



# MAGNETISiM

Analysing Results: Magnet Simulation  
Power Loss Viewer I

# GUI Overview

## TAB MENU

Core Geometry Tab (Ctrl+1)

Winding Geometry Tab (Ctrl+2)

Sim Config Tab (Ctrl+3)

Magnet Tab (Ctrl+4)

## INPUT FRAME

The screenshot displays the MAGNETISiM software interface. At the top, a menu bar includes 'File', 'Edit', 'Tool', and 'Help'. The main window is divided into two primary sections. On the left is the 'INPUT FRAME', which contains two main panels: 'Core Geometry' and 'Core Material'. The 'Core Geometry' panel features dropdown menus for 'Manufacturer', 'Geometry Core', and 'Core Reference', followed by input fields for dimensions A [mm], B [mm], Bp [mm], C [mm], Cp [mm], D [mm], E [mm], F [mm], G [mm], I [mm], and Gap [mm], all currently set to 0. The 'Core Material' panel includes a 'Material' dropdown, four tabs for 'Magnet', 'Power Loss', 'Electrical', and 'Thermal', and input fields for 'Real Permeability', 'Imag Permeability', and 'Conductivity', all set to 0. A button labeled 'Add Permeability(f) Curve' is present, along with a checkbox for 'Permeability(f) from Internal-Database'. On the right is the 'MODELER WINDOW', which shows a 2D grid plot with axes ranging from -0.6 to 0.6. At the bottom of the plot area are buttons for 'Export', 'Refresh Plot', and 'Fit All'. A 'BAR TOOL' is indicated at the top right of the window.

## BAR TOOL

## MODELER WINDOW

# Core Selection

The screenshot displays the MAGNETISIM software interface. On the left, the 'Core Geometry' section is active, showing the following settings:

- Manufacturer: Ferroxcube
- Geometry Core: U
- Core Reference: U67/27/14
- A [mm]: 5.0
- B [mm]: 3.0
- D [mm]: 2.0
- E [mm]: 0.6
- F [mm]: 5.0
- Gap [mm]: 0.0

The 'Core Material' section is also visible, showing:

- Material: 3C96
- Real Permeability: 2000.0
- Imag Permeability: 0.0
- Conductivity: 0.3333333333333333

On the right, a 2D plot shows a dark blue U-shaped core on a grid. The core has a central rectangular window. The plot axes range from -4 to 4 on both the x and y axes. The core is centered at the origin. The plot includes buttons for 'Export', 'Refresh Plot', and 'Fit All'.

Before diving into the results, these slides briefly recap our setup.

We have configured a **U-shape geometry core with Ferroxcube 3C96 material.**

# Winding Selection

The image displays two instances of the MAGNETISiM software interface. The left instance shows the 'Winding Geometry' tab with the following parameters:

- General Winding: Conductor Type: PCB
- PCB/Bobbin Geometry: Left selected; Clearance XY [mm]: 0.2; Clearance Z [mm]: 0.1; Number of Layers: 3; Layer Pitch [mm]: 0.1
- Winding Geometry: Left selected; Nturns: 1,4,1; Copper Thickness [mm]: 0.105; Width of Copper [mm]: 1.1,0.2,1.1; Pitch [mm]: 0.1; Edge [mm]: 0
- Winding Material: Material: Copper; Magnet selected; Real Permeability: 1.0; Imag Permeability: 0.0; Conductivity: 58.0

The right instance shows the same software with the 'Winding Geometry' tab selected, but with the 'Right' option selected in the PCB/Bobbin Geometry section. The 2D plot shows a central dark blue square with four red horizontal bars labeled w1, w2, w3, and w4. The plot axes range from -4 to 4. Buttons for 'Export', 'Refresh Plot', and 'Fit All' are visible at the bottom of the plot area.

