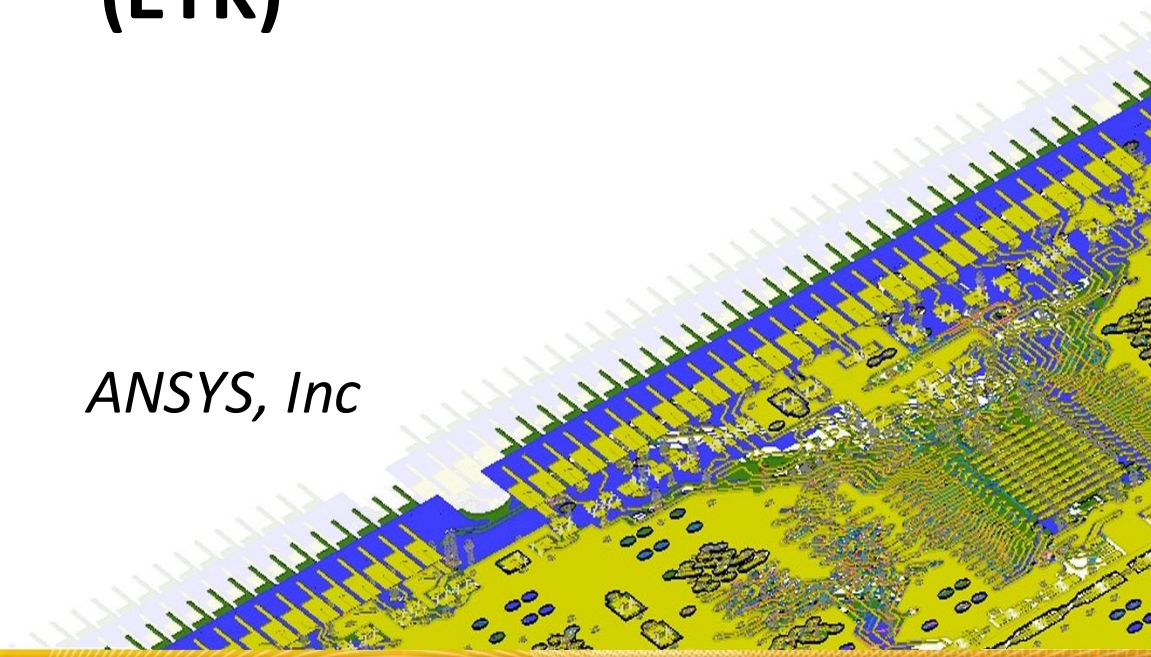
ACT: Electronic Transformer R19.1 (ETK)

ANSYS, Inc



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ETK Overview

- Supported releases: ETK supports Electronics Desktop of versions r19.1 and higher
- What does the "Electronic Transformer ACT" do?
  - → It automatically sets up a ready-to-solve Maxwell 3D Eddy Current design for planar magnetic components. Permeability is linear and frequency dependent. Steinmetz core loss coefficients are frequency dependent. A frequency dependent state-space model can be created for Simplorer (and Pspice) using Network Data Explorer.
- What devices can it model?
  - → It is intended for electronic ferrite core transformers and inductors in the 100kHz range (but NOT for oil-filled transformers in the 50-60Hz range).
- How easy is it to use?
  - → ACT consists of three input steps which can be setup in 10-15 minutes
- Are any manufacturer libraries included?
  - → Philips and Ferroxcube with 15 core shapes are included in the initial release.
- How is the "Electronic Transformer ACT" different from PExprt?
  - → The "Electronic Transformer ACT" is a script using only Maxwell 3D (PExprt uses both 2D and 3D). It provides only an FEA based solution (PExprt creates both analytical and FEA based) using pre-defined design inputs (PExprt totally creates designs). Litz and twisted wire cannot be considered in the ETK. Capacitance is not considered in the ETK unless a separate electrostatic design is created manually.

ACT App Store

- ***https://appstore.ansys.com/shop/ACTApps_act%20apps***
- **Great place to get started**
  - A library of helpful applications available to any ANSYS customer
  - New apps added regularly
  - Applications made available in either binary format (.wbex file) or binary plus scripted format (Python and XML files)
  - Scripted extensions are great examples
  - Documentation and training materials available on the ANSYS Customer Portal: https://support.ansys.com/AnsysCustomerPortal/en_us/Downloads/ACT+Resources

Information

- **Please pay attention to paragraph 9 of the CLICKWRAP SOFTWARE LICENSE AGREEMENT FOR ACS EXTENSIONS regarding TECHNICAL ENHANCEMENTS AND CUSTOMER SUPPORT (TECS): "TECS is not included with the Program(s)"**

