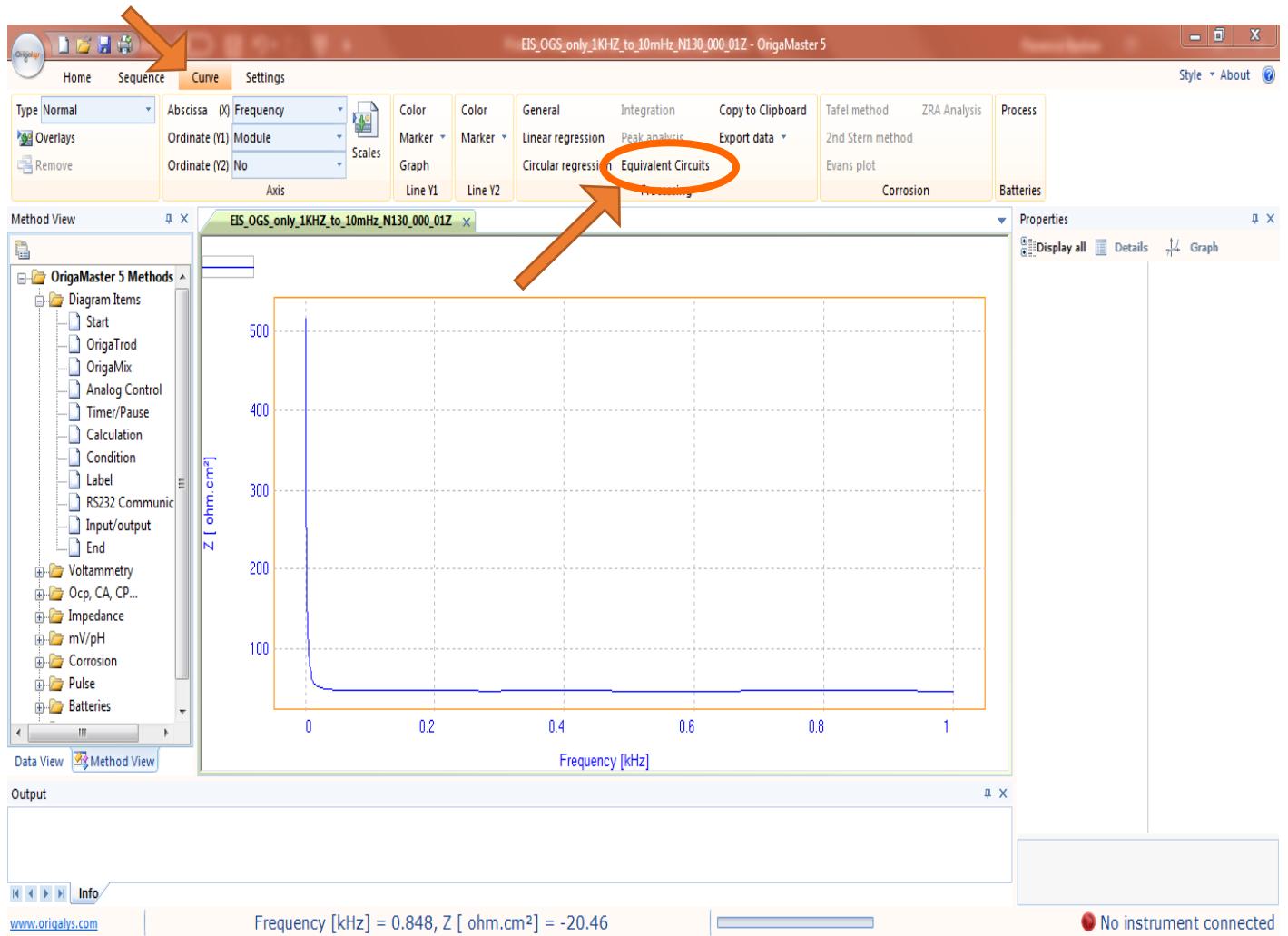


Quick start of the tool Equivalent Circuits



The Equivalent Circuits tool is only accessible with an impedance curve.

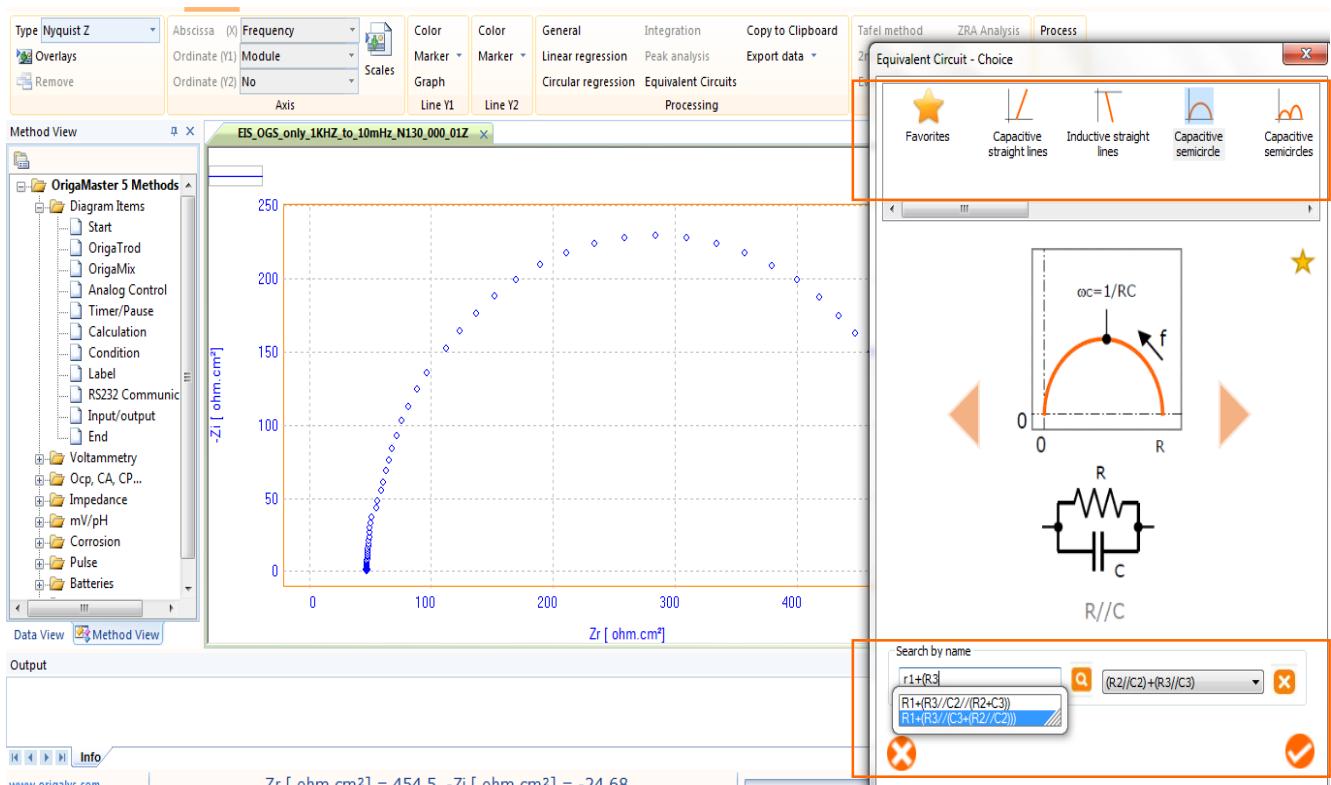




Summary

- I. Choice of the equivalent circuit p.3
- II. Determination of areas p.4
- III. Display of results p.7
- IV. List of available elements and circuits p.9

