

APPLICATION NOTE - 008

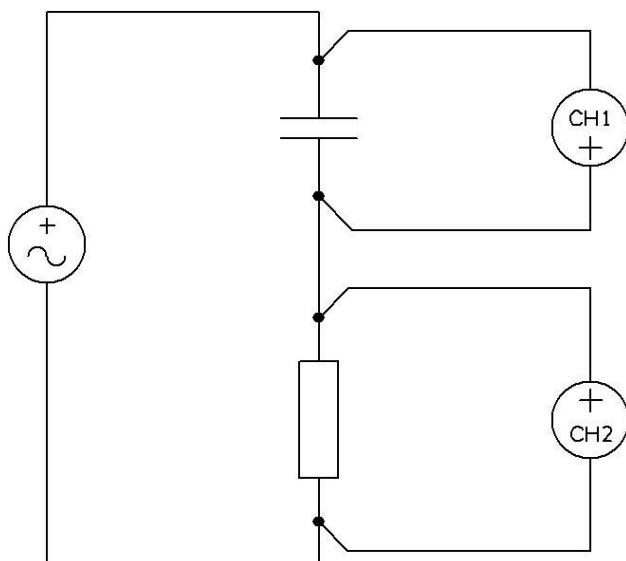
LCR Measurements with the PSM range

Introduction

All PSM range units can be used to measure the characteristics of inductors, capacitors and resistors under precise operating conditions. The two inputs are both voltage inputs, so some external shunt arrangement is needed. By using an external shunt, the shunt can be optimised for the conditions of the test. The LCR Active Head and Impedance Analysis Interface are available as accessories from Newtons4th Ltd and these include different high frequency shunts that can be selected from the instrument front panel. Alternatively, the circuit arrangements shown here can be used.

Circuit arrangements

1. Passive shunt



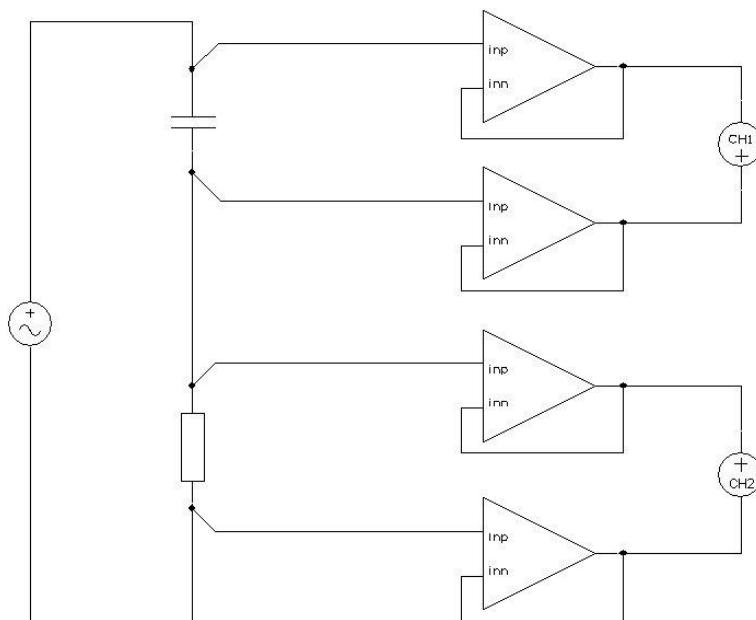
This is the simplest arrangement, using an external resistor as a current shunt.

Note the polarity of the connections: the signal inputs for both channels are connected to the junction of the device and the shunt in order to minimise the loading effects of common mode capacitance to ground.

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2. Buffered passive shunt

This arrangement uses two dual op-amps to buffer the 4-point connections from the test circuit to the instrument. This isolates the cabling and instrument inputs from the test circuit, which minimises any loading effects and stray capacitance/inductance.

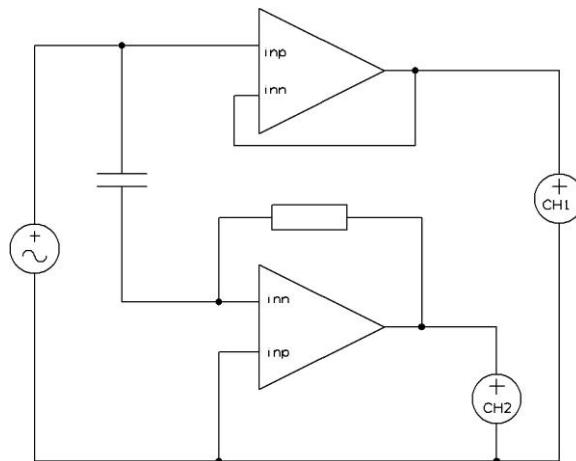


The connections to the instrument are the same as for the passive shunt. The amplifiers must be unity gain stable and should be selected for high open-loop gain, high frequency performance, and capability of driving capacitive loads if there is significant cabling between the amplifiers and the instrument.

3. Active shunt

This arrangement uses an amplifier in an inverting current to voltage configuration. Because of the virtual earth of the amplifier, CH1 and CH2 input 0V can be connected directly to the generator ground. Although there is no need to buffer the CH1 input because its impedance does not appear across the component under test, a buffer amplifier can be used to minimise the phase delay difference between the voltage and current channel.

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Note that both input channels are connected normally as the active shunt performs an inversion of the current signal. The amplifier has the same requirements as listed for the buffered passive shunt - high frequency performance is particularly important if only one amplifier is used as any phase delay within the amplifier will appear as a phase error in the measurement. Using a dual amplifier as shown, with the second amplifier buffering the voltage channel to introduce a comparable phase delay, helps to minimise the error but the amplifier should still be selected for good high frequency performance.

Test conditions

For the arrangements using the passive shunt, the shunt should be selected to be about the same but no bigger than, the minimum impedance of the component under test across the frequency range of the test. For the active shunt, the value is less critical but should be selected to maximise the output signal without overdriving the amplifier. In all cases, for high frequency measurement, the shunt should be low inductance and no more than a few kOhms.

Select passive head in the LCR mode SETUP menu and enter the shunt value for CH2; measurements may now be made in the normal way.

The easiest way to set a specific voltage level is to press OUT then NEXT and enable ac trim on ch1 with the desired rms level in the ac trim value. The instrument will then adjust the generator to maintain that voltage across the component even when the frequency changes. To test with a fixed current, enable the trim on ch2 and enter the required current as the trim value.

The frequency may be set manually, or the instrument will automatically adjust the frequency in LCR mode to select a suitable value.

The buffered passive shunt and active shunt arrangements need an appropriate power supply for the amplifiers. This can be provided by an external dc power supply or could be generated from 5V available from the instrument. Pin 1 & pin 8 on the 15-way D type extension port on the rear of the instrument carry +5V dc at up to 100mA total; pins 2-7 are connected to 0V. This supply could be used to power a 5V to +/-15V dc – dc converter (e.g. Newport NMA0515 or equivalent) to provide a +/-15V, 15mA dc supply for the amplifiers. Whichever supply option is used, ensure that there is adequate power supply decoupling close to the amplifier supply pins.

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