- **Report any issue or provide feedback related to this app please contact:**

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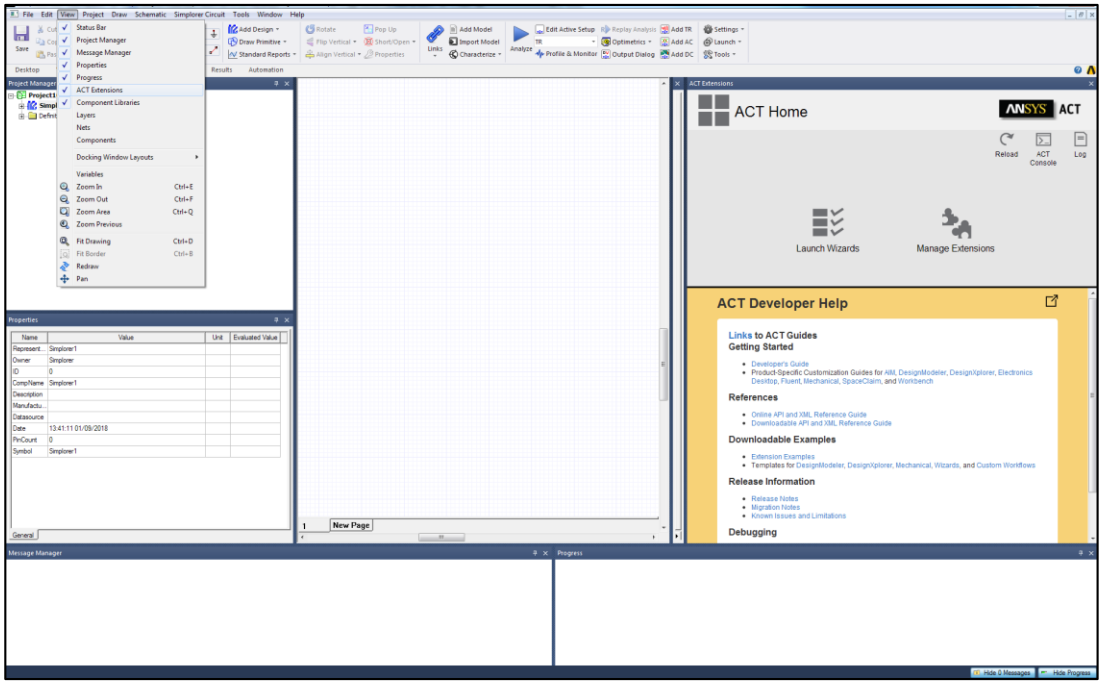
Install the Extension

- **The extension can be downloaded from ANSYS ACT Application Store https://appstore.ansys.com/shop/ACTApps_act%20apps**

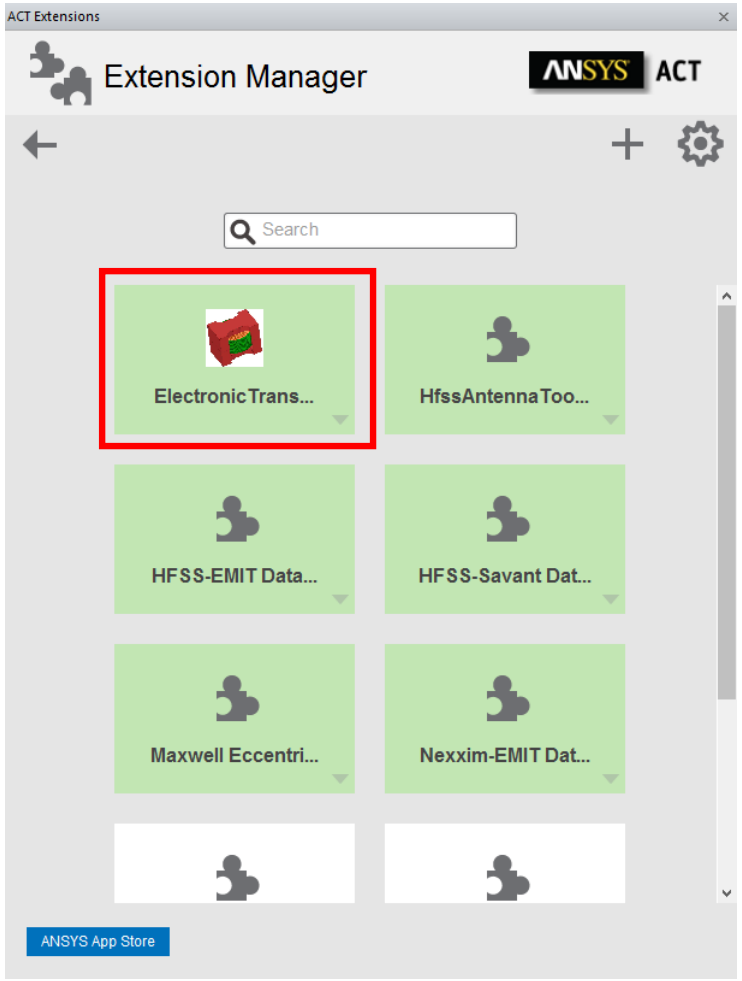


To install extension:

1) Open Electronics Desktop
2) Ensure the ACTs are visible by selecting from the menu:
View -> ACT Extensions
(there should be a checkmark next to ACT Extensions, then you'll be able to access the ACT Home window as shown in the right figure)
3) Click on *Extension Manager*, click on the "+" sign to install extensions, select the *wbex* file downloaded from the ANSYS ACT Application Store.