I. Choice of the equivalent circuit

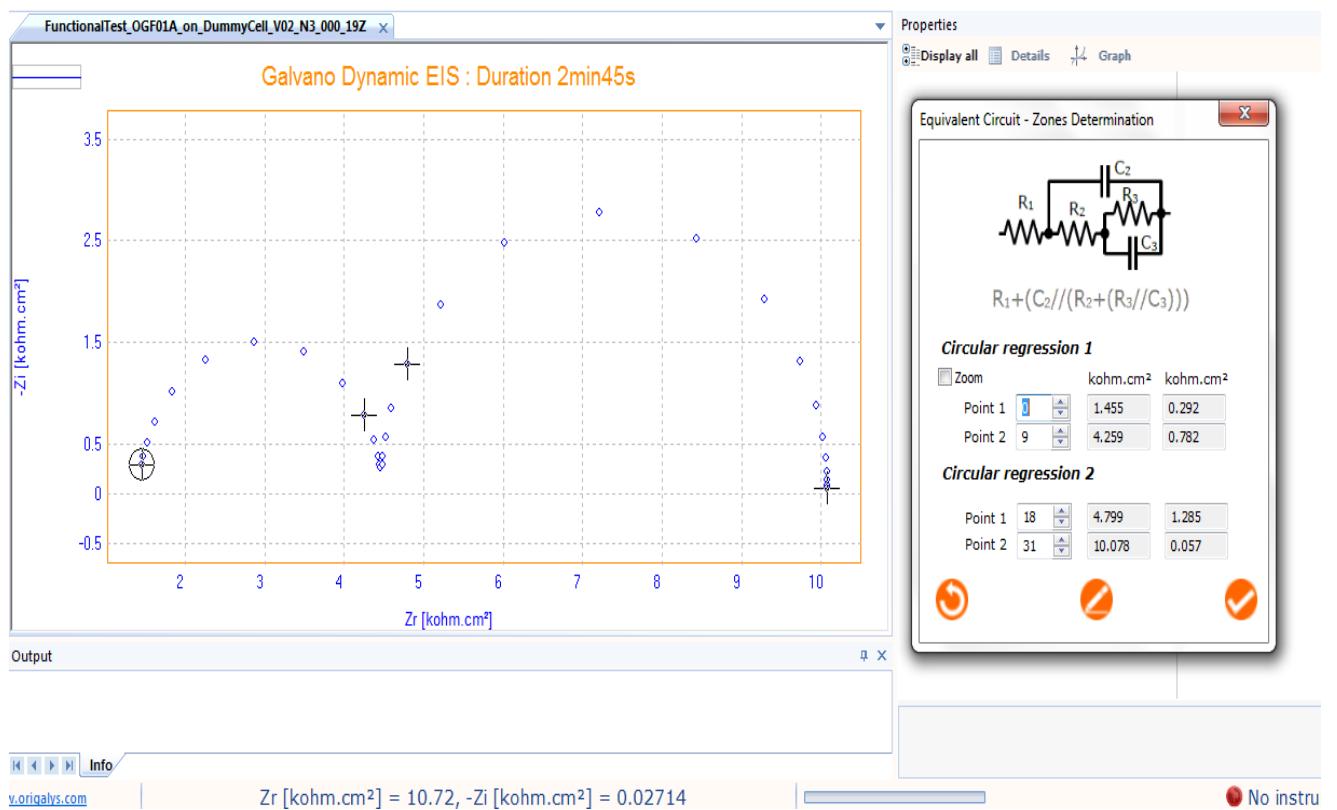


Two methods are available to find the corresponding equivalent circuit :

- By type of equivalent circuit (1)
 - Arrow buttons allow to scroll through the different circuits
- By name using the search bar (2)
 - Once the name has been entered, the user must use the search button to display the results in the scroll bar on the right. Results can be cleared by the delete button.

To display the results, the user must use the validation button.

II. Determination of areas



Depending on the chosen circuit, different types of regressions are needed to calculate the different elements.

For each regression, the user must determine the correct zone by selecting point 1 (beginning of the zone) and point 2 (end of the zone). The regression will be done and drawn between these two points.

By checking the zoom box, the user can zoom in to choose the desired point 1 or 2 more easily.

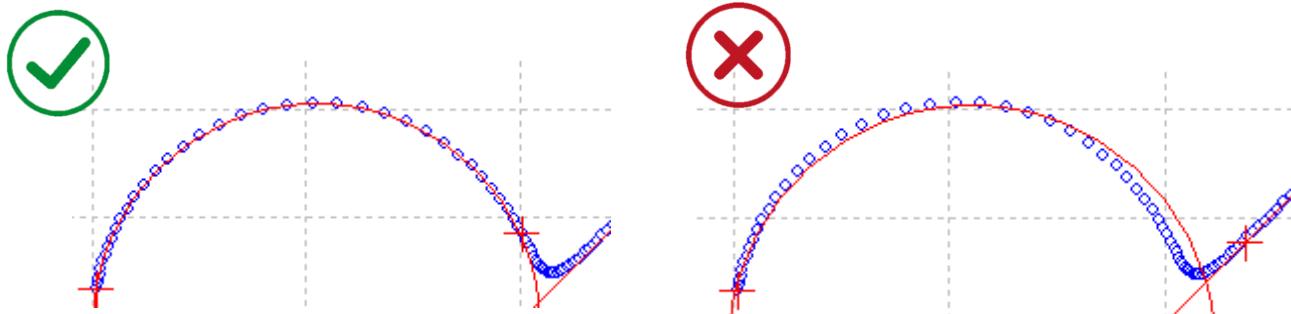
It is advisable to try different paths using the pencil button. Thus the user visualizes the regressions plot without seeing the results.

Nous donnons quelques conseils sur la page suivante de ce document.

