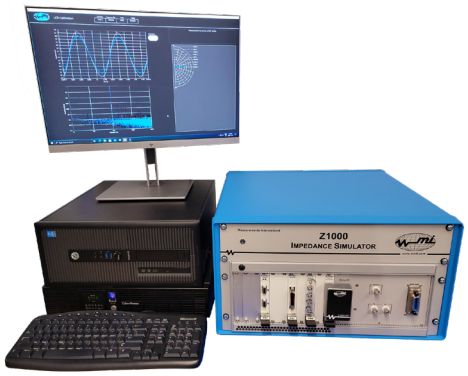
Measurements International

Metrology is Our Science, Accuracy is Our Business™

Z1000 iSIMULATOR IMPEDANCE SIMULATOR

Advanced LCR Meter Calibration



Featuring

- One Instrument Full LCR Meter Calibration
- Utilizing State-of-the-Art 24-bit ADC and DAC Converters
- Simulates Impedances from 1 Ω to 10 MΩ

Overview

With the release of the commercial Z1000 iSimulator, the process for calibration of LCR meters has been taken to a new level. The Z1000 covers the full calibration of LCR meters over simulated impedances from 100 Hz to 20 kHz while eliminating the need for external standards and providing a much simpler, easier-to-use method of LCR meter calibration.

Feature	Benefit
One instrument full LCR meter calibration.	Simple, easy-to-use method of calibration of LCR meters.
Only two probes (resistors) require calibration.	Cost savings of not having to have artifacts calibrated.
Characterization over full range.	Not limited in the range like artifact method.
Eliminates external standard requirements.	Eliminates manual artifact method, requires little space.
Large frequency range 100 Hz to 20 kHz.	Calibrate a large range of LCR meters.
NMI METAS design.	Design and instrumentation industry proven by leading experts.
Fully automated software.	All calculations and work is already done in the provided software.

Z1000 iSIMULATOR IMPEDANCE SIMULATOR

The Measurements International model Z1000 prototype and initial design were done by METAS in Switzerland. It was designed to address and fill the need and requirement for a better way to calibrate LCR meters. The current method of calibration of LCR meters requires highly accurate impedance standards (inductors, capacitors and resistors) that have to have traceability maintained, in which the procedure for calibration is time-consuming and requires a lot of manipulation of the standards making the measurement procedure complicated. Another large drawback of the previous method was that only a small fraction of the measurement capability of the LCR meter is tested because the reference standards usually have a decade value and phase angles close to the -90 degrees (capacitors), 0 degrees (resistor) or 90 degrees (inductors).

If you are familiar with the current method used to calibrate LCR meters (external inductors, resistors, capacitors) then you are aware of the very time-consuming and multiple manual manipulation components of the process. The Z1000 was designed with this in mind. It was designed with a very user-friendly operational software that limits the customer's need for manual changing of connections and offers a simple step-by-step operation that provides constant automatic verification of the setup, and automatic switching and measurement procedures.

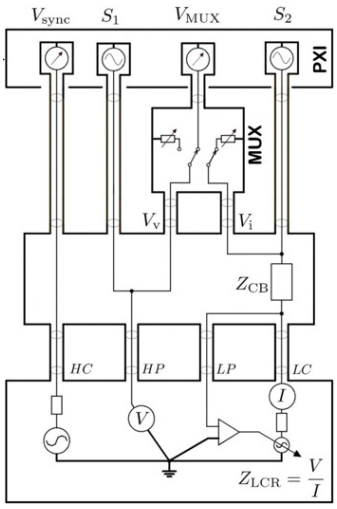
The Z1000 was developed by METAS and commercialized by Measurements International to offer customers a simpler, easier to use instrument for the calibration of LCR meters.

Z1000 iSimulator Method

The Z1000 offers a new more advanced approach. In the Z1000, the current and the voltage measured by the LCR meter to calculate the impedance are independently generated by two external voltage sources.

Adjusting the amplitudes and the relative phase of the voltage sources, the synthesized impedance can cover the entire complex plane. This concept was first proposed in 1994. More recently, a new design of the Z1000 – based on recently available, high-grade electronics components – have been designed.

The Z1000 covers calibrations in the frequency range from 100 Hz to 20 kHz and the magnitude of the synthesized impedance ranges from 1 Ω to 10 MΩ with an arbitrary phase angle.



$$S_1 \Rightarrow V_{HP} = V_V$$

$$S_2 \Rightarrow i_{LC} = \frac{V_i}{Z_{CB}}$$

$$Z_{REF} = \frac{V_{HP}}{i_{LC}} = \frac{V_v}{V_i} \cdot Z_{CB}$$

S_1 supplies the voltage to HP, the second source S_2 supplies the current to the LC port. Then the LCR meter calculates the value of the impedance. Because the two sources are independent, it is possible to arbitrarily choose the relative phase between the two, therefore the resulting impedance can be simulated to cover the entire complex plane.

A single MUX is used to accurately measure the actual voltage V_v supplied to HP input, and the voltage drop V_i generated by the current flow through Z_{CB}.

The uncertainty of the LCR meter calibration made with the use of the Z1000 is mostly depending on the accuracy of the LCR meter under test. This is because the uncertainty of the resistor is around 10^{-8} and the uncertainty of the clock is 10^{-12}. Most LCR meters have a specification of about 500 ppm. When calculating the overall uncertainty, the resistor and clock are negligible!

Uncertainty Calculation

$$u(\mathrm{UUT}) = \sqrt{u(Probe)^2 + u(DFT)^2 + u(ADC)^2 + u(MUX)^2 + u(zero)^2}$$

$$= \sqrt{u(R_{ac})^2 + u(R_{dc})^2 + u(A)^2 + u(\varphi)^2 + u(q)^2 + u(MUX)^2 + u(zero)^2}$$

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Specifications: Rev 3

Simulated Impedance	
Magnitude Range	1 Ω to 10 MΩ
Phase Range	90 deg to -90 deg
Resolution	0.06 µΩ/Ω
Frequency	
Range	100 Hz to 20 kHz
Resolution	1 µHz
Accuracy	$< 5 \times 10^{-11}$
Phase Noise	-55 dBc/Hz
Harmonic Distortion	-35 dBc
Probe	
DC Long-term Stability	$< 2 \times 10^{-6}$/year
Environment	
Operating Temperature, Humidity	18 °C to 35 °C, 10 % to 80 % RH (non-condensing)
Storage Temperature, Humidity	-20 °C to 50 °C, 0 % to 90 % RH (non-condensing)
Line Voltage	100 V to 250 V, 50 Hz/60 Hz
Atomic Clock (Optional)	
Frequency	10 MHz
Phase Noise	-130 dBc/Hz
Harmonic Distortion	-25 dBc
Retrace	$\pm 5 \times 10^{-11}$
Mechanical	
Height	330 mm (13 in.)
Width	520 mm (20.5 in.)
Depth	495 mm (19.5 in.)
Weight	16 kg (35 lbs)
Warranty	1 Year Parts & Labour

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