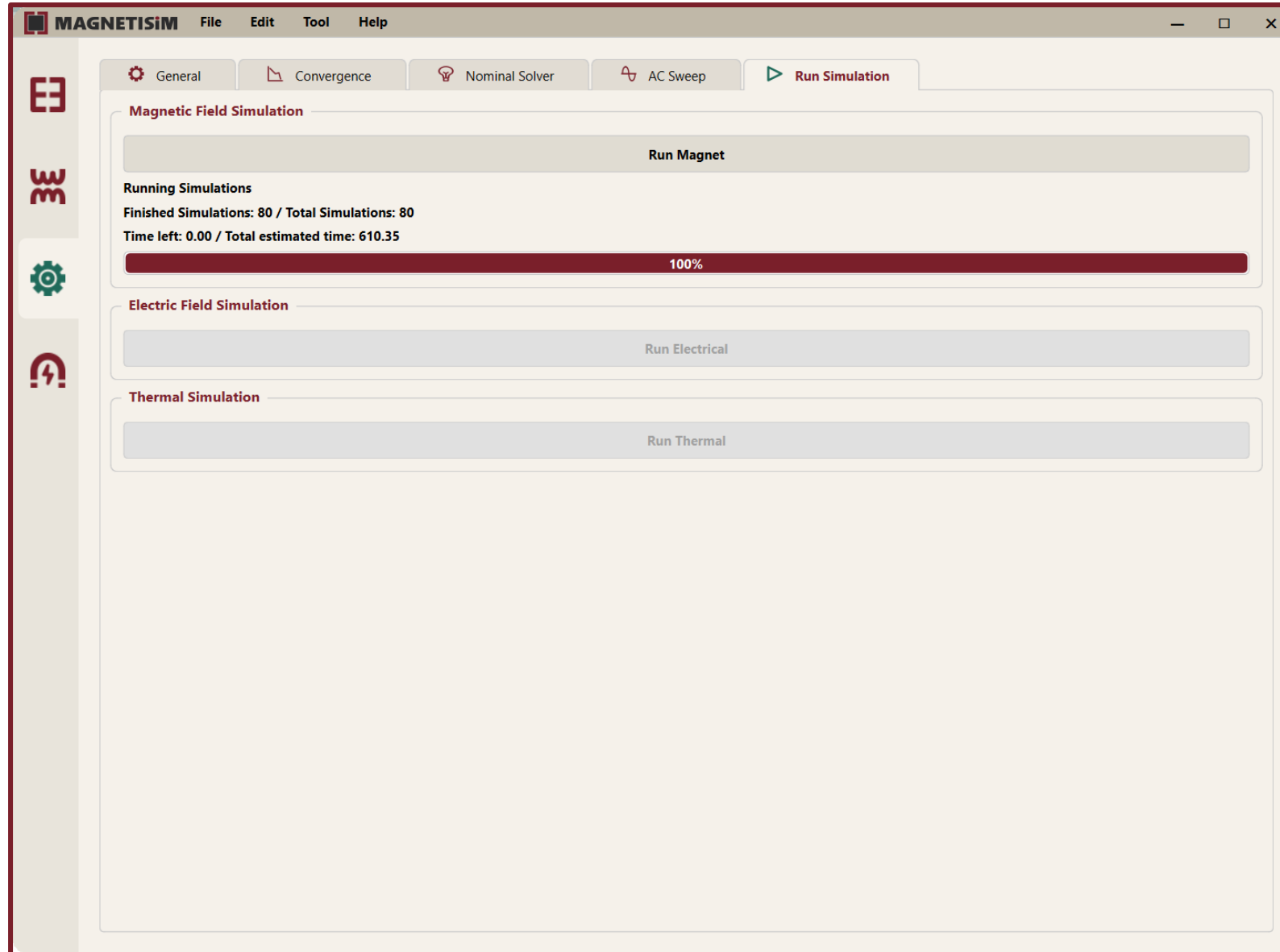
In the **Winding Geometry** tab, we defined four separate PCB windings, visually represented in the 2D modeler as w1, w2, w3, and w4.

The image displays four sequential screenshots of the MAGNETISIM software interface, illustrating the setup process for a simulation. Each window shows the 'MAGNETISIM' title bar and a menu bar with 'File', 'Edit', 'Tool', and 'Help' options.

