Testing Inductors and CM Chokes with DC Bias.

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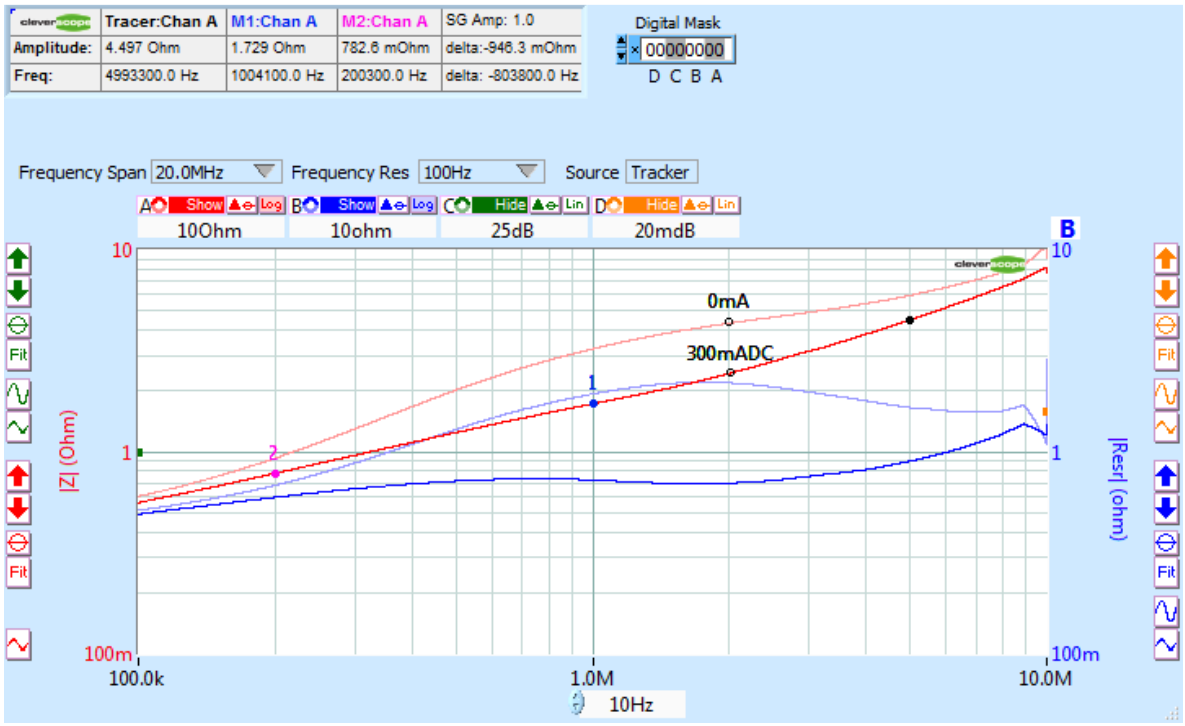
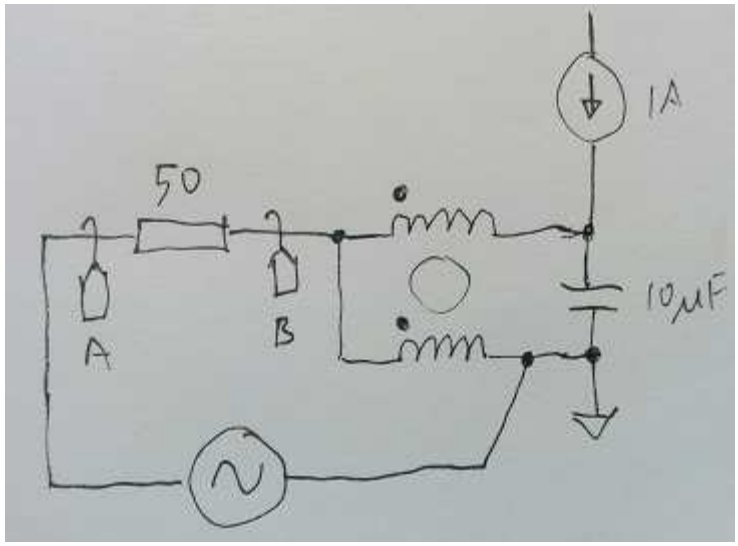
The CS1070 Amplifier can be used to apply a DC bias while testing an inductor, however the output current is limited to 1A. This document shows a method to apply more DC bias above 1A.

