GENERAL

ansoft maxwell circuit editor example

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Introduction

Electromagnetic simulation has become a cornerstone of modern electrical engineering, enabling designers to predict performance, optimize layouts, and reduce costly prototypes. Among the most widely used tools in this domain is **Ansoft Maxwell**, a 3 D electromagnetic field solver that provides detailed insights into magnetic, electric, and thermal phenomena. A powerful feature within Maxwell that often goes under utilized is its **Circuit Editor**, a module that bridges the gap between circuit design and field analysis.

In this article we explore the **ansoft maxwell circuit editor example** in depth, walking through real world scenarios that demonstrate how the Circuit Editor can streamline the design of inductors, transformers, motors, and other magnetic components. Whether you are a seasoned Maxwell user or a newcomer looking to harness the full potential of the software, this guide will equip you with the knowledge and practical steps needed to create robust, accurate simulations.

We'll cover:

- What the Circuit Editor does and why it matters.
- Step by step tutorials for beginner and advanced examples.
- Best practices for setting up, meshing, and interpreting results.
- Common pitfalls and how to avoid them.
- How to integrate circuit data with the full Maxwell workflow.

By the end of this article you will have a solid foundation for leveraging the Circuit Editor in your own projects, as well as a set of practical examples to reference in future work.

1. Overview of Ansoft Maxwell

Ansoft Maxwell, now part of the Ansys family, is a 3 D electromagnetic field solver that uses finite element analysis (FEA) to model complex magnetic and electric environments. It supports a wide range of physics, including:

- Magnetostatic and eddy current analysis.
- Transient and harmonic AC simulations.
- Thermal coupling and structural stress.
- Multi physics coupling with mechanical, thermal, and fluid modules.

Engineers use Maxwell to design transformers, inductors, motors, magnetic shielding, and even RF components. The software's strength lies in its ability to capture fine geometric details and material properties, producing highly accurate field distributions, flux densities, and loss predictions.

However, field analysis alone can be time consuming, especially when iterative circuit changes are required. This is where the Circuit Editor shines, allowing designers to edit circuit parameters, run parametric sweeps, and directly link electrical quantities to field results.

2. The Circuit Editor Feature

The Circuit Editor in Ansoft Maxwell is essentially a schematic environment embedded within the field solver. It lets you:

- Define voltage sources, current sources, and resistive elements.
- Assign these elements to specific nodes or ports in the 3 D geometry.
- Set up parametric sweeps for voltage, current, or frequency.
- Export circuit data to other Ansys modules or third party tools.
- Visualize current paths, voltage drops, and power dissipation directly in the geometry.

By coupling circuit data with field results, the Circuit Editor enables a more holistic view of the device's performance, making it easier to identify hotspots, optimize winding layouts, and balance electrical and magnetic requirements.

3. Why Use the Circuit Editor?

While Maxwell's standard setup allows you to prescribe current or voltage boundary conditions, the Circuit Editor adds several layers of convenience and insight:

1. Rapid Iteration: Change a voltage or current value in the editor and instantly see updated results without re defining boundary conditions manually.
2. Parametric Sweeps: Run a sweep over a range of frequencies or currents to analyze behavior across operating conditions.
3. Integrated Power Analysis: Directly calculate power loss, heating, and efficiency metrics within the same environment.
4. Consistent Data Management: Keep circuit parameters and field models in sync, reducing errors caused by manual data transfer.
5. Exportability: Export circuit tables for use in system level simulations or for documentation.

For many engineers, the Circuit Editor becomes a single point of control, dramatically reducing simulation turnaround time.

4. Getting Started with the Circuit Editor

Before diving into examples, let's walk through the basic workflow for setting up a Circuit Editor in Maxwell.

4.1 Open a New Project

Launch Ansoft Maxwell, click **New Project**, and give it a descriptive name such as *Inductor_CircuitEditor_Example*. Choose the appropriate analysis type (e.g., *Magnetostatic* or *Transient AC*).

