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Magnetic Parts Editor Help

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What is Magnetic Parts Editor?

Magnetic Parts Editor is a tool provided by PSpice that can be used by designers and engineers to design magnetic components. Using Magnetic Parts Editor, you can design power transformers, flyback converters, forward converters, and DC inductors.

You can also use Magnetic Parts Editor to:

- generate PSpice model for the designed component.
- generate data required by the manufacturer to create magnetic components for end-users.
- maintain a database of commercially available components, such as cores, wires, and insulation material, used in the magnetic design process.

See the following topics for more information:

- Selecting a component
- Providing general information
- Providing electrical information
- Selecting a core
- Selecting bobbin and winding wire
- Viewing results
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Selecting a component

This is the first step for designing a transformer for Switch Mode Power Supplies (SMPS). In this step, you select the type of magnetic component to be designed using Magnetic Parts Editor. The topologies supported by Magnetic Parts Editor are:

- Power transformers
- Forward Converter (Single and Double Switch)
- Flyback Converter (Discontinuous conduction mode)
- DC inductors.

Providing general information

In the second step of the design process, you specify the values of design parameters such as number of secondary windings to be used, current density through the winding wires, insulation material to be used as inter layer and end layer insulation, and the required efficiency of the magnetic component. The actual parameters depend on the type of transformer or DC Inductor being designed.

Number of secondary

In the No. of secondary text box, enter the required number of secondary windings in the transformer. For example, if you want to design a transformer with two secondary windings enter 2 in the No. of secondary text box.

Tip

Using Magnetic Parts Editor, you can design a transformer with a maximum of nine secondary windings. Therefore, the valid values for this field are integer values from 1 to 9.

Note: For Forward Converters, Magnetic Parts Editor support only one secondary winding.

Insulation Material

Specify the insulation material to be used by selecting an entry from the Insulation material drop-down list.

Tip

If the material that you want to use is not available in the Insulation Material drop-down list, you can add the information for the same in the Magnetic Parts Editor database.

Current Density (J)

In the Current Density text box, enter the value of the current density in the transformer winding.

Current density is the amount of current flowing per unit area. The value of the current density influences copper loss and wire selection for core winding.

Efficiency

In the Efficiency text box, specify the desired output efficiency for the transformer.

Regulation

In the Regulation text box, specify the required voltage regulation. Voltage regulation is required only in case of Power transformers.

Inductance (L)

In the Inductance text box, enter the inductance value required for the DC inductor to be designed. Inductance is required only in case of DC Inductors.

After you have entered appropriate values in all the field, click Next to move to the next step in Magnetic Parts Editor.

Providing electrical information

In the third step of design process, you specify the values for the electrical design parameters to be used for designing transformers or DC Inductors.

Primary Voltage (Vp/Vin)

Primary voltage is the voltage across the primary winding of a transformer or an inductor.

In the Primary Voltage text box, specify the input voltage applied to the primary winding.

Secondary Winding

This field is available only if you are designing a transformer using Magnetic Parts Editor. In the secondary winding group box, you specify the electrical parameters for each of the secondary winding in the component. For transformers with multiple secondary winding, the Winding Name column lists the name of each of the secondary winding. This field is not editable. The number of windings that appear in the Winding Name column is equal to the number of secondary windings specified by you in the second step of Magnetic Parts Editor. To change the number of secondary windings, you need to change the value in the Number of secondary text box. Depending on the type of transformer being designed, for each secondary winding, you may need to specify one or more electrical parameters.

Voltage (Vs)

In the voltage column, enter the rms voltage across the secondary winding.

Current (Is)

In the Current column, enter the rms current through the secondary winding.

The voltage and current across secondary windings is used to calculate the output power.

Turns ratio (K)

Turn ratio (K) is the ratio between the number of turns in the primary winding and the number of turns in the secondary winding. This value is to be specified only in the case of Forward Converters.

In the Turns Ratio column, specify the turn ratio for the secondary winding.

Operating frequency (f)

In the Operating Frequency text box, enter the frequency of operation for the transformer.

Voltage Isolation

In the Voltage Isolation text box, specify the gap or the distance between primary and secondary windings.

Waveform

In the Waveform list box, select the type of waveform that is to be provided as input to the transformer. This field is editable only for power transformers where you can either have a sine or a square wave as input waveform.

Maximum Duty Cycle (D)

Duty cycle needs to be specified for the forward and flyback converters.

Selecting a core

In this step, you select the core to be used in the transformer or DC Inductor being designed.

