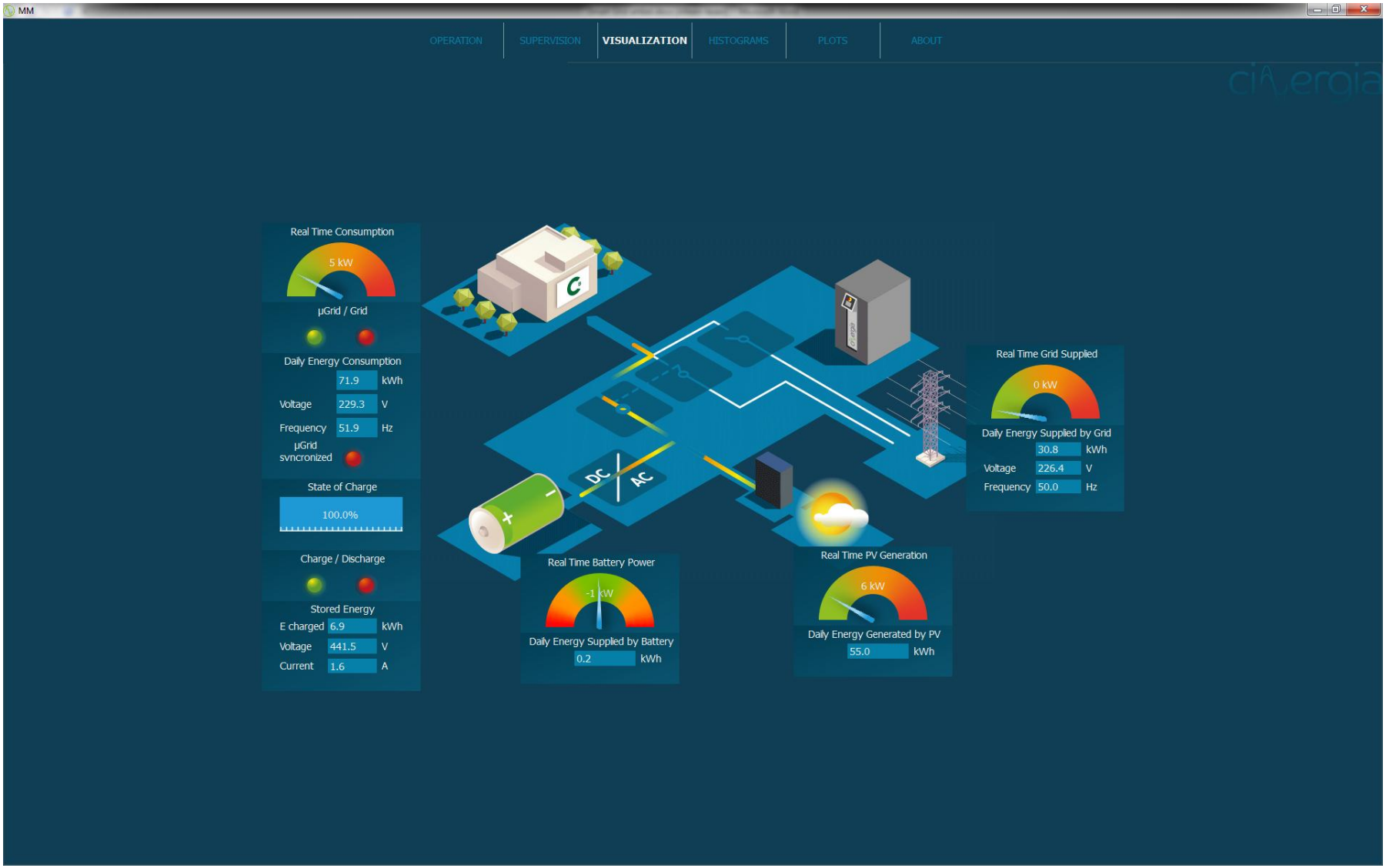
  - Regenerative Load
- Conclusion

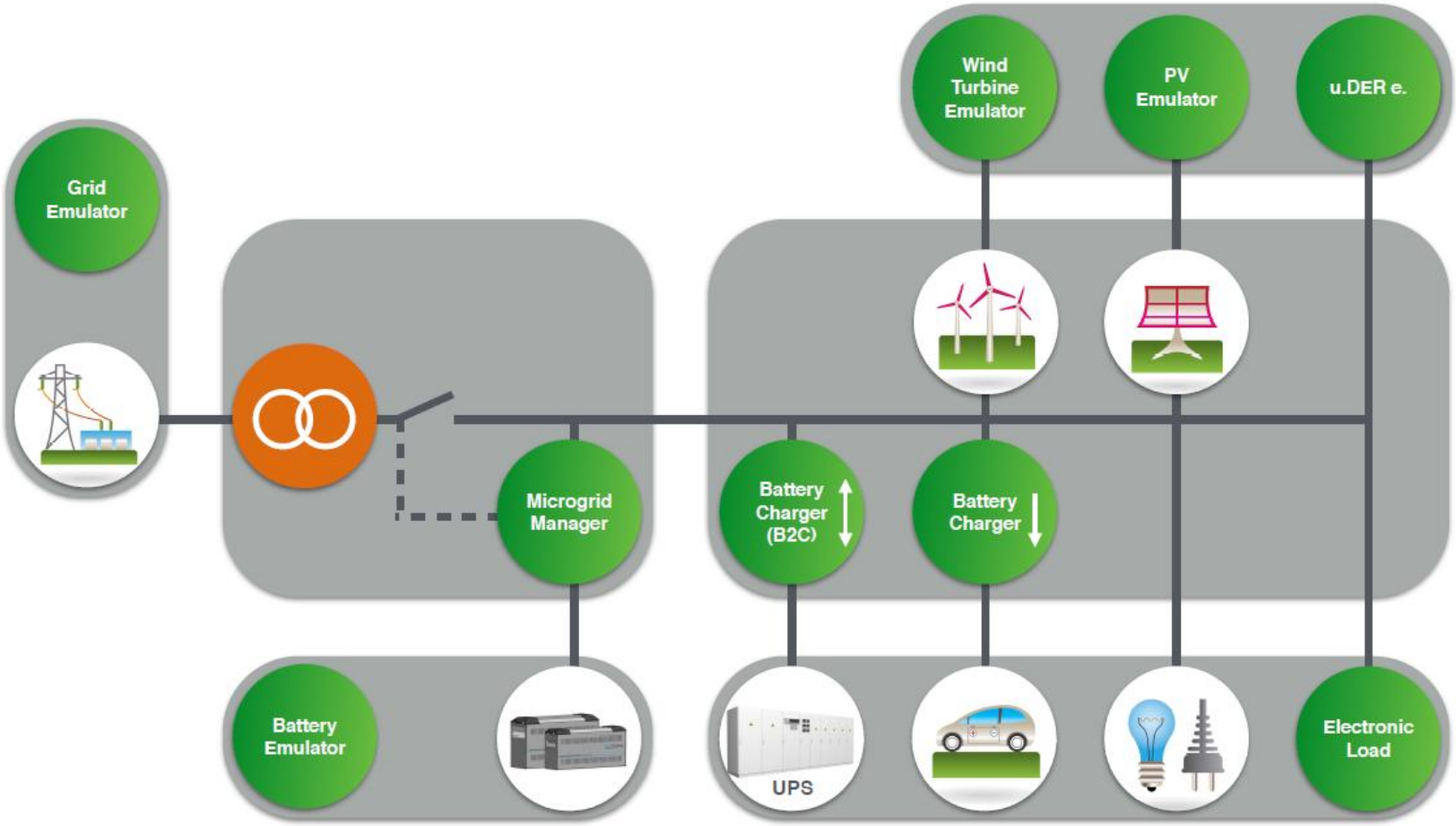
Regenerative Power Converter

- Power Converter
  - Control of electrical variables: voltage, current, harmonics, power, frequency
  - Conversion of: AC/AC, AC/DC, DC/DC, DC/AC
- Regenerative => COST-REDUCTIVE

