



# MAGNETISiM

Analysing Results: Magnet Simulation  
Matrix 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, there is a menu bar with 'File', 'Edit', 'Tool', and 'Help'. Below the menu bar is a vertical 'TAB MENU' on the left side, containing four icons: a core geometry icon, a winding geometry icon, a gear icon, and a magnet icon. The main area is divided into two sections. The left section is the 'INPUT FRAME', which is currently showing the 'Core Geometry' tab. It contains several dropdown menus for 'Manufacturer' and 'Core Reference', and a series of 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]. Below these is the 'Core Material' section, which includes a 'Material' dropdown, four tabs for 'Magnet', 'Power Loss', 'Electrical', and 'Thermal', and input fields for 'Real Permeability', 'Imag Permeability', and 'Conductivity'. There is also a button to 'Add Permeability(f) Curve' and a checkbox for 'Permeability(f) from Internal-Database'. The right section is the 'MODELER WINDOW', which is currently showing a 2D plot with a grid. The x-axis ranges from -0.6 to 0.6, and the y-axis ranges from -0.9 to 0.9. At the bottom of the plot area, there are three buttons: '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. The left sidebar contains navigation icons for Home, Settings, and Refresh. The main window is divided into two panels: 'Core Geometry' and 'Core Material'.

**Core Geometry 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

**Core Material Settings:**

- Material: 3C96
- Real Permeability: 2000.0
- Imag Permeability: 0.0
- Conductivity: 0.3333333333333333
- Buttons: Magnet, Power Loss, Electrical, TH
- Checkbox:  Permeability(f) from Internal-Database

The right panel shows a 2D plot of the core geometry on a grid. The core is a dark blue U-shape with a central window. The plot axes range from -4 to 4. The core has a width of 5.0 mm (A), a height of 3.0 mm (B), and a gap of 2.0 mm (D). The plot includes 'Export', 'Refresh Plot', and 'Fit All' buttons.

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 shows two instances of the MAGNETISiM software interface. The left instance is in the 'Winding Geometry' tab, showing parameters for four separate PCB windings (w1, w2, w3, w4). The right instance is in the '2D' view, showing a 2D plot of the windings on a grid.

**Left Window 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

**Right Window Parameters:**

- General Winding:** Conductor Type: PCB
- PCB/Bobbin Geometry:** Right selected. Clearance XY [mm]: 0.2, Clearance Z [mm]: 0.1, Number of Layers: 1, Layer Pitch [mm]: 0.2,0.2,0.2
- Winding Geometry:** Right selected. Nturns: 1; Copper Thickness [mm]: 0.175; Width of Copper [mm]: 1.0; Pitch [mm]: 1.0; Edge [mm]: 0.0
- Winding Material:** Material: Copper. Magnet selected. Real Permeability: 1.0, Imag Permeability: 0.0, Conductivity: 58.0

The 2D plot shows a central square core with four windings (w1, w2, w3, w4) placed around it. The plot axes range from -4 to 4 on both X and Y.