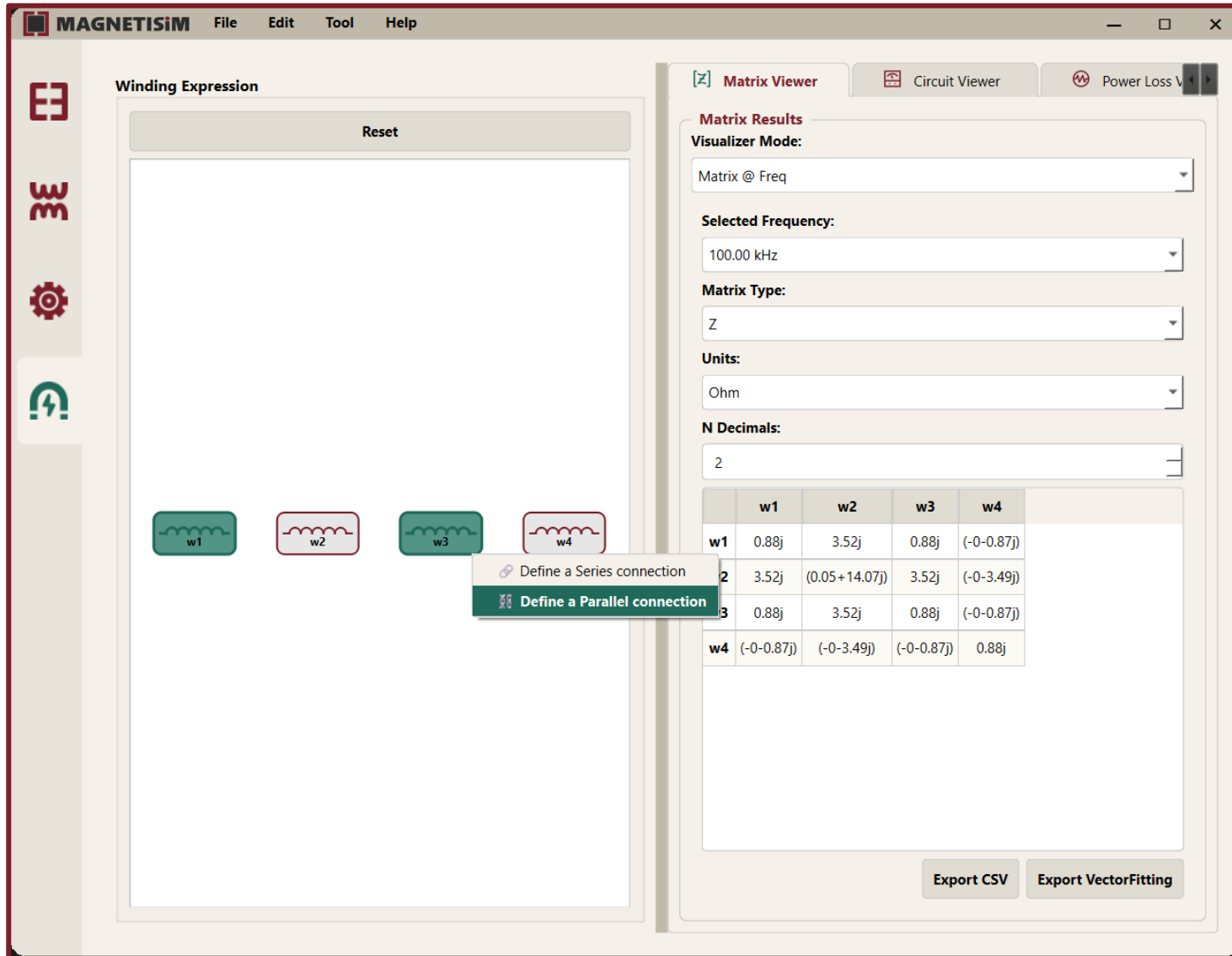
- First Screenshot:** The 'General' tab is active. The 'Name Simulation' field contains 'MAGNETISIM\_file'. The 'Magnetic Field Simulation' checkbox is checked, and the 'Electric Field Simulation' checkbox is unchecked.
- Second Screenshot:** The 'Convergence' tab is active. The 'Max Error [%]' for 'Magnetic Field Simulation' is set to '1e-08', and for 'Electric Field Simulation' it is set to '1e-05'.
- Third Screenshot:** The 'Nominal Solver' tab is active. The 'Nominal Frequency [kHz]' is set to '100'.
- Fourth Screenshot:** The 'AC Sweep' tab is active. The 'Select AC Sweep Type' is set to 'Waveform', the 'Waveform' is set to 'Square', and the 'Number of Harmonics' is set to '10'. Below the settings is a plot titled 'Actual Waveform and Harmonic Creation' showing 'Magnitude' on the y-axis (ranging from -1.0 to 1.0) and 'Time (us)' on the x-axis (ranging from 0 to 10). The plot displays a square wave (Actual Waveform) and its corresponding harmonics (Harmonics).

Finally, we ran a **Magnetic Field Simulation** using a **nominal frequency of 100 kHz** and an **AC Sweep** with a **square waveform** until the progress bar reached 100%.