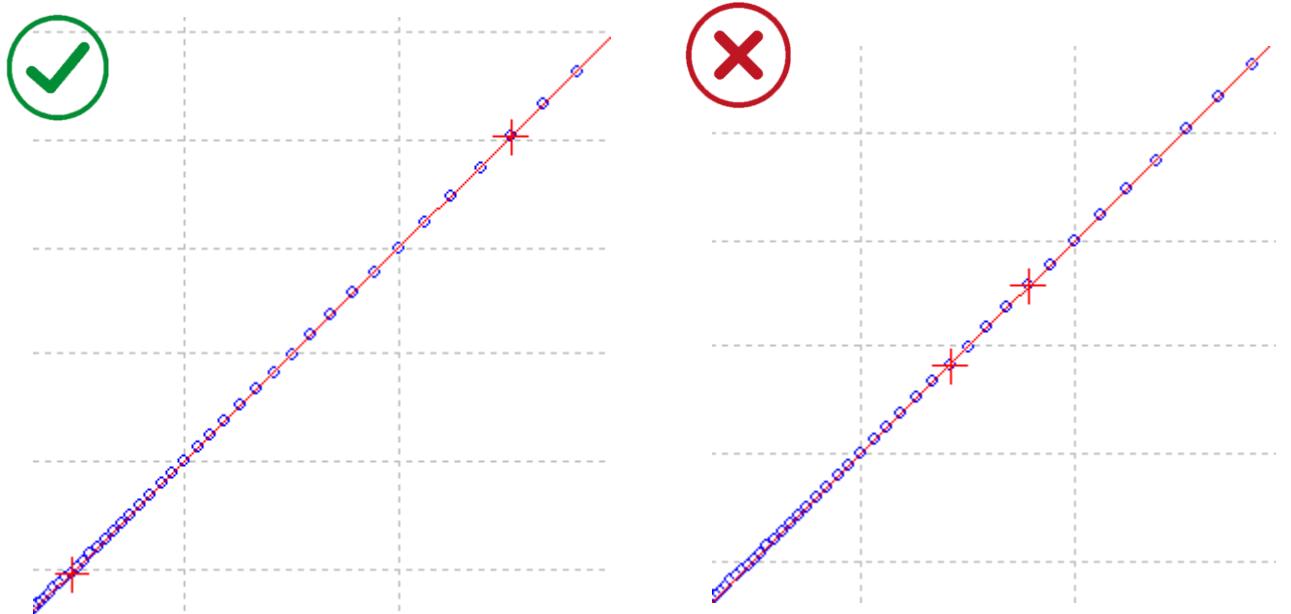
In order to display the results, the user must use the validation button.

Conseils du choix des zones

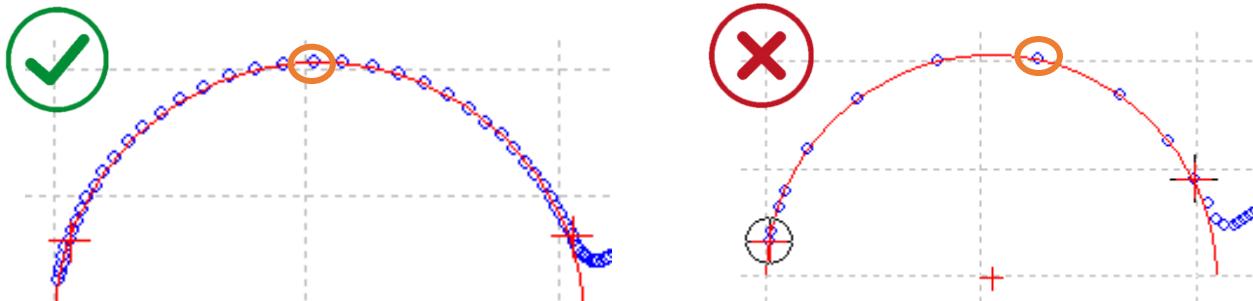
- The actual curve must be as close as possible to the regression performed.



- Calculations average all of the points in the selected area. A wider area refines the results.



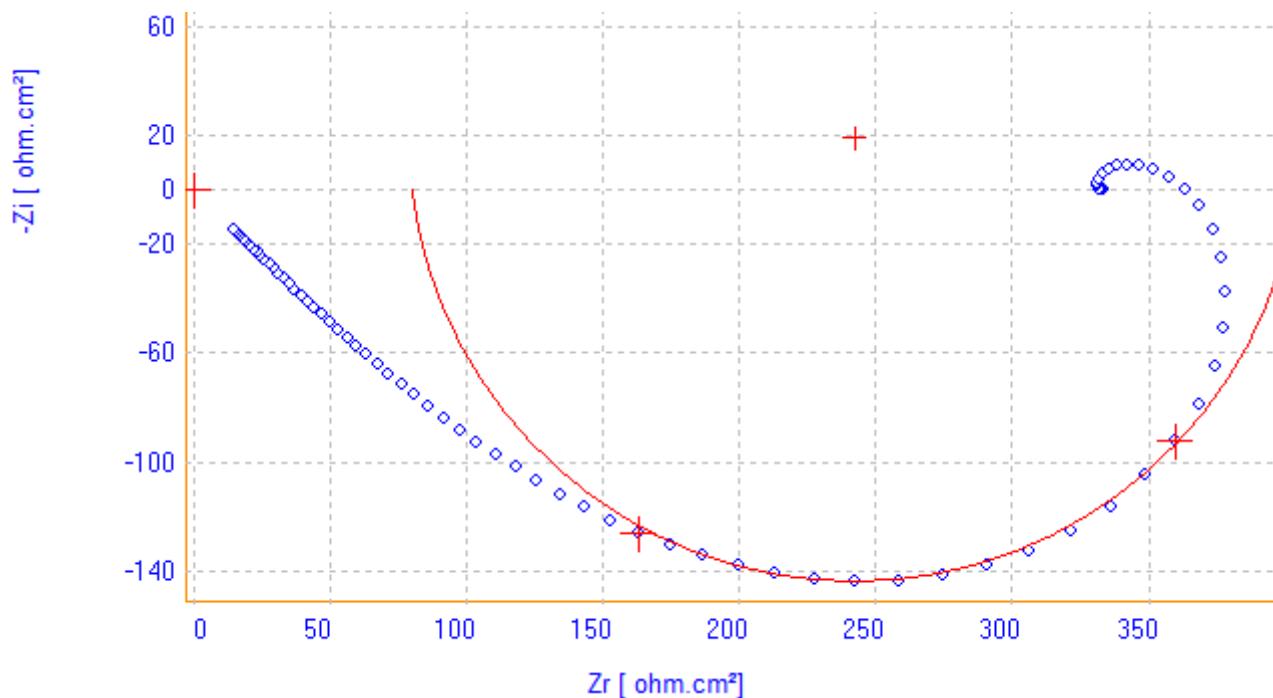
- The calculations use the point closest to the top of the semicircle. A curve with a maximum of points refines the results.



