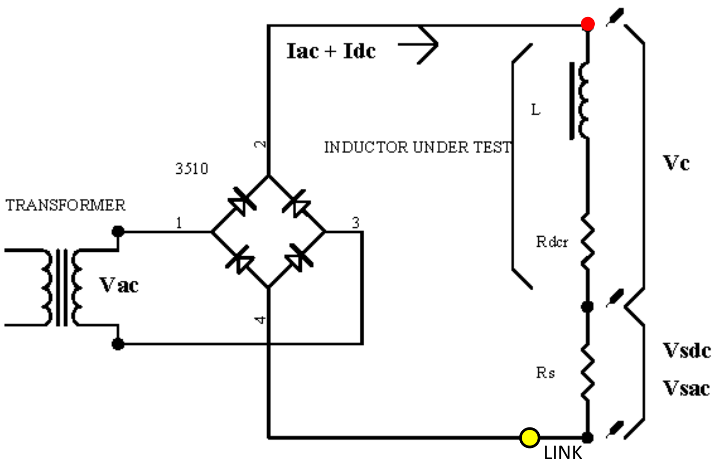
This is a description of an example measurement jig to support the article on choke measurement [1] – it is only meant as a functional example and can be modified to suit the user's available resources and parts.

The tester general schematic is shown below, along with the jig front fascia. The jig includes 4mm sockets:

- 2 sockets connect to a variable AC voltage supply - Vac in schematic - black and red labelled 'Vac Tx'. These sockets connect internally to a bridge rectifier.
- 2 sockets connect to the choke being tested – L+Rdcr in schematic - black and red labelled 'Choke'. The red socket connects internally to the positive output of the bridge rectifier. The black socket connects internally to the commoned end of the sense resistors.
- 8 sockets connect internally to a variety of sense resistors – Rs in schematic – blue and black labelled with their respective resistance value in ohm. The commoned end of the sense resistors connects internally to the 'Choke' black socket.
- 1 socket connects to the negative polarity end of the bridge rectifier – yellow - located in centre of sense resistor sockets to allow a shorting banana plug to make a link to the required sense resistor.



Three meter measurements are needed for each calculation of choke inductance:

- Choke AC voltage (Vc in schematic) is measured by piggybacking the meter leads to the test leads connected to the 'Choke' sockets.
- Sense resistor AC voltage and DC voltage measurements can be made using two separate meters or from the same meter (meter measurement mode is changed at the meter). The meter(s) connect by piggy-backing to the yellow socket (meter negative polarity) and to the black socket of the 'Choke' terminals (meter positive polarity).

In addition, the dc resistance of the choke (Rdcr) needs to be measured. A calculation spreadsheet is available, and accounts for the effect of Rdcr on the choke inductance calculation. The spreadsheet identifies the power dissipated in the sense resistor (Rs), as well as the choke (due to Rdcr).

Measurement Notes

Preferably turn-off or disconnect the AC voltage supply before adjusting the sense resistor link, to avoid the choke generating a high voltage spike that may stress any connected meter. As a backup, fit a MOV to constrain any accidental reverse voltage spike (I have fitted a 250Vac rated 15mmD disk).

Use a true-rms meter to measure Vsac across sense resistor Rs (to derive Iac=Vsac/Rs), and to measure Vc across the choke. If possible, use 3 meters (for Vc, Vsac, Vsdc) to simplify each measurement.

Check your meter performance specification as part of preparing to take measurements. Note that some DVM's like a Fluke 115 handheld may not do (although it has a 600mV AC-DC range, this can over-range due to the DC level exceeding 600mV even though the AC level being measured is low, and so the 6VAC range is only available).

The value of the sense resistor Rs is varied in order to lower or increase the DC current level relative to the applied inductor AC voltage level, as Idc/Vac ~ 0.9 /(Rdcr + Rs). The example test jig has 8 pre-wired sense resistors to allow for easy step changes.

The AC supply voltage Vac is also varied so that both Vac and Idc can be changed. Any AC supply should be through a transformer to isolate the test jig from the mains AC. One option is to use a tapped transformer (I use the heater supply of a vintage valve tester that can switch from 0.6 to 117V in 19 steps). Another option is to use a mains AC variac to drive a fixed transformer. The AC supply needs sufficient current rating to suit the DC current being applied to the choke (eg. Vac with a 1A secondary rating would suit many chokes used in valve amps).

Chokes designed for choke input filtering experience a high applied AC voltage – to present these conditions to the choke being tested requires a larger Rs (eg. Rs=470Ω with higher power rating >20W) to apply say 50Vrms and pass over 100mAdc, otherwise the measured inductance may be significantly different than actually experienced in service.

Using a small value for Rs (ie. 10Ω) may need a meter to have at least 1-10 mV resolution (ACrms and DC), such as a cheap Aneng AN8009. Also note that there is a lower voltage limit to Vac that is needed to generate a level of Idc, due to inherent Rdcr.

