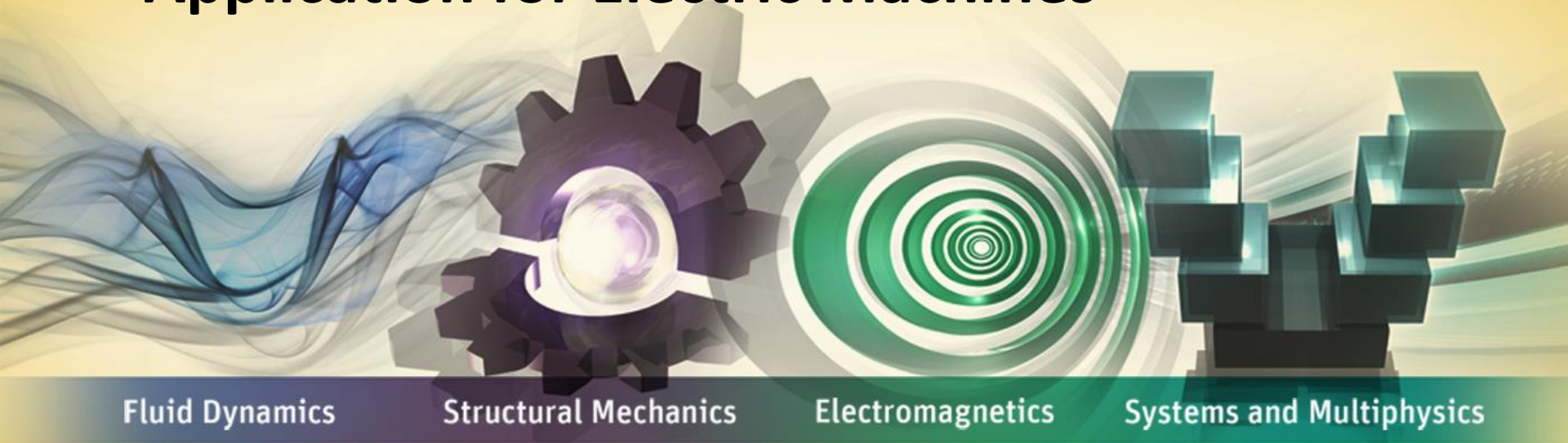


Plotting Radial and Tangential Flux Density: Application for Electric Machines



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Solution # 2039308

This document provides an answer to a simple question with some guidelines highlighting various methods that can be used within ANSYS products. These guidelines are meant to be used in conjunction with the information provided in the ANSYS, Inc. product documentation.

For the latest version, please visit the [ANSYS Customer Portal](#).

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By default we can plot the Magnitude of the calculated magnetic fields in Maxwell. The instructions in this document will show how to decompose the field into Radial and Tangential components which can be plotted, such as along a line in the air gap.

Within the 3D-modeler, draw an arc polyline object within the air gap and name it meaningfully. The best position for this arc is between the Band and the stator teeth, so that the arc is stationary. This arc object can either be a “Model” or “Non Model” object. See the following discussion for more information on creation of the arc polyline object.

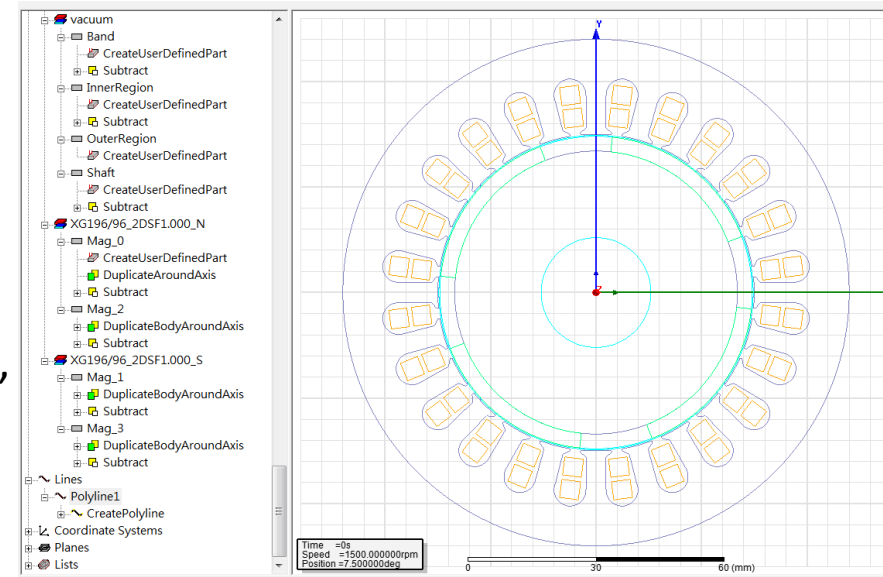
In the Transient solver, remember to Save Fields for any time-steps that you would like to view and post-process.

