

Typhoon HIL Power Amplifier Interface

NRG.LAB product catalog
POWER CONNECTED TO HIL

10/02/2017

NRG.Lab AC HIL INTERFACE



NRG.Lab Interface Technical Details

- 3 isolated analog output ports. Output range $\pm 10V$ overcurrent and overvoltage protected ports.
- 4 non-isolated analog output ports. Output range $\pm 10V$ overcurrent and overvoltage protected ports.
- 4 non-isolated analog input ports. Input range $\pm 10V$ overcurrent and overvoltage protected ports.
- 8 open collector and 5V-TTL compatible digital input ports driven to Typhoon HIL digital input pins.
- 8 digital output ports 5V-TTL compatible driven from Typhoon HIL digital output pins.
- 6 NO/NC relay outputs driven by Typhoon HIL digital output pins.
- Maximum relay operating specifications: voltage 125 VAC / 60 VDC and current 1A.
- High voltage isolated analog output ports, 1500V maximum.
- Output overcurrent protected analog signals at 10mA and overvoltage clamped at $\pm 12V$.

Features and Benefits

- High input-output linearity.
- Wide bandwidth until 200 kHz.
- Pin-to-pin compatible with all the Typhoon HIL devices.
- Precision low offset voltage Instrumentation Operational Amplifier construction, under 50 μV .

Mechanical Characteristics

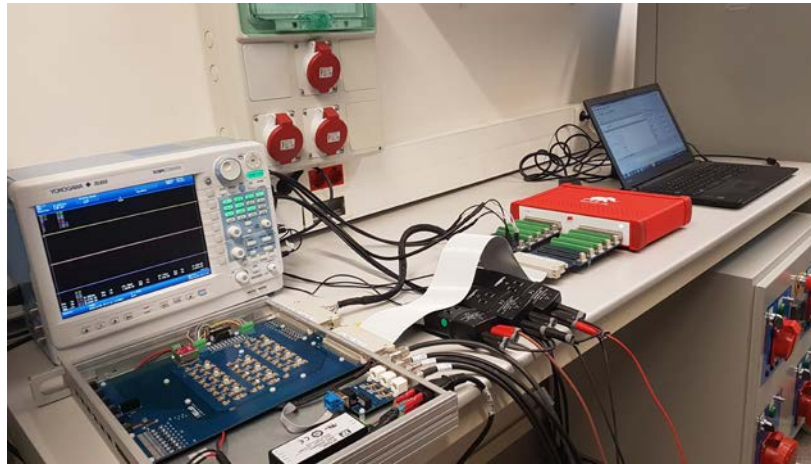
- 19" rack cabinet mounting.
- Size of 1U high
- 280 mm depth.

PCB board interface



Amplifier and NRG.Lab HIL interface setup connection

- HIL 402 - Controlled PC
- Amplifier Mode



02

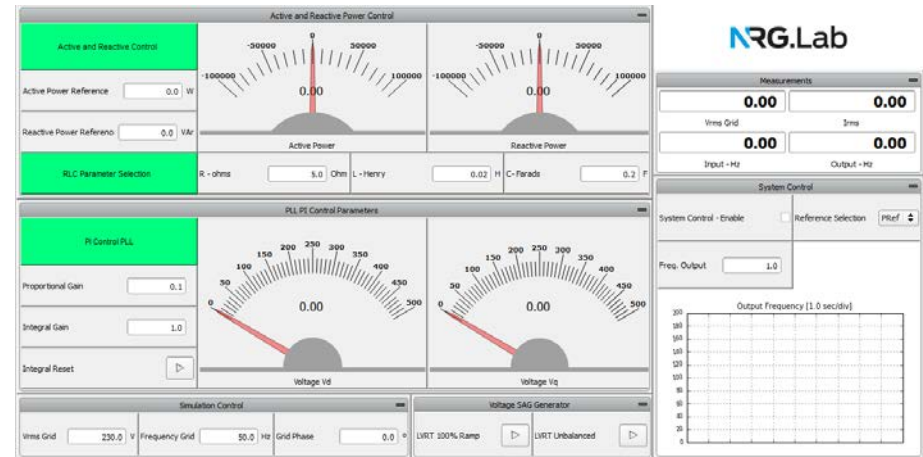
GRID EMULATOR Voltage Control



External Signal Generator – NRG.Lab HIL Control panel

➤ Functionalites of the software

- Synchronization to the grid voltage
- Active and Reactive Power reference control
- RLC Load Mode control
- LVRT generator
- Grid Simulator – Closed Loop