A generic diode bridge with at least 4-6A rating is recommended (eg. 3510). The photo shows a custom bridge made from BYW81PI200 diodes that was used to confirm there was no measurement accuracy change when using a bridge with different on-voltage diodes.

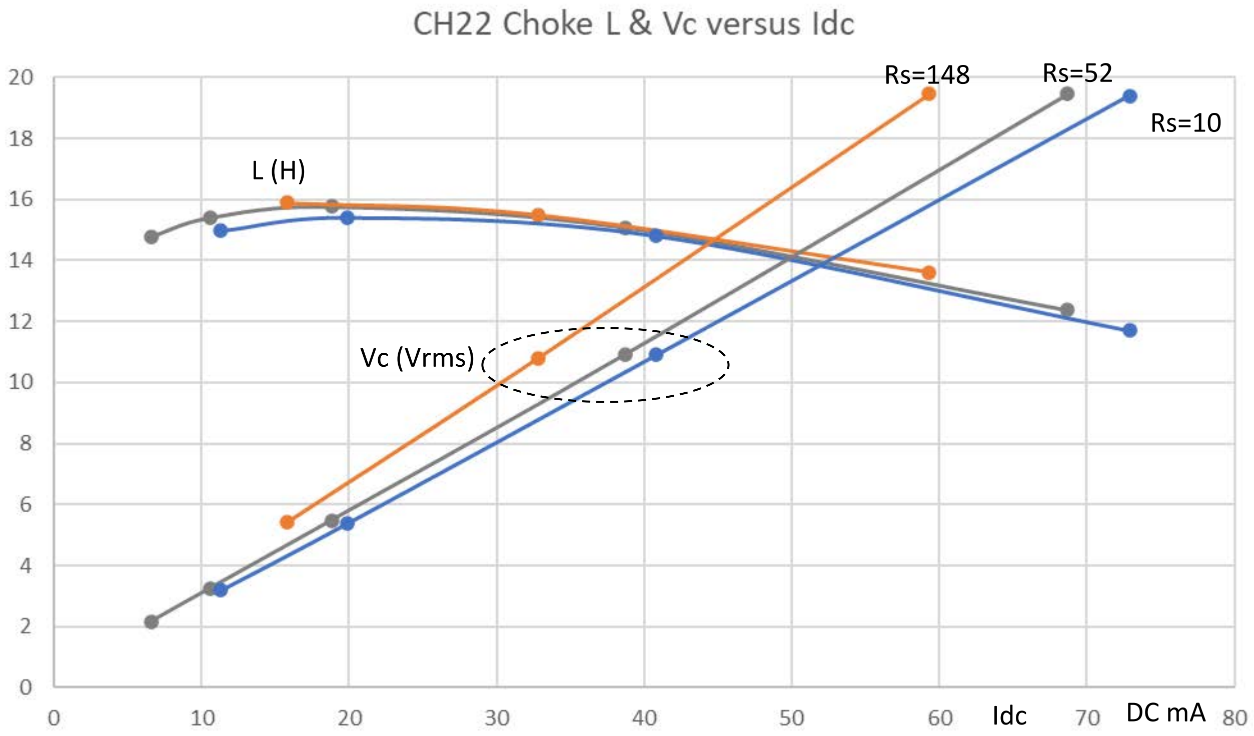
Various junk-box resistors were used in the example test jig, but note that they should have sufficient power dissipation ratings for the range of choke measurements expected.

Example choke test #1

A ROLA CH22 choke was tested using three sets of measurements made with Rs = 10Ω, 52Ω and then 148Ω. The supply transformer voltage was varied in steps between 5Vac and 45Vac (using 5, 7.5, 12.6, 25 and 45 steps, but not all steps were used for each change in Rs).

The CH22 choke catalog rating from ROLA was 10.8H at 50mAdc and 10Vac with Rdcr=500 Ω, however the choke was also marked 12/50 which has a choke catalog rating from ROLA of 12H at 50mAdc and 10Vac with Rdcr=540 Ω. The measured Rdcr was 510 Ω, indicating a continuous internal power dissipation of up to 1.3W at 50mAdc (ie. a small choke with core dimensions of 43x36x18mm).

A plot of the measurement results below shows three curves for Y-axis choke inductance L in H (horizontal grouping of 3 curves), and three curves for the applied choke Y-axis Vc in Vrms, versus an X-axis choke dc current Idc in mA. Each set of measurements is a curve displayed with the same colour, and the sense resistor used for each set is marked.

