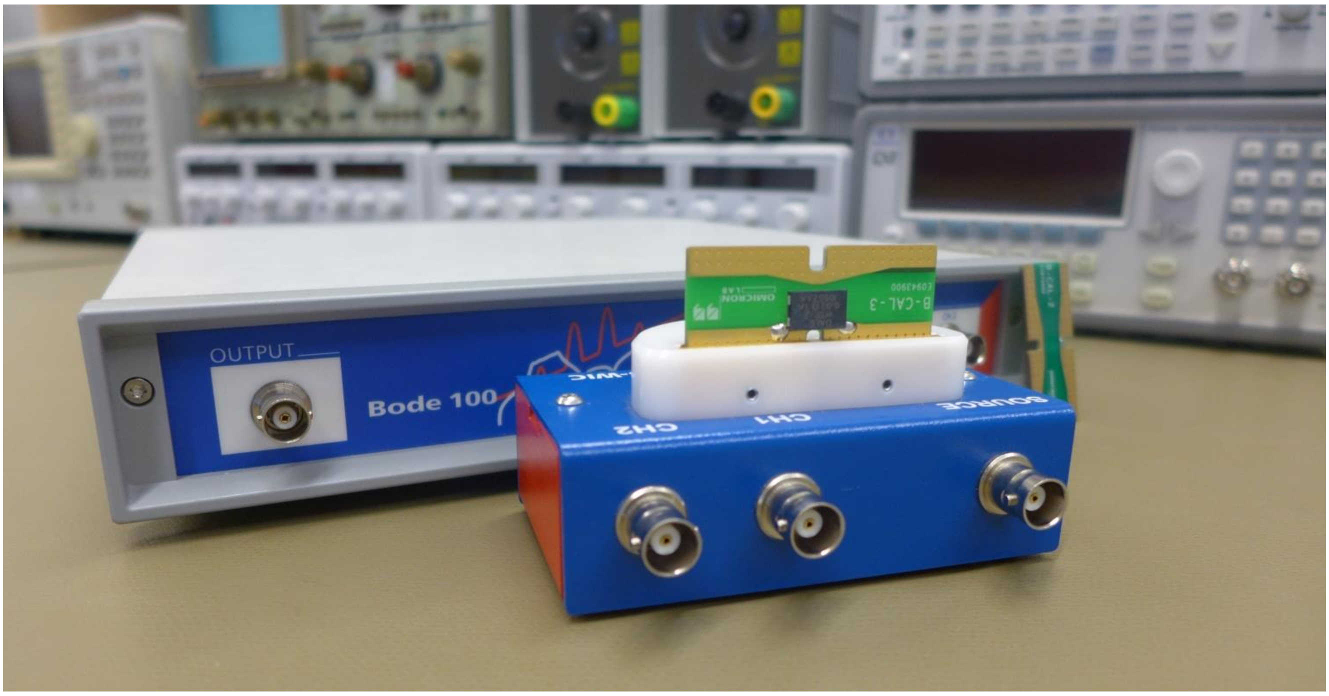
Bode 100 - Application Note

Low Value Impedance Measurement with Impedance Adapter



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Visit www.omicron-lab.com for more information.
Contact support@omicron-lab.com for technical support.

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Note: Basic procedures such as setting-up, adjusting and calibrating the Bode 100 are described in the Bode 100 user manual. You can download the Bode 100 user manual at www.omicron-lab.com/bode-100/downloads#3

Note: All measurements in this application note have been performed with the Bode Analyzer Suite V3.0. Use this version or a higher version to perform the measurements shown in this document. You can download the latest version at www.omicron-lab.com/bode-100/downloads

1 Introduction

The impedances of current sensing devices are generally in the range of several milliohms. Measuring the impedance of such a part can be a challenging task.

This document shows how we did use the Bode 100 to measure the impedance of a $20\ \mathrm{m\Omega}$ SMD[1] shunt resistor using the impedance adapter B-WIC.

The DUT[2] resistor is displayed in the picture below.

Figure 1: $20\ \mathrm{m\Omega}\ \pm 1\ \%$ SMD resistor

[1] Surface Mount Device
[2] Device Under Test

2 Measurement

2.1 Measurement Setup

We use the impedance adapter B-WIC to measure the impedance of the $20\ m\Omega$ SMD resistor. The impedance of the resistor is outside the measurement range specification of the adapter but can be measured when special care is taken. The following figure shows the impedance adapter B-WIC connected to the Bode 100.

