



Model created in COMSOL Multiphysics 6.4

Position Optimization of Grading Rings

Introduction

This model extends the model [High Voltage Insulator](#) in the AC/DC Module Application Library by adding an Optimization study node. The Optimization study is aimed at finding the optimum position of the grading rings to obtain the highest flashover voltage.

Model Definition

In this model, a boundary probe defining the maximum value of the vertical component of the tangential electric field of the high voltage insulator is first created. The boundary probe is then set as the Objective Function. The control variables are the diameter of the grading ring and the distance from the end.

Results and Discussion

[Figure 1](#) compares the vertical component of the tangential electric field along the first six sheds from the line end under different conditions. It is shown that the maximum of the tangential electric field is further reduced with the use of the Optimization study.

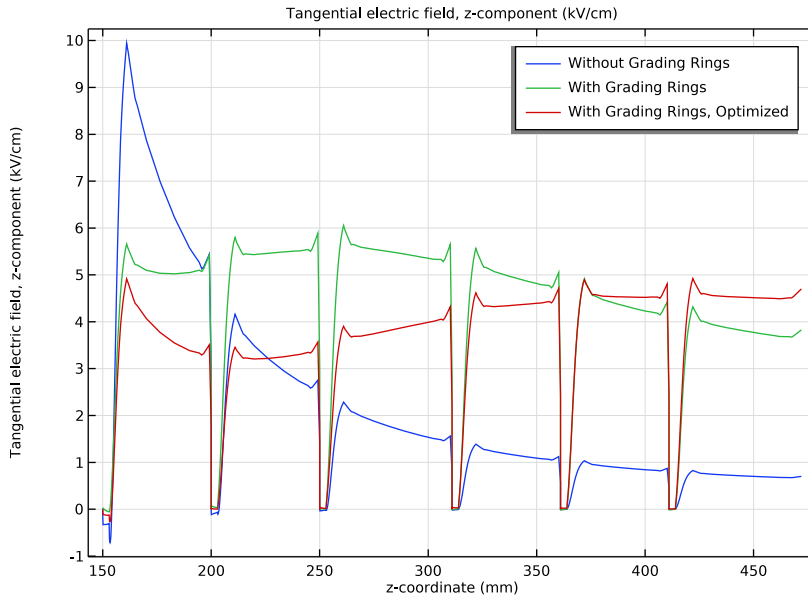


Figure 1: Comparison of the z-component of the tangential electric field along the surface of the first six sheds from the line end in different cases.


Application Library path: ACDC_Module/Electromagnetics_and_Optimization/
grading_ring_optimization

Modeling Instructions



ROOT

In this model version you determine the optimum position of the grading rings by using an **Optimization** study node.

APPLICATION LIBRARIES

- 1 From the **File** menu, choose **Application Libraries**.
- 2 In the **Application Libraries** window, select **ACDC Module > Devices, Capacitive > high_voltage_insulator** in the tree.
- 3 Click  **Open**.

ADD STUDY

- 1 In the **Home** toolbar, click  **Add Study** to open the **Add Study** window.
- 2 Go to the **Add Study** window.
- 3 Find the **Studies** subsection. In the **Select Study** tree, select **General Studies > Stationary**.
- 4 Click the **Add Study** button in the window toolbar.
- 5 In the **Home** toolbar, click  **Add Study** to close the **Add Study** window.

STUDY 3

Parameter Optimization

In the **Study** toolbar, click  **Optimization** and choose **Parameter Optimization**.

COMPONENT 1 (COMP1)

In the **Model Builder** window, expand the **Component 1 (comp1)** node.

DEFINITIONS

Boundary Probe 1 (bnd1)

- 1 In the **Model Builder** window, expand the **Component 1 (comp1) > Definitions** node.
- 2 Right-click **Definitions** and choose **Probes > Boundary Probe**.

- 3 In the **Settings** window for **Boundary Probe**, locate the **Probe Type** section.
- 4 From the **Type** list, choose **Maximum**.
- 5 Locate the **Source Selection** section. From the **Selection** list, choose **Shed Surface**.
- 6 Locate the **Expression** section. In the **Expression** text field, type $es.tEz$.
- 7 In the **Table and plot unit** field, type kV/cm .

STUDY 3

Parameter Optimization

- 1 In the **Model Builder** window, under **Study 3** click **Parameter Optimization**.
- 2 In the **Settings** window for **Parameter Optimization**, locate the **Optimization Solver** section.
- 3 From the **Method** list, choose **Nelder–Mead**.
- 4 Click **Add Expression** in the upper-right corner of the **Objective Function** section. From the menu, choose **Component 1 (comp1) > Definitions > comp1.bnd1 - Boundary Probe 1 - V/m**.
- 5 Locate the **Control Parameters** section. Click $+$ **Add** twice.
- 6 In the table, enter the following settings:

Parameter	Initial value	Lower bound	Upper bound	Unit
D (Diameter of the grading ring)	350 [mm]	200 [mm]	1000 [mm]	m
d (Distance of the grading ring from the end)	150 [mm]	10 [mm]	500 [mm]	m

- 7 In the **Study** toolbar, click $=$ **Compute**.


OBJECTIVE TABLE 3

- 1 Go to the **Objective Table 3** window.
- 2 Click the **Display Probe Table 1** button in the window toolbar.



RESULTS

With Grading Rings, Optimized

- 1 In the **Model Builder** window, expand the **Results > Tangential Electric Field, z-Component** node.
- 2 Right-click **With Grading Rings** and choose **Duplicate**.

- 3 In the **Settings** window for **Line Graph**, type With Grading Rings, Optimized in the **Label** text field.
- 4 Locate the **Data** section. From the **Dataset** list, choose **Study 3/ Parametric Solutions I (sol4)**.
- 5 From the **Parameter selection (D, d)** list, choose **From list**.
- 6 Locate the **Selection** section. From the **Selection** list, choose **Shed Surface**.
- 7 In the **Tangential Electric Field, z-Component** toolbar, click  **Plot**.

Tangential Electric Field, z-Component

- 1 In the **Model Builder** window, click **Tangential Electric Field, z-Component**.
- 2 Click  **Plot**.
- 3 Click the  **Zoom Extents** button in the **Graphics** toolbar.