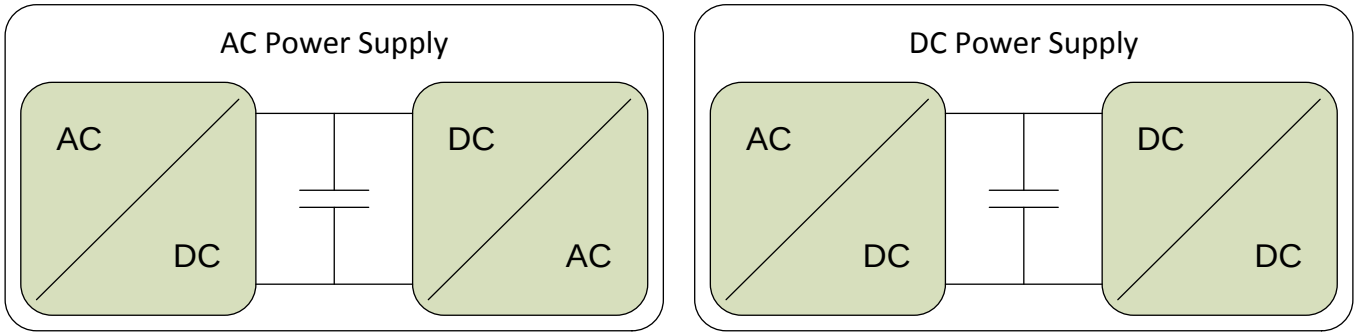
Smart grid


MM
OPERATION
SUPERVISION
VISUALIZATION
HISTOGRAMS
PLOTS
ABOUT
Real Time Consumption
5 kW
µGrid / Grid
Daily Energy Consumption
71.9 kWh
Voltage 229.3 V
Frequency 51.9 Hz
µGrid syncronized
State of Charge
100.0%
Charge / Discharge
Stored Energy
E charged 6.9 kWh
Voltage 441.5 V
Current 1.6 A
DC
AC
Real Time Battery Power
-1 kW
Daily Energy Supplied by Battery
0.2 kWh
Real Time PV Generation
6 kW
Daily Energy Generated by PV
55.0 kWh
Real Time Grid Supplied
0 kW
Daily Energy Supplied by Grid
30.8 kWh
Voltage 226.4 V
Frequency 50.0 Hz

