GENERAL

ansys maxwell 2d 14 user guide

Published: September 19, 2026 | Index ID: #-

Introduction

Electromagnetic simulation has become an indispensable tool for engineers designing motors, transformers, inductors, and a host of other devices that rely on magnetic fields. Among the leading software packages in this domain, **ANSYS Maxwell 2D 14**stands out for its robust physics models, intuitive user interface, and powerful post processing capabilities. Whether you are a seasoned simulation professional or a newcomer looking to master 2D electromagnetic analysis, this comprehensive user guide will walk you through every step—from installation and workspace navigation to advanced modeling techniques and troubleshooting tips.

By the end of this article, you will have a solid understanding of how to create high quality models, run accurate simulations, and extract meaningful results with **ANSYS Maxwell 2D 14**. Let's dive in.

What is ANSYS Maxwell 2D 14?

ANSYS Maxwell 2D 14is a finite element analysis (FEA) software designed specifically for two dimensional electromagnetic field problems. It solves Maxwell's equations in the magnetostatic, electrostatic, and harmonic regimes, making it ideal for analyzing magnetic circuits, electric motors, transformers, and other devices where the geometry can be reasonably approximated as a 2D cross section.

Key features of the 14th release include:

- Enhanced material libraries with temperature dependent properties.
- Improved solver performance and faster convergence.
- Expanded support for multi physics coupling (thermal, mechanical).
- Advanced post processing tools such as streamline plots and surface flux integration.
- Integrated optimization and design exploration modules.

Because Maxwell 2D focuses on planar problems, it offers a streamlined workflow and reduced computational cost compared to its 3D counterpart, while still providing accurate results for a wide range of engineering applications.

System Requirements & Installation

Hardware Requirements

Before installing **ANSYS Maxwell 2D 14**, ensure that your computer meets the minimum hardware specifications:

- Processor: Dual core Intel or AMD CPU (3 /GHz or faster recommended).
- RAM: 8 /GB (16 /GB or more for large models).
- Hard Drive: SSD with at least 20 /GB of free space for installation and temporary files.
- Graphics: DirectX 11 compatible GPU with 512 /MB VRAM.

Software Dependencies

ANSYS Maxwell 2D 14 relies on the ANSYS Workbench platform. Make sure the following components are present:

- Windows 10 (64 bit) or newer.
- Microsoft .NET Framework 4.8.

- Python 3.6 or higher (for scripting and automation).
- ANSYS Workbench 14.0 or newer.

Installation Steps

1. Download the ANSYS installation package from the official ANSYS website or your organization's licensing portal.
2. Run the installer as an administrator. The wizard will guide you through license configuration, component selection, and installation directory setup.
3. Choose the "Maxwell 2D" component during the component selection step.
4. Complete the installation and reboot your computer if prompted.
5. Launch ANSYS Workbench and open the Maxwell 2D module to confirm that the installation was successful.

Getting Started: The Workspace Overview

The Maxwell 2D interface is organized into three main areas: the Project Manager, the Design Tree, and the Graphics Window. Understanding how these components interact will help you navigate the software efficiently.

Project Manager

The Project Manager acts as the central hub for all your projects. Here you can create, open, and organize multiple Maxwell 2D studies. Each project contains a set of models, solver settings, and results.

Design Tree

The Design Tree provides a hierarchical view of the components within a project. It displays the geometry, materials, boundary conditions, and solver settings in a structured manner, allowing you to quickly locate and edit any element.

Graphics Window

The Graphics Window is where you create and visualize the geometry, mesh, and simulation results. It supports 2D sketching tools, interactive zooming, and panning, making it the primary workspace for model development.

Creating a 2D Electromagnetic Model

Let's walk through the process of building a simple 2D magnetic circuit—a single phase inductor—using **ANSYS Maxwell 2D 14**.

Sketching the Geometry

1. In the Design Tree, right click on "Geometry" and select "New Sketch." Choose the appropriate plane (e.g., XY plane) and click "OK."\\n2. Use the sketching toolbar to draw the core, winding, and air gaps. For a single phase inductor, you might sketch a rectangular core with a circular winding inside and a small air gap at the top.\\n3. Apply dimensions using the "Dimension" tool. Specify the core width, height, and the winding diameter. Use constraints (e.g., parallel, perpendicular) to ensure a clean, well defined geometry.\\n4. When the sketch is complete, click "Close" to exit the sketcher. The geometry will now appear in the Design Tree and the Graphics Window.

Defining Materials

Materials are critical for accurate field calculations. Maxwell 2D offers a built in material library, but you can also create custom materials:

1. Right click on "Materials" and choose "New Material."
2. Give the material a meaningful name (e.g., "Silicon Steel").

3. Under the “Magnetic Properties” tab, specify the relative permeability (μr) and saturation flux density (Bs) values. If temperature dependence is needed, add a temperature dependent table.
4. Assign the material to the core by selecting the core region in the Design Tree, clicking “Material” in the Properties panel, and choosing your new material.
5. Assign copper to the winding and air to the surrounding region similarly.

Applying Boundary Conditions

Boundary conditions define how the magnetic field interacts with the simulation domain:

- Magnetic Insulation: Apply to the outer boundaries to simulate an infinite domain.
- Magnetic Flux Density: Use when you know the magnetic flux entering or leaving a boundary.
- Current Density: Assign to the winding to specify the excitation current.

To apply a condition, right click the desired boundary in the Design Tree, select “Add Boundary Condition,” and choose the appropriate type. Input the required parameters (e.g., current magnitude, flux density).

Setting up Excitations

Excitations drive the simulation. For a magnetostatic study, you’ll typically specify a current source in the winding:

1. Right click on “Excitations” and select “New Excitation.”
2. Choose “Magnetostatic” as the study type.
3. Define the excitation waveform (DC or AC). For a simple inductor, a DC current of 5 /A might suffice.
4. Assign the excitation to the winding region.

Meshing the Model

A good mesh is essential for accurate results and efficient solver performance. Maxwell 2D offers automatic and manual mesh controls.

Mesh Controls

Right click on “Mesh” in the Design Tree and select “Mesh Controls.” Here you can set the global mesh size, edge refinement, and element quality parameters. Typical settings for a magnetostatic problem might be:

- Global Mesh Size: 0.5 /mm.
- Edge Refinement: Enable for edges with high field gradients (e.g., air gaps).
- Element Quality: Minimum of 0.8 to avoid distorted elements.

Refinement Strategies

To capture sharp field variations, use local refinement:

1. Select the region around the air gap.
2. Right click and choose “Add Mesh Refinement.”
3. Set a finer mesh size (e.g., 0.1 /mm).
4. Run a preliminary mesh to verify element quality.

Running the Solver

With the model fully defined and meshed, you can now solve the magnetostatic problem.

Solver Settings

Right click on “Solver” and choose “Edit Solver Settings.” Key parameters include:

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