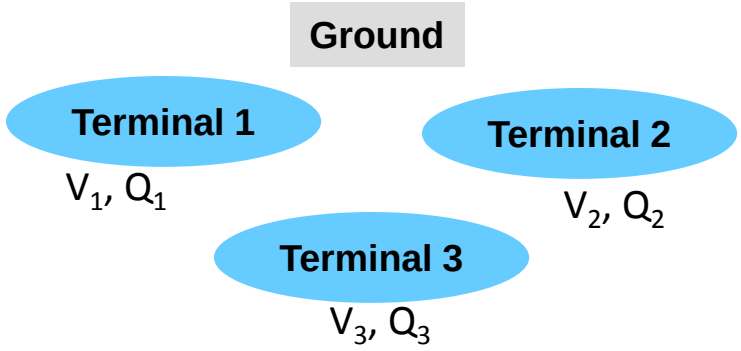
Capacitance Matrix: Background

- Capacitance matrix of an electrical system allows one to evaluate cross talk between excitation ports

- The capacitance values, terminal charges, and terminal voltages are related by the following matrix relation:

$$\begin{bmatrix} Q_1 \\ Q_2 \\ Q_3 \end{bmatrix} = \begin{bmatrix} C_{11} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \\ C_{31} & C_{32} & C_{33} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}$$



- If we excite terminal j with voltage V_j and set the other terminals to ground, then elements of the capacitance matrix are evaluated as

$$C_{ij} = \frac{Q_i}{V_j}, \quad i = 1,2,3$$

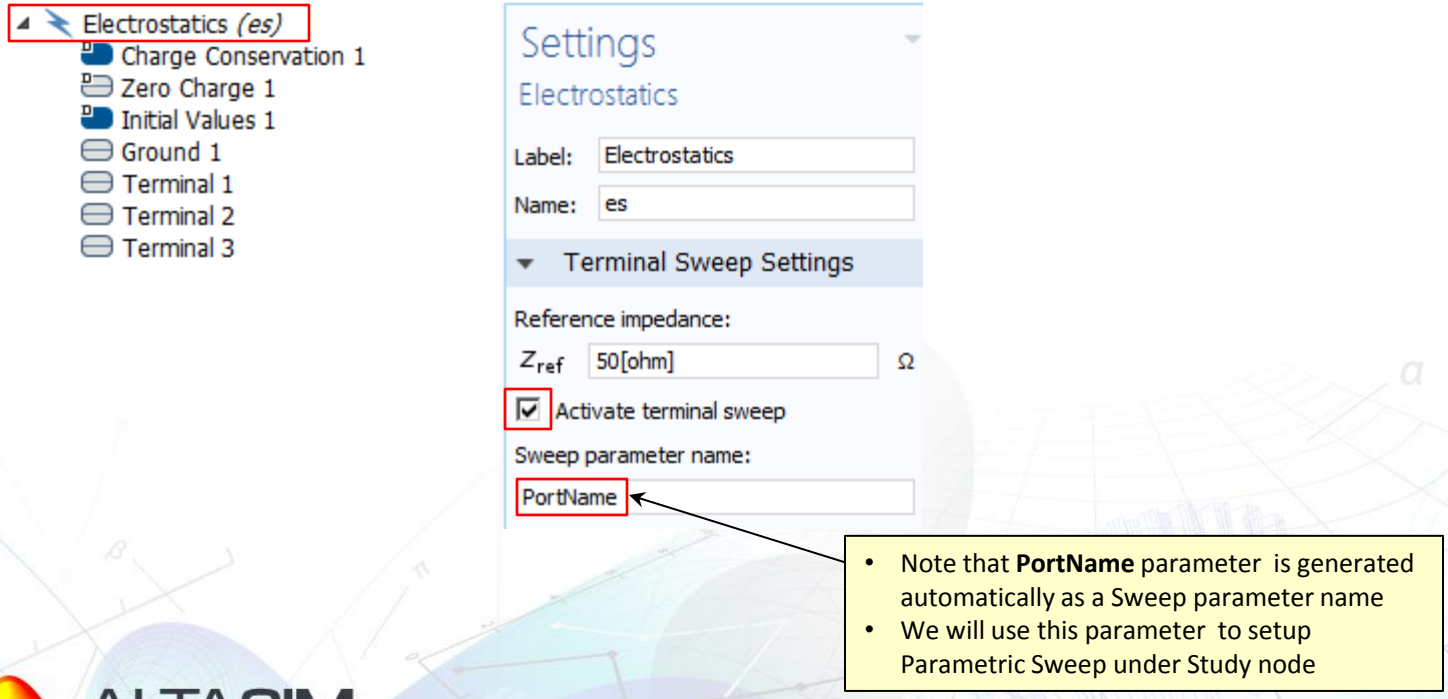
- By repeating the procedure of the excitation of one terminal at a time, we calculate the full mutual capacitance matrix