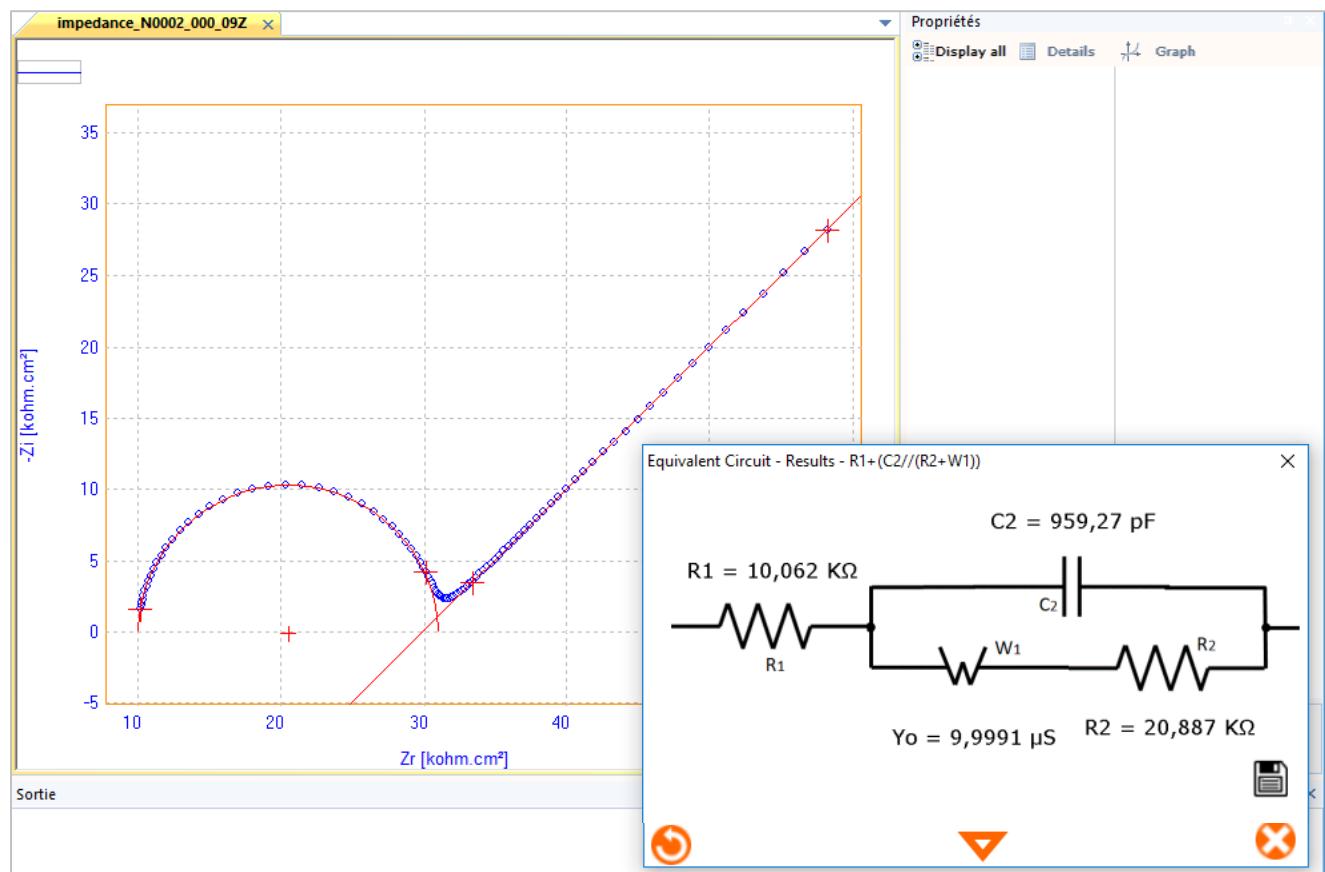
Particular cases

- Circuits **Wo** and **R+Wo**

The circulare regression must be drown on the part containing the top of the curve.



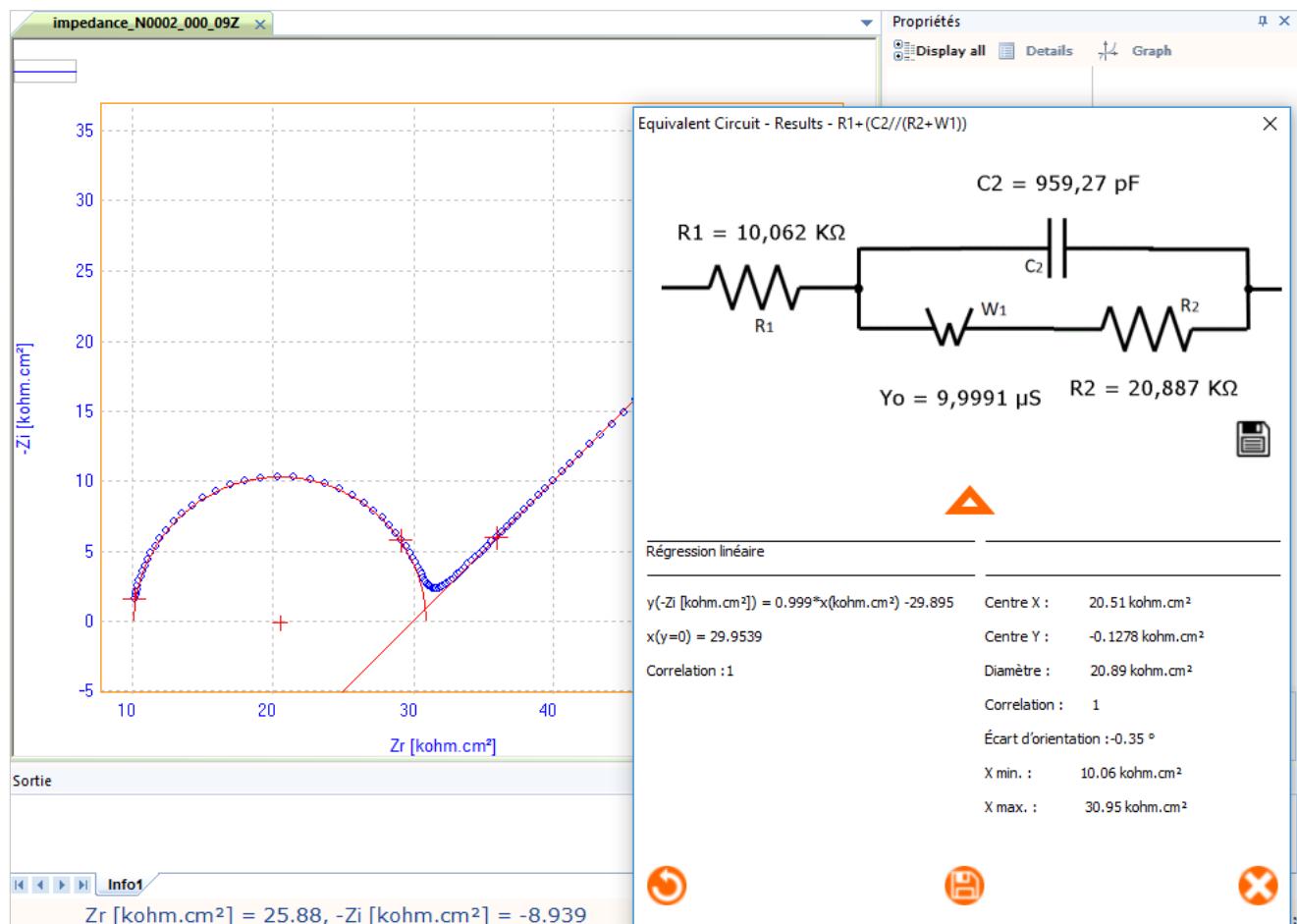
III. Display of results



Results are displayed on the chosen circuit and can be exported as a picture data with the disk button.



The arrow button allows to see calculation details and to export the results as a text data.



The results can be exported in text format with the floppy button, the file will be placed in the folder containing the curve.

