Setup and Function of a Capacitor

A capacitor consist of two electrically conducting plates that are separated through an insulator – the dielectric - , which lies in between. The (electrical) unit of the capacitor is called the capacitance. It is calculated as follows:

$C = \varepsilon r \cdot A/d \cdot 8.85 \cdot 10^{-12}$ [F]

So **εr** is the relative dielectric constant of the insulator, A the electrically active surface of the plates (in m²) and d is the gap between the plates (in m).

Hence it can be seen that the capacity will be increased or decreased, if the plate gap is minimised or maximised. The capacity is directly proportional to the relative dielectric constant. Thus the larger the specific value of the inserted dielectric is, the larger is the capacitance as well. In the following table the different dielectric constants for diverse materials are listed.

Material	εr
Air	1.0001
Aluminium Oxide	7...8
Ceramics	10 and higher
Glass	4...10
Mica	6...8
Paper	2...5
Pertinax	5
Porcelain	4...8
Polycarbonate	3
Polyester	3...3.2
Polypropylene	2.1...2.3
Polystyrene	2.5
Tantalum Oxide	11
Teflon	2.0...2.1

The plate distance and the dielectric chosen determine the voltage resistance of the capacitor. The dimensions of a capacitor are thus not only specified through the capacitance but also by the voltage resistance (and also by the setup, of course).

An ideal capacitor according to the textbook would have a reactance that is exactly determined by the formula **$X=1/(2\pi \cdot f \cdot C)$**

As always in reality things are different. In *(fig. 04)* the equivalent circuit diagram of a real capacitor is displayed. The equivalent circuit diagram is illustrated in practically the same manner in the entire technical literature. Merely the components plotted dashed are less frequently seen. However for the sound quality of a capacitor they exactly play a big roll.

The actual capacity in the equivalent circuit diagram is **C**. Parallel with it lies the resistance **R_p**, it represents the insulation resistance of the dielectric. Usually **R_p** has the magnitude of a couple of megohms and is therefore for our reflections confidently negligible. In series with **R_p** and **C** lies the resistance **R_s**, that stands for the quite small transfer resistance between the components lead-/-plate-/-dielectric-/-plate-/-lead. The minimum impedance of a capacitor can never be smaller than **R_s**.

Especially in applications where sometimes larger currents flow, e.g. in diplexers, the serial resistance plays an important role.

The last part of the common equivalent circuit diagram is the serial inductance **L_s**. Its sizte depends on the design of the capacitor, the leads and the way, the wires are attached, e.g. only at a point or at a larger part of the plate.

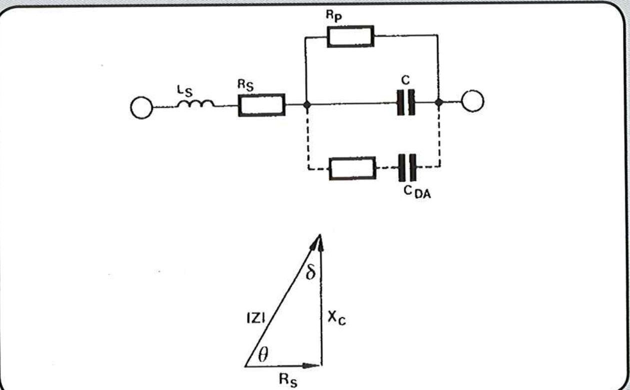

FIG. 04

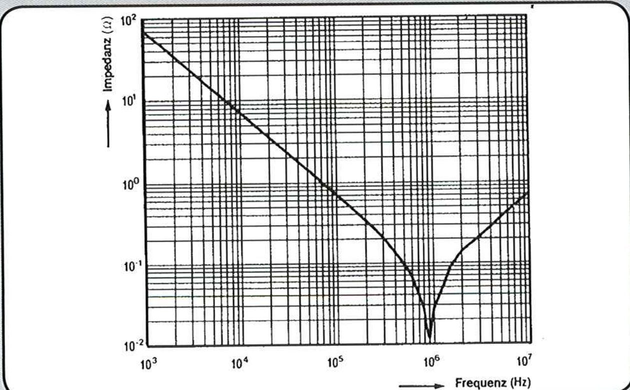

FIG. 05