- Core selection involves:
- Selecting a core vendor
- Selecting the material used for core construction
- Selecting the shape of the core
- Selecting a core with appropriate physical dimensions, such that all your design requirements are satisfied.

1. From the Vendor Name drop-down list, select the desired manufacturer name.
2. From the Family Name drop-down list, select the required core geometry.

   The Family Name list provides a list of all core geometries provided by the selected manufacturer and are supported by Magnetic Parts Editor.
3. From the Material drop-down list, choose the material that should be used for core construction.

   This list is also populated using entries from the database.
4. In the Operating B text box, specify the operating flux density for the transformer. The default value is derived from the saturation flux density for the material used and is different for different transformer topologies.

   For example, for power transformers operating flux is 0.75 times the saturation flux density (Bsat). Similarly, for forward flow transformer, this value is .75(Bsat-Br).
5. By default, the Utilization Factor text box is also populated. If required, you can change this value to a value less than 1.

   Utilization factor is an indication of the window area used for winding. For example, utilization factor of 0.6 indicates that 60% of available window area will be used for winding purposes.
6. To generate a list of core parts that meet your requirements, click the Propose Part button.

   The part number visible in the Vendor Part Number list box is actually the part which is a best match for your requirements. For the selected part, Core Properties get populated. You can either use this part or select any other part from the Vendor Part Number list.

   Notice that as the part number changes, the core properties also change.

Note: Currently Coupling is supported for non-linear core.

7. After you have selected a core, click Next.

Selecting bobbin and winding wire

The last step in the design process using Magnetic Parts Editor, is to select a bobbin to be used between the core and the winding, and to select winding wires of appropriate size.

Selecting bobbin

- If there are any bobbins in the Magnetic Parts Editor database for the selected core, they are listed in the Bobbin Part Number list box.
- If the database does not contain information for the selected core, the Bobbin Part Number list box displays NO_NAME. In this case, Magnetic Parts Editor calculates bobbin dimensions using 1 mm as the default value of bobbin thickness.

Note: Non-linear Ferrite family bobbin uses only the LENGTH as user input, while the toroid family also uses outer diameter (OD) and inner diameter (ID) values. Therefore, the model text shows LENGTH as well as OD and ID.

Selecting winding wire

1. Specify the wire type by selecting either Single , Litz , or Foil radio button.

   Note: Foil type winding is not supported for toroid cores.

2. Specify the wire standard by selecting the AWG or SWG radio buttons.
3. From the Gauge drop-down list select a suitable wire gauge for each of the windings listed below the Winding Name column.
4. To complete the design process and to view the results generated by Magnetic Parts Editor, click Next.

Viewing results

The last step in the transformer design process is to review the report generated by Magnetic Parts Editor. After you complete the bobbin and winding selection, Magnetic Parts Editor calculates the winding layout and performance parameters for the designed component.

The results of the design process are displayed in the Results View. The results view has data displayed in two tabs:

- The Manufacturer Report tab
- The Model View tab

Manufacturer Report

The Manufacturer Report tab displays a summary of the entire design process. It provides a list of design parameters, and their corresponding values, that are required by a manufacturer to generate the designed transformer or DC Inductor. This tab also allows design engineers to make changes to the design and iterate the design. The design parameter values, irrespective of whether they were specified as inputs by the user or were calculated by Magnetic Parts Editor, are displayed in one of the three columns of the report. The columns in the report are Electrical Specifications, Winding Parameters, and Calculated Values. The values listed in the Winding Parameters and Calculated Values columns are the winding layout and performance parameters values, calculated by Magnetic Parts Editor after you have selected a winding wire.

The success or the failure of the design process is indicated in the Design Status field. In case of error, you can change certain values and recalculate the results.

To know more about various fields in the Manufacturer Report, see Entries in manufacturer report.

Model View

The Model View tab displays the model text for the PSpice model generated by Magnetic Parts Editor. The PSpice model is saved in a .lib file. The name of the .lib file is same as the name specified by you in the Selecting a component.

Initializing database

When you install Magnetic Parts Editor, installer automatically configures the database shipped with Magnetic Parts Editor. You can view the configuration details using the Windows' Control Panel.

1. Open the Control Panel window.
2. Double-click Administrative Tools.
3. Right-click on DataSources (ODBC) and choose Open.
4. In the User DSN tab, the Magnetic Parts Editor database is configured as magdes.
5. In cases when your database has no records, you will receive an error message stating that no information is available in the database.

Vendor data

To view the Vendor data stored in the database, choose *Tools-Data Entry-CoreDetails-Vendor*.