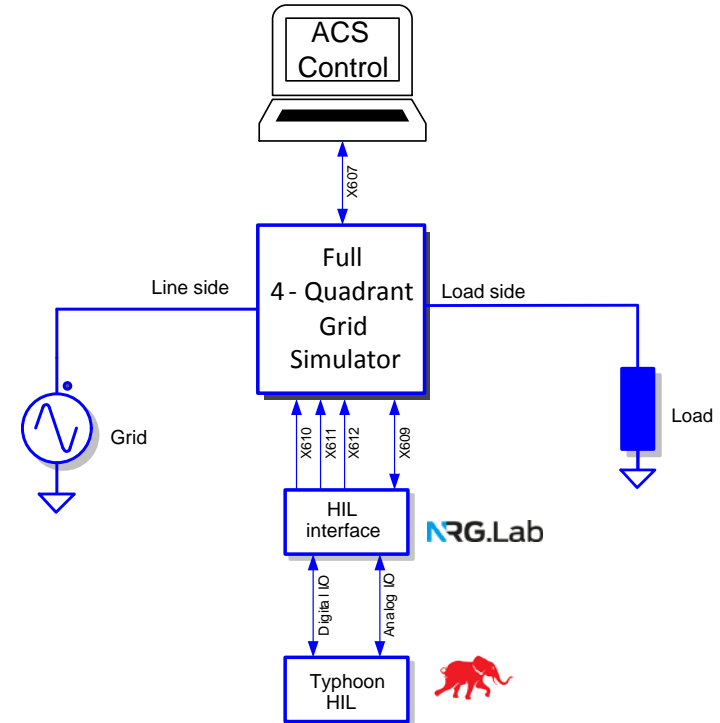




Amplifier Mode – HIL Control Panel grid simulator over a resistor

➤ Hardware setup

- External HIL Controller
- External communication
- Resistive Load





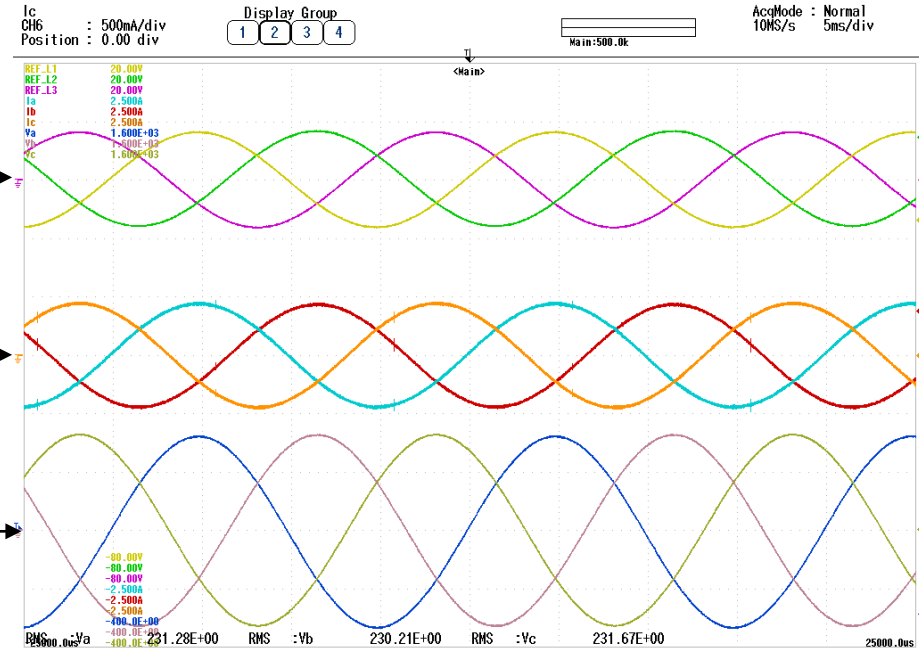
Amplifier Mode – HIL Control Panel grid simulator over a resistor

- HIL 402 - Controlled PC
- Amplifier Mode on voltage control

External
reference
signal

Current to
the resistor

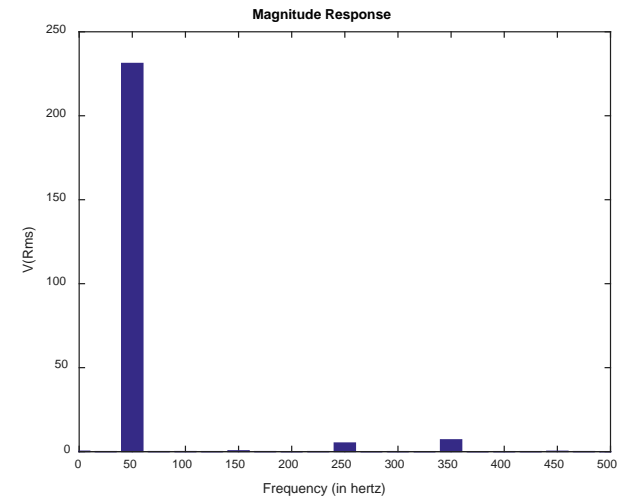
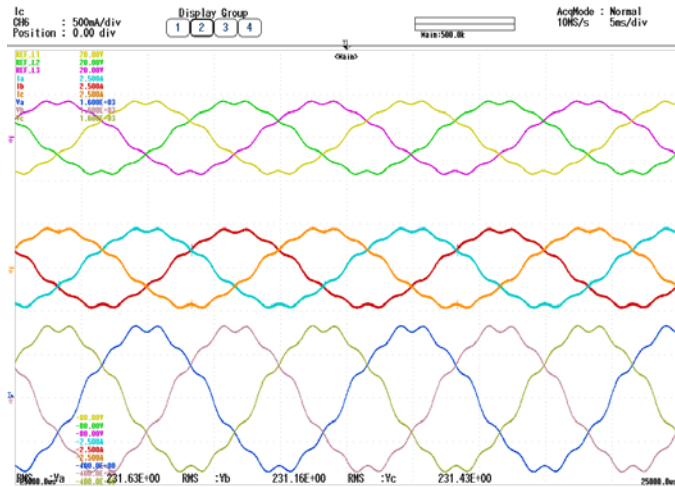
Voltage
Generated





Amplifier Mode – HIL Control Panel grid simulator over a resistor

- Harmonic injection over a resistor
- Capability of generating a specific voltage harmonic in p.u.

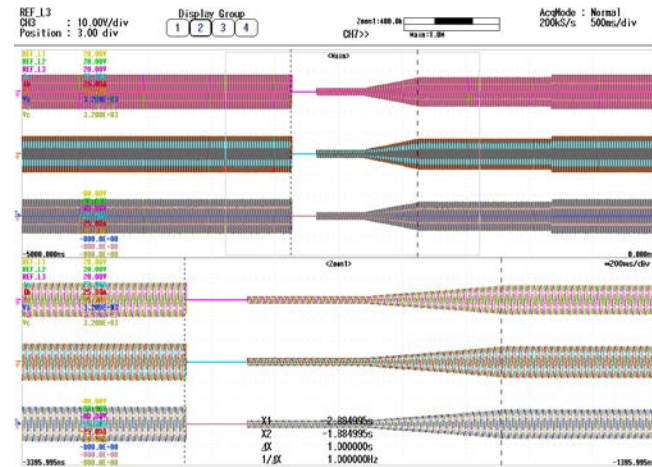




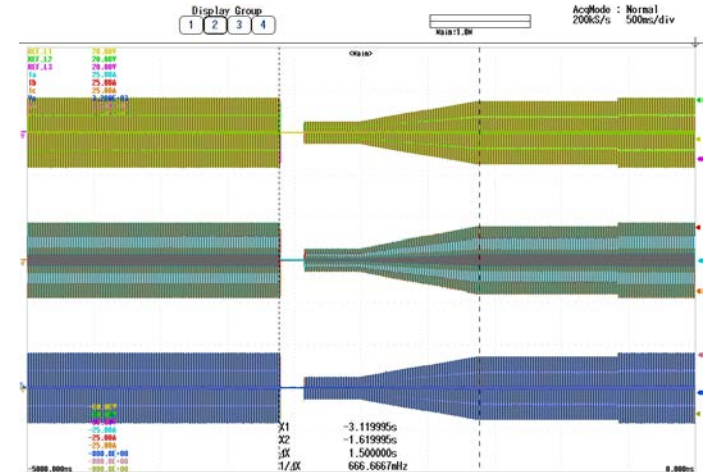
Amplifier Mode – Low Voltage Ride Through (LVRT)