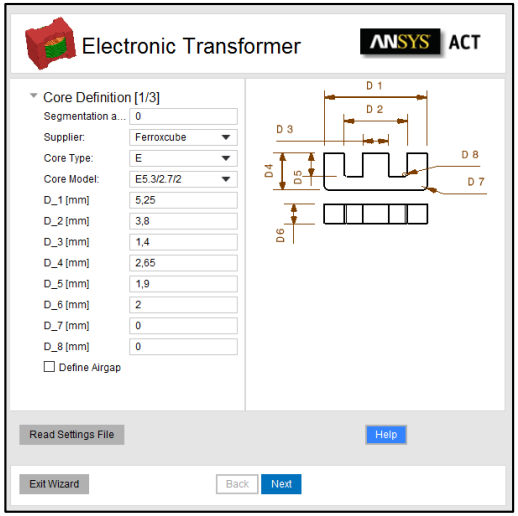
Install the Extension

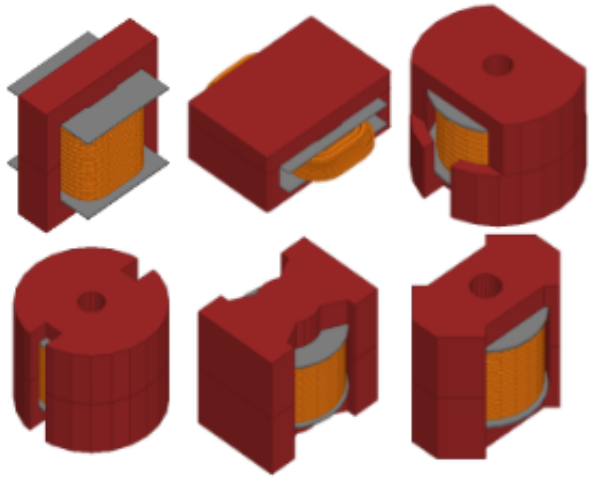
- After installing the extension, you will see the extension.
- Import extension appears in the Extension Manager with a white background, which means it has been installed but not yet loaded. To load the extension, you can just simply click on it. If the extension is loaded successfully, the icon's background should be green.
- Now you can run ACT from Launch Wizard panel



Input panel 1 of 3: Core Definition

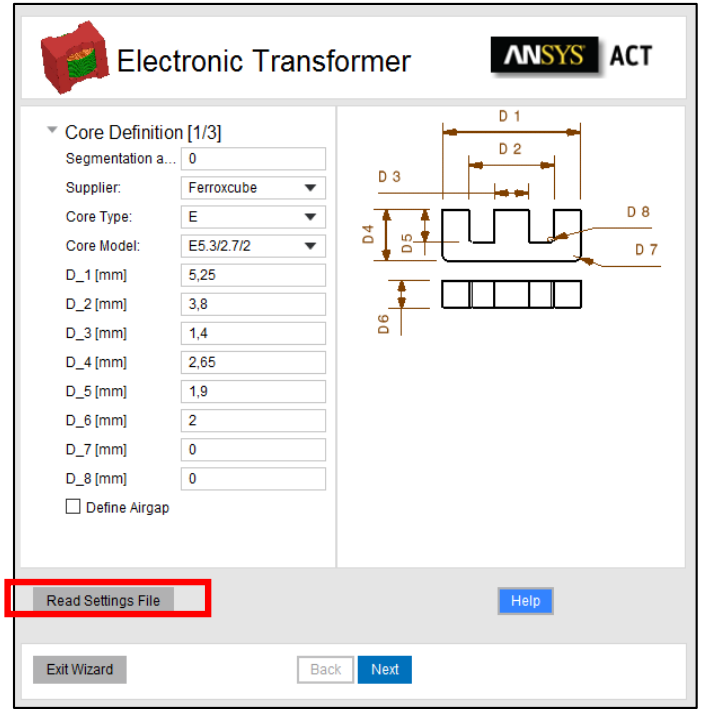
- Two options to set-up a transformer model:
  1. Read input data from a previously recorded .tab text file
  2. Create a totally new design
- Select Supplier, Core Type, Core Model
- 15 available core shapes from Philips/Ferroxcube
- Choose default dimensions or manually modify





Recorded input file – used to recreate model in future

- A .tab file is automatically recorded and saved in the Maxwell default project folder each time when analysis is setup
- Input file can be re-run by selecting "Read Settings File" on the core definition input step *(note Core Model box will remain unchanged)*
- The .tab file can also be manually modified in text editor to make changes in parameters before re-running




```
15          %Segmentation Angle: should be between 0 to 20
mm          %Model Units: mm or inches
Phillips            %Supplier Name
EI          %Core Type
64.0    53.8    10.2    10.2    5.1 50.8    0.64    5.08            %CoreDimensions: D1,D2,D3,D4,D5,D6,D7,D8
0           %Include Airgap: 0 to exclude, 1 for Airgap on central leg, 2 for Side leg, 3 for both
1           %Winding Status: 1 for Create Winding, 0 for exclude winding
8           %Number of Layers
0.2 0.1 0.2 0           %Margin Dimensions (Top Margin, Side Margin, Layer Spacing, Bobbin Thickness)
0           %Bobbin Status 0:Exclude bobbin from Geometry 1:Include Bobbin in Geometry
1           %Winding Type 1:TopDown 2:Concentric
1           %Conductor Type 1:Rectangular 2:Circular
21.2    0.25    1   0.05            %Layer 1 specifications :Conductor Width, Conductor Height, Number of Turn
21.2    0.25    1   0.05            %Layer 2 specifications :Conductor Width, Conductor Height, Number of Turn
7   0.25    3   0.05            %Layer 3 specifications :Conductor Width, Conductor Height, Number of Turns, I
7   0.25    3   0.05            %Layer 4 specifications :Conductor Width, Conductor Height, Number of Turns, I
7   0.25    3   0.05            %Layer 5 specifications :Conductor Width, Conductor Height, Number of Turns, I
7   0.25    3   0.05            %Layer 6 specifications :Conductor Width, Conductor Height, Number of Turns, I
21.2    0.25    1   0.05            %Layer 7 specifications :Conductor Width, Conductor Height, Number of Turn
21.2    0.25    1   0.05            %Layer 8 specifications :Conductor Width, Conductor Height, Number of Turn
```