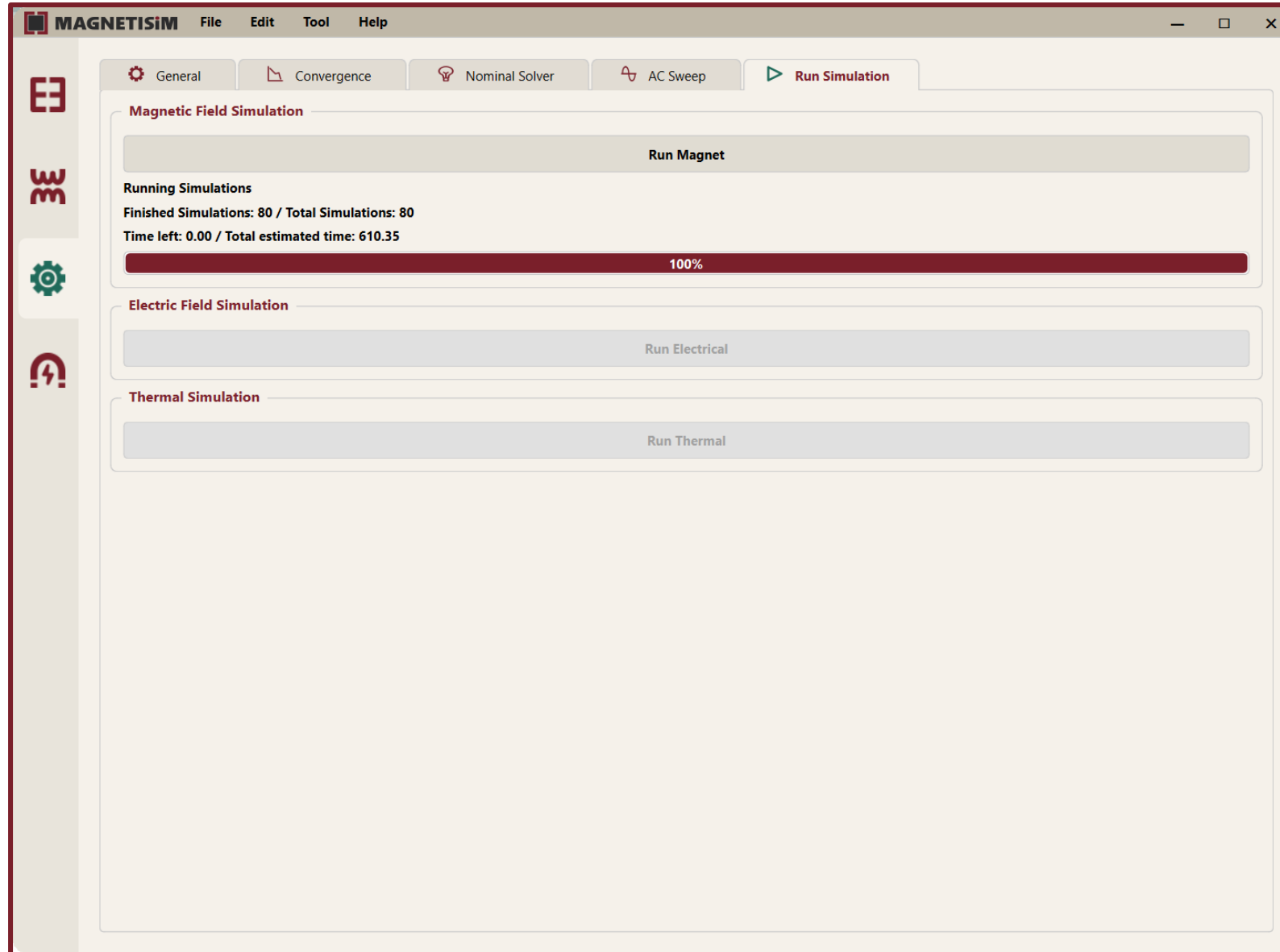
In the **Winding Geometry** tab, we defined four separate PCB windings, visually represented in the 2D modeler as w1, w2, w3, and w4.

The image displays four sequential screenshots of the MAGNETISIM software interface, illustrating the setup process for a Magnetic Field Simulation. The interface includes a menu bar (File, Edit, Tool, Help) and a toolbar with icons for General, Convergence, Nominal Solver, AC Sweep, and Run Simulation.

- First Screenshot:** The 'General' tab is active. The 'Name Simulation' field is set to '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 the 'Magnetic Field Simulation' is set to  $1e-08$ , and for the '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 the magnitude of the waveform and its harmonics over time (0 to 10  $\mu\text{s}$ ). The plot shows a square wave with a magnitude of 1.0 and -1.0, and a dashed line representing the harmonics.

