ARTA - APPLICATION NOTE

No 2: RLC measurement with LIMP

The program *Limp* can be used to measure value of resistors, capacitors and inductors, simply by calculating resistive, inductive or capacitive parts of the measured impedance. For example, Fig. 1 shows impedance curves of an inductor with nominal value of 1.5mH.
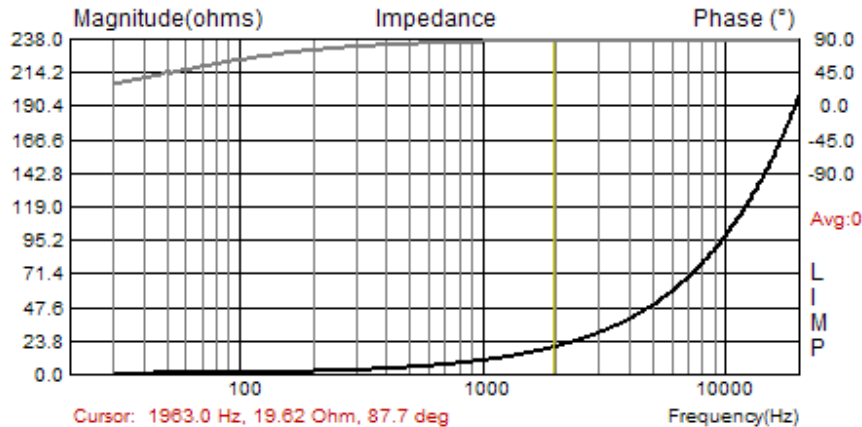

Figure 1 The impedance graph of a 1.5mH inductor

By clicking to menu command **Analysis->RLC Impedance value at cursor position** we get the dialog box with report as shown on figure 6.2. Limp reports that measured impedance has resistive part of 0.776 ohms and imaginary part is inductive with value of 1.589mH.
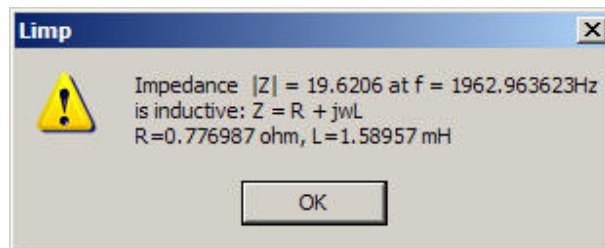

Figure 2 The impedance graph of an air core inductor

The same way Limp measures the capacitance or even pure resistance.

Importance of calibration

When measuring impedance and capacitance it is very important to make calibration before the measurement, and it is best to make the calibration with impedance connected.

Why?
Even if there is a very small difference between channel sensitivities (i.e. 0.1dB) the Limp can give very erroneous result, because inductor impedance has phase close to 90 degree, and

1

capacitor impedance has phase close to minus 90 degree. In that case if there is a difference in sensitivity of measured generator voltage V1 and impedance voltage V2 (if sensitivity of V1 is larger than sensitivity of V2) estimated impedance gives phase values that are larger than 90 degree and in graph we have warped jump in the phase for 180 degree (see Fig.3).
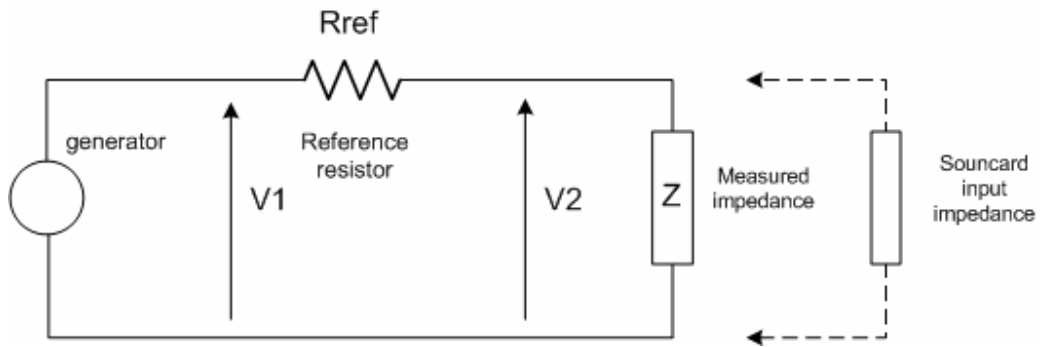