IV. List of available elements and circuits

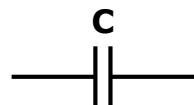
« Classic » components

Resistance



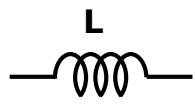
$$\overline{Z_R} = R = [R; 0]$$

Condensateur



$$\overline{Z_C} = \frac{1}{iC\omega} = \left[\frac{1}{C\omega}; \frac{-\pi}{2} \right]$$

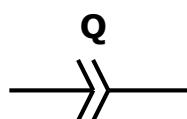
Inductance



$$\overline{Z_L} = iL\omega = \left[L\omega; \frac{\pi}{2} \right]$$

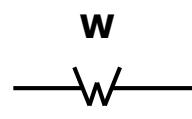
Components with constante phase

CPE



$$\overline{Z_Q} = \frac{1}{Y_0(i\omega)^\alpha} = \left[\frac{1}{Y_0\omega^\alpha}; \frac{-\alpha\pi}{2} \right]$$

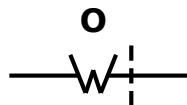
Warburg Impedance



$$\overline{Z_W} = \frac{1}{Y_0\sqrt{i\omega}} = \left[\frac{1}{Y_0\sqrt{\omega}}; \frac{-\pi}{4} \right]$$

Diffusion : (Finite-length Warburg element)

FLW (Transmissive boundary)



$$\overline{Z_O} = \frac{1}{Y_0\sqrt{i\omega}} \tanh(B\sqrt{i\omega})$$

FSW (Restricted boundary)

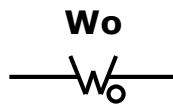


$$\overline{Z_T} = \frac{1}{Y_0\sqrt{i\omega}} \coth(B\sqrt{i\omega})$$

Diffusion layer thickness knownⁱ

Modified FSW

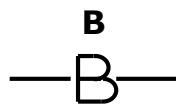
Anomalous diffusion (Bisquert)



$$\overline{Z_{W_O}} = \frac{1}{Y_0} \tanh(B\sqrt{i\omega})$$



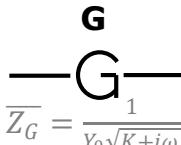
$$\overline{Z_{T_O}} = \frac{1}{Y_0(i\omega)^\alpha} \coth(B(i\omega)^\alpha)$$



$$\overline{Z_B} = \frac{1}{Y_0(i\omega)^{1-\alpha}} \coth(B(i\omega)^\alpha)$$

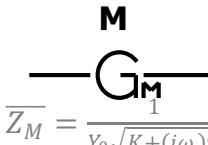
Gerischer Impedance

Gerischer Impedance



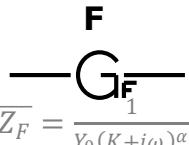
$$\overline{Z_G} = \frac{1}{Y_0\sqrt{K+i\omega}}$$

Modified Gerischer



$$\overline{Z_M} = \frac{1}{Y_0\sqrt{K+(i\omega)^\alpha}}$$

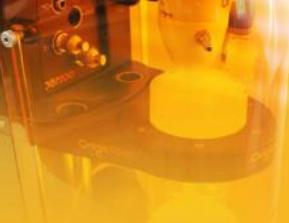
Fractal Gerischer



$$\overline{Z_F} = \frac{1}{Y_0(K+i\omega)^\alpha}$$

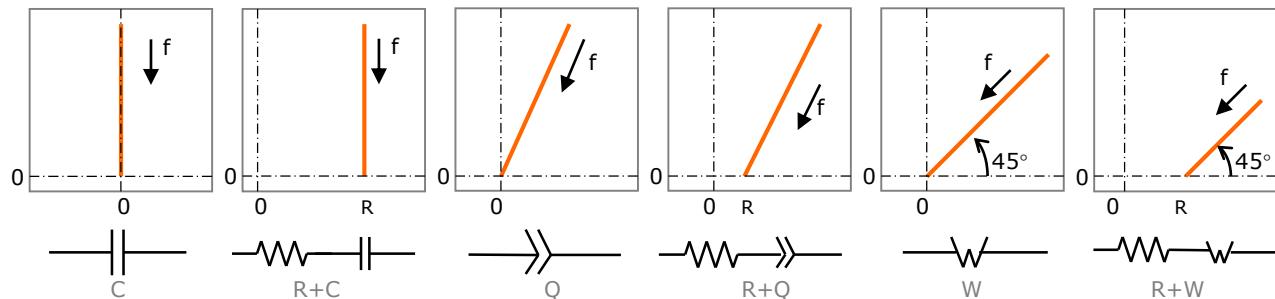
ⁱ Cas correspondants à des valeurs particulières de « α » pour un CPE, avec : $-1 \leq \alpha \leq 1$

- $\alpha = 0$...résistance pure ... ($R = 1/Y_0$)
- $\alpha = 1/2$..impédance de Warburg ($A_w = 1/Y_0$)
- $\alpha = 1$...condensateur pur ($C = Y_0$)
- $\alpha = -1$..inductance pure .. ($L = 1/Y_0$)
- $\alpha > 0$...CPE capacitive ($Q = [Y_0 ; \alpha]$)
- $\alpha < 0$...CPE inductive ($Q = [Y_0 ; \alpha]$)