➤ Capability of generating LVRT. Different type of LVRT profile can be generated

- Spanish Grid Code LVRT



- German Grid Code LVRT



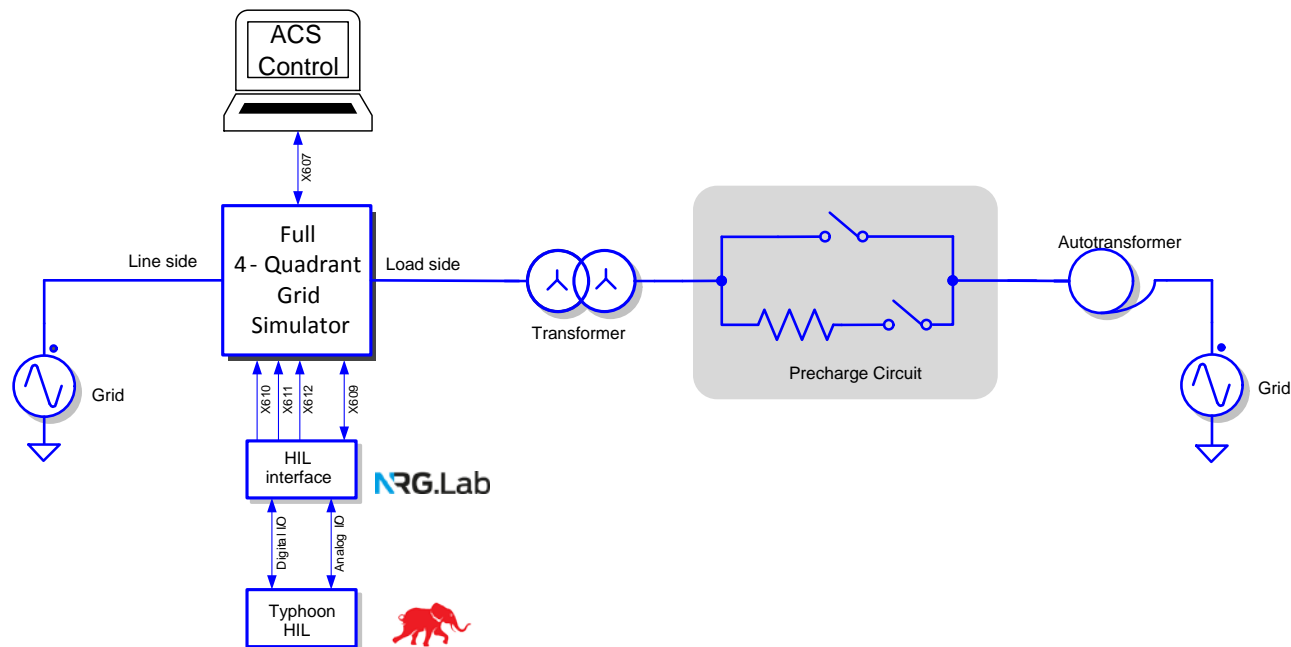
03

LOAD EMULATOR Current Control



Amplifier Mode – Grid Connection

- Hardware setup configuration





Amplifier Mode – Grid Connection

- This section consists of 2 parts:
 - Grid connection with power reference control mode. Includes the capability to inject a specific amount of active and reactive power, either positive or negative.
 - Grid connection RLC control mode, includes the capability to work as a load and changing parameters of the RLC in real time.

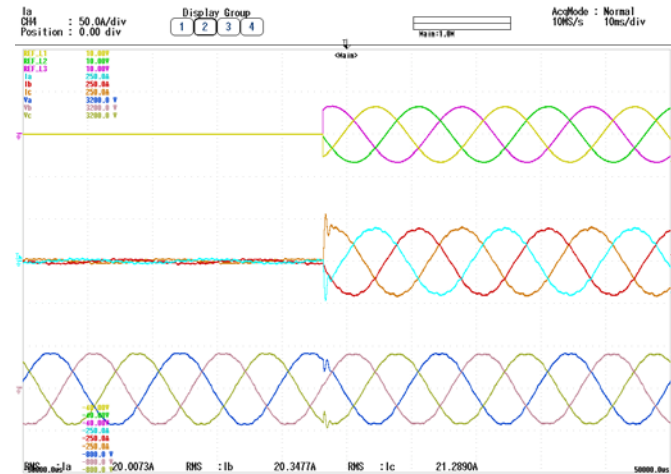
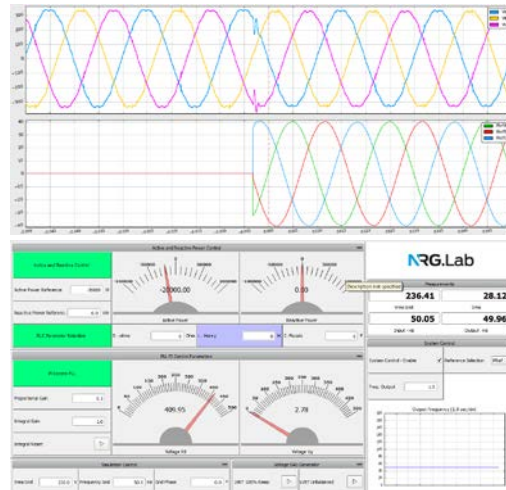
03-1

Power Reference Control Mode



Amplifier Mode – Grid Connection power reference

- Connection to nominal voltage is achieved without any resonance issue.
- Capability of synchronizing and providing a reference in phase with the grid, active or reactive power in any direction can be set by using the control panel.