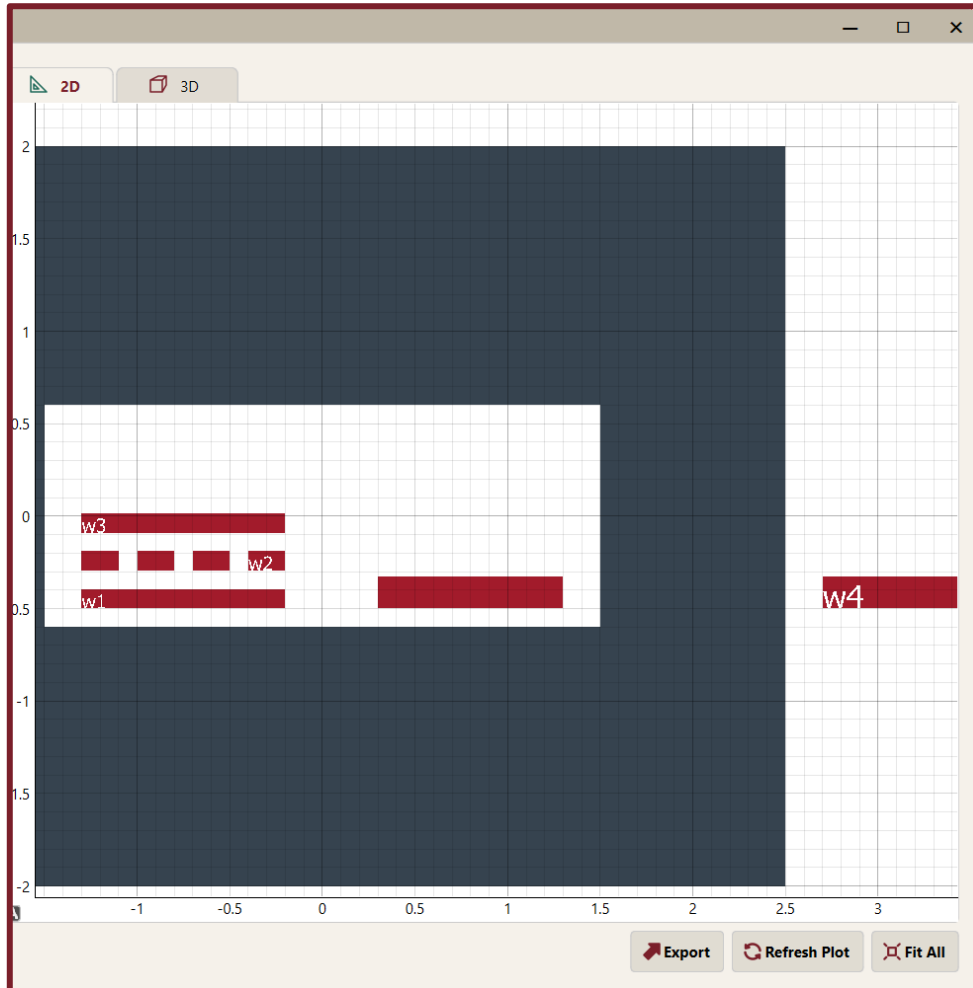
Finally, we ran a **Magnetic Field Simulation** using a **nominal frequency of 100 kHz** and an **AC Sweep** with a **square waveform** until the progress bar reached 100%.

# Run simulation



# Matrix Viewer

Once the simulation is complete, we navigate to the **Matrix Viewer tab**. By setting the **Visualizer Mode** to "**Matrix @ Freq**", we can view the data as a table for a specific selected frequency, such as 100 kHz. If we set the **Matrix Type** to **R (Resistance)** and **Units** to **uOhm**, we get a 4x4 matrix showing the resistance values for our four independent windings.



MAGNETISIM Matrix Viewer interface. The **Winding Expression** section shows four windings labeled w1, w2, w3, and w4. The **Matrix Results** section shows the following settings:

- Visualizer Mode:** Matrix @ Freq
- Selected Frequency:** 100.00 kHz
- Matrix Type:** R
- Units:** uOhm
- N Decimals:** 2

	w1	w2	w3	w4
w1	2218.17	1604.83	385.99	-42.74
w2	1604.83	45715.46	1538.96	-194.15
w3	385.99	1538.96	2182.82	-55.25
w4	-42.74	-194.15	-55.25	1654.0