Example 1: Using CS1070

Use the CS1070 Amplifier to drive 300mADC while measuring impedance of a Ferrite Bead (BLM18BA750SN1, 75Ω@100MHz, 300mA, 0.7Ω). Get impedance at 1MHz: 3.2ohms (0mA) or 1.7ohms (300mA). The 1ohm output of the CS1070 is used to set the current level with the DC bias setting on the signal generator control.

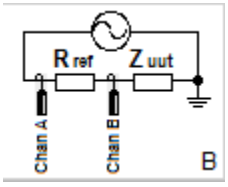


Example 2: CM Choke with External Current Source



Test a 2x2.2mH (Wurth 744272222) Common Mode Choke with different levels of DC bias current flowing in differential mode. This is how the DC current normally flows when the CM choke is used to filter a DC supply rail.

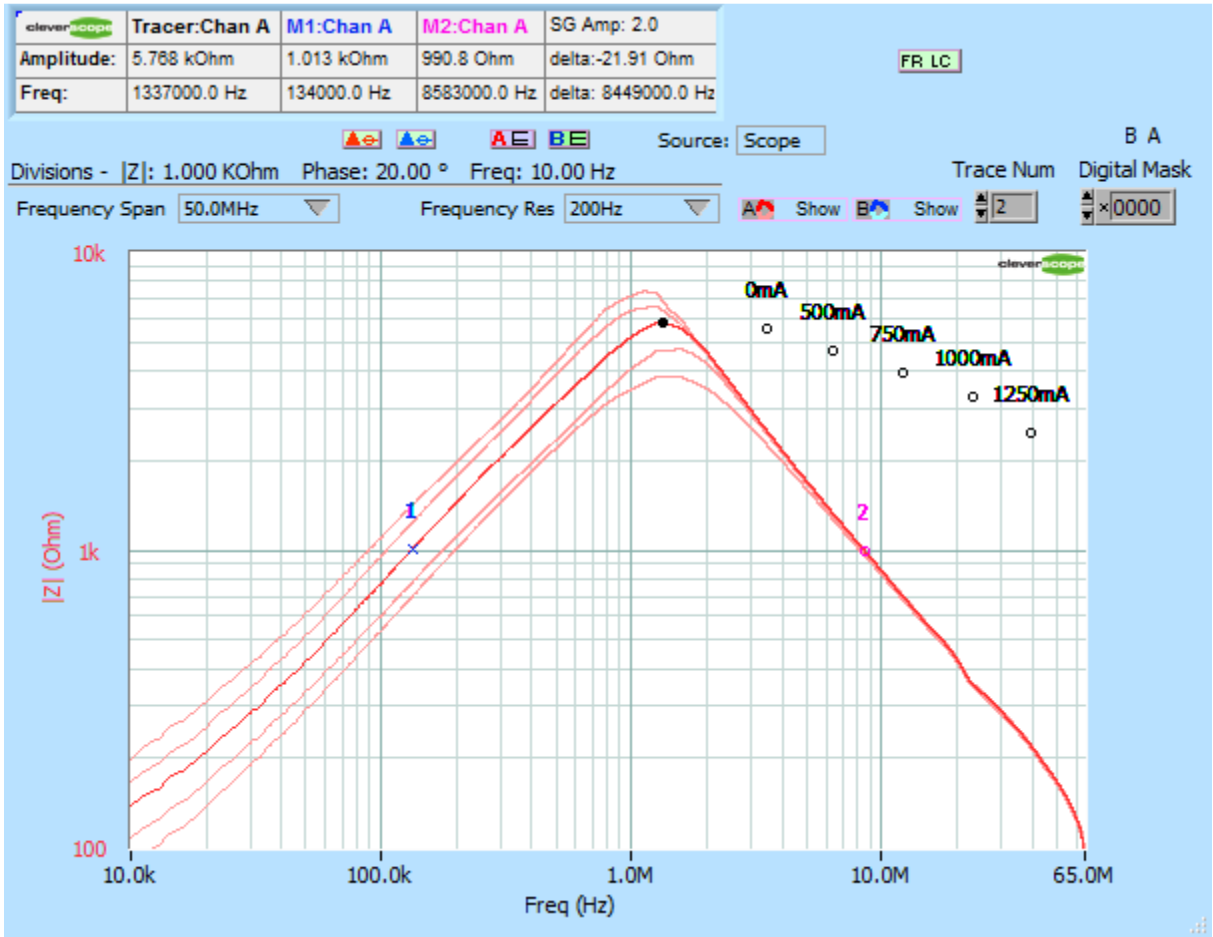
Use Circuit B on the FRA set-up, and apply the DC bias current at the "ground" end of the Zuut. This way it does not influence the measurement nodes at ChA & ChB which will be high impedance.