Figure 3 Basic elements of impedance measurement circuit

Figure 4 shows the case of measuring capacitor without calibration. In half the range the phase is close to 90 degree. It is very erroneous results as it suggest that we deal with an inductance. Figure 5 shows capacitor impedance after the calibration. We see correct values for phase in whole frequency range.
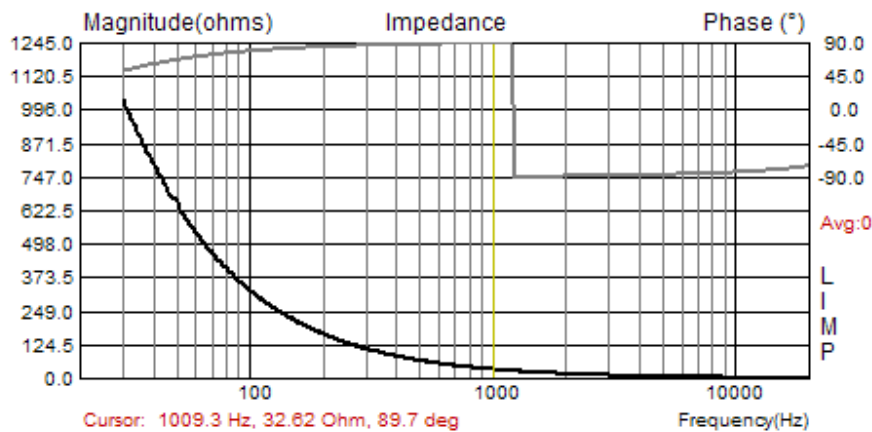

Figure 4 Wrongly estimated impedance of a plastic capacitor 4.7uF/250V (measured without the calibration)
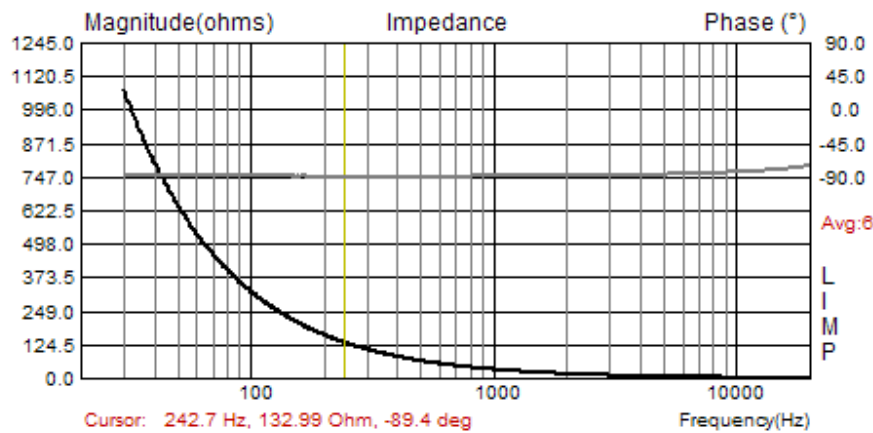
Figure 5 Correctly estimated impedance of a plastic capacitor 4.7uF/250V (measured after the calibration)

Not all *Limp* users will have this problem. As explained before, the problem exists when probe for impedance voltage V2 has higher sensitivity than it is the sensitivity of probe for generator voltage V1. To circumvent this condition we can change probes sensitivity or we can simply exchange input channels and also change the reference channel in the *Limp* measurement setup.

Note:

To get good estimation of capacitance or inductance it is recommended to put cursor on frequency where impedance magnitude is lower than 100 ohms. It assures measurement of impedance with 1% tolerance. Why? The answer lies in fact that measured impedance is bypassed with probe or soundcard input impedance that usually has value of 10k ohms.