Buttons: Export CSV, Export VectorFitting

# Matrix Viewer

The screenshot shows the MAGNETISiM software interface. On the left, the 'Winding Expression' panel contains a 'Reset' button and four inductor symbols labeled w1, w2, w3, and w4. On the right, the 'Matrix Viewer' tab is active, showing the following settings:

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

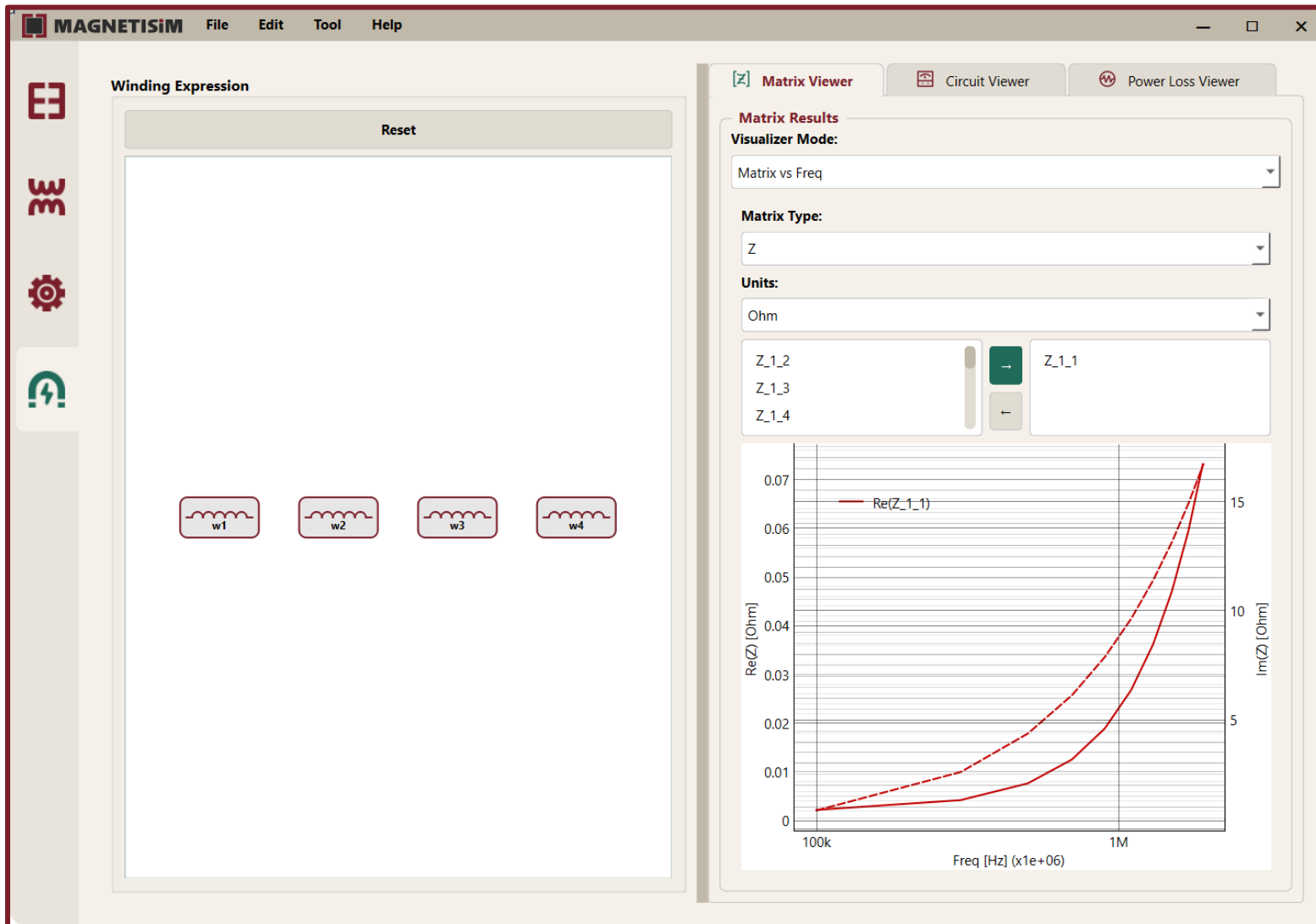
The resulting matrix is displayed in the following table:

	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 for 'Export CSV' and 'Export VectorFitting' are located at the bottom right of the Matrix Viewer panel.