Simulation of a smart grid



Power Supply Hardware

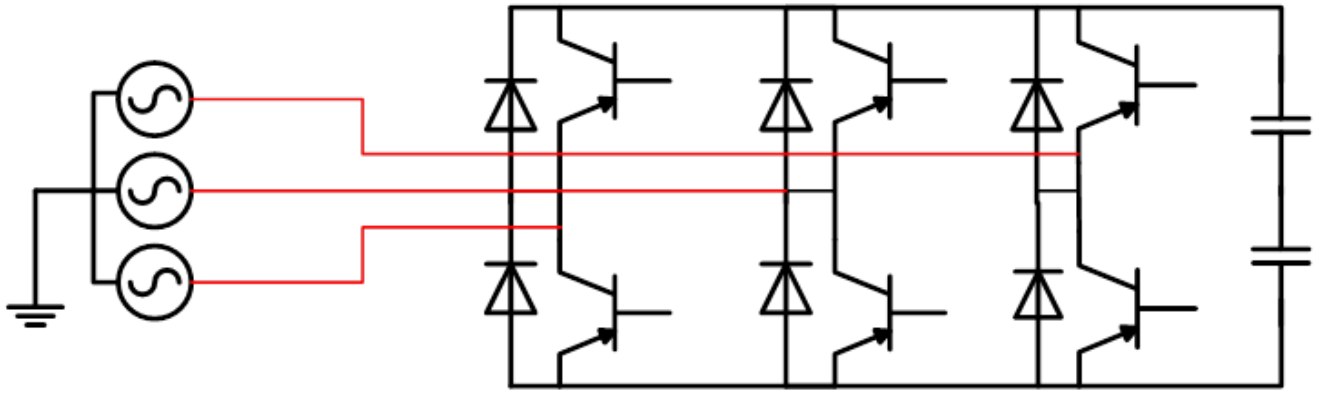


Grid-side (AC-DC) converter: Non-controlled rectifier, Power Factor Controller, Active Rectifier

Output converter: a DC-AC inverter or DC-DC converter (Buck, Buck-Boost, Full-bridge)

Isolation: low frequency transformer or high-frequency transformer (half-bridge, full-bridge)