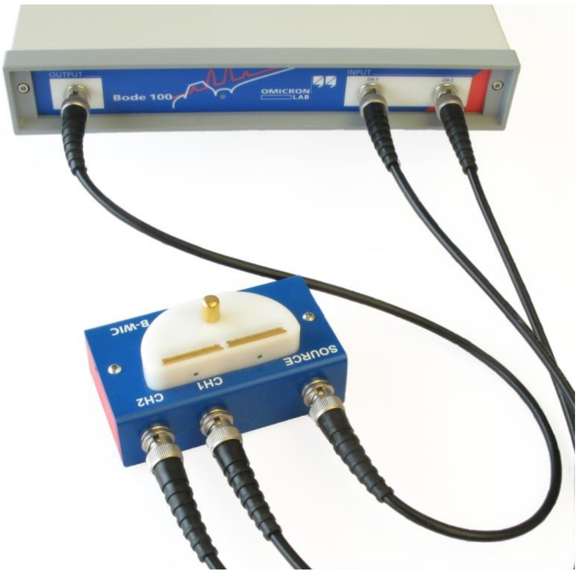

Figure 2: Impedance Adapter B-WIC

2.2 Device Configuration

Measurements with the impedance adapter are performed in the Impedance Adapter measurement type of the Bode Analyzer Suite:

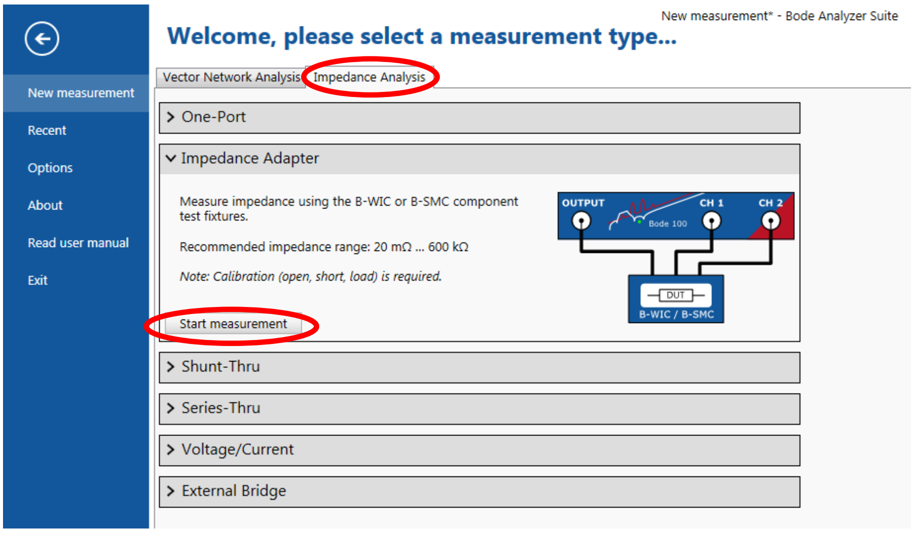

Figure 3: Start menu

Further settings are chosen as shown below:

Start Frequency:	10 Hz
Stop Frequency:	10 MHz
Sweep Mode:	Logarithmic
Number of Points:	201 or more
Level:	13 dBm
Receiver Bandwidth:	10 Hz

2.3 Calibration

When measuring very low impedance values (in the range of $1\ \Omega$), the measurement accuracy mainly depends on the quality of the SHORT calibration.

The B-WIC impedance adapter is calibrated (see Figure 4) by performing a user range calibration using the B-CAL-2 calibration board.

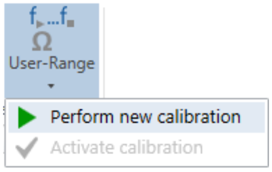

Figure 4: User-Range Calibration icon

The B-WIC impedance adapter is calibrated using the OMICRON Lab B-CAL calibration board as shown in the following figures.

Note: The SHORT calibration is performed last!