4.2 Create the Geometry

Use the **Geometry** module to design your component. For a simple inductor, you might create:

- A rectangular core.
- Multiple winding layers.
- Air gaps and insulation.

Once geometry is complete, assign material properties (e.g., silicon steel for the core, copper for windings).

4.3 Define Circuit Elements

Navigate to the **Circuit Editor** tab. Here you can:

- Drag and drop Voltage Source or Current Source blocks.

- Place Resistor blocks to model winding resistance.
- Connect these blocks using wires or nodes that correspond to points in your geometry.
- Label each element with a unique identifier.

4.4 Assign Circuit Nodes to Geometry

To link a circuit element to a physical location, right click the element and select **Assign to Geometry**. Choose the corresponding surface or line in the 3 D model. This step ensures that the solver knows which part of the geometry the voltage or current is applied to.

4.5 Set Up Parameters

In the Circuit Editor, you can define parameters such as:

- Voltage amplitude.
- Current amplitude.
- Frequency.
- Temperature.

Use the **Parameters** window to create variable definitions that can be referenced elsewhere in the project.

4.6 Run the Simulation

Click **Run** to launch the solver. The Circuit Editor will automatically apply the defined circuit conditions to the geometry and produce field results.

4.7 Visualize Results

After the solver completes, switch to the **Results** tab. You can plot:

- Magnetic flux density (B field).
- Electric field (E field).
- Current density.
- Power loss maps.

Use the **Field Viewer** to overlay circuit paths and see how the circuit interacts with the magnetic fields.

5. Step by Step Example: Designing a Simple Inductor

Let’s walk through a concrete example that demonstrates how to use the Circuit Editor to model a basic air core inductor.

5.1 Define the Geometry

In the **Geometry** module, create a rectangular core with dimensions 20 mm × 20 mm × 10 mm. Add a cylindrical winding with a radius of 5 /mm and a height of 10 /mm, positioned concentrically around the core. Assign the following materials:

- Core: Air.
- Winding: Copper with conductivity 5.8 /× /107 /S/m.

5.2 Set Up the Circuit Editor

1. Voltage Source: Drag a Voltage Source block into the Circuit Editor. Name it V1 and set its amplitude to 5 /V.
2. Resistor: Add a Resistor block named R1 with a value of 0.1 /:’ Fò &W &W6VçB v–æF–ær &W6—7F æ6P.
3. Connections: Connect V1 !’ R1 !’ Ground. Use wires to represent the path.

5.3 Assign Nodes to Geometry

Right click V1 and choose **Assign to Geometry**. Select the top surface of the winding cylinder. Then assign R1 to the winding surface. This ensures the voltage is applied across the winding and the resistor models the series resistance.

5.4 Define Parameters

In the **Parameters** window, create variables:

- V_amp = 5.0 /V.
- R_val = 0.1 /:'à
- Freq = 1 /kHz.

Link these parameters to the circuit elements by editing the block properties and replacing the hard coded values with the parameter names.

5.5 Mesh the Geometry

Open the **Mesh**module. Use a fine mesh in the winding region (element size 0.1 mm) and a coarser mesh in the surrounding air (element size 0.5 /mm). This balances accuracy with computational cost.

5.6 Run the Simulation

Click **Run**. Maxwell will solve the magnetostatic problem with the applied voltage and series resistance. The solver will also calculate induced currents, flux density, and power loss.

5.7 Analyze Results

In the **Results** tab, generate the following plots:

- Magnetic Flux Density (B field): View the distribution around the core.
- Current Density: Visualize how current flows through the winding.
- Power Loss Map: Identify hotspots due to resistive heating.

Use the **Field Viewer**to overlay the circuit path on the geometry, confirming that the voltage source is correctly applied.

5.8 Perform a Parametric Sweep

To study the effect of varying voltage amplitude, create a sweep:

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