To browse through Vendor database

Select this button...	to...
	Jump to the first record in the navigation list.
	View the record previous to the displayed record.
	Navigate to the next record in the database.
	Move to the last record in the navigation list.

To add data for a new vendor

Click the New button.

1. In the Vendor Name text box, enter the name of the new vendor.
2. In the Person Name text box, add the name of the contact person.
3. In the Address and Address Extension fields, add the vendor address.
4. If available, add E-mail, Fax, and telephone numbers for the Vendor in the relevant fields.
5. To save the data in the database, click Save.
6. To clear the data entered in each of the fields, click Reset.

   Note: Vendor Name, Person Name, Address, and Address Extension are the required fields. Rest of the fields are optional.

Material data

To view the Material information stored in the database, choose Tools--Data Entry--CoreDetails--Material.

To browse through the material data

The material data is stored in a manner such that you can browse the material data for the core material provided by each vendor.

1. In the Vendor Name drop-down list box, select the vendor for which you want to view the material data.

   For example, if you want to view the properties of the core material used by Magnetics, select Magnetics in the Vendor Name list box.

2. Use the navigation buttons, to navigate the records in the database.

Select this button...	to...
	Jump to the first record in the navigation list.
	View the record previous to the displayed record.
	Navigate to the next record in the database.
	Move to the last record in the navigation list.

To add new material data

1. In the Enter Material dialog box, click the New button.
2. From the Vendor drop-down list box, select the vendor of the material to be added.

Tip

While adding information about a material from a new vendor, ensure that the Vendor information is added to the Magnetic Parts Editor database before you add material data.

3. Enter values for all the fields in the dialog box, as provided by the manufacturer.

Tip

The core loss data entered by you is used by Magnetic Parts Editor to arrive at an empirical formula for calculating core loss. Therefore, while entering the values for Core Loss Figures, ensure that you add at least two core loss values data for at least two frequencies.

Note: The units used for specifying core loss information depend on the vendor for which you are adding the data. If the vendor is Magnetics, frequency is specified in KiloHertz (KHz), core loss in milli-watt-per-cubic centimeter (mW/cm3), and operating flux density in kiloGauss. For Ferroxcube, and all other vendors entered by you, frequency is specified in Hertz (Hz), core loss in watt-per-kilogram (W/Kg), and operating flux density in Tesla.

4. To save the data entered by you, click the Save button.

Core data

To display the core data stored in the Magnetic Parts Editor database, choose Tools-Data Entry-CoreDetails-Core.

To add new core

1. Select a vendor name.

   Note: If the required vendor name does not appear in the drop-down list, you first need to enter the vendor data using the steps covered in the topic, Vendor data.

2. From the Family Name drop-down list, select the shape of the core for which data is to be added.

   The shape associated with the selected family is visible

3. Select the material used for making the core.

   If the required material is not available in the database, add material information using the steps covered in the topic, Material data.

4. In the Vendor Part Number text box, enter the part number for which you want to enter information in the database.

5. Enter core properties using datasheets provided by the vendor.

6. To save the information to the database, click Save.

Bobbin data

To view the Bobbin data, from the Tools menu, choose Data Entry - Core Details - Bobbin.

To add bobbin information

1. From the Vendor Name drop-down list box, select the name of the vendor that has provided the bobbin data.
2. From the Family Name drop-down list box, select the type of core for which bobbin information is to be added.
3. From the Core Part Number drop-down list box, select the core part for which bobbin data is to be added.
4. Enter bobbin properties.
5. Click the Save button.

Bobbin properties for EE and UU families

- Window Width, Ww

  Bobbin window width is same as the window width available for winding.

- Window Height, Hw

  Bobbin window height is an indication of the window height available for winding.

- Bobbin Lx and Bobbin Ly

  Bobbin Lx and Ly, are used while calculating mean turn length, MTL, for the winding wire.

Bobbin properties for Toroid family

- Outer diameter
- Inner diameter
- Height

Wire data

To display the Enter Wire data dialog box, from the Tools menu, choose Data Entry -- Wire.

To add wire information

1. To add information about new wire, click New.
2. From the Wire Type drop-down list, select the wire type as AWG or SWG.

   Note: AWG (American Wire Gauge) and SWG (Standard Wire Gauge) are the standard for specifying wire measurements.
3. In the Wire Gauge field, enter the wire gauge number.