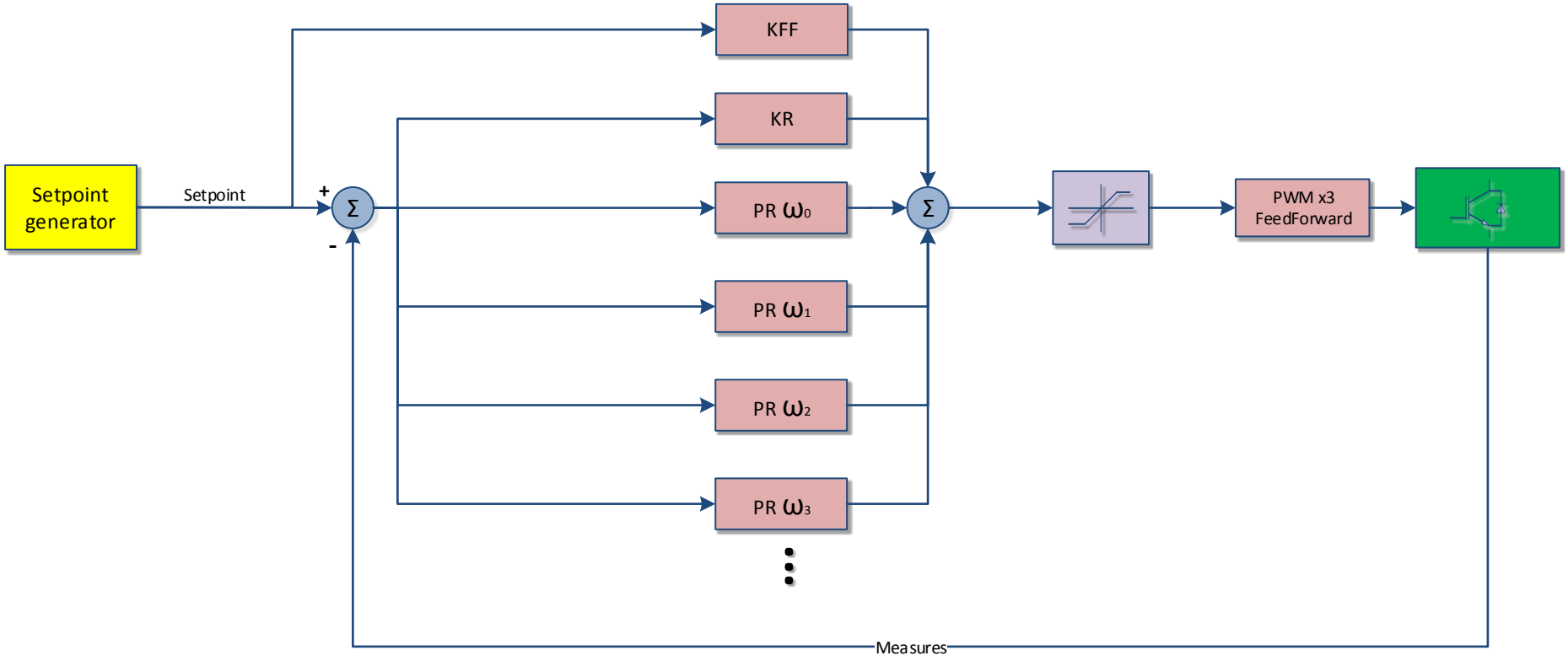
Grid side Converter: Active Rectifier



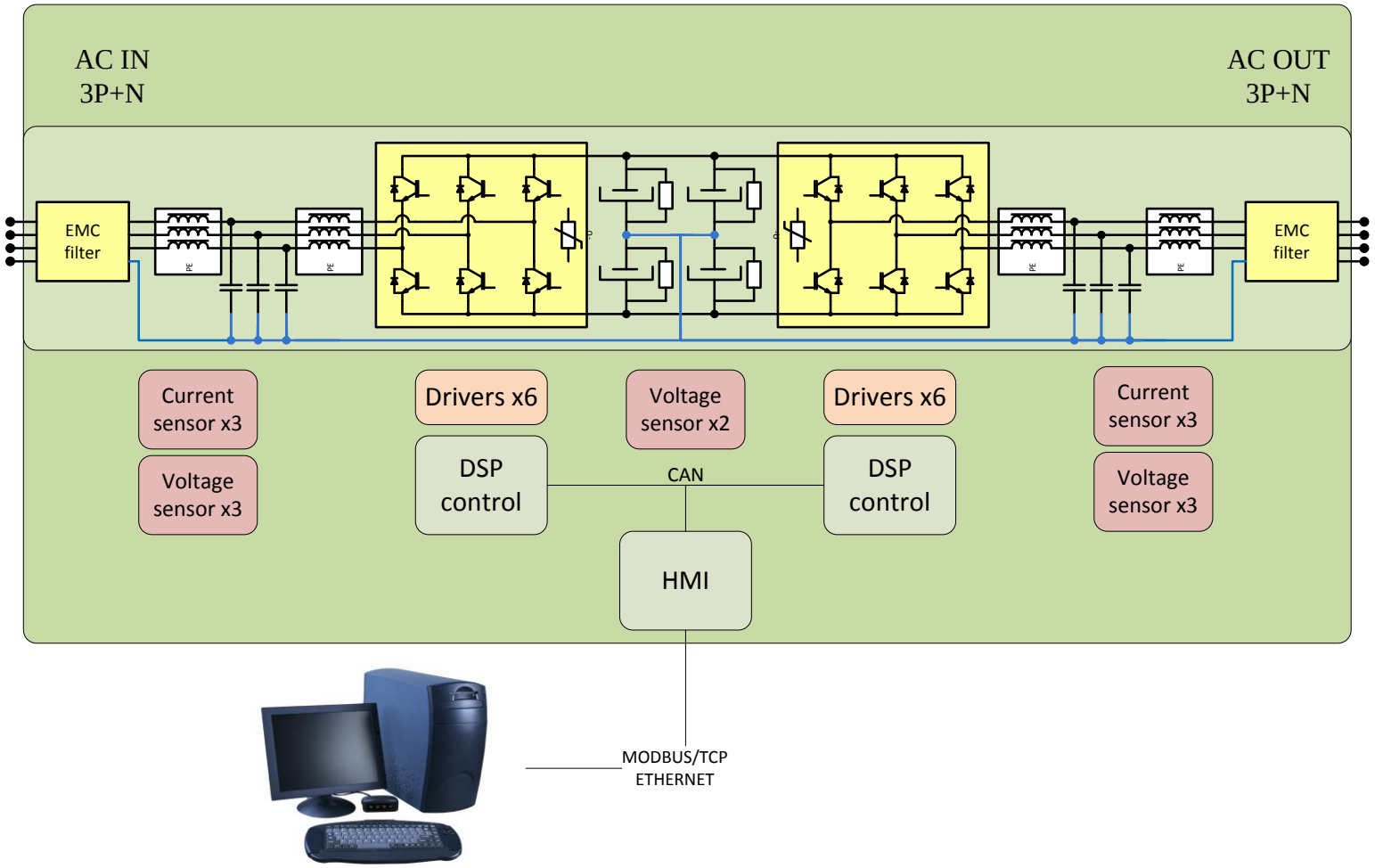
- Sinusoidal current with low distortion (THDi)
- Control of power factor (reactive power)
- Control of DC-link voltage
- Reversible