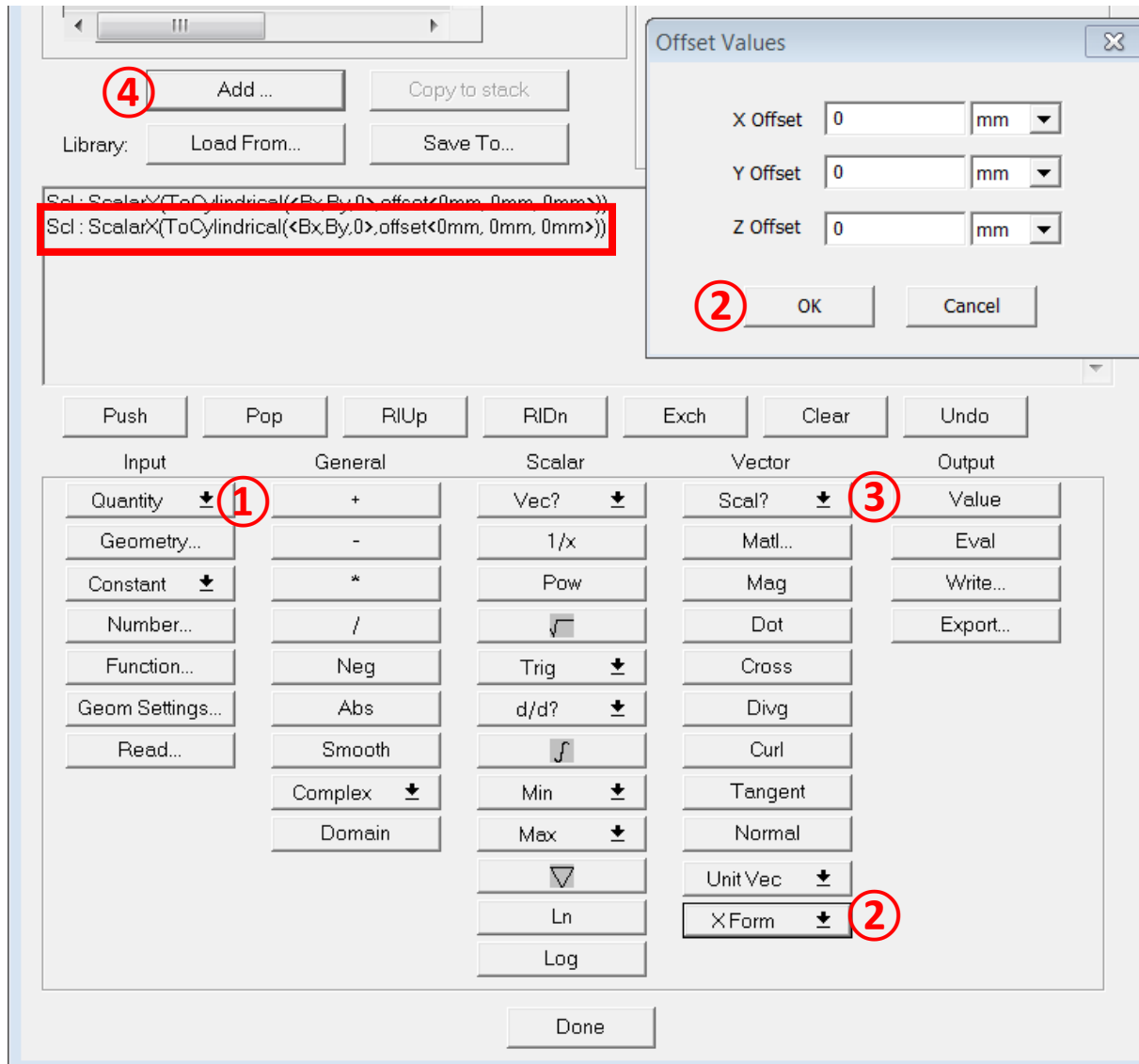
Draw an Arc

If the line is created as a Model object, it must be created before solving the simulation. A Non-Model object can be used after solving as a post-processing object. In a 2D simulation, the Model object will be used in the initial meshing. In 3D, and for 2D Non-Model objects, the line object will not affect the mesh and will cut across mesh elements.

Do not place the arc used for plotting on the surface of the moving Band interface.

If you want to plot on a 360° arc, you cannot use a single 3-point arc, or Center-point arc. You will either have to use multiple arcs that are united together, or else you can use a circle and delete the CoverLines operation. If you draw a circle and only want to keep the line, the best way to remedy this is to select the Circle object, and choose the menu item *Modeler > Delete Last Operation*.