# Run simulation



# Grouping Windings



The screenshot shows the MAGNETISiM software interface. The main window is titled "Winding Expression" and contains a "Reset" button and a large empty area. Below this area are four winding icons labeled w1, w2, w3, and w4. A context menu is open over the w1 and w3 icons, showing two options: "Define a Series connection" and "Define a Parallel connection". The "Define a Parallel connection" option is highlighted in green.

The "Matrix Viewer" window is open, showing the following settings:

- Matrix Results
- Visualizer Mode: Matrix @ Freq
- Selected Frequency: 100.00 kHz
- Matrix Type: Z
- Units: Ohm
- N Decimals: 2

The matrix data is as follows:

	w1	w2	w3	w4
w1	0.88j	3.52j	0.88j	(-0-0.87j)
w2	3.52j	(0.05+14.07j)	3.52j	(-0-3.49j)
w3	0.88j	3.52j	0.88j	(-0-0.87j)
w4	(-0-0.87j)	(-0-3.49j)	(-0-0.87j)	0.88j

Buttons at the bottom of the Matrix Viewer: Export CSV, Export VectorFitting

MAGNETISiM allows you to group physical windings to reflect real-world connections.

**How-to?** Select windings w1 and w3 in the interface, right-click, and select "**Define a Parallel connection**".

The software automatically mathematically combines them into a single equivalent winding labeled (w1\*w3).

# Power Loss Viewer

**Winding Expression**

Reset

w2 w4

(w1\*w3)

**Power Loss Results**

Frecuencia: 100.00 kHz

Winding Conf.	Excitation Type	Value
1 w2	v	0
2 w4	v	0
3 (w1*w3)	v	0

Analytical Power Loss Simulate Power Loss

	Power Loss (W)
w1	0.000000-0.000000j
w2	0.000000+0.000000j
w3	0.000000+0.000000j
w4	0.000000-0.000000j
<b>Total Winding Loss</b>	0.000000
<b>Bpk (mT)</b>	0.000000
<b>Core Loss</b>	0.000000

Export to CSV

**Define the Operating Point** - First, select the target Frequency from your simulated AC Sweep range. Power losses are highly frequency-dependent due to skin/proximity effects and core material properties.

**Set Excitations** - Just like in the Circuit Viewer, you must define how the component is being driven. Assign an Excitation Type (Voltage or Current) and a numerical Value to your active windings (or winding groups).

**Execution Options** - You have two ways to calculate the results:

- **Analytical Power Loss** - Uses mathematical approximations for a rapid estimation.
- **Simulate Power Loss** - Uses the full Finite Element Analysis (FEA) field data for highly accurate results, capturing complex geometries and non-sinusoidal waveforms.

# Comparison

By comparing these side-by-side, you can validate whether standard analytical equations are sufficient for your specific geometry, or if full FEA is required to ensure Core loss.

The image displays the MAGNETISIM software interface, divided into three main sections:

- Winding Expression:** Shows three winding configurations: w2, w4, and (w1\*w3).
- Power Loss Results:** Displays a table of power loss values for each winding and total winding loss.
- Circuit Diagram:** Shows a circuit with an AC source (SINE(0 50 100k)) connected to a transformer (MAGNETISIM\_3Ports) with three secondary windings (P1: w2, P2: w4, P3: (w1\*w3)) and resistors (R4, R5).

The **Power Loss Results** table is as follows:

Winding Conf.	Excitation Type	Value
1 w2	v	50
2 w4	r	10
3 (w1*w3)	r	10

	Power Loss (W)
w1	2.238538-1.754659j
w2	-15.225281+88.915824j
w3	5.573215+1.754659j
w4	7.712357+0.000000j
<b>Total Winding Loss</b>	<b>0.298830</b>
<b>Bpk (mT)</b>	<b>3801.895313</b>
<b>Core Loss</b>	<b>167.944406</b>

The **Waveform** analysis shows the following statistics:

- Interval Start: 17.3ms
- Interval End: 18.5ms
- Average: 283.66mW
- Integral: 340.4μJ

The waveform plot shows a high-frequency signal with a period of approximately 20ms. The circuit diagram includes an AC source (SINE(0 50 100k)) connected to a transformer (MAGNETISIM\_3Ports) with three secondary windings (P1: w2, P2: w4, P3: (w1\*w3)) and resistors (R4, R5).