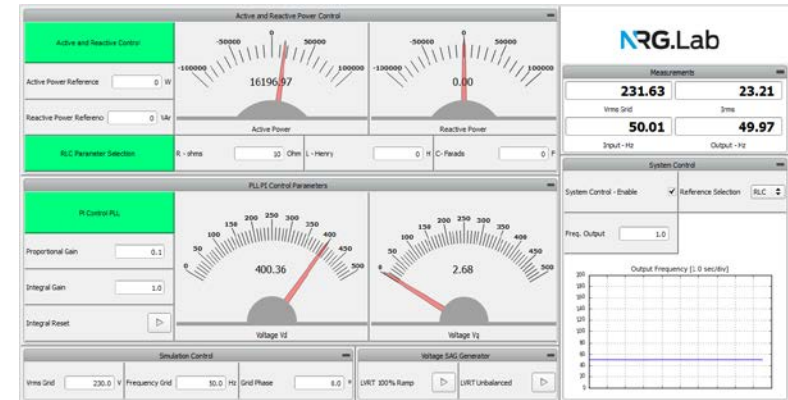
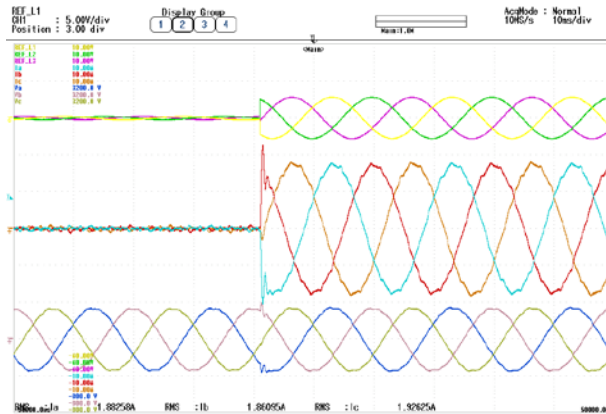
03-2

RLC Control Mode

Amplifier Mode – Grid Connection RLC

- Possibility to work as a RLC load.
- Controllable parameters on real time from the control panel.

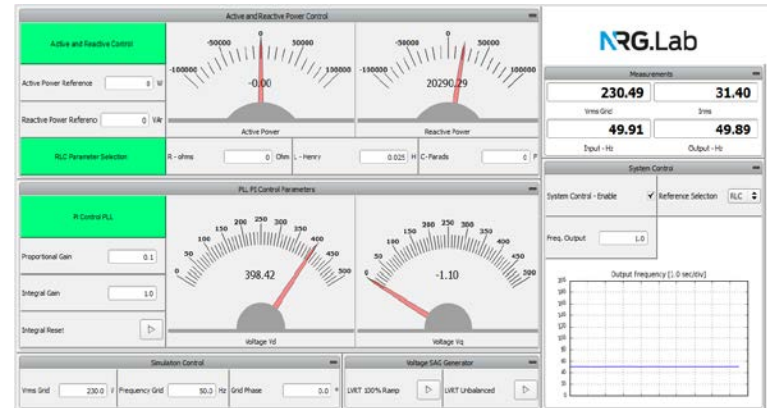
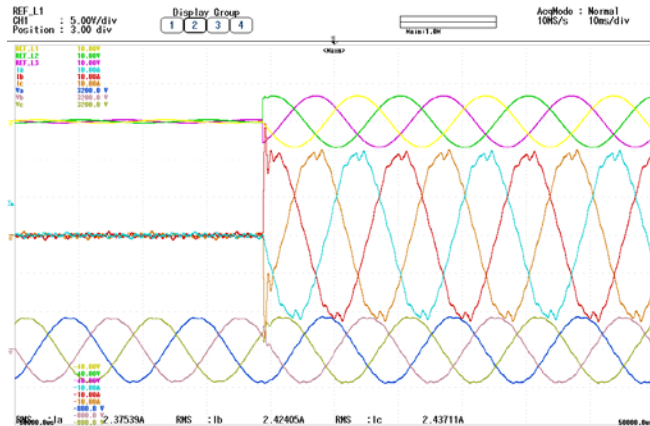
Connection of a 10 ohm resistor load



Amplifier Mode – Grid Connection RLC

- Possibility to work as a RLC load.
- Modifiable parameters on real time from the control panel.

Connection of a 0,025H inductor load

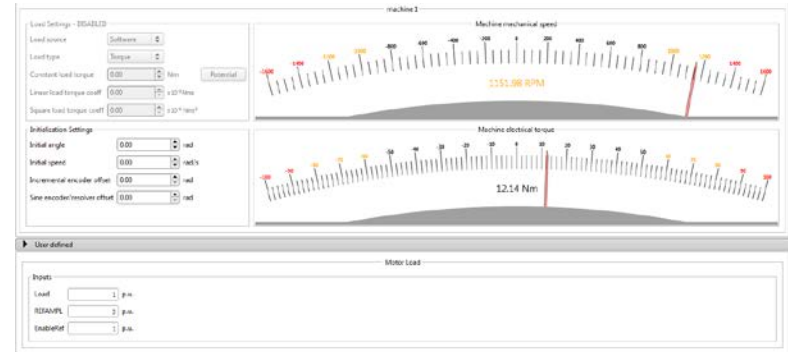
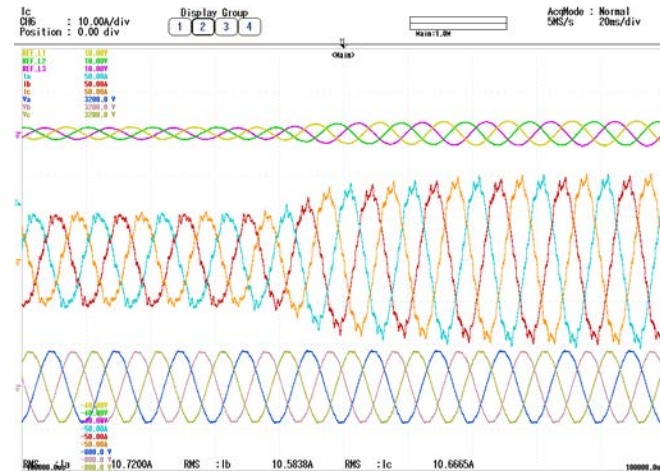


