

Power Electronics HIL Teaching Laboratory

Includes software, hardware and customizable exercises



Power Electronics HIL Teaching Laboratory by OPAL-RT TECHNOLOGIES is an educational courseware intended to teach power electronics to university undergraduate students.

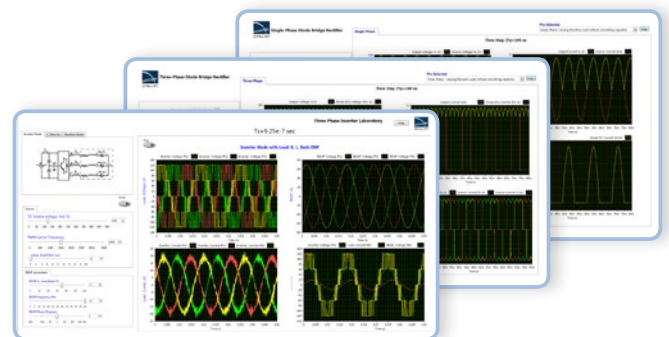
Students can experiment and learn power electronics, such as converters, rectifiers, and inverters, including the control logic with HIL and RCP Tools commonly used in innovative power electronics industry research and development.

The tutorial set is designed to work on OPAL-RT hardware and on the National Instrument Compact NI cRIO-9068. This association aims to reach the most OPAL-RT and NI Power Electronics students and teachers, and to create a community of users who can enhance their experience through mutual activities.

MAIN BENEFITS

Learning power electronics through HIL and RCP technologies provides many advantages, including:

- Less analogic lab equipment is needed, with subsequent lower maintenance time and cost.
- Editable and upgradable courseware to fit with specific courses or activities.
- Provides a good platform to pursue graduate research on the same setup.



FPGA FOR HIGH DEFINITION ACCURACY

All power electronics models used in the teaching courseware run on FPGA for very high definition accuracy. Students can discover and learn power electronics with very high definition tools that are fast enough to visualize all phenomena that can be seen on more expensive and time-consuming analogic setups.

The Power Electronics HIL Teaching Laboratory comes in four modules

Power Electronics Software provides real-time simulation of DC-DC, AC-DC, DC-AC converters for educational purposes in power electronic laboratories. The teaching laboratory is divided into four modules. All power electronics modules include laboratory exercises.

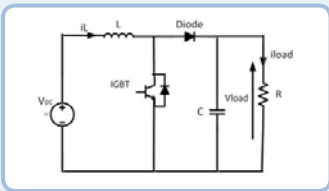
MODULE 1 - OP1180 DC-DC Converters

Objectives

- Learn different types DC to DC converters (boost, buck, buck-boost) and their characteristics
- Understand the impact of duty cycle value on the converter in continuous conduction mode.
- Become Familiar with operation diode and switching transistor operating principles

Laboratory Exercises include:

- Impact of varying parameters of converter
- Effect of varying the duty cycle
- Calculation of PI controller parameters using MyRio External controller



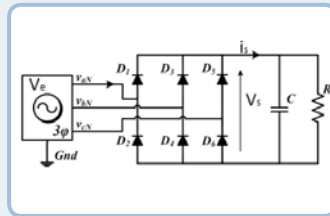
MODULE 2 - OP1181 AC-DC Rectifiers

Objectives

- Learn principles of operation of the diode rectifier circuits
- Deduce the role of the single-phase and the three-phase diode bridge rectifier
- Become familiar with its operation and diode operating principles

Laboratory Exercises include:

- Impact of varying rectifier parameters
- Calculation of the form factor and the ripple factor
- Impact of activation of smoothing capacitor



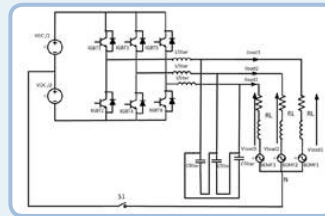
MODULE 3 - OP1182 DC-AC Converter

Objectives

- Learn principles of operation of three-phase two-level Inverter and PWM modulation technique
- Study the effect of the neutral connection on waveforms of the phase voltages and line currents
- Study the effect of filtering

Laboratory Exercises include:

- Impact of neutral connection and filtering
- Impact of varying PWM frequency and dead time
- Introduction to the hysteresis controller using MyRio external controller



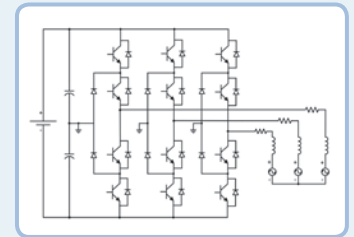
MODULE 4 - OP1183 Three-Phase Three-Level NPC Converter

Objectives

- Learn principles of operation of Three-phase Three-Level NPC Topology
- Operating in Inverter and Rectifier Modes
- Filtering at the input and the output of the converter

Laboratory Exercises include:

- Design aspects: Component sizing / switch control
- Variable-configuration load: AC-motor / Capacitive / Inductive
- Power flow / Waveforms



PLATFORM OFFER FOR POWER ELECTRONICS HIL TEACHING



OFFER 1: 1- Bundle with OP4500 Serie 500-10 and OP8665 (optional)

OPAL-RT offers a system that combines high performance, flexibility and low entry-level cost. The integration of high-end INTEL multi-core processors with powerful Kintex 7 FPGA allows greater simulation power and sub-microsecond simulation time step to maximize precision of fast power electronic systems.

HIGHLIGHTS:

- Allows you to develop customized exercises
- Allows you to expand the software for all the PowerGrid suites from OPAL-RT

Optional: The offer can come with the OP8665. The OP8665 is a rapid control prototyping platform using commercial DSP to interface quickly and easily with the OP4500 system acting as an internal controller for the courseware.

OFFER 2: Using the courseware on existing OPAL-RT Hardware. The courseware could run on any OPAL-RT TECHNOLOGIES HIL system with FPGA ML605 and Kintex-7. Possibility of upgrading FPGA systems on some HIL systems is possible.



The **NI cRIO-9068** combines a dual-core processor, a reconfigurable FPGA, and eight slots for C Series I/O modules within one chassis. Featuring a 667 MHz dual-core ARM Cortex-A9 processor running the NI Linux Real-Time OS and an Artix-7 FPGA.

The Crio comes with four C series modules:

- Ni 9401 8 ch Digital I/O
- Ni 9403 32 Ch bidirectional Digital I/O
- Ni 9263 = 32 ch +/- 10 V Analog out
- Ni 9205 = 32 ch +/- 200mv to +/-10V Analog input

For more information about the offer, please check the link on the NI Web site at: www.goo.gl/8s1l6X

For more information or to order any of the modules, please contact one of our representatives

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