# Analytical Calculation: Local

**MAGNETISiM** File Edit Tool Help

Winding Expression

Reset

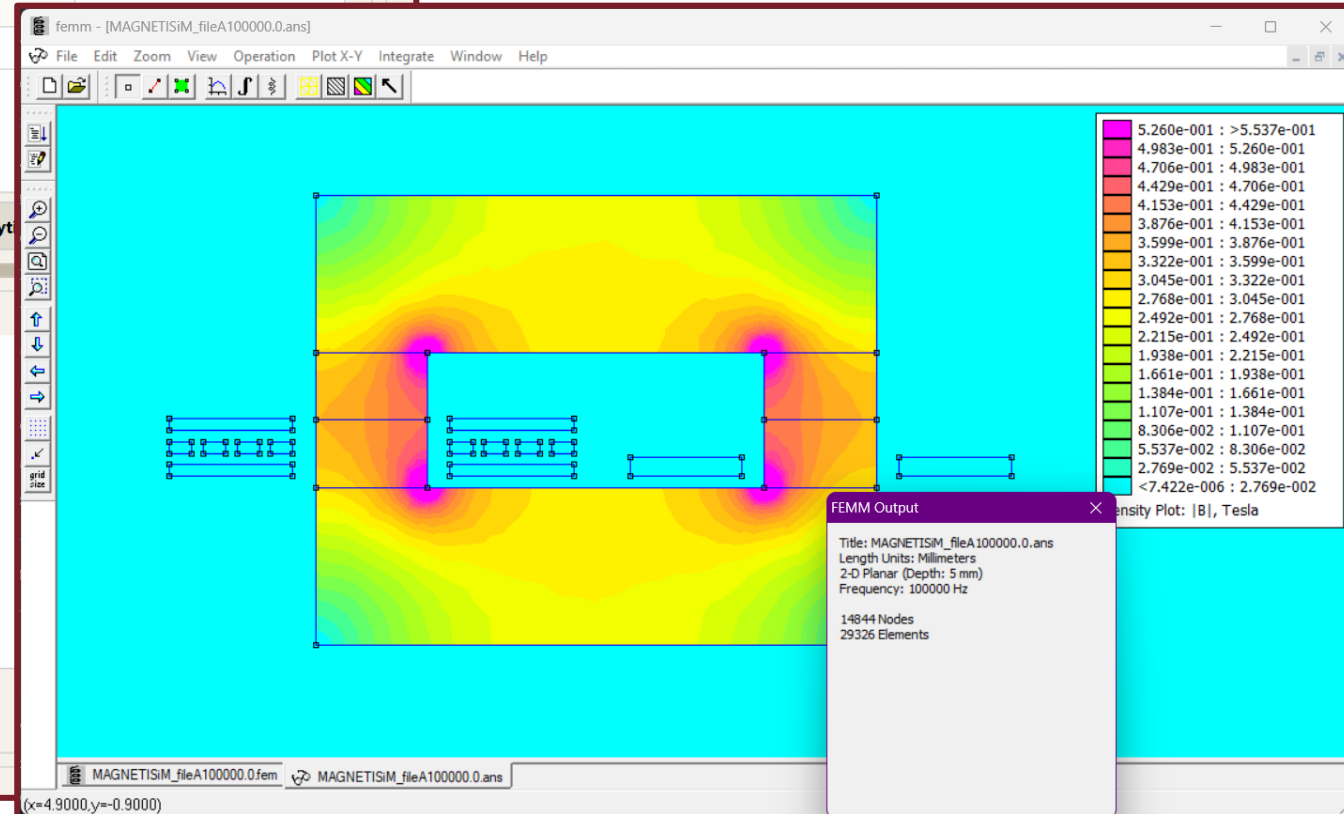
Winding Conf. Excitation Type Value

1	w2	v	5
2	w4	r	10
3	(w1*w3)	r	10

Power Loss Results

Frecuencia: 100.00 kHz

	Power Loss (W)
w1	0.022385-0.017547j
w2	-0.152253+0.889158j
w3	0.055732+0.017547j
w4	0.077124+0.000000j
<b>Total Winding Loss</b>	0.002988
<b>Bpk (mT)</b>	380.189531
<b>Core Loss</b>	0.321341