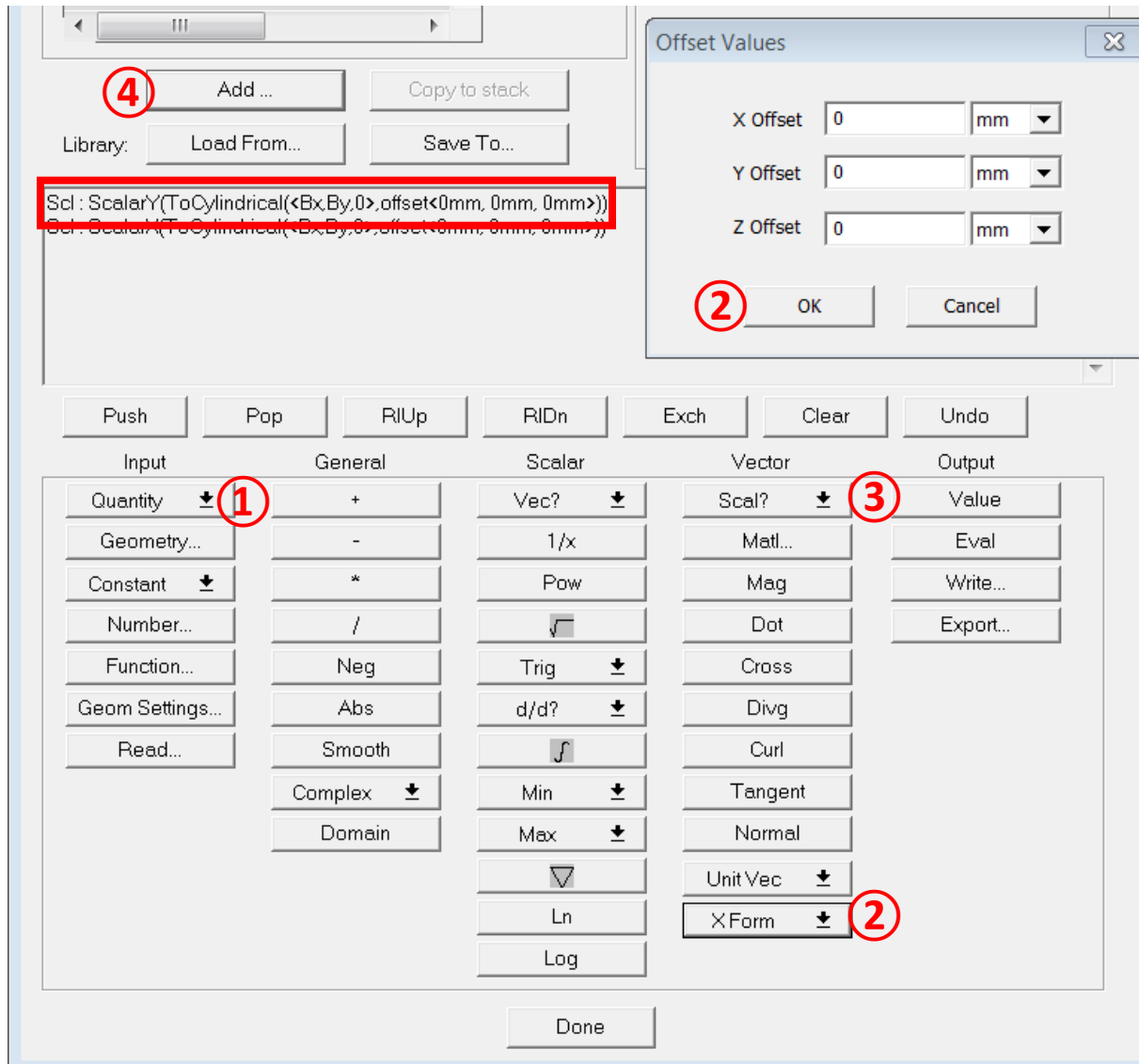
① Quantity → B

② X Form → ToCylindrical
In the box appears, enter OK.

③ Scal? → ScalarX
This selects the first cylindrical component, which is radial.