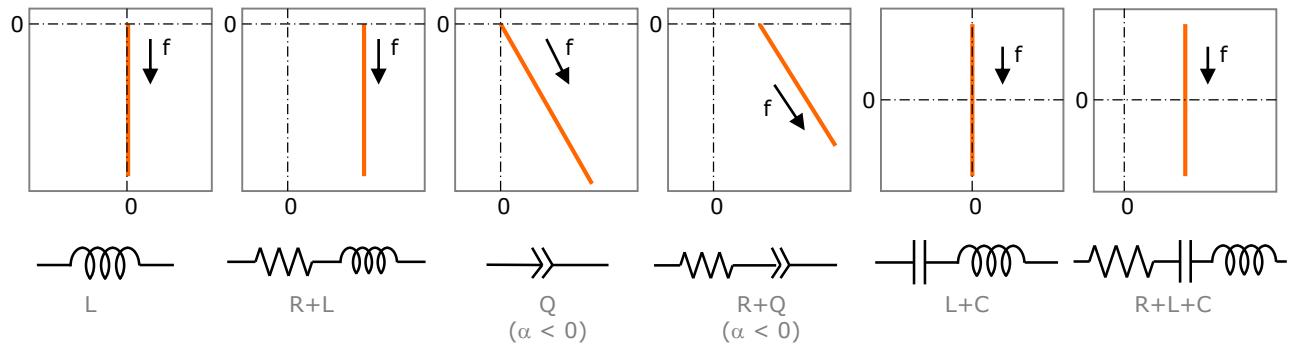


Available circuits

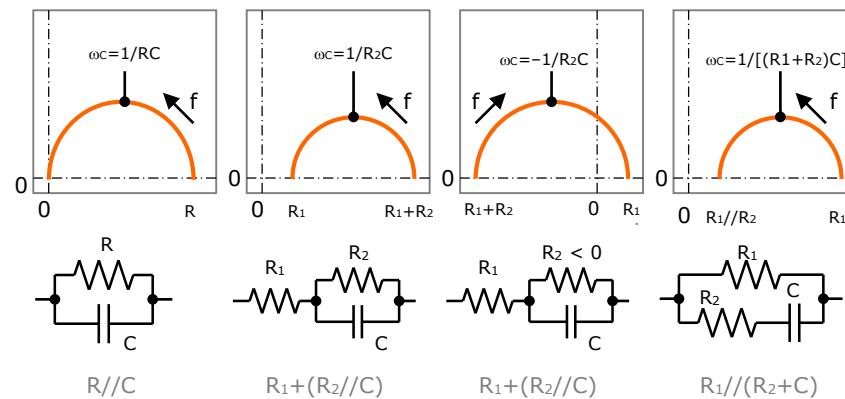
Capacitive straight lines

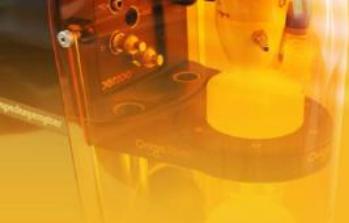


Inductive straight lines

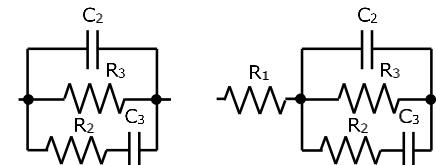
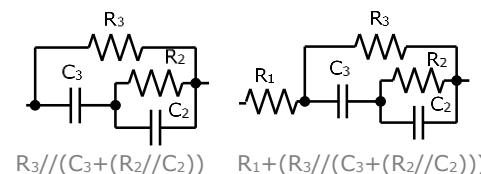
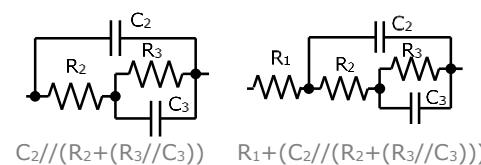
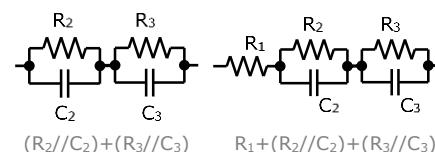
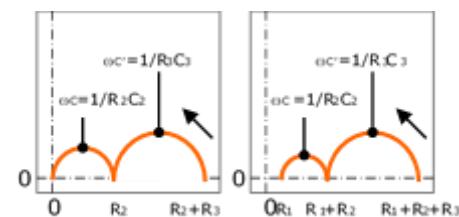


Capacitive semicircle diagrams



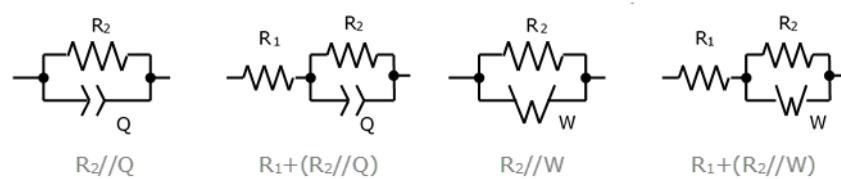
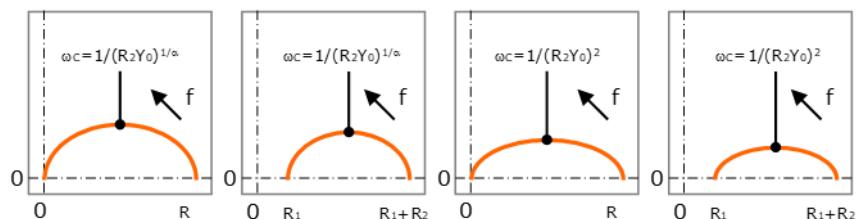


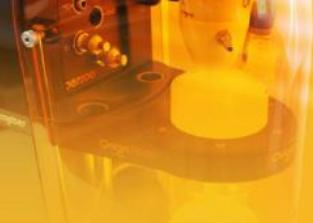
Capacitive semicircle diagrams



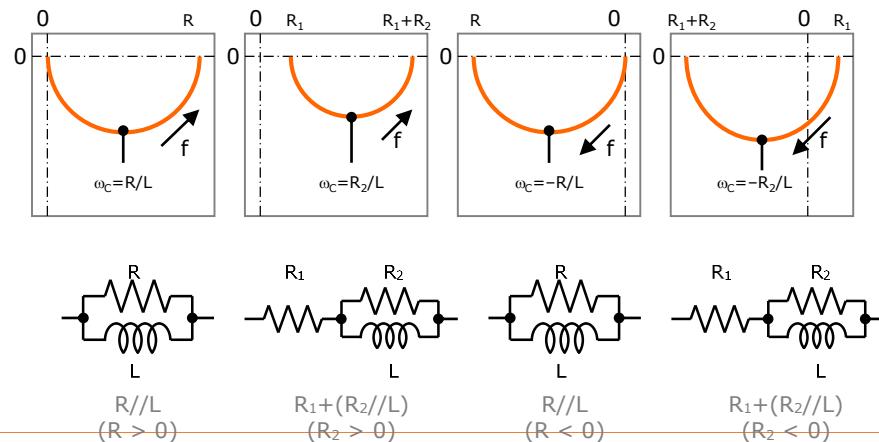
$R_3//C_2//(R_2+C_3)$ $R_1+(R_3//C_2//(R_2+C_3))$