03-3

Induction Motor Emulation

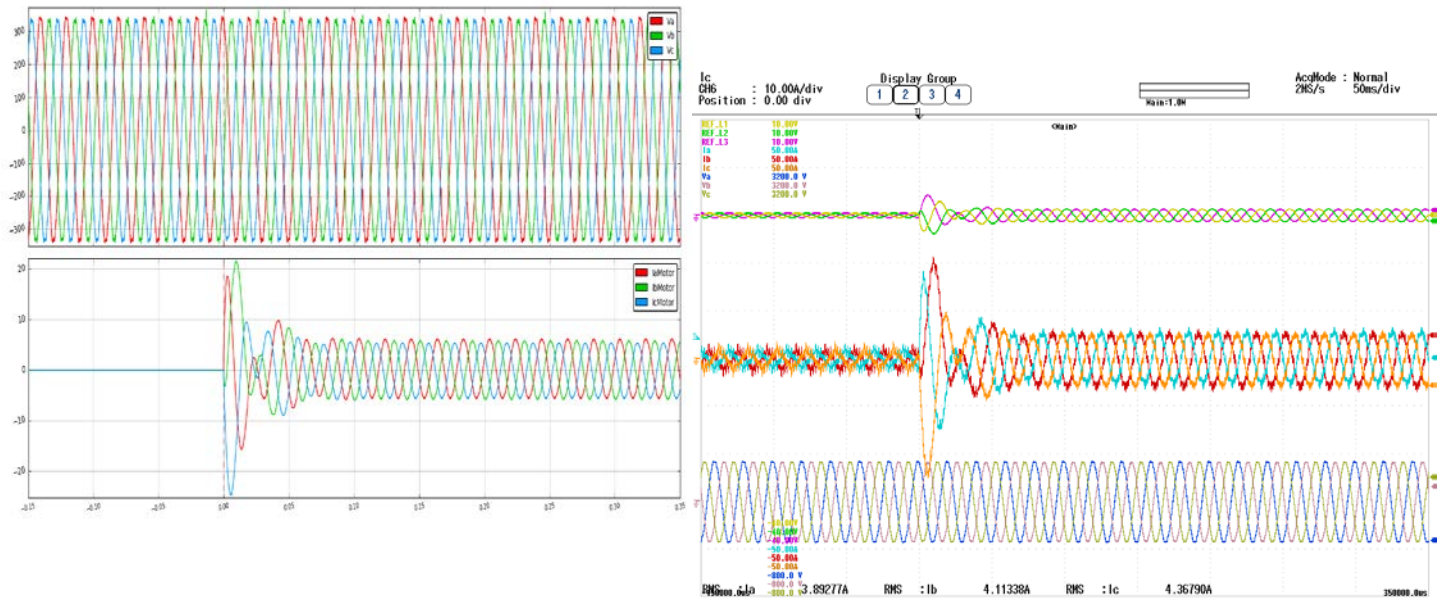
Amplifier Mode – Emulating a motor change of torque and current consumption

- Possibility to emulate different type of motors connected to the grid, by emulating the current that they are absorbing at each moment.



Amplifier Mode – Emulating a motor change of torque and current consumption

- Motor connection with different loads, load change or connection to a grid can be emulated and observed at the output of the amplifier.

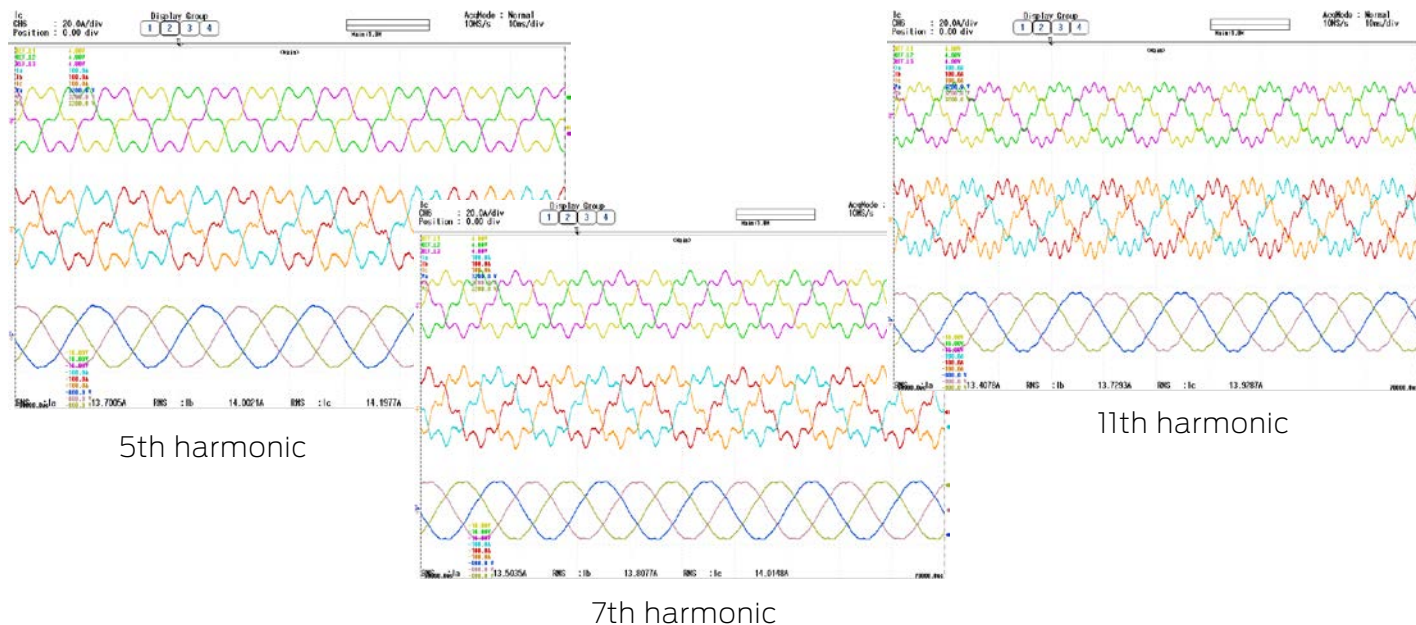


03-4

Harmonic control

Amplifier Mode – Current Harmonics Control

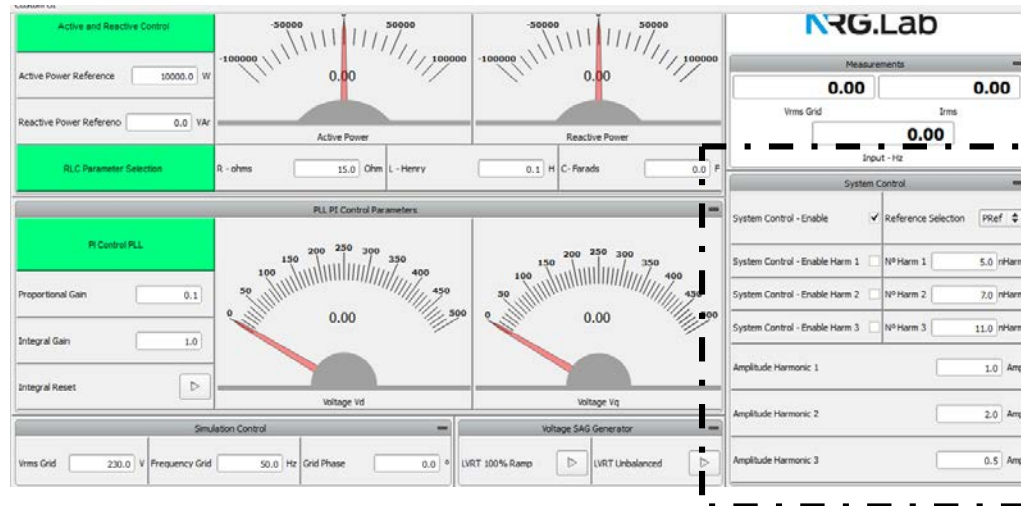
- Possibility to add current harmonics to the grid. By controlling its phase and amplitude.





