

# EcosimPro

## Modelling and Simulation Software



### ELECTRICAL LIBRARY

The ELECTRICAL library makes electrical and electronic system modelling easy, interacting with subsystems in other libraries and creating multidisciplinary systems.

#### EcosimPro

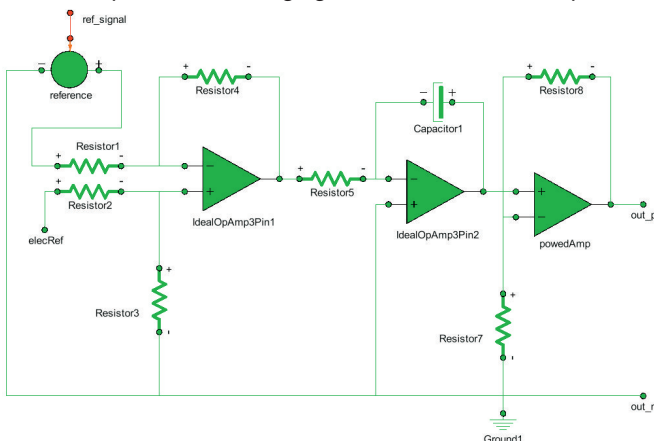
EcosimPro is a powerful **modelling** and **simulation** tool with a simple interface that makes the design of **multidisciplinary** dynamic systems easy and intuitive using graphic diagrams.

For users with specific needs, EcosimPro provides an object-oriented non-causal approach towards creating reusable component libraries and is based on very powerful symbolic and numerical methods capable of processing **complex systems** represented by differential-algebraic equations (DAE) or ordinary-differential equations (ODE) and discrete events. However, low-level problems such as programming calls with numerical solvers, equation handling, etc, are solved automatically or using simple wizards.

#### Features

ELECTRICAL is a standard library supplied with EcosimPro and contains the basic components for building electrical and electronic systems.

Using **drag & drop** methodology, the user can quickly create the wiring diagram to be analysed, the representation of which is very similar to the physical system. The library has a wealth of possibilities, ranging from the simulation of power



electronics and digital electronic elements.

Thanks to EcosimPro's features, the ELECTRICAL library is very easy to **configure** and **extend**, adding any components and characteristics as needed. This can be done graphically through a simple, user friendly interface, or through EcosimPro's **object-oriented language** which makes it possible to re-use existing codes.

Applying the object-oriented methodology, a group of components can be encapsulated into a single subsystem used like a **black box**, with a defined number of inputs and outputs. This enables **modular** design of the overall system and makes it possible to share tasks among different specialised **users** or merely simplify the system.

One of the library's biggest advantages is the possibility of its use in the multidisciplinary facet of EcosimPro, a step forward for specific electrical or electronic simulation software. This means that we can carry out an overall system study, preventing possible interferences between modules and therefore minimising design costs.

#### The components

In summary, different component groups will be established and included in the ELECTRICAL library with several representative examples:

- **Signal generators:** The input possibilities cover the classic forms of generation: voltage and direct current supplies - senoidal, trapezoidal. There are voltage, current, voltage-current and current-voltage converters. There are also two very interesting components, generators of current/voltage signals that track a control signal, which greatly expands the input possibilities



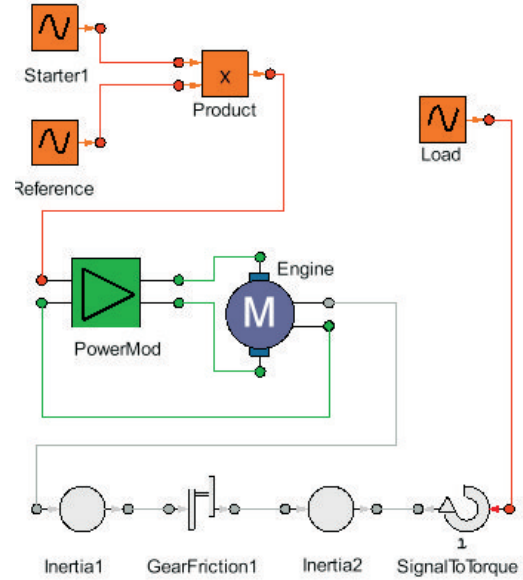
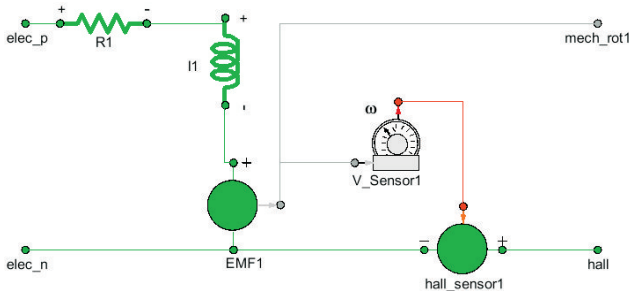
- **Passive elements:** In addition to the classic elements: inductors, resistance and ideal capacitors, there are other components specialised in electric transmission: Lossy transmission line and uniform distributed RC line, transformers, ducting and shortcircuits
- **Active elements:** The library contains the main semiconductors: diodes (they take temperature into account), NMOS transistor, PMOS transistor, NPN transistors, thyristors and operational (ideal) amplifiers. By changing their parameters, these elements can be used both as power and electronic components
- **Signal handlers:** There are ideal circuit breakers and switches
- **Sensors:** The library can be directly connected to the control library by means of the current, voltage and power sensors. These can be considered as variables to be controlled or as system control parameters
- **Power transformation:** Finally, a component to transform electrical energy into rotational mechanical energy has been contemplated. It is used as the basic building block for an electric motor

### Example

This example demonstrates one of EcosimPro's greatest facets -that of multidisciplinary simulation - for which we have selected the model of a motor fed by a power stage and a mechanical unit coupled to the shaft.

Both the motor and the power stage have been modelled as separate, re-usable components. The motor is illustrated in the diagram below. It is a simplified model which includes a Hall sensor to measure the shaft rotation speed. On the previous page we have the wiring diagram of the power stage which has a control gate as input.

In the general diagram we can see that the motor is controlled by a group of control components (orange) which



consist in a sine function. To prevent motor startup current peaks, the signal has been attenuated by a gradient of variable length.

Two masses have been placed on the shaft, separated by a gear, and coupled to the second mass is a moment of continuous value always in the same direction.

The operation of the model can be seen in the graph. The first plot corresponds to the generation of the reference signal: a sine with its first semiperiod attenuated by a gradient from 0 to 1. The second plot corresponds to the current that circulates through the motor, where we can see the good behaviour at startup, preventing the peak that would be produced if we applied the sine directly. Finally, the moments on each of the mechanical elements are illustrated and we can see that in the first instance there are some small oscillations for it to stabilise and track the reference signal.

It is interesting to observe that, as expected, the oscillations on the shaft caused by the inertias of the masses coupled to it affect the motor current.