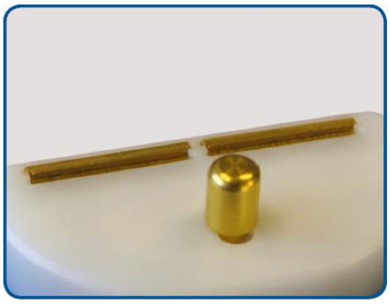

Figure 5: OPEN

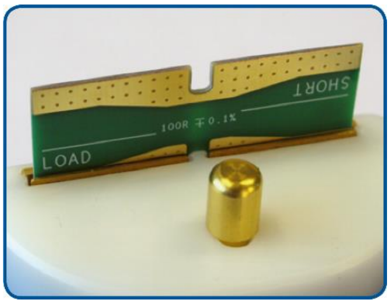

Figure 6: LOAD

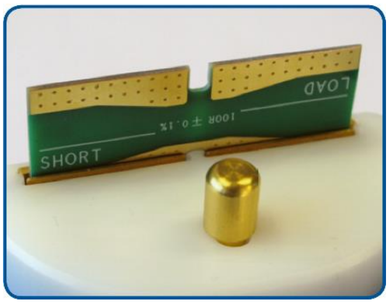

Figure 7: SHORT

To check the quality of the SHORT calibration the calibration object is not removed from the adapter and a single sweep is performed after closing the calibration window (red line Figure 8)).
Then the calibration object is removed from the adapter and placed again into the adapter. When performing a second single sweep (orange Figure 8), the measured impedance magnitude should not increase more than $\approx 1\ \mathrm{m}\Omega$.
From the graph below can be seen that the impedance magnitude of the SHORT after replacing the adapter did not exceed $1\ \mathrm{m}\Omega$.

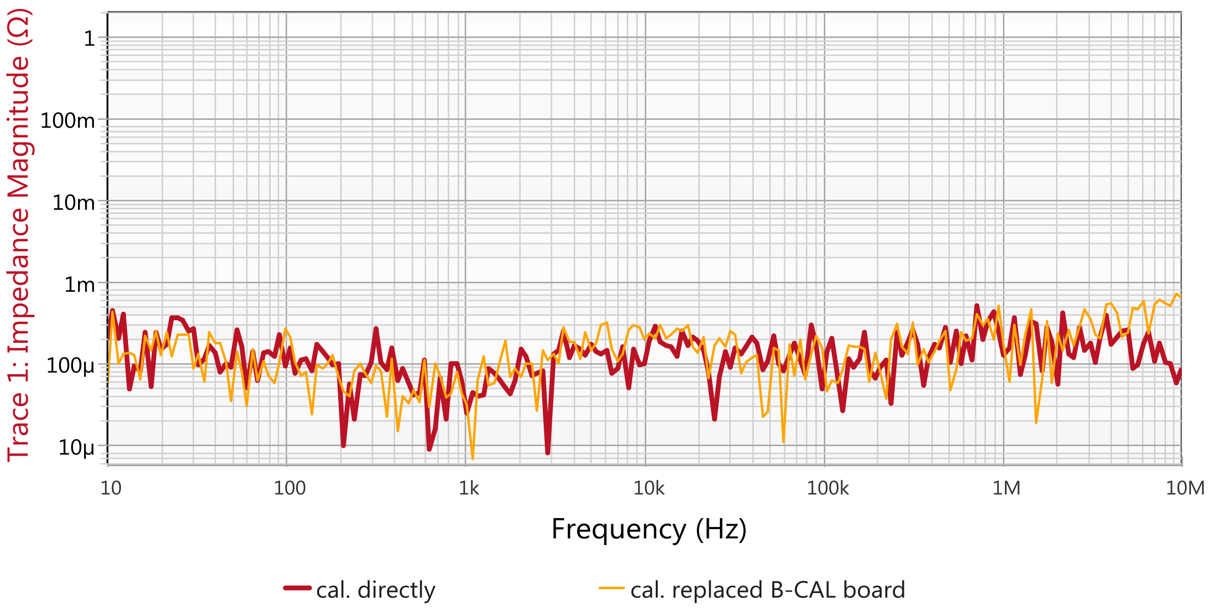

Figure 8: Measurement of the SHORT

2.4 Measurement

The resistor to be measured is placed to the adapter in a similar way to the SHORT calibration object as shown in the following picture. We did solder the resistor on a board similar to the one of the calibration board.