Amplifier Mode – Current Harmonics Control

- Harmonic amplitude and phase control on the control panel.



- Harmonic number selection
- Control Harmonic Output
- Amplitude of the Harmonic

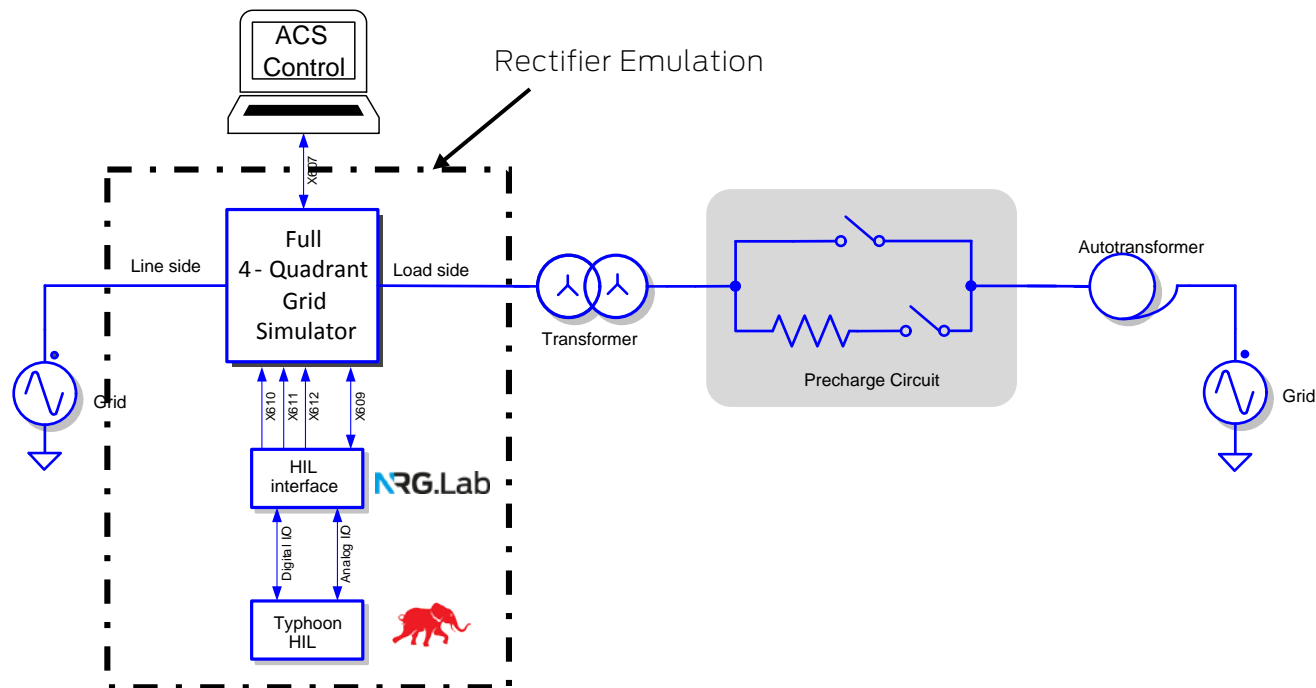
03-5

Rectifier Emulation



Amplifier Mode – Rectifier emulation

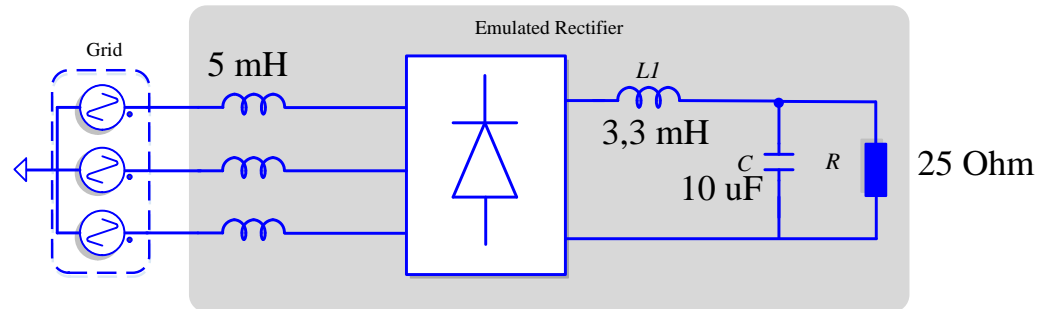
- Hardware setup configuration





Amplifier Mode – Rectifier emulation

- Schematic of the rectifier emulation.
 - Capability of emulating the current absorbed by a rectifier.