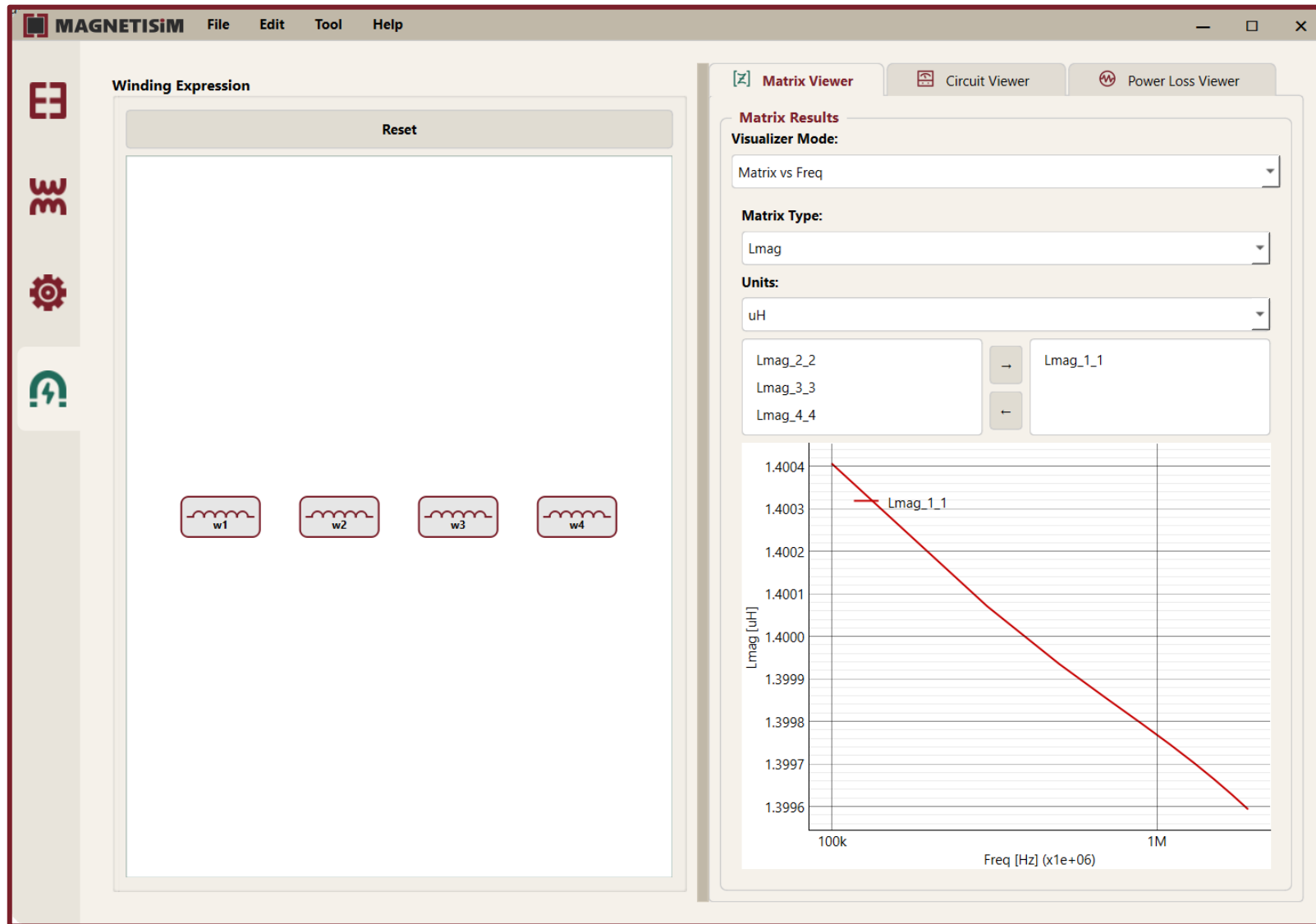
If we switch the Matrix Type to **Z (Impedance)** in **Ohms**, the table updates to display complex numbers, providing both the real and imaginary components.