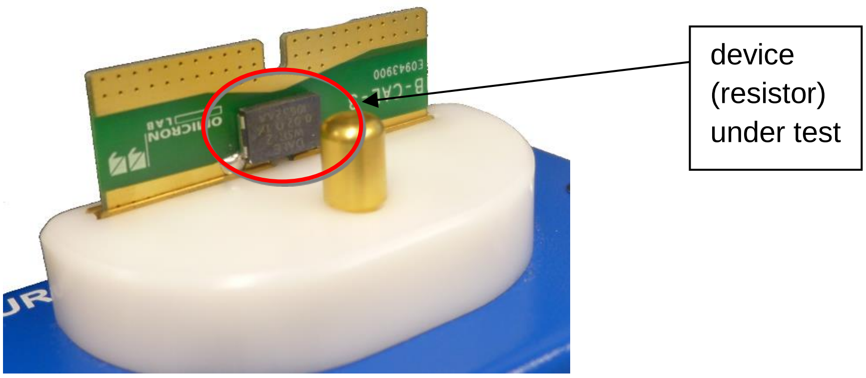

Figure 9: DUT placed in the adapter

Performing a single sweep leads to the measurement result shown in the following graph:

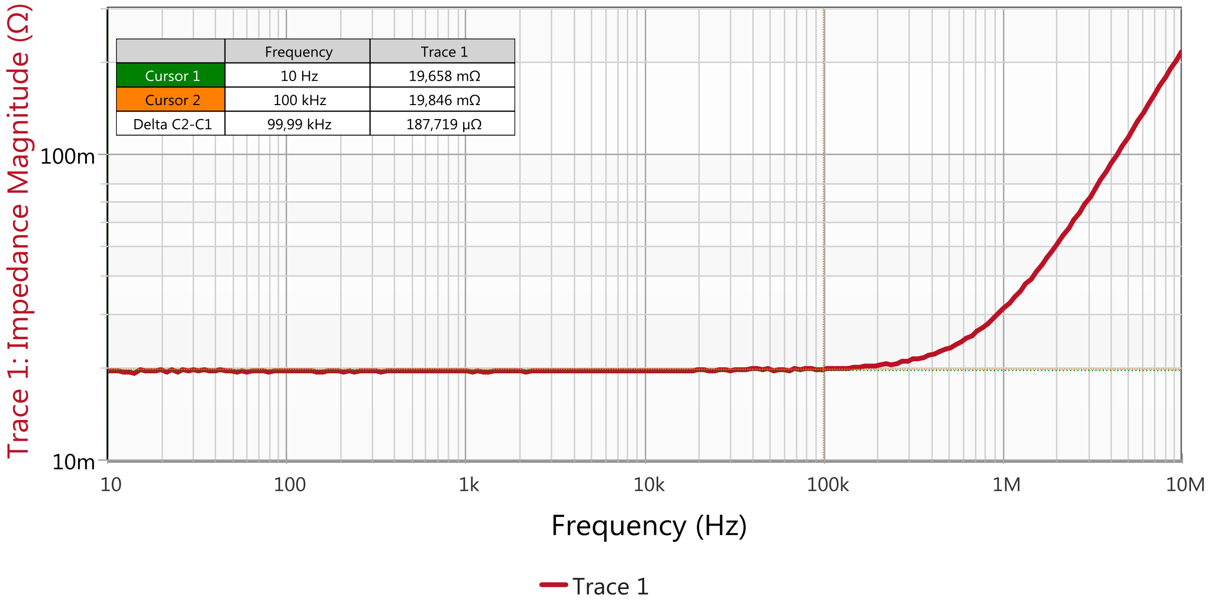

Figure 10: Impedance of the DUT

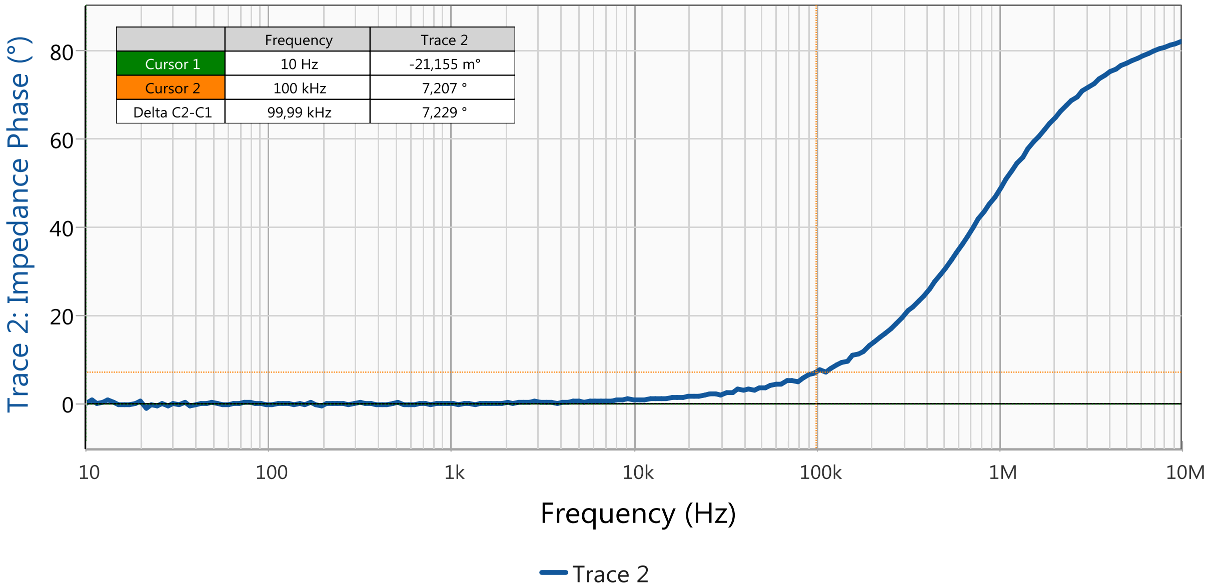

Figure 11: Phase (°) of the DUT

Between $10\ \mathrm{Hz}$ and $100\ \mathrm{kHz}$ the measurement result shows a series resistance between $19.66\ \mathrm{m\Omega}$ and $19.85\ \mathrm{m\Omega}$.

The resistor shows nearly perfect resistive behavior up to $10\ \mathrm{kHz}$ and starts to turn inductive above $\approx 2\ \mathrm{MHz}$. At $10\ \mathrm{MHz}$ the measured impedance magnitude is $|Z| = 