Examples of .tab files

- ***In the archive downloaded from ACT App store you can find examples of four .tab files. This files contain geometry definition and setup ready to run analysis.***

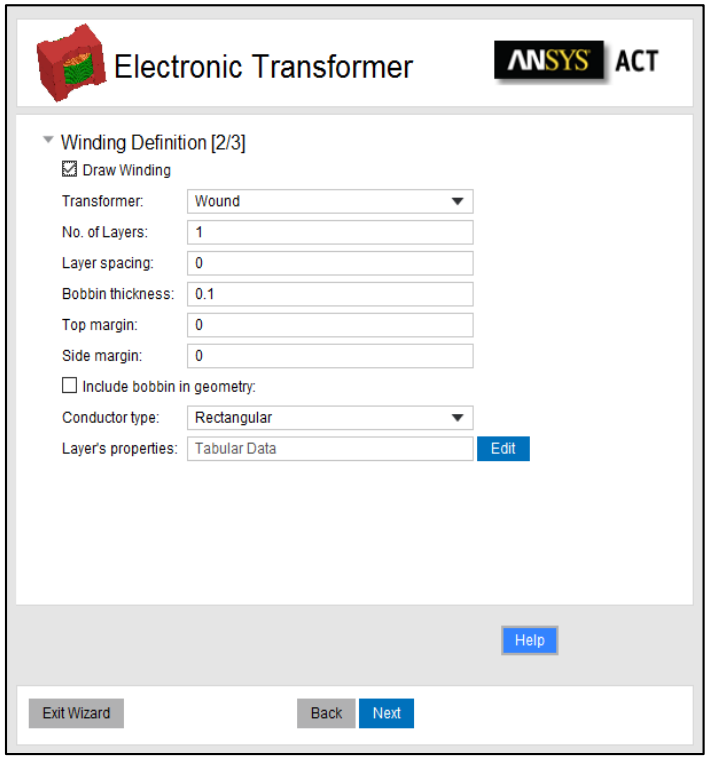
Planar:	***Wound:***
Demo_PlanarComponents_9.tab	*Demo_Gap_Influence_74_.tab*
Demo_IEEE.tab	*Demo_WireWound.tab*

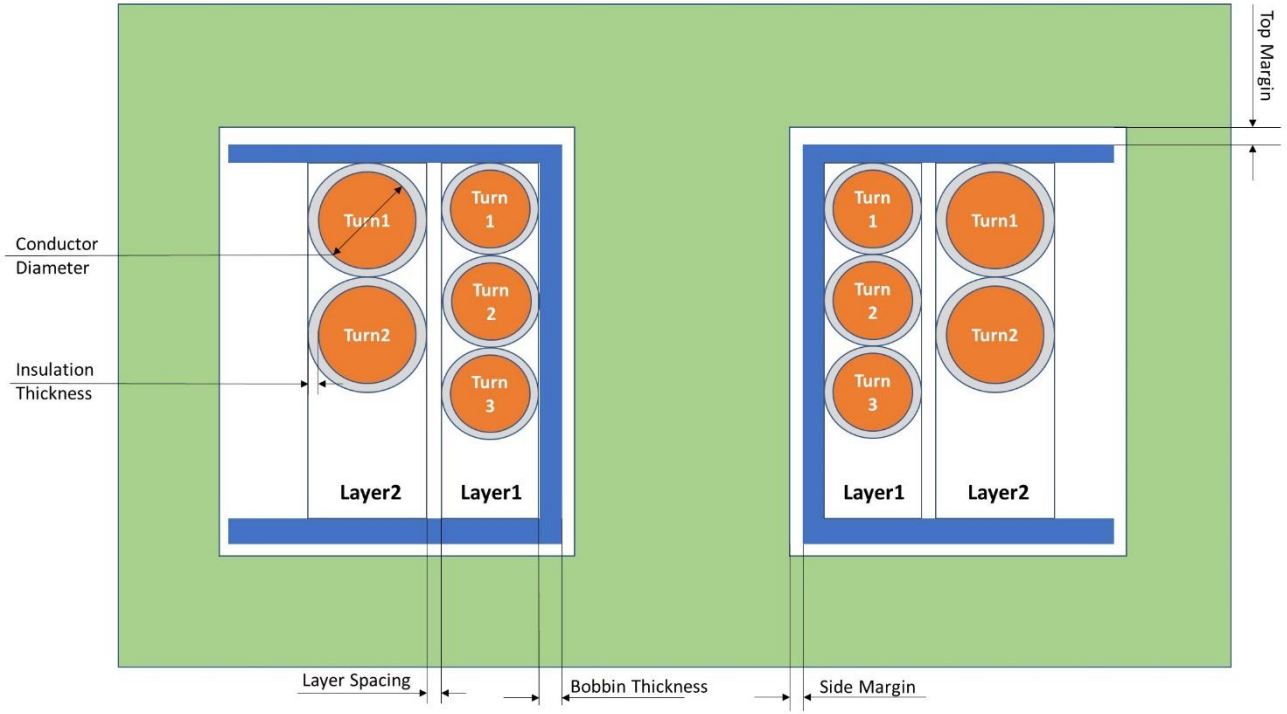
Note: Inside of .wbex file are also prebuild this four examples. To find them after installation copy/paste the following path:

%USERPROFILE%\AppData\Roaming\Ansys\v191\ACT\extensions\ElectronicTransformer

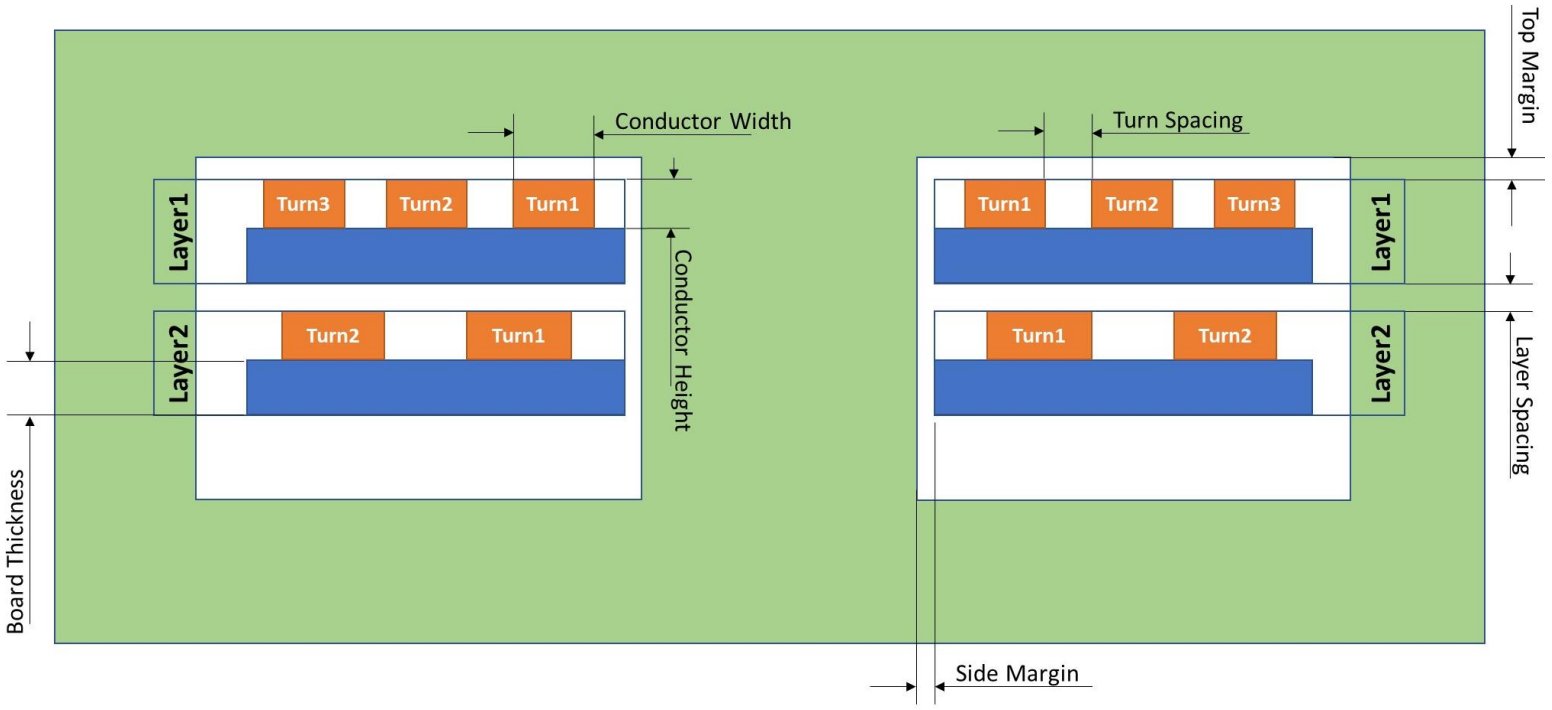
Input panel 2 of 3: Winding Definition

- Transformer type: Wound/Planar
- Number of Layers, Layer Spacing, Bobbin/Board Thickness, Top/Bottom Margin size, Side Margin size
- Layer Type: Top Down or Concentric
- Conductor Type: Rectangular or Circular (only for wound)
- For each layer: Conductor Width, Conductor Height, Number of Turns, and Insulation Thickness/Turn Spacing