Capacitive pseudo-elliptic diagrams

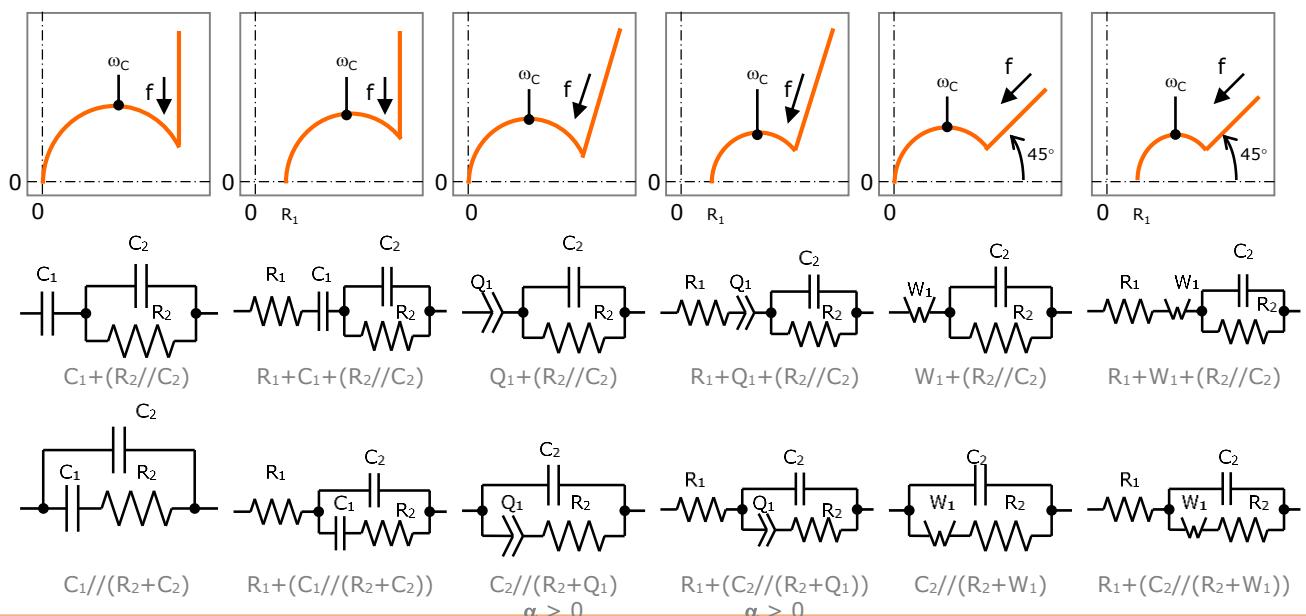




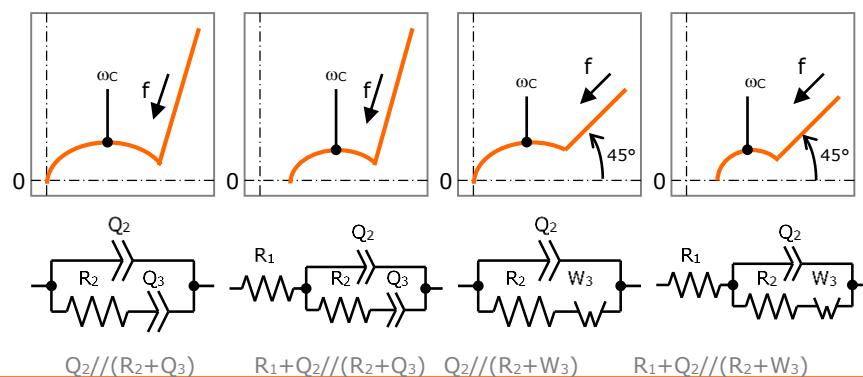
Inductive semicircle diagrams



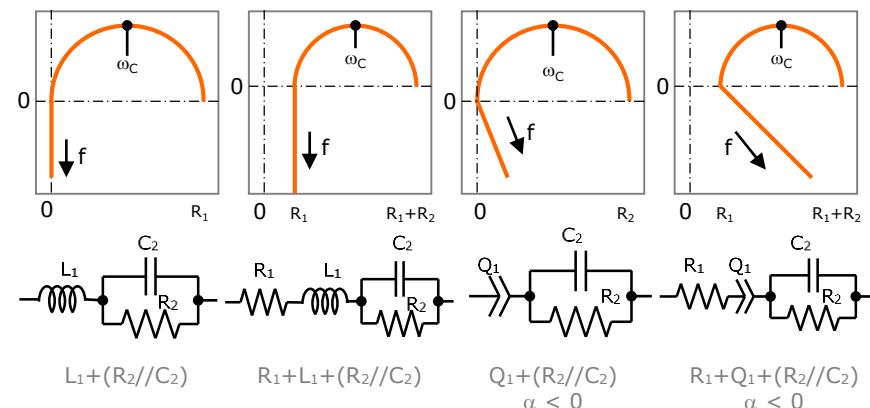
Capacitive diagrams, semicircle and straight line



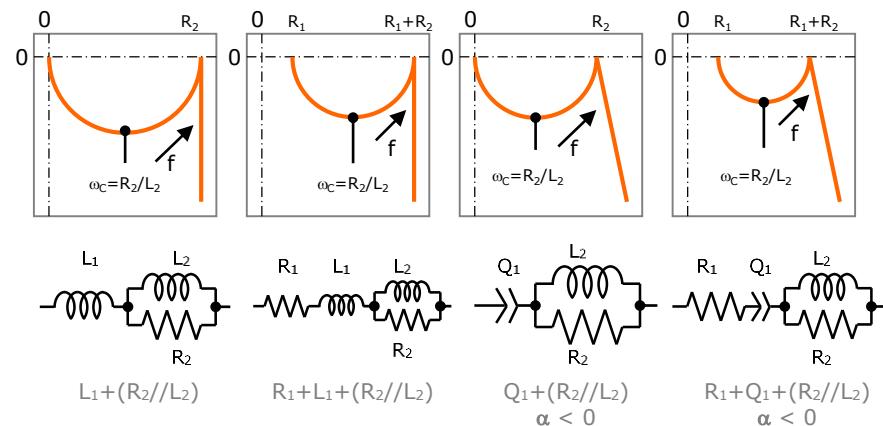
Capacitive diagrams, pseudo-elliptic and straight line



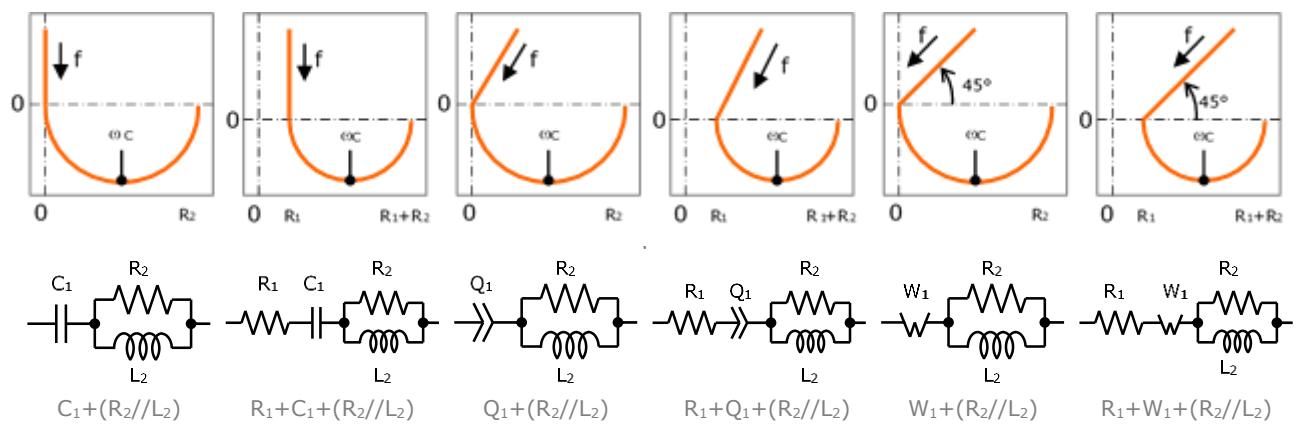
Diagrams: capacitive semicircle and inductive straight line



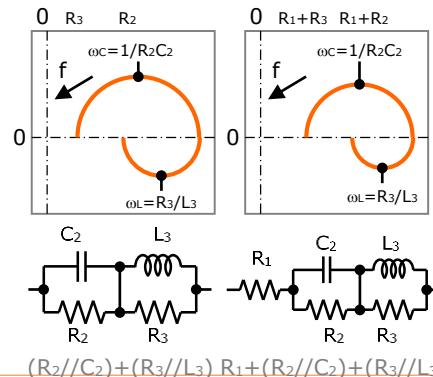
Inductive diagrams, semicircle and straight line