# Matrix vs Freq

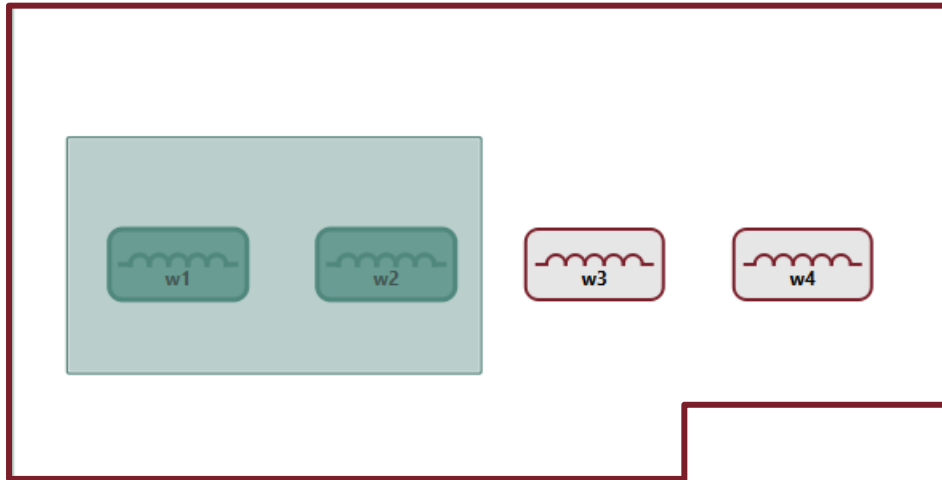


To see how parameters behave across the simulated spectrum, change the **Visualizer Mode** to "**Matrix vs Freq**".

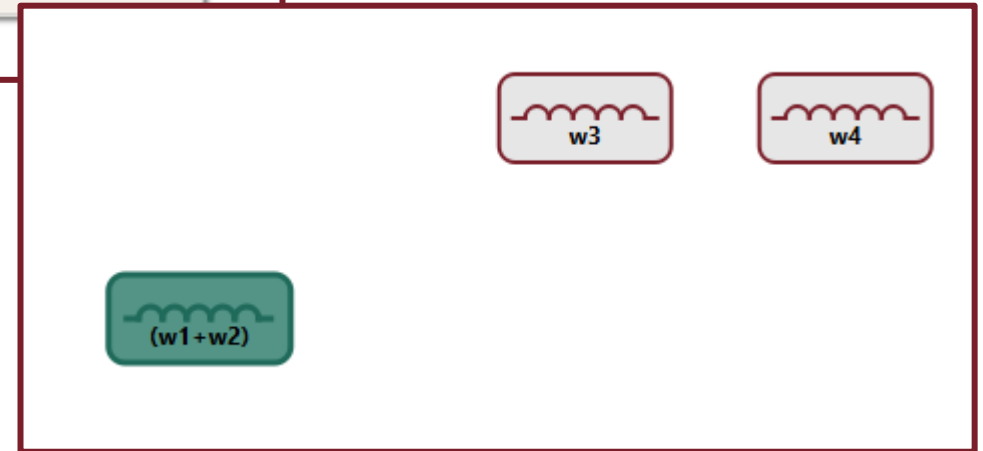
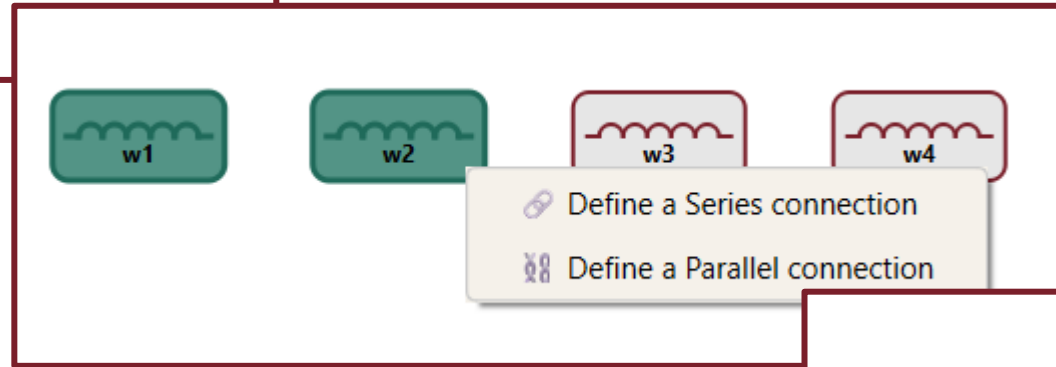
# Also, the magnetising inductance