Terminal Sweep

- Comsol offers **Terminal Sweep** functionality which allows to sweep the excitation over different terminals, one at a time

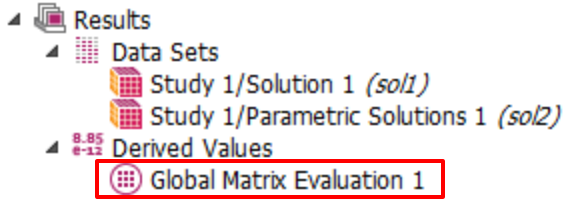
- This allows to evaluate the full capacitance matrix in a single run

❑ To enable terminal sweep functionality, check **Activate terminal sweep** box in the settings window for the Electrostatics (es) interface

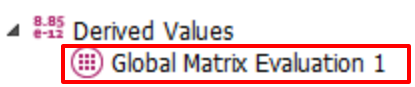


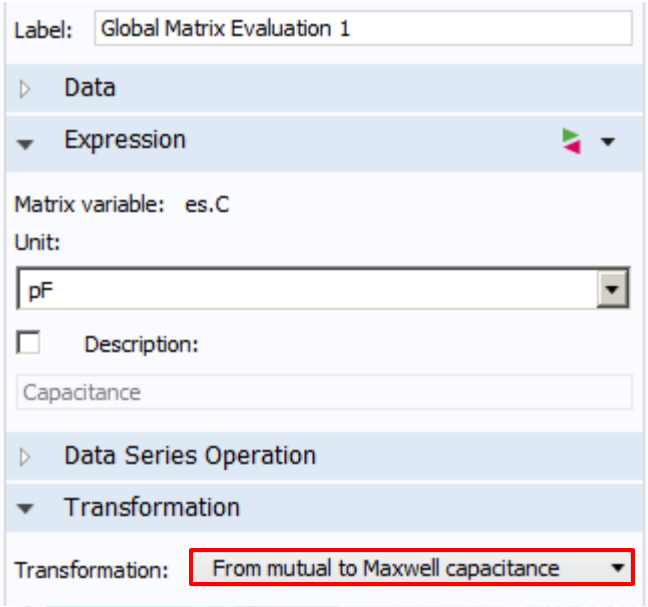
Results: Full Maxwell Capacitance Matrix

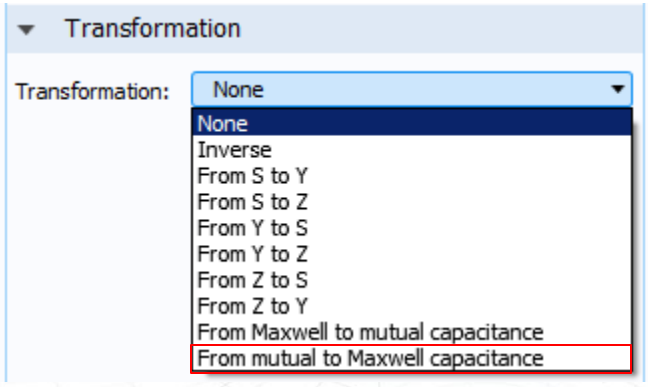
- Right-click **Derived Values** and choose **Global Matrix Evaluation**



- Use Comsol's build-in **Transformation** options to obtain capacitance matrix in different formats:







Capacitance (pF)		
233.53	20.765	1.4199
20.765	217.71	20.767
1.4199	20.767	233.56