Add a decoupling cap so that both inductors see either ground or a virtual ground. The cap should be big enough so that the LC F_{RES} is below the frequency range of interest. e.g. with 2x2.2mH & 10uF, F_{RES} = 759Hz. The voltage across the cap will be 2x $ESR_{INDUCTOR}$ x I_{DC}, so low voltage ceramics can be used.

Use a bench power supply with adjustable current limit to apply the DC bias.

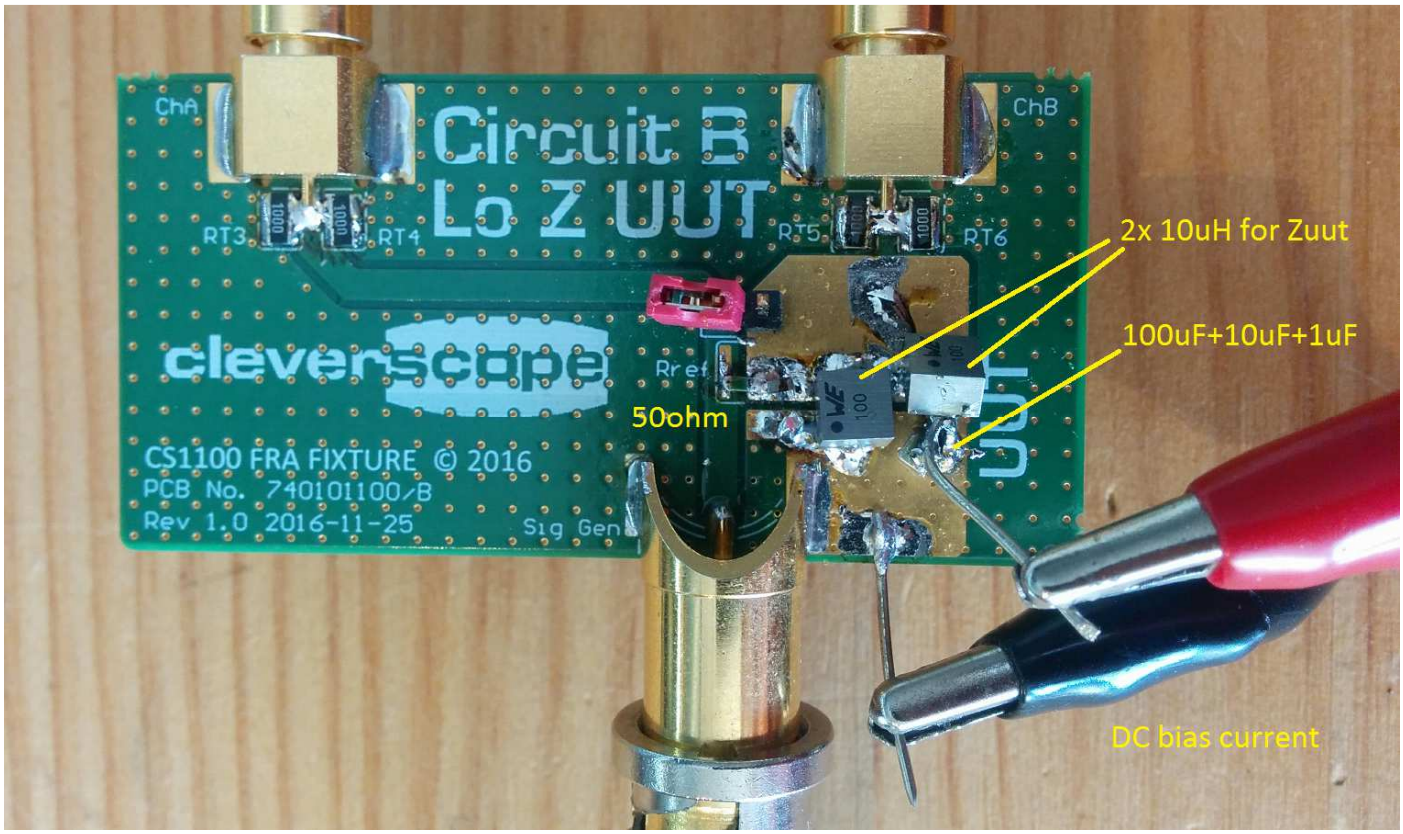
Here is the CM impedance reducing as the current increases. Note that after the self resonance of the CM choke at about 1MHz there is less change of impedance with increasing current. This is because after self resonance the impedance is mainly due to capacitance and so is not effected by bias current.