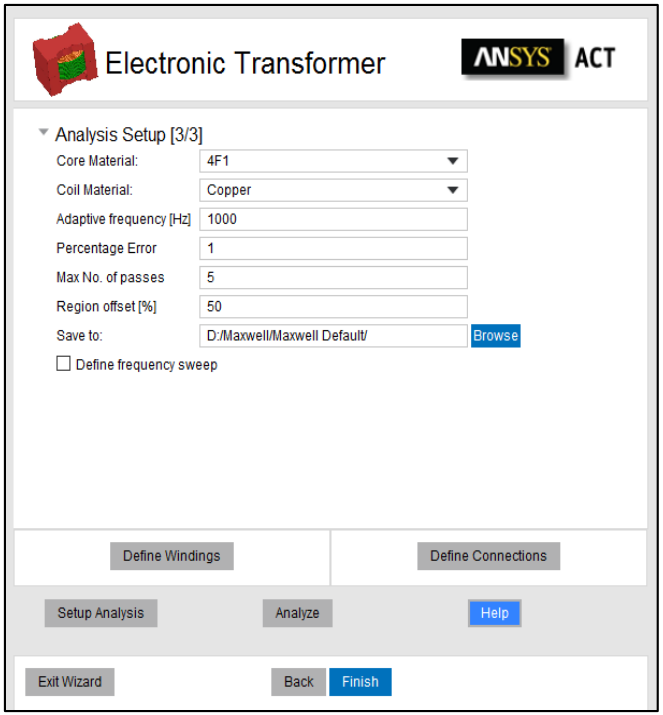
Wound Transformer

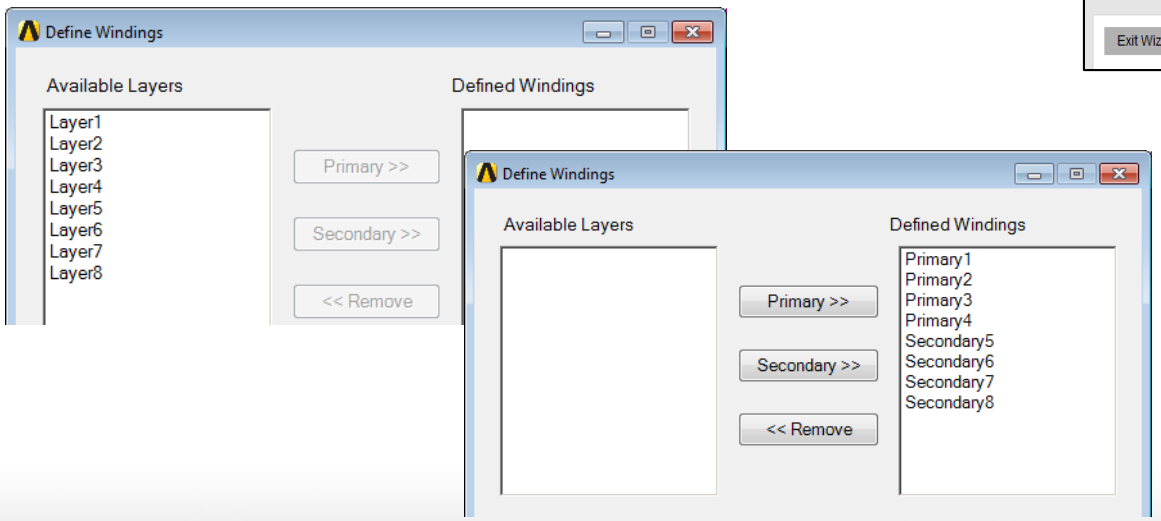


Planar Transformer

Input panel 3 of 3: Analysis Setup

- Define Core Material and Coil Material
- Define Primary and Secondary Windings
- Define series or parallel connections for primary and secondary windings
- Define adaptive frequency, frequency sweep, % error and max number of passes
- Setup Analysis to create design OR Analyze to setup and solve design





Adding a New Core Material

In order to add a new core material, users can follow below steps

1. Make test run of the ACT to create geometry, this will create file folder *Materials* and file *matdata.tab* in personalLib folder defined in Electronics Desktop
2. Create a tab file for frequency versus permeability for the required core. Sheet Scan option available in Maxwell can help for creation of the tab fil.
3. Name the tab file same as the name of the material to be added
4. Place the tab file in that folder …*PersonalLib**Materials*
5. Open "matdata.tab" file in Excel
6. Add a row for the material to be added and specify name and other material properties
7. Save the file with same name.

Once this is done, the material should be available for selection for next run of the ACT

1	"X" "Y"
2	0 1800
3	98459.681589469503 1805
4	128193.25309275401 1810
5	164335.10138502999 1815
6	197983.598439825 1836
7	246043.12589684501 1880
8	296421.78101870802 1923.2
9	346199.02680051897 2014.5999999999999
10	391975.05251181999 2086
11	450746.729490244 2160
12	502485.57112693402 2236.5
13	596047.538592714 2426