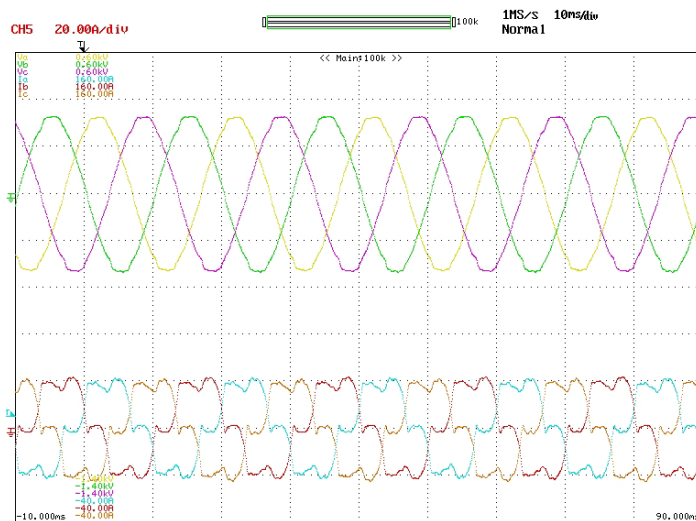




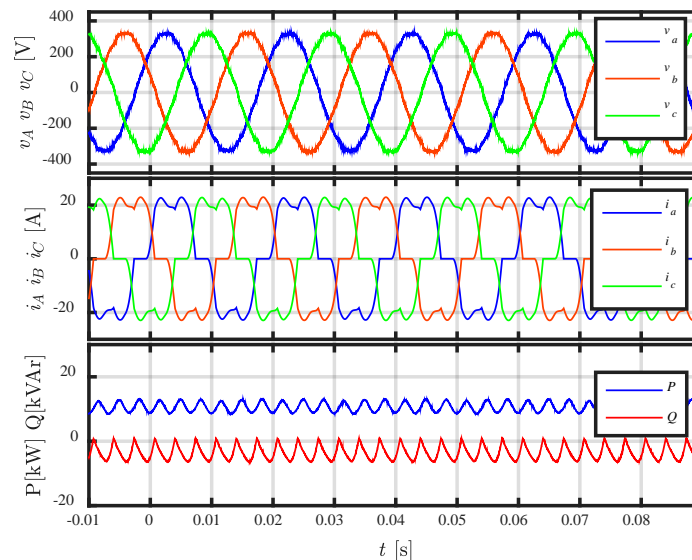
Amplifier Mode – Rectifier emulation

- Grid connection on the amplifier mode, current control injecting the current absorbed by the rectifier.

Real Voltage and Current flow



HIL measuring Simulation



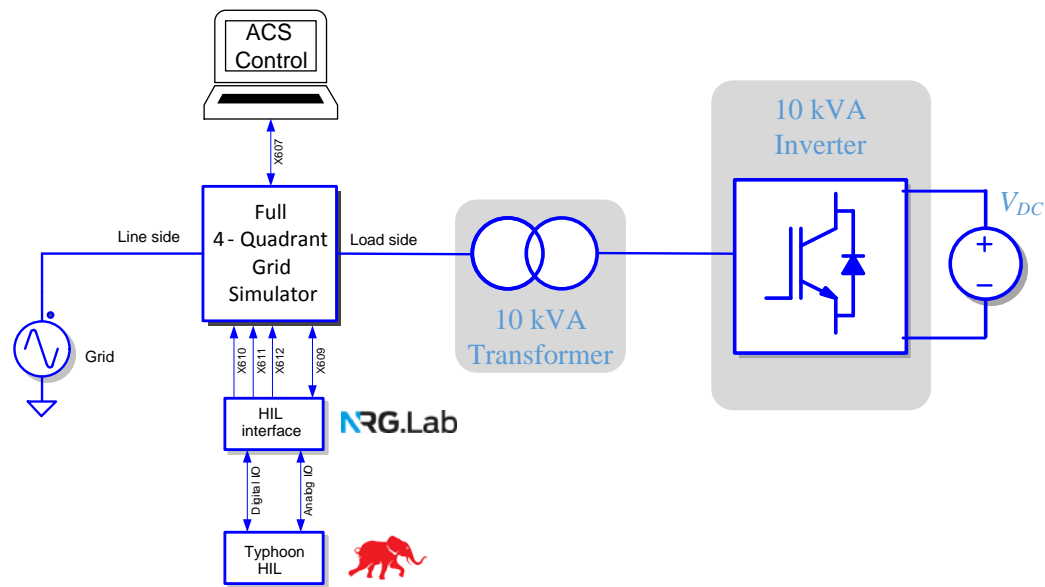
04

GRID EMULATOR - Closed Loop



Amplifier Mode – Grid Emulator Closed Loop

- Hardware setup configuration

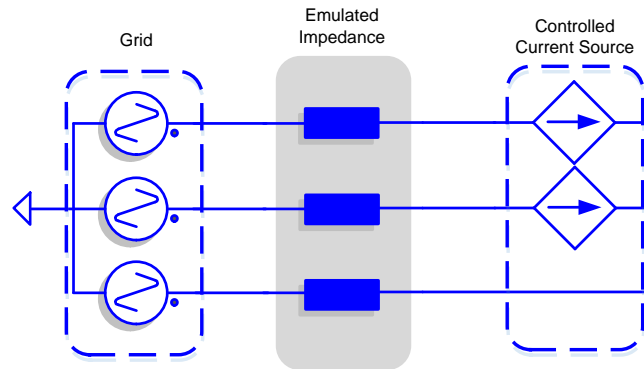




Amplifier Mode – Grid Emulator Closed Loop

➤ Schematic to close loop grid emulation

- In order to fulfill Kirchhoff, only two current sources have to be set, the third one is automatically calculated. By this, you ensure that there is no current flowing on the neutral.

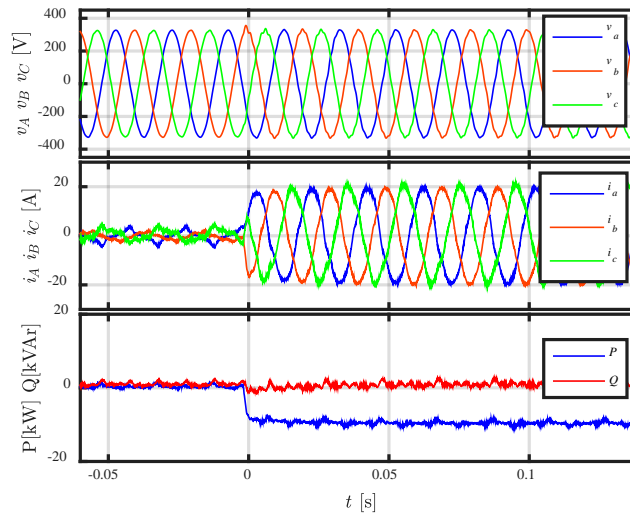




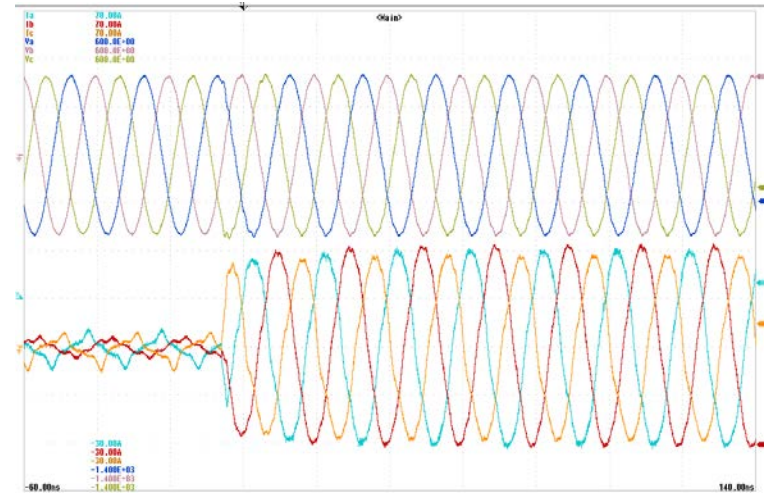
Amplifier Mode – Grid Emulator Closed Loop

- Capability of connecting to a real inverter, performing the voltage deviations caused by the current injected by the inverter.

