Measuring of Self Resonance Frequency

1. Introduction

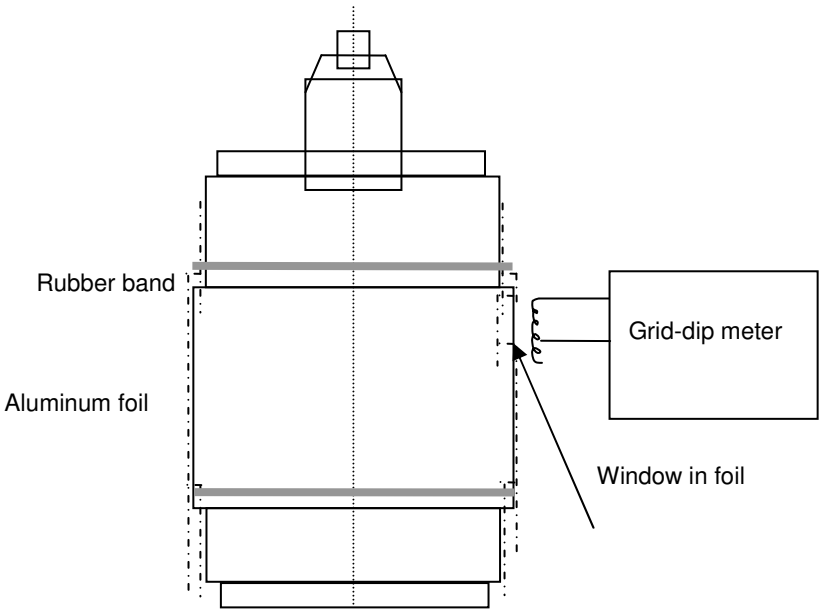
The self inductance of a vacuum capacitor depends mainly on its design and dimensions. It is extremely small and constant for fixed capacitors ranging form approximately 2 to 10 nH, depending on the type. Variable capacitors have a larger internal inductance, ranging from approx. 6 to 50 nH. This is due to the extended structure, such as the bellows, which connect the movable electrode to the external mounting flange.

The self resonance frequency of a vacuum capacitor is determined by its capacitance and self inductance. Detailed data for most capacitors are given on the second page of the data sheets.

2. Measurement the Self Resonance Frequency

The self resonance frequency as a function of capacitance can be measured with a grid-dip oscillator (manufacturer for example Radiometer Copenhagen). The variable vacuum capacitor is wrapped with aluminium foil to create a resonance cavity. The foil is secured to the capacitor metal-ceramic seal area by means of a tight wire or with a rubber band.

A window is cut in the foil (area of approx. 6 cm^2) in the upper part of the ceramic cylinder for RF coupling of the coil of the grid-dip meter.



The capacitor is adjusted to the maximum capacitance value, and the grip dip meter is placed in a stable position near to the window and the frequency adjusted slowly until the meter indicates a dip in the display.

Please note: As the Q-factor is very high the dip will be very narrow and can be seen as a small peak only!

The measurement should be repeated for several different capacitance values.

3. Calculation of the Self Inductance

With the following formula the self inductance of the capacitor can be calculated as follows:

Example:

$$fr = \frac{1}{2 \cdot \pi \cdot \sqrt{L \cdot C}}$$

Capacitance = **655 pF**

Self resonance frequency = **39 MHz**

Self inductance → **25,4 nH**