Output side: DC-AC Inverter

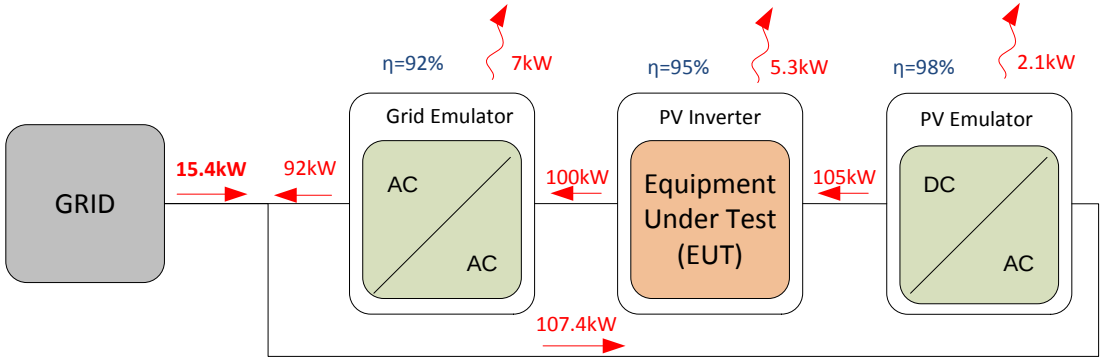
Resonant controller algorithm:

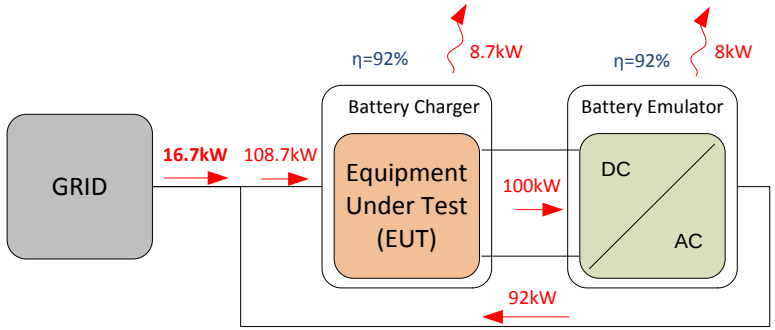


Regenerative Power Hardware, AC



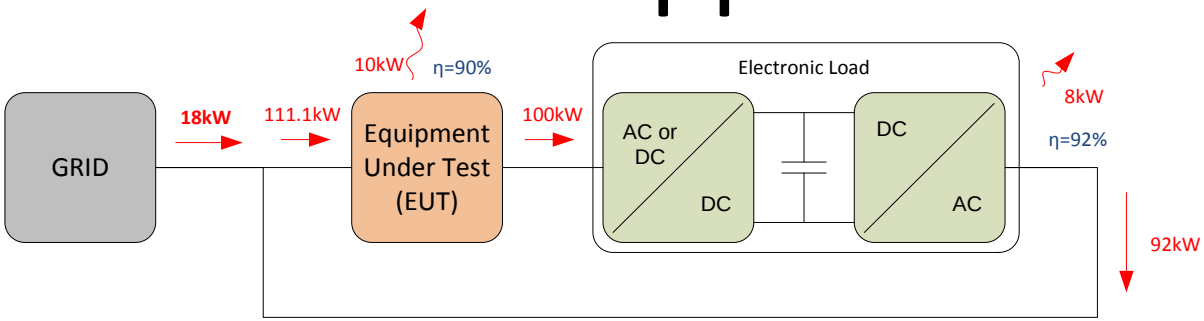
Regenerative Voltage Source Applications