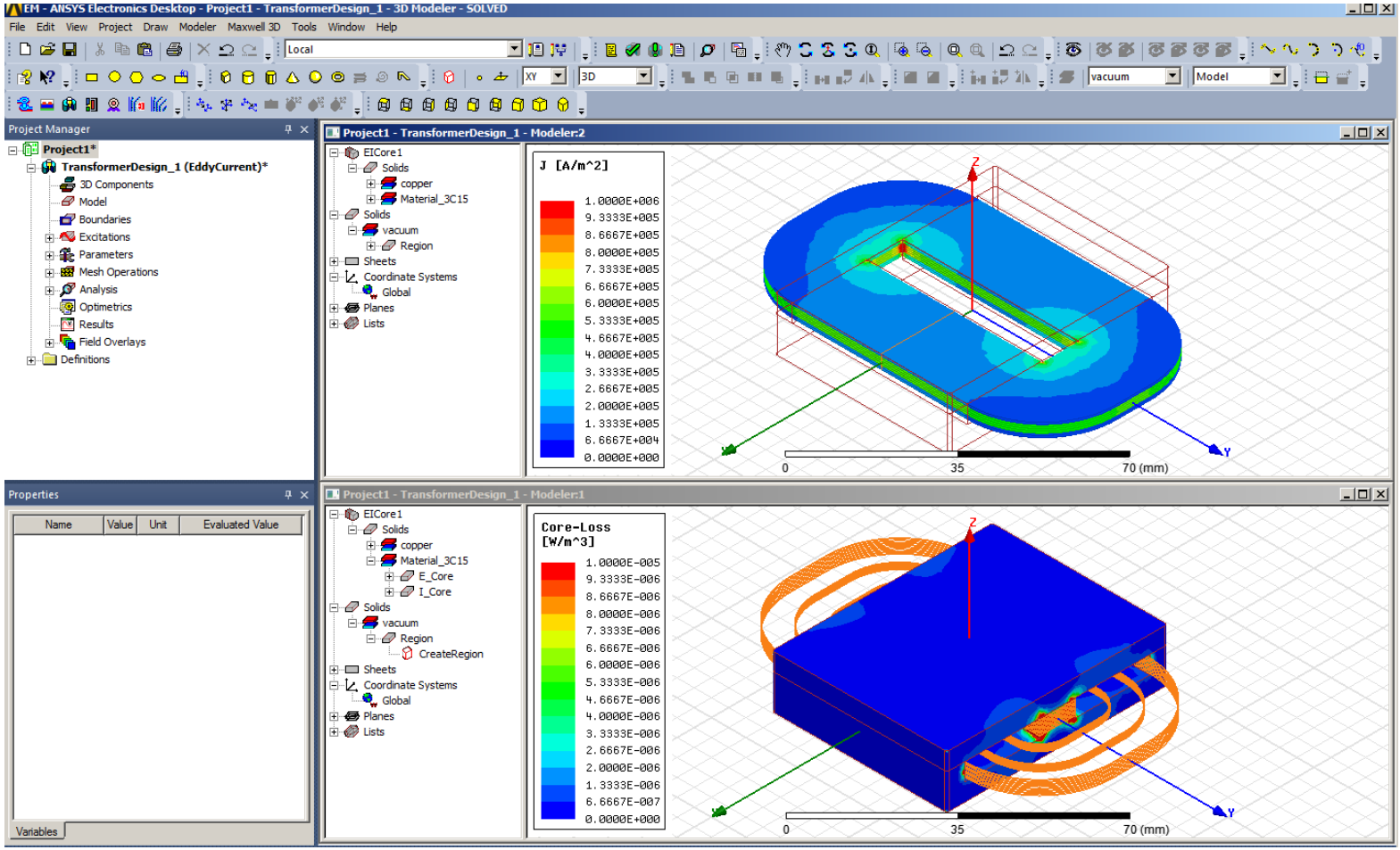
frequency versus permeability

	Material N	Conductiv	Cm	x	y	density
2	3C15	1	0.535	1.615	2.766	4800
3	3C30	0.5	0.867	1.533	2.7	4800
4	3C34	0.2	1.06	1.5	2.8	4800
5	3C81	1	2.55	1.485	2.51	4800
6	3C91	0.2	1.9	1.5	2.875	4800
7	3C90	0.2	0.823	1.54	2.69	4800
8	3C94	0.2	2.18	1.44	2.725	4800
9	3C96	0.2	0.244	1.6	2.576	4800
10	3F3	0.5	0.195	1.561	2.15	4750
11	3F4	0.1	2.981	1.368	2.1	4700
12	3F35	0.1	0.718	1.577	2.744	4750
13	4F1	0.000001	15.358	1.29	2.181	4600