   Note: Wire thickness decreases with an increase in wire gauge number. The wire gauge number has different meaning for different Wire Types. For example, for a SWG wire, gauge number 20 refers to a wire of 0.0360 inches diameter, whereas in AWG it will be a wire of 0.0320 inches diameter.
4. In the Cu. Cross Section Area text box, enter the cross section area of the copper wire in millimeter square.
5. In the Bare Cu, Wire diameter text box, enter the diameter of the copper wire.
6. In the Wire diameter with Insulation text box, enter the diameter of the insulated copper wire.
7. To update the database with these changes, click Save.

Insulation data

To display the Enter insulation material dialog box, from the Tools menu, choose Data Entry - Insulation.

To add information on new insulation material

1. Click the New button.
2. In the Material Name text box, enter the name of the insulation material.
3. Enter the breakdown strength of the material in Volt per millimeter.

   Note: Breakdown strength is the maximum electric field strength that a material can withstand and still function like an insulator.
4. In the Thickness list box, enter the values in which this insulation material is commercially available.
5. Click Save to save the records to the database.

Entries in manufacturer report

The entries in the manufacturer report are listed under the heading Input Parameters and Output Parameters.

Input Parameters

These are the design parameters values provided as input to Magnetic Parts Editor. Magnetic Parts Editor uses these values to complete the transformer design process. The values for these parameters can either be provided as user inputs or can be the values read from the Magnetic Parts Editor database.

User Inputs

`Primary Voltage`	voltage across primary winding
`Secondary Voltage`	voltage across secondary winding
`Power`	output power (Pout)
`Frequency`	operating frequency in Hz
`Efficiency`	desired efficiency of the magnetic component
`Regulation`	desired voltage regulation
`Type`	topology of the magnetic component being designed

Values read from Magnetic Parts Editor database

Magnetic Parts Editor reads the properties of the selected core and the winding properties from the database shipped with it. The values for these input parameters are listed under the heading Core Details.

Design Status

Indicates whether the magnetics design process was successful or not.

This field can have two possible values, success or error. Success indicates that you were able to design the transformer or DC Inductor, with specified input requirements, using Magnetic Parts Editor. An Error in the design status indicates that a fitment error has occurred while designing the winding layout. This implies that the total area available for the winding is less than the required buildup area, which is the sum of the insulation layers and the winding area.

Output Parameters

The output parameters are the design parameters for which, values are calculated by Magnetic Parts Editor. The output parameters are listed in two columns under the headings Winding Details and Calculated values.

Winding details

Winding Name	Lists the names of the windings used in the magnetic component.
Peak Current (A)	Peak current through the windings.
RMS Current	Root mean square (rms) value of the current through the windings.
No of Turns	Number of turns in the transformer winding. **Note:** To know more about how Magnetic Parts Editor calculates number of turns, see Chapter 3, “Electrical Parameters", of the Magnetic Parts Editor User's Guide.
Magnetizing Inductance (H)	Inductance across the primary winding. The value of the magnetizing inductance impacts the magnetizing current through the primary winding. Valid only for forward and flyback converters.
Wire Gauge	Wire gauge number used for each of the winding wire. Wire gauge is the measure of the cross-section area of the winding wire. The values that appear in this field are the same values that appear in the Bobbin and winding selection step of the design process. **Note:** To know how Magnetic Parts Editor calculates wire gauge, see Chapter 3, “Electrical Parameters", of the Magnetic Parts Editor User's Guide.
Turns/layer	Number of winding turns that can be accommodated in a single winding layer. **Note:** To know how Magnetic Parts Editor calculates turns per layer, see Chapter 4, “Winding Layout", of the Magnetic Parts Editor User's Guide.
No of layer	Number of winding layers required to accommodate the required number of turns in the transformer winding.
Inter layer Insulation (mm)	Thickness of the insulation material between two consecutive winding layers.
End Insulation (mm)	Insulation thickness between the core (bobbin) and the first layer of the winding wire.
Winding Buildup (mm)	Total height of the winding layers including the inter layer and end insulation.

Winding resistance (ohm)	Effective resistance of the winding wire. **Note:** To know how Magnetic Parts Editor calculates turns per layer, see Chapter 5, “Transformer Performance", of the Magnetic Parts Editor User's Guide.
Copper Loss (Watts)	Power loss due to the winding currents. **Note:** To know how Magnetic Parts Editor calculates power losses, see Chapter 5, “Transformer Performance", of the Magnetic Parts Editor User's Guide.
Leakage Inductance (H)	Energy stored in the non-magnetic regions between windings, caused by imperfect flux coupling.
Voltage Drop (V)	Drop in the secondary voltage from no-load to full-load condition.
No of Strands	Number of wires used in parallel in the winding wire.This field is valid only if you have Litz type of windings. For Single winding, the value of this field is set to 1. **Note:** To know how Magnetic Parts Editor calculates the required number of strands for a winding wire, see Chapter 3, “Electrical Parameters", of the Magnetic Parts Editor User's Guide.
Foil Thickness (mm)	Thickness of foil used for the winding. This field is populated only if the Wire Type is selected as Foil. If Foil Thickness is specified, Wire Type, Wire Gauge, and Number of Strands fields will not be populated.
Foil Width (mm)	Width of foil used for the winding.