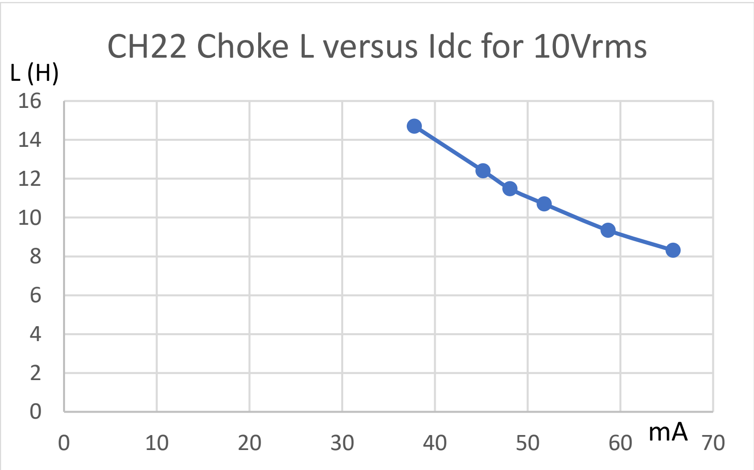


It's not appropriate to infer from the inductance plots that the inductance value L changes just due to rising DC current (ie. it rises a bit before falling as current increases beyond 50mA), as the choke voltage Vc is being changed between each point on a plot curve.

The circled group of three data points relates to where the applied choke voltage Vc is about the same (10.9 Vrms), and the corresponding inductance values (on the other set of curves) for those three data points indicates that inductance falls from 15.5H at 33mAdc to 14.8H at 41mAdc.

To take measurements at the same choke voltage (ie. 10Vrms) for a range of dc current levels requires varying AC supply voltage Vac to where Vc is 10Vrms, and changing Rs from a lower value (ie. lower Idc) to a higher value (higher Idc).

A resistance decade box and a variac was used to take measurements at Vc=10Vrms with Rs= 10, 12, 13, 14, 16 and 18Ω, and the plot shows that choke inductance L falls significantly as Idc passes through 50mA, and is circa 10.8H at 50mA (as rated).

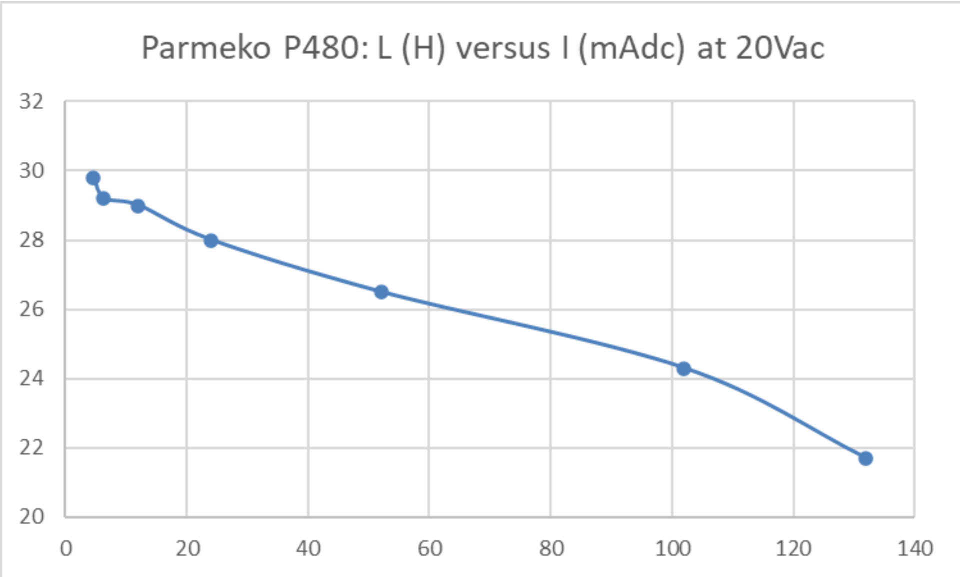


As an independent test, an LCR meter (MCP BR2822) measured the Rola choke as 11.8H with 0.21Vrms 100Hz excitation and no DC current.

Example choke test #2

A Parmeko P480, Neptune 6000/55 model (oil filled) with label rating of 20H 120mAdc was tested using seven sets of measurements made with Rs = 52Ω, 148Ω, 534Ω, 1489Ω, 3k3Ω, 6k8Ω and 10kΩ. The transformer feed voltage Vac was provided by Paton VCT2 valve tester's heater supply (19x voltage steps from 0.6Vac to 117Vac via Filament Volts switch, and 11x 5V mains voltage steps from 215V to 265V via Line Adjustment switch). For this set of measurements, Vc was kept constant at 20Vrms at 100Hz (twice mains frequency), as the choke was being used in a choke-input filter power supply. The VCT2 supply voltage setting was up to 50V (ie. above the 20Vac across the choke) due to the voltage drop across the sense resistor, and the VCT2 Line Adjustment was varied to keep Vc constant.

The plot below shows the choke inductance noticeably increases at lower DC current, and is 29H at 10% of rated current, with an inductance swing increase of about +30%, which indicates the choke was not designed as a 'swinging choke'.



References

[1] Choke measurement article.