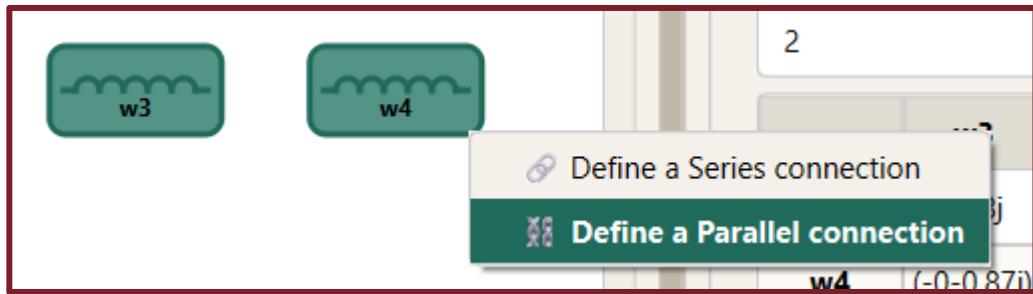


# Winding Expression window

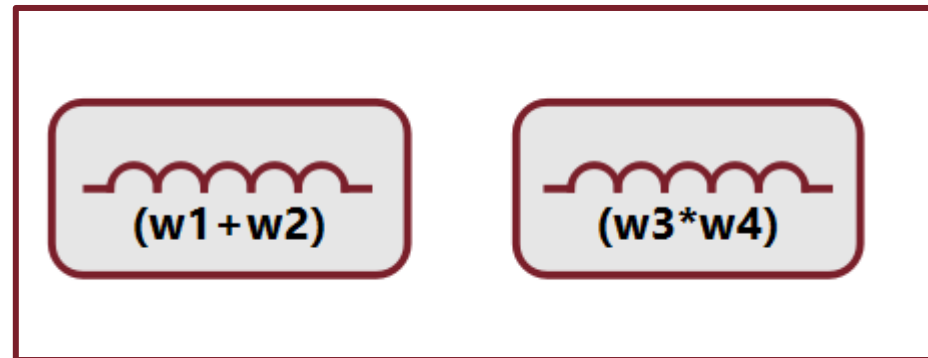


Instead of analyzing four separate wires, you can simulate physical connections. By selecting windings w1 and w2 and right-clicking, you can choose "**Define a Series connection**".





Similarly, you can select  $w_3$  and  $w_4$ , right-click, and choose "**Define a Parallel connection**", which creates a group labeled  $(w_3*w_4)$ .



# Matrix Viewer

**Winding Expression**

Reset

(w1+w2) (w3\*w4)