Calculated values

The parameters listed under this section are mainly the design parameters used to analyze the transformer performance.

Core loss	Power loss due to magnetization and demagnetization of the core.
Achieved Efficiency	Efficiency of the transformer designed using Magnetic Parts Editor

Achieved Regulation	Measure of fluctuations in secondary voltage with a change in load currents. **Note:** This values is calculated only for power transformers.
Window Occupied	Percentage of the available window area occupied by the copper.
Temperature Rise	Increase in temperature of magnetic component due to power loss.
Total copper loss	Sum of copper loss through all the transformer windings.

Tweaking designs

After the design process is complete, you can tweak your designs by changing the values of some of the design parameters. The editable design parameters have an asterisk (*) symbol against them in the manufacturer report. The rest of the parameter values are read only and cannot be directly modified by you.

The editable parameters depend on the type of component designed using Magnetic Parts Editor. The editable parameters for each type of component supported by Magnetic Parts Editor are listed in the table below.

Component..	Editable Parameters...
Power Transformer	■ Operating flux density, B ■ Current density, J ■ Wire gauge ■ Insulation ■ Number of wires in parallel
Transformer for Forward Converters	■ Operating flux density, B ■ Current density, J ■ Wire gauge ■ Insulation ■ Number of wires in parallel
Transformer for Flyback Converter	■ Operating flux density, B ■ Current density, J ■ Wire gauge ■ Insulation ■ Number of wires in parallel ■ Air gap (GAP)

DC Inductors

- Operating flux density, B
- Current density, J
- Wire gauge
- Insulation
- Number of wires in parallel
- Air gap (GAP)

Operating flux density (B)

You can modify the operating flux density such that the modified value should be less than the saturation flux density, Bsat, for the selected core material.

Magnetic Parts Editor compares the new value of B with the Bsat value in the database. If the new value specified by you is greater than the saturation flux density, Bsat, an error is thrown and the original value of B is retained.

Current Density (J)

Changing current density causes you to redo wire gauge selection and winding design calculations. This may also influence the copper losses in the transformer. Current density is inversely proportional to the components size and directly proportional to the copper loss. Therefore, in a transformer, an increase in current density will increase copper loss, reduce transformer size thereby increasing the rise in temperature.

Wire Gauge

If you change the wire gauge for one or more windings, based on this change winding design has to be redone. While changing the wire gauge selection, you must ensure that the selected wire has cross section area equal to or greater than the required area, and diameter less than two times the skin depth of the wire.

Insulation

Winding build up needs to be calculated again. Reducing the insulation thickness will reduce the leakage.

User can change:

- Insulation material
- End insulation
- Inter layer insulation
- Gap between windings

Number of wires in parallel

If you are using Litz type of wire, you can change the number of strands of wires used in parallel.

In this case, wire gauge selection and winding design has to be done again.

Air gap (GAP)

Valid for flyback converters and DC Inductors only.

A change in the air gap results in recalculation of operating flux (B), AC flux density (Bac), and magnetizing inductance, based on new value. You can specify a minimum GAP value of 0 cm, which will be treated as an infinitesimal number for all internal calculations.

Editing manufacturer report

When you edit a parameter value in the manufacturer report, Magnetic Parts Editor creates a new view, Modified:1, and displays the modified results in the new view. Multiple views of the report provides you with the option of comparing your modified results to the original design. Every time you modify a design parameter in the original report a new view is created. Magnetic Parts Editor supports a maximum of four view, by the name Modified:1, Modified:2, Modified:3, and Modified:4.

In the modified view, you can change multiple design parameters and then update the transformer design with these changes at one go. Whenever you change the value of a design parameter in the modified view, the changed parameter value is displayed in red color. This is to indicate that the design is not yet updated with the changes.

To update the design

1. Modify the design parameter value and press Tab.

   The modified value appears in red.

2. From the View drop-down menu, choose Refresh Design.

   Note: Alternatively, you can also select the Refresh Design button from the toolbar.

3. A message box appears asking you whether if the changes are to be made in the same view or a new view is to be created.

4. Select the appropriate button and view the results of the modification.