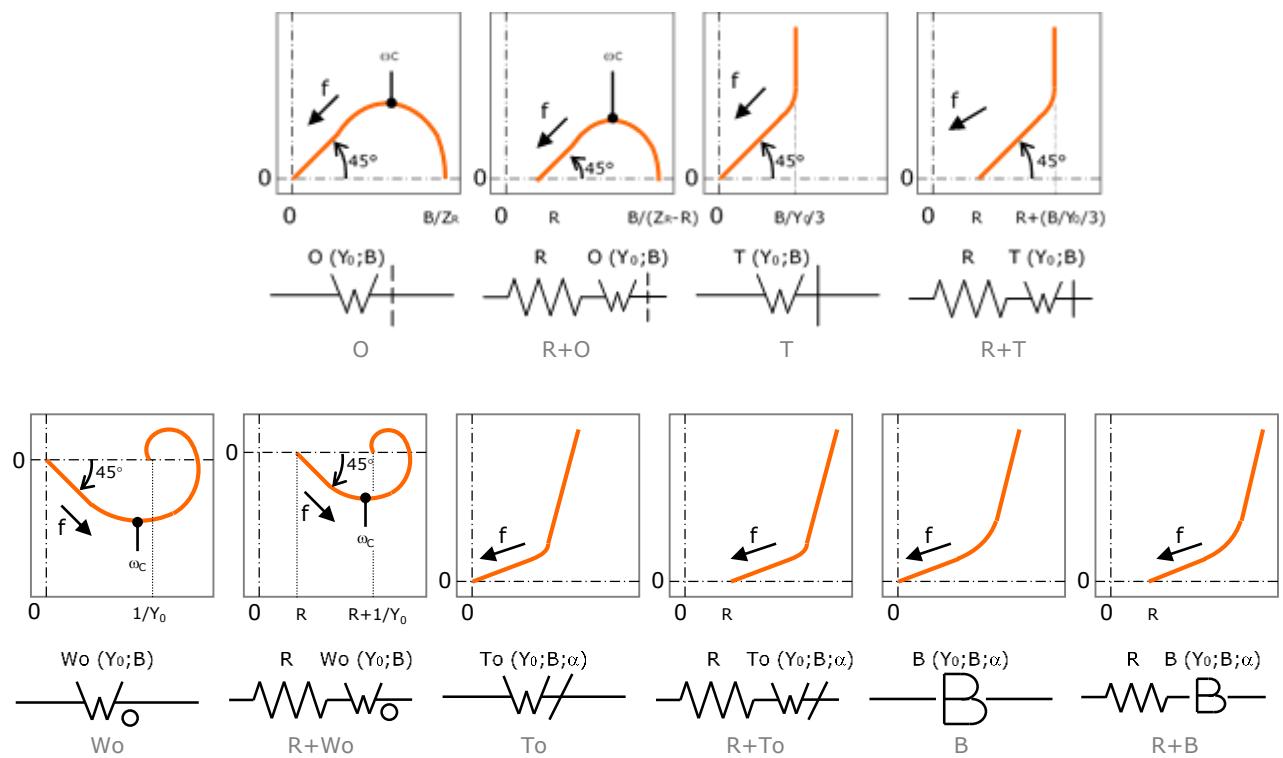
Diagrams: inductive semicircle and capacitive straight line



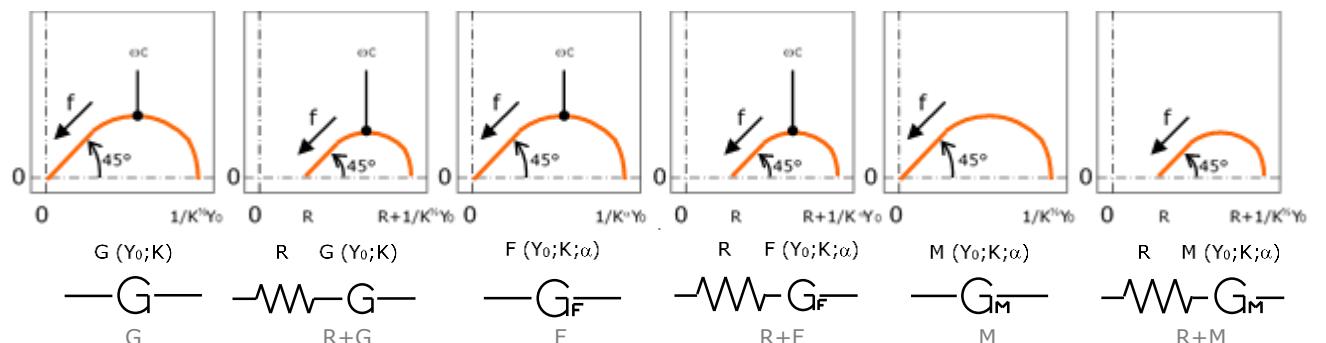
Diagrams in semicircles, capacitive & inductive



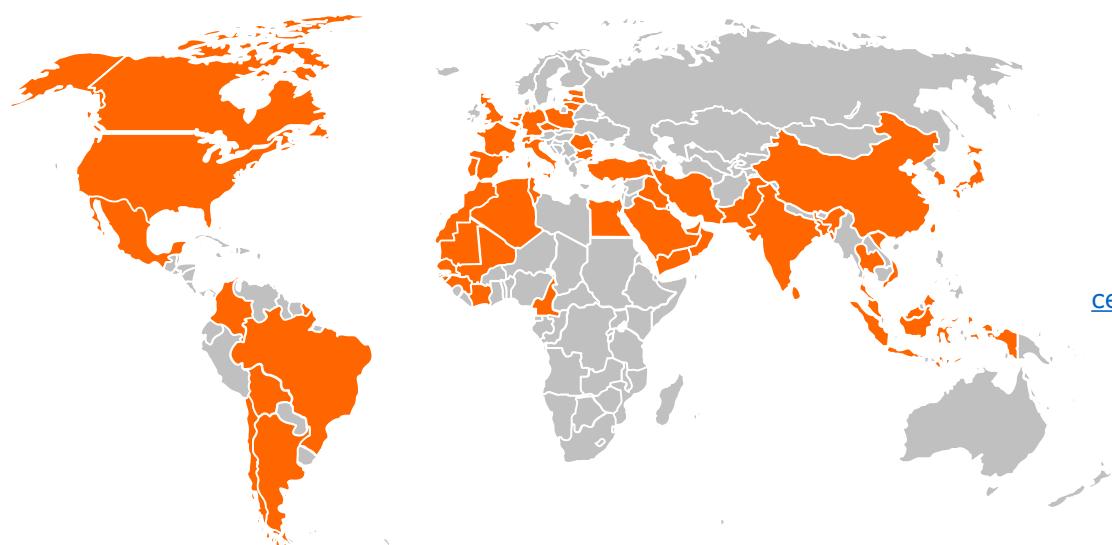
Diffusion



Gerischer impedance



➤ A worldwid Network



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