**Matrix Viewer** | Circuit Viewer | Power Loss Viewer

**Matrix Results**

Visualizer Mode: Matrix @ Freq

Selected Frequency: 100.00 kHz

Matrix Type: L

Units: uH

N Decimals: 4

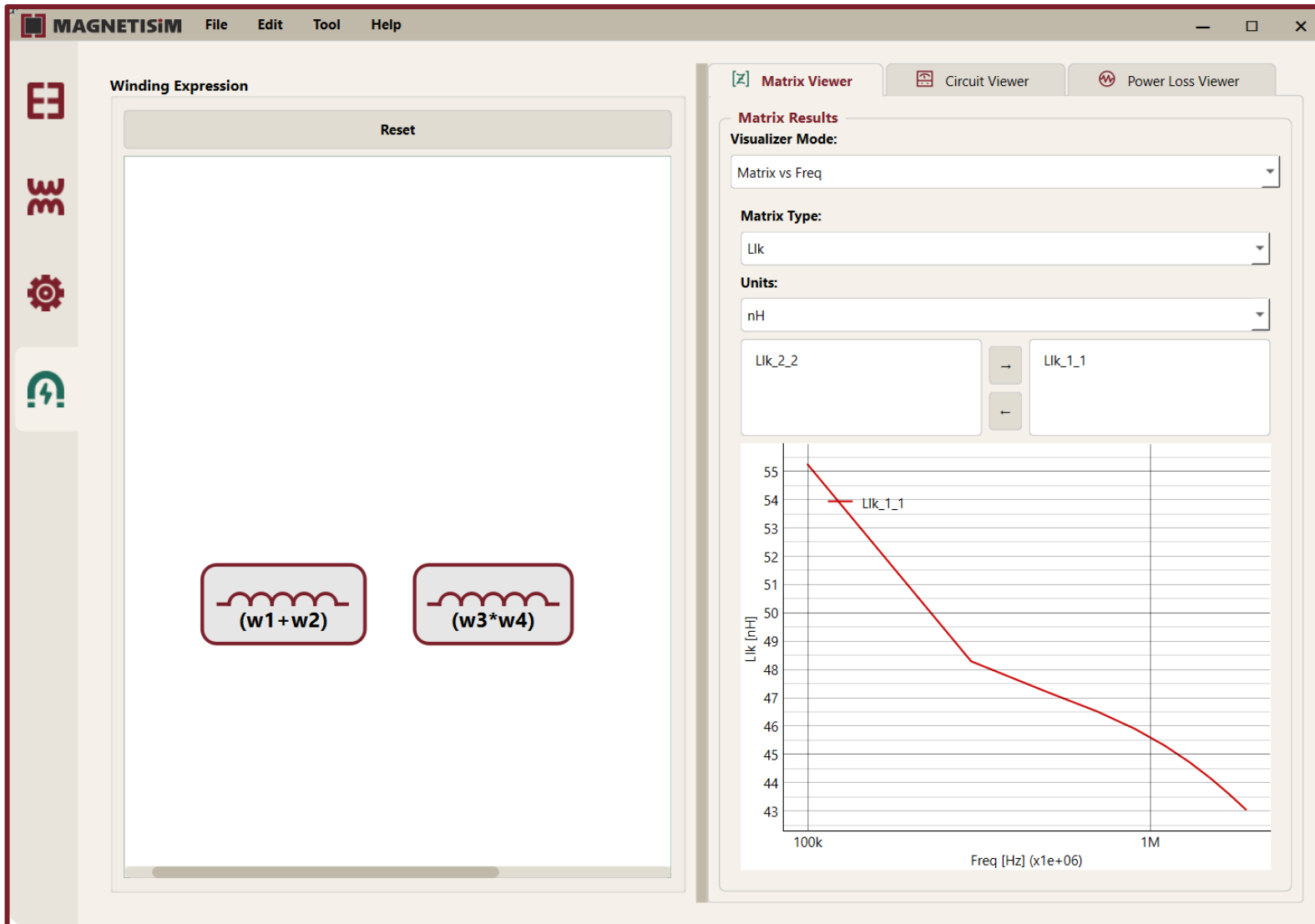
	(w1+w2)	(w3*w4)
(w1+w2)	0.1487	0.0226
(w3*w4)	0.0226	0.0051

Export CSV | Export VectorFitting

Once you group your windings, the mathematical matrix on the right dynamically updates to reflect these new connections.

Because we combined four windings into two groups, the matrix automatically reduces from a 4x4 to a 2x2 matrix.

# Plotting leakage



With the new grouped setup, you can plot advanced parameters.

Here, we select the Matrix Type Llk (Leakage Inductance) in nanohenries (nH) and plot it against frequency to analyze the magnetic leakage of our newly connected winding groups.



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