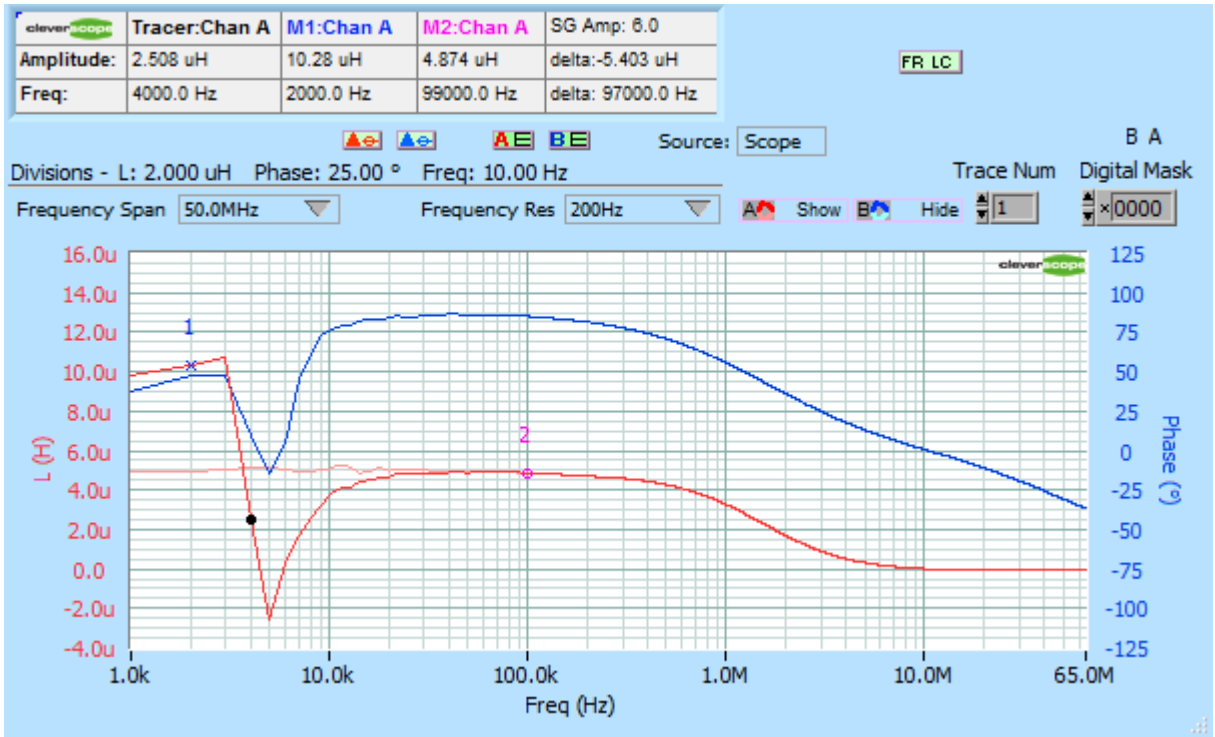
Example 3: Inductor with External Current Source

Use the same circuit as for the CM choke but put two of the inductors as Zuut in place of the CM choke. The result will measure half of the required inductance because there are two in parallel.

In this test we use 2x 10uH Wurth 74438357100 (15MHz SRF, 110mOhm, 4.6A sat).



Ensure that the DC bias decoupling cap is big enough so that the LC F_{RES} is below the frequency range of interest. e.g. here 100uF+10uF+1uF & 2x 10uH gives F_{RES} = 3.4kHz. In the following graph, below F_{RES} the measured inductance is 10uH (M1) because only the inductor between ground and signal is active. Above F_{RES} both inductors appear in parallel so the measured inductance is 4.874uH (M2). The reference trace (light red) shows the inductance measurement with both inductors connected in parallel (caps shorted).



Then using a bench power supply with adjustable current limit, set the DC bias current through the inductor pair and take measurements.

Here the current has been varied from 0 to 3A. The inductance has dropped from 4.874uH at 0A to 4.237uH at 3A (M1):