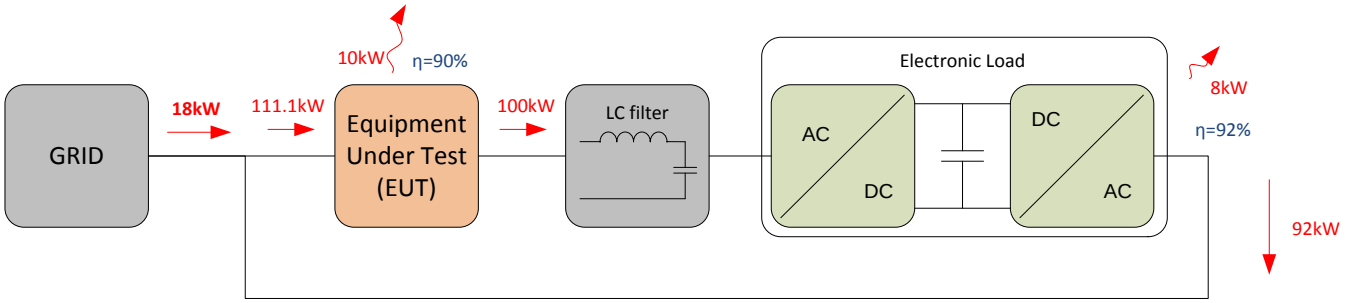




- Battery Chargers
- Renewable Inverters (PV, Wind)
- CHP, Diesel generators (grid-tied)
- Regenerative (Braking) Motor Inverters

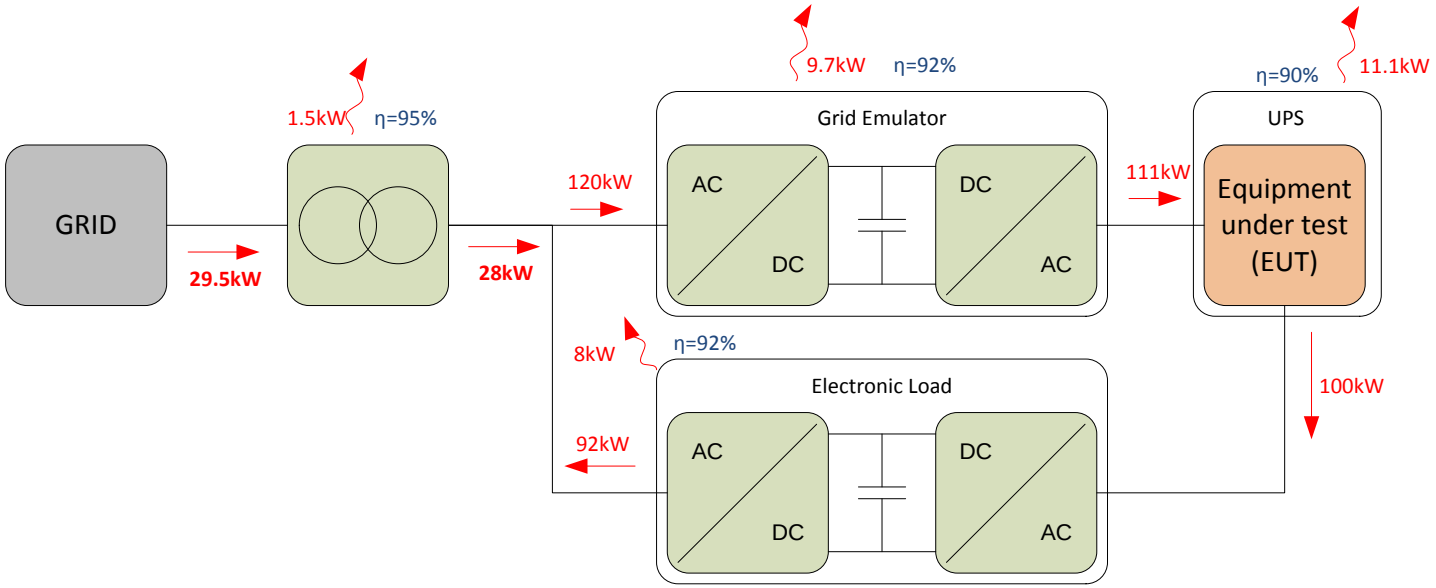
Regenerative Voltage Source Applications