HIL measuring Simulation

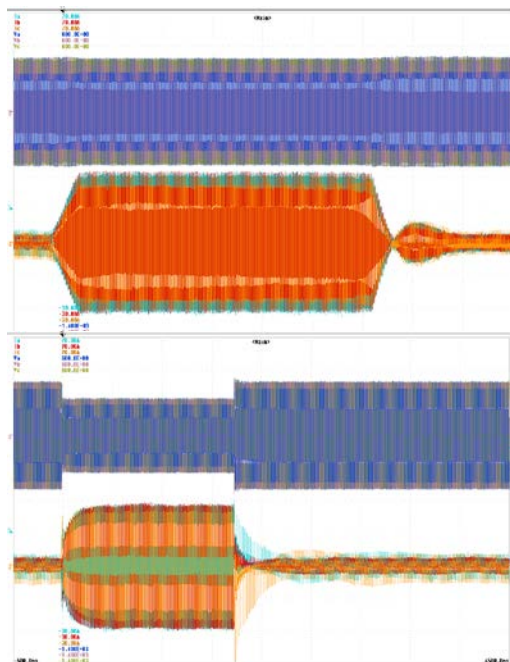


Real Voltage and Current flow



Amplifier Mode – Grid Emulator Closed Loop

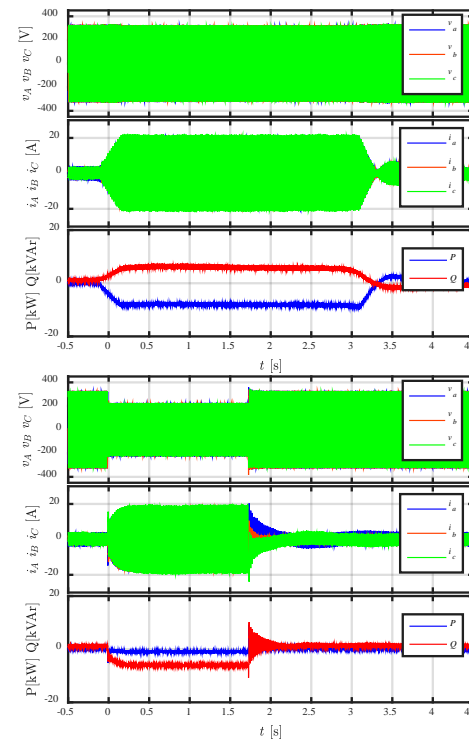
- Different algorithms and tests can be performed under this structure.



Power Step
control



Voltage Sag
50%

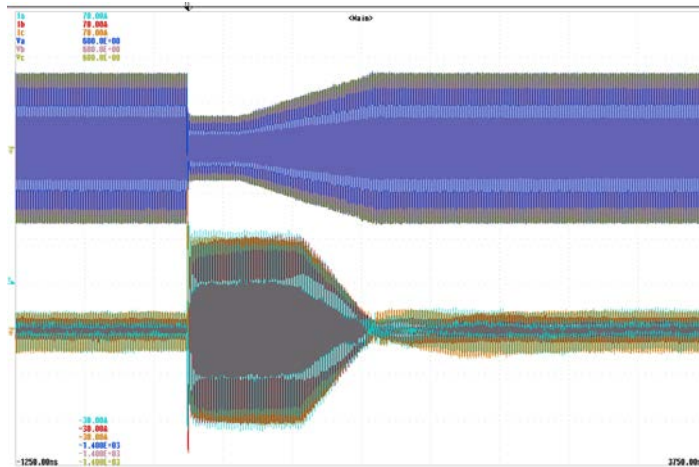




Amplifier Mode – Grid Emulator Closed Loop

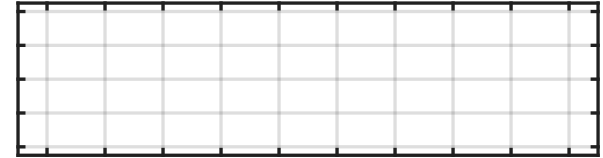
- Grid codes LVRT test profile. Able to generate different LVRT profile to see the inverter interaction with the grid.

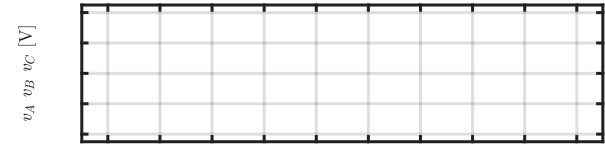
Real output measurement



v_A, v_B, v_C [V]

Emulated HIL measurement





05

Connection Procedure



4-Quadrant Grid Simulator & Typhoon - Procedure for connection

- In order to connect the 4-full quadrant grid simulator to the typhoon HIL simulation, some steps have to be done.
 - Setting the parameters inside the 4-full quadrant grid simulator in order to read either voltage or current.
 - Set the 4-full quadrant grid simulator to the amplifier mode. (Voltage or current mode) depending on the case.
 - Typhoon HIL simulation schematic, adding the probes and the sources needed for the simulation.
 - Setting output channels and input channels selection to fit with the NRG lab interface board.
 - Calibration of the offset on the output signal of the interface board.
 - Open the control panel inside the Typhoon HIL software.
 - Your system is ready to work.

The background is a dark blue collage of various technology-related images. It includes a close-up of a hand using a soldering iron on a circuit board, a computer monitor displaying a waveform, a solar panel, and a circuit board with a large integrated circuit. At the bottom, there is a faint circuit diagram with labels like 'U1D', 'J16L', 'U7F', and numbers '10', '12', '17', '13'.

NRG.Lab

NRG.Lab a UPC spin-off

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