④ Add...
Give the expression name, such as "B_radial" or "Br"

Tangential B



① Quantity → B

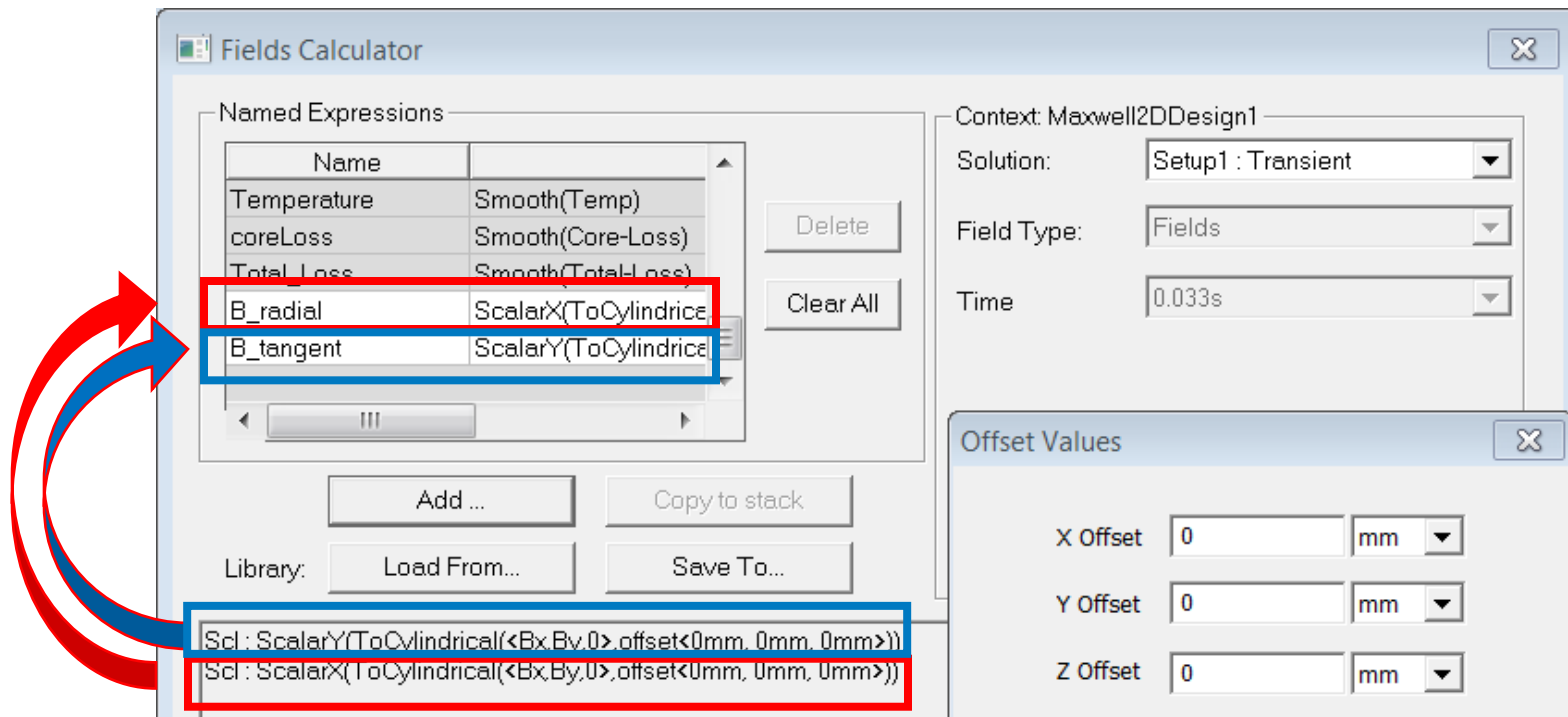
② X Form → ToCylindrical
In the box appears, enter OK.