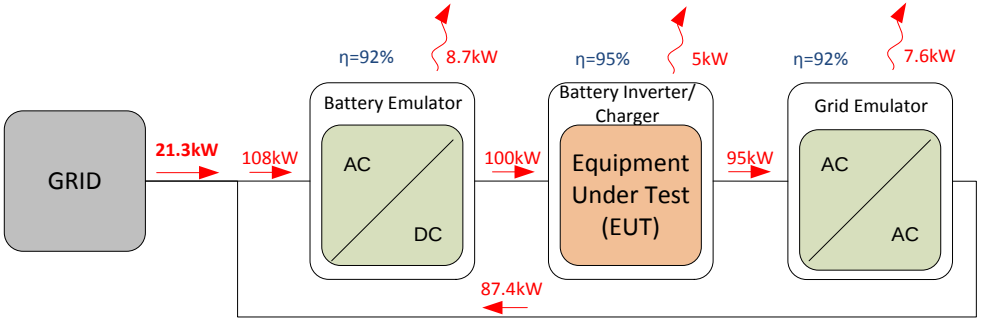




- UPS (AC or DC)
- Electrical Generators, Power Supplies
- Transformers, circuit breakers, fuses
- PWM Inverters

Voltage and Current Source Platforms





Grid Emulator

- Designed to emulate Electrical Grids in AC and DC
- The equipment is 4 quadrant regenerative
- It can generate standard electrical networks:
  - Three phase power grid (3F+N) from 0 to 480Vac
  - Power grid with variable frequency from 0 to 400Hz
  - 400Hz Aeronautic network
  - DC Voltage Source from -750 to 750Vdc (optional)
- It can generate standardized disturbances as well:
  - Voltage harmonics up to 15th independent per phase
  - Flickers (programmable amplitude and frequency)
  - Overvoltage
  - Interruptions and voltage dips (balanced and unbalanced)
  - Programmable variations in frequency
  - Z Impedance of grid variable

Grid Emulator

Applications:

It can generate standard electrical networks:

- Testing of electric and electronic equipment against electrical disturbances (inverters, UPS, battery chargers, rectifiers, transformers, etc…)
- PCC: point of common coupling
- Testing of control algorithms for electrical microgrid
- Testing of electronic equipment under special conditions: 60 Hz, 400 Hz, 110 Vrms, 127 Vrms
- Aircraft grid tests & disturbances
- DC voltage source (optional): photovoltaic panels, batteries...

Regenerative Loads

- 4 bedrijfsmodi:
  - Constant Impedance
  - Constant Current
  - Constant Power
  - User Defined Waveform
- Specificaties:
  - 3-Fasig AC 0-480V
  - DC -750 – 750V
  - 0-400Hz
  - 15-200KVA
  - Harmonics up to 15th per phase
- Regeneratief

Regenerative Loads

- Applications:
  - PSU/generator testing
  - Train inverter testing
  - Real power factor testing up to 180°
  - High power switchtesting
  - UPS systems
  - …

Conclusion

- Regenerative power converter
  - Flexible solution for emulation of smart grid components
    - Grid emulator
    - Battery emulator
    - Charger
    - Electronic load
    - Universal DER emulator
  - Cost-reductive R&D solution for high power applications

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Hartelijk dank voor uw aandacht.

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