# FEA B Calculation: Average

**MAGNETISiM** File Edit Tool Help

Winding Expression

Reset

w2 w4

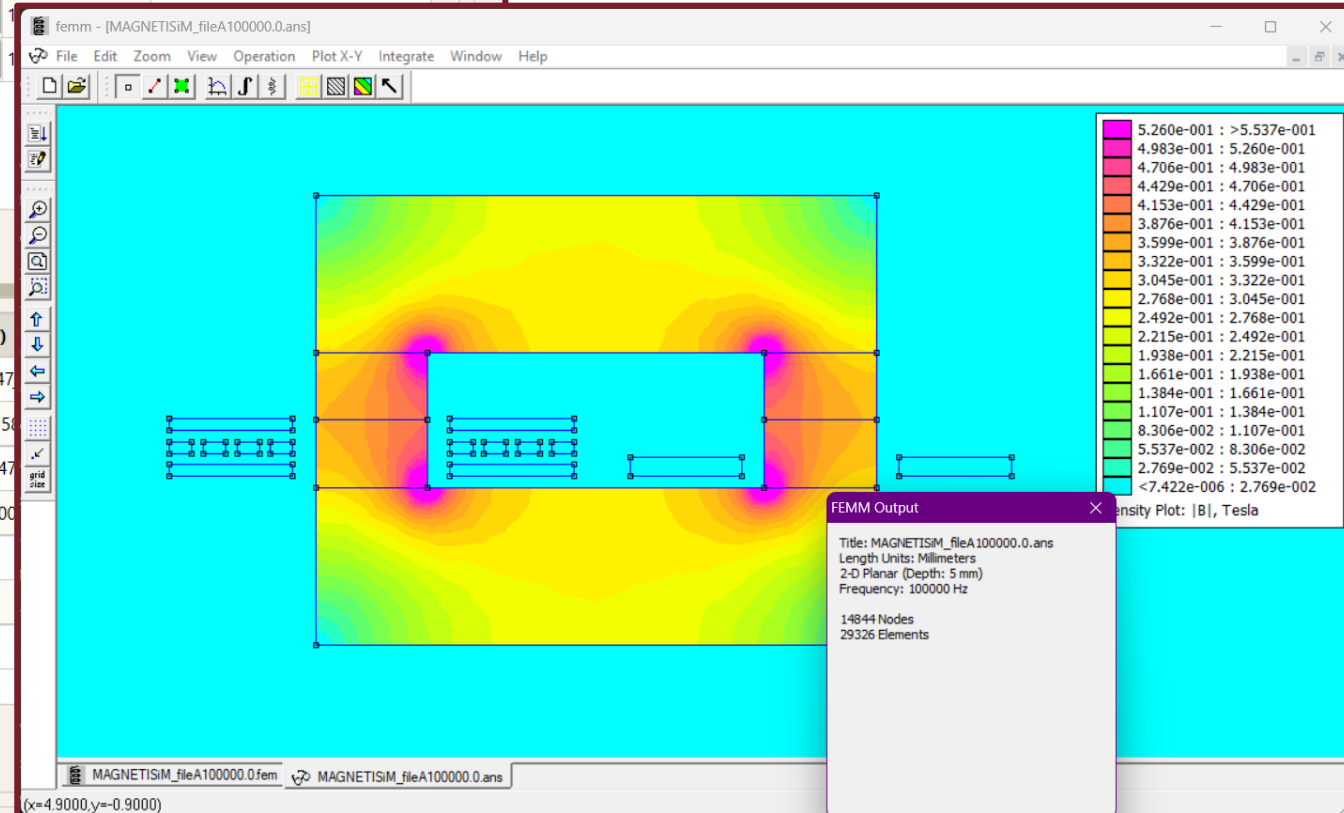
(w1\*w3)

Matrix Viewer Circuit Viewer **Power Loss Viewer**

**Power Loss Results**  
Frecuencia: 100.00 kHz

Winding Conf.	Excitation Type	Value
1 w2	v	5
2 w4	r	1
3 (w1*w3)	r	1

	Power Loss (W)
w1	0.022385-0.017547
w2	-0.152253+0.889158
w3	0.055732+0.017547
w4	0.077124+0.000000
<b>Total Winding Loss</b>	<b>0.002988</b>
<b>Bpk (mT)</b>	<b>296.804658</b>
<b>Core Loss</b>	<b>0.163938</b>





**Alberto Vital Pagola**

[alberto.vital@upm.es](mailto:alberto.vital@upm.es)

CEIMM-UPM

Madrid, Spain



**Alberto Delgado**

[a.delgado@upm.es](mailto:a.delgado@upm.es)

CEIMM-UPM

Madrid, Spain



[magnetisim.com](http://magnetisim.com)