INTRODUCTION to PHIL
Power Hardware-In-the-Loop

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Power Hardware-In-the-Loop

PHIL simulation is a scenario where a simulation environment virtually exchanges power with real hardware, in contrast to the usual case in hardware-in-the-loop simulation, which involves only signal exchange.
Benefits, features and accomplishments

• Join the real-time simulator capabilities to the power equipment
  • Power systems, power electronic, protection equipment, controller logic, etc.

• Requires high quality amplifier
  • High accuracy, low distortion, high bandwidth, low phase lag, etc.

• Connect a real power device under test
  • Wind turbine, solar panel, motors/generators, protection relays, etc.
Potential Applications

• **Grid Applications**
  - Grid Emulator (50, 60, 400 Hz)
  - Grid Load
  - PV-Inverter Emulation
  - Wind-Generator Emulation
  - UPS (Uninterruptible Power Supply) Emulation
  - Grid Inverter Emulation
  - Grid Motor / Generator Emulation

• **Motor Applications**
  - Motor / Generator Emulator
  - Drive Inverter Emulator
  - Frequency Inverter Emulator

• **Aerospace / Military**
  - 400 Hz Supply Grid Emulator
  - DC-Supply emulation
  - 400 Hz Aerospace device emulator
  - AC-DC Coupling Emulator
  - Generator / Motor Emulator
  - 400 Hz Inverter Emulator

• **Automotive Applications**
  - **Electrical drive train emulation**
    - Battery Emulator
    - Drive Inverter Emulator
    - Motor Emulator
  - **eVehicle Applications**
    - eVehicle charging station emulator
    - Test Bench for charging
  - **Test Benches for combustion engine drive train**
    - Drive Inverter for electrical machines connected to combustion machines, wheel, gear boxes

• **Transportation**
  - Supply Grid Emulator
  - Machine Emulator
  - Inverter Emulator
  - Electrical drive train emulation

Courtesy of EGSTON
OPAL-RT Solutions

• OP5600
  • IO and EtherCAT

• OP4500
  • IO, EtherCAT and ORION

• OP5607
  • IO, FPGA motor modeling and cascading of units

• OP7000
  • IO, Multi-FPGA ans FPGA motor modeling
Partnerships

Proud Sponsors of RT14

Other PHIL partners
Today’s presenters

• Triphase
  • Amplifiers with the EtherCAT daisy-chain network solution for PHIL

• EGSTON
  • COMPISO amplifier with the ORION optic fiber communication solution for PHIL
To Be connected to the 13th house as a Hardware Under Test