③ Scal? → ScalarY
This selects the second cylindrical component, which is tangential.

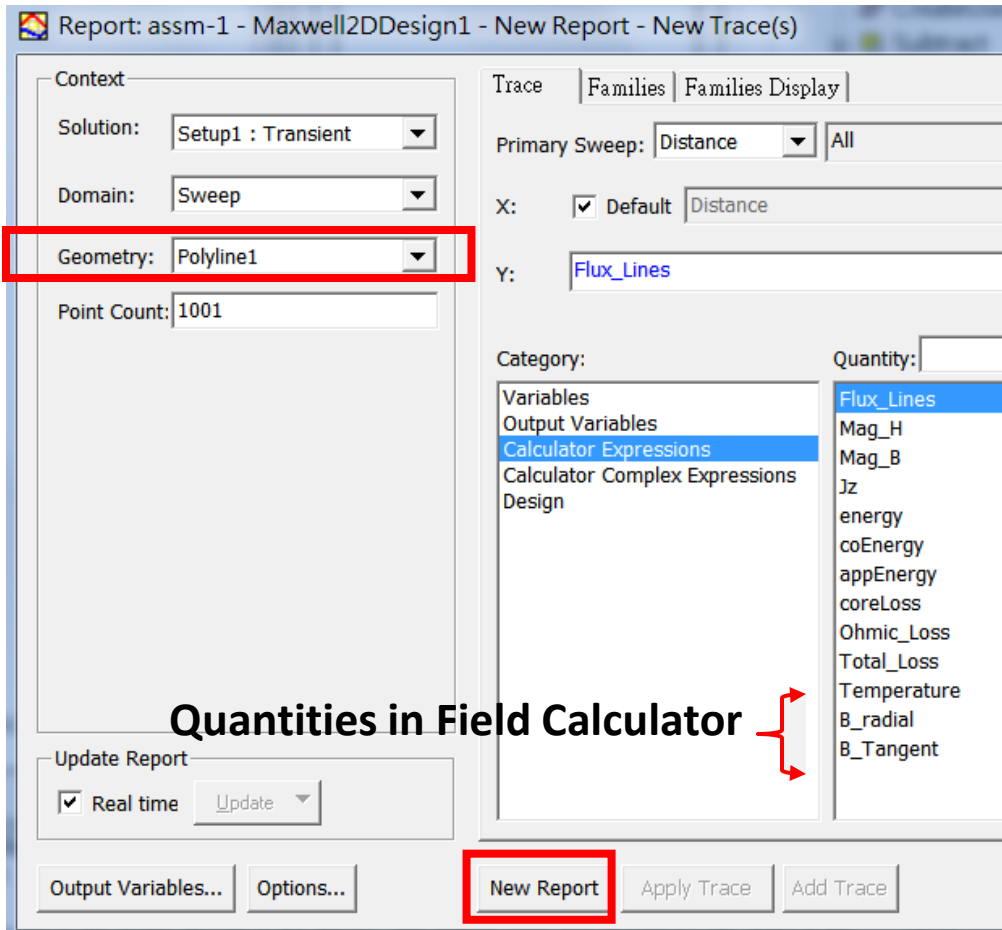
④ Add...
Give the expression name, such as “B_tangent” or “Bt”

Variable in Field Calculator

By adding the field calculator expressions to the Named Expressions list, these calculations will now be available in the rest of the software for quick plotting and access.