matdata.tab

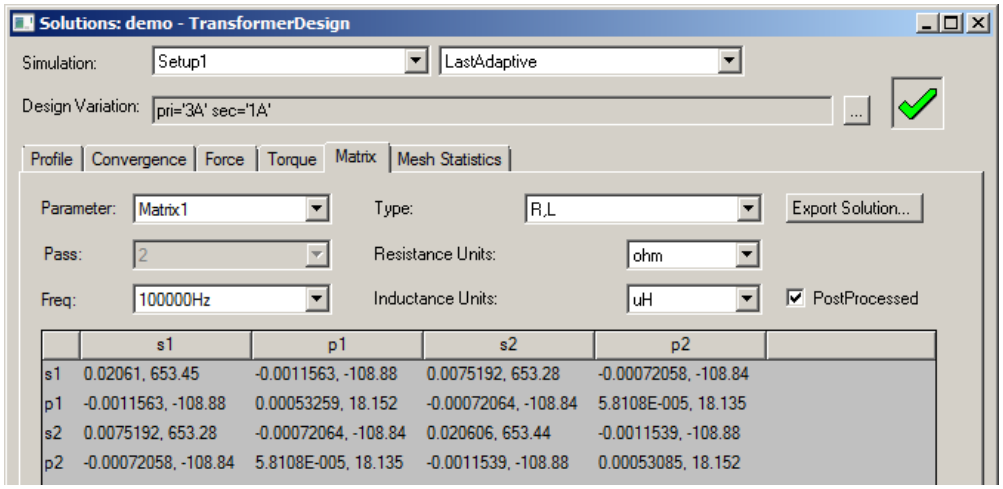
Maxwell Results - Plots

- **At this time, plots are not automatically created by the ACT**



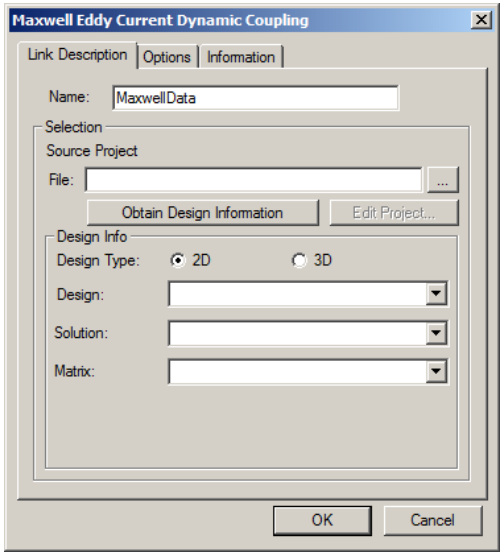
Maxwell Results – Matrix and Netlist

- Impedance Matrix results at solved frequencies
-

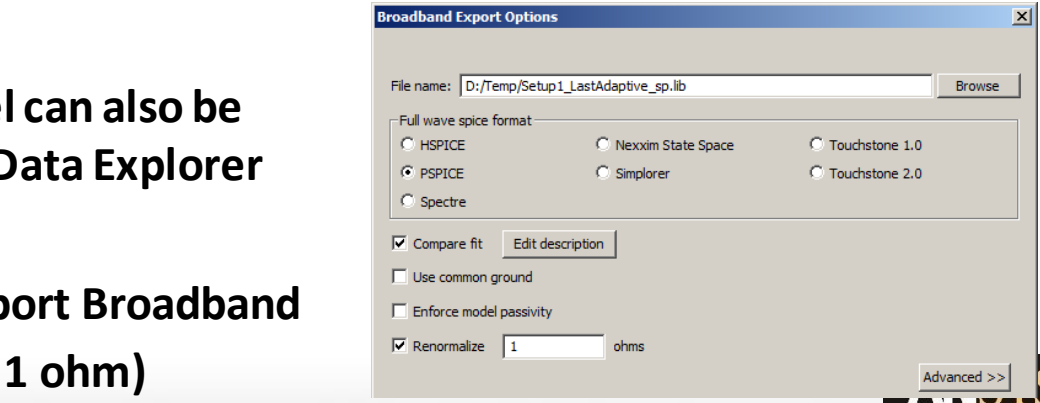


- Frequency dependent State Space model can be imported into Simplorer for circuit simulation using "Dynamic Eddy Current" link
- Frequency dependent netlist model can also be exported to PSpice using Network Data Explorer
  - Right-click on Analysis / Setup1
  - In the NDE window, click on Export Broadband
  - Choose PSPICE (Renormalize to 1 ohm)

Maxwell to Simplorer

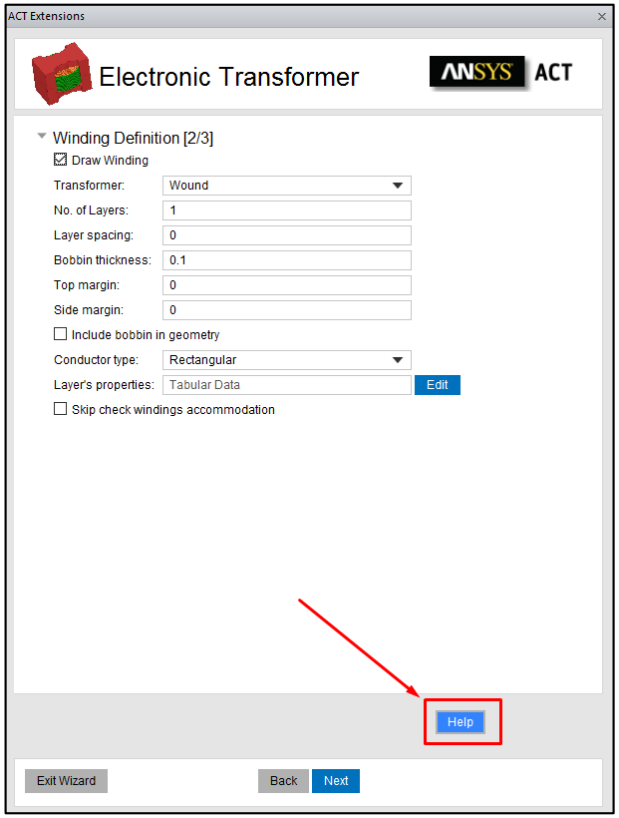


Maxwell to PSpice



Help

- **Help contained exhaustive information about settings on each step. It is recommended to read help before starting to work with ACT since this presentation is given only a short overview of ACT**
- **Accessed with “Help” button on any ACT panel**



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Thank you

Join the ACT Group on LinkedIn:

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