217.12\ \mathrm{m\Omega}$ and the inductive part predominates. The inductance can therefore be calculated by

$$L \approx \frac{|Z|}{2 \cdot \pi \cdot f} \approx 3.4\ \mathrm{nH}$$

or directly be displayed by changing the Format to Ls.

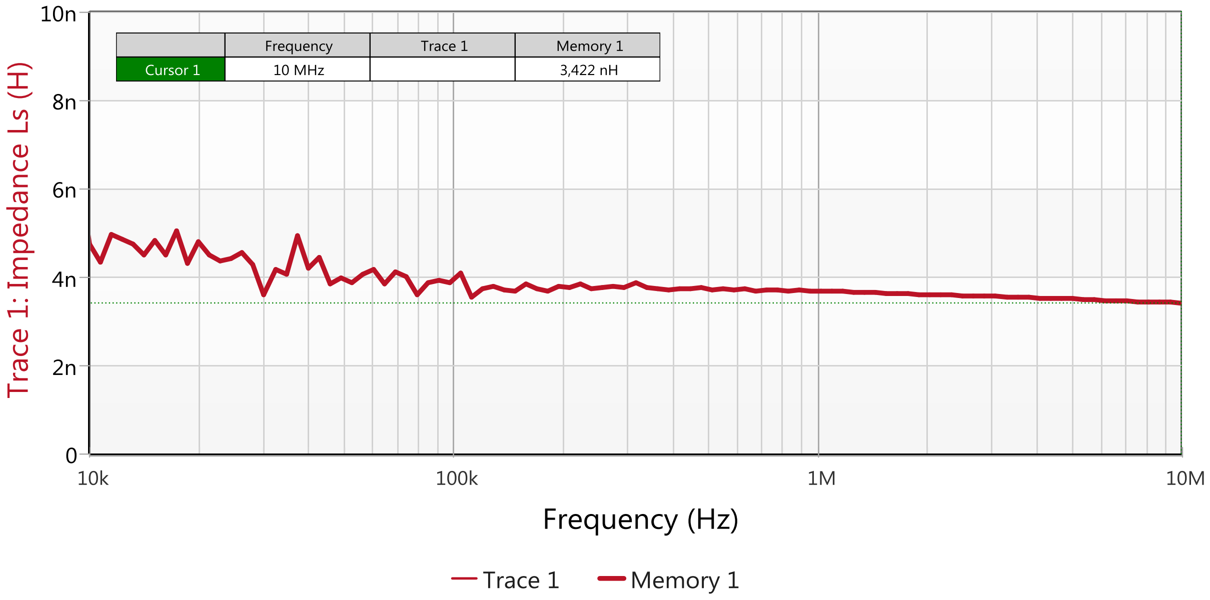

Figure 12: Measurement result – Ls (zoomed)

Note: In the chart above, we have zoomed in a bit, for better visibility.

3 Conclusion

We have demonstrated how very low impedance values can be measured using the Bode 100 and additional accessories like the B-WIC impedance. Impedance values down to several milliohms can be measured over a wide frequency range.

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