Results → Create Field Report → Rectangular Report

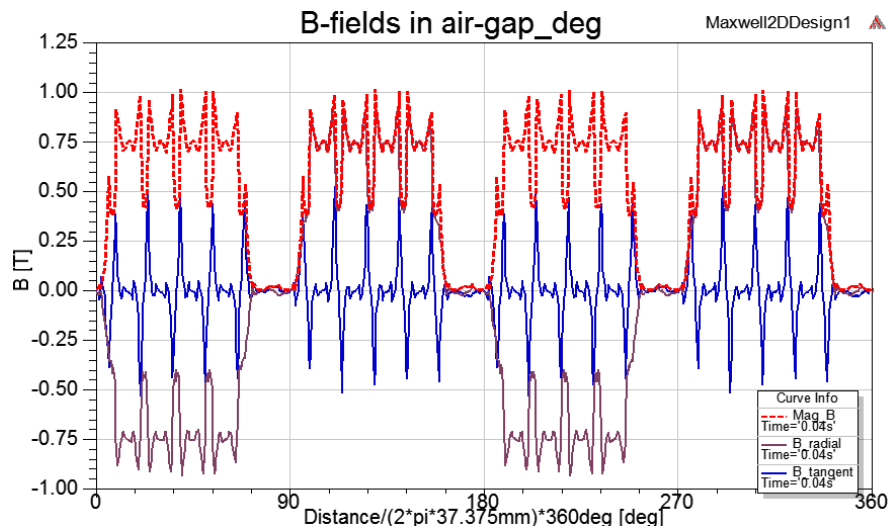
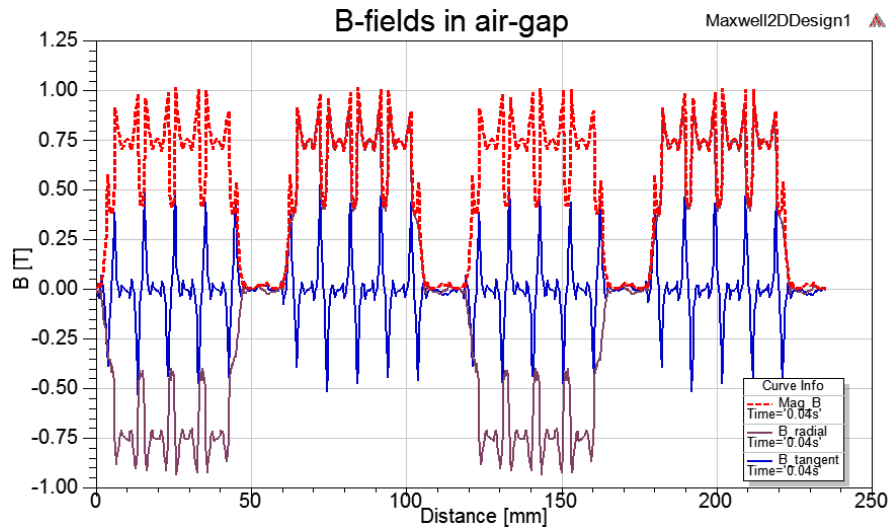


If you are in the transient solver, the time used for plotting the field is determined in the *Families* tab. You can plot the result at any combination of simulation times with Saved Fields (specified before solving in the Solution Setup).

Select **New Report** to create a new report with the calculated quantity plotted vs. distance along the selected polyline. The direction of increasing distance along the polyline is determined by the order of creation of polyline points.

The calculated value has SI (mks) units – in the above example for Magnetic Flux Density, this is [Tesla].

Radial and Tangential B



When plotting the results, the X-axis will be in units of length. You can convert this to units of mechanical degrees in the Report Setup window. In the Trace tab, the X-axis is specified as the Default, *Distance*. Un-check the Default option, and then enter the following text into the X-value for an example with 37.375mm radius arc:

$\text{"Distance}/(2*\pi*37.375\text{mm})*360\text{deg}"$.
The X-axis units will be in units of angle (either radian or degree).

You can similarly use the function *normalize* to transform the arc length to a normalized zero-one scale with the expression: $\text{"normalize(Distance)"}$.