2014/11/18

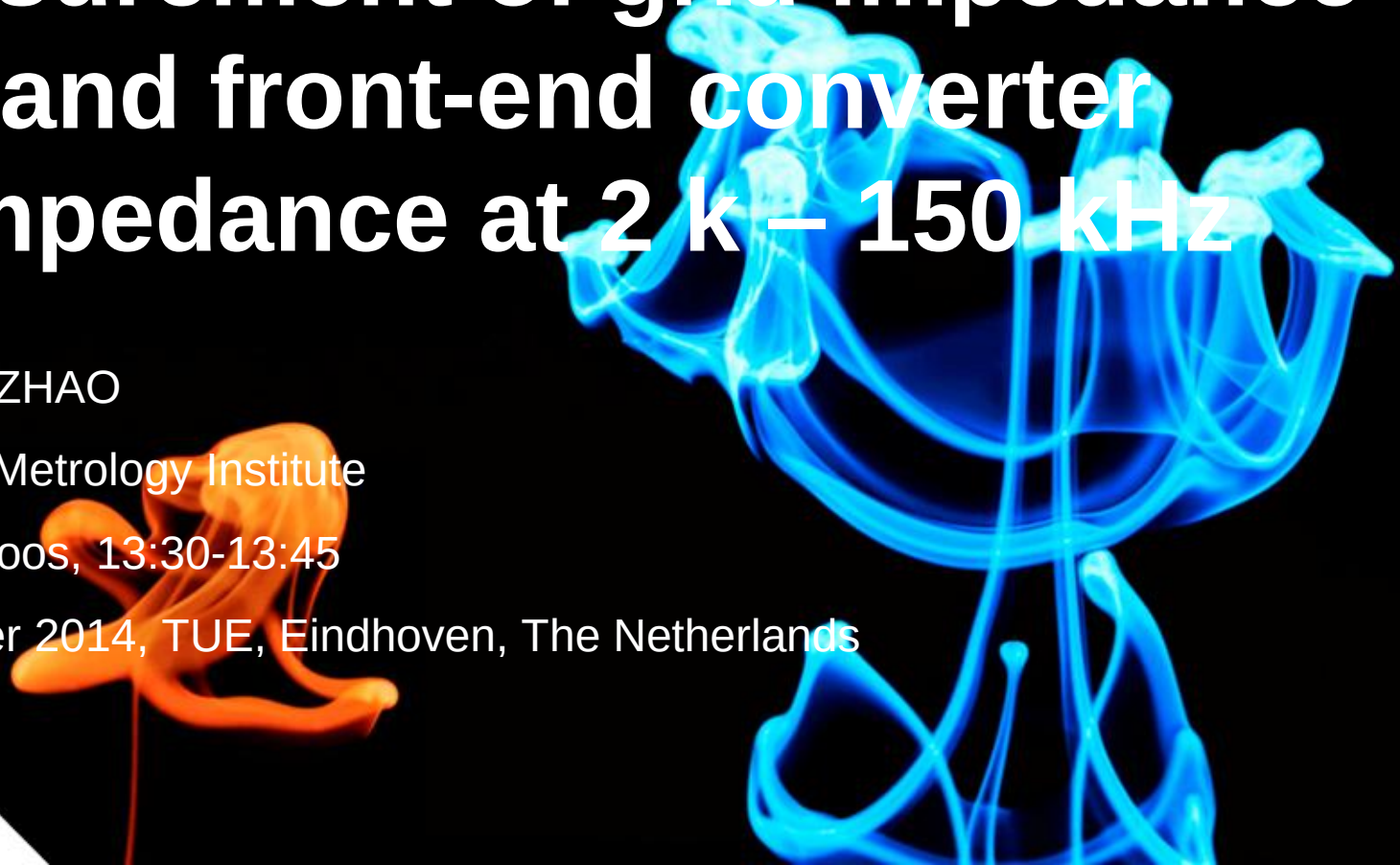
A method for in-situ measurement of grid impedance and front-end converter impedance at 2 k – 150 kHz

Dongsheng ZHAO

VSL, Dutch Metrology Institute

De Zwarte doos, 13:30-13:45

November 2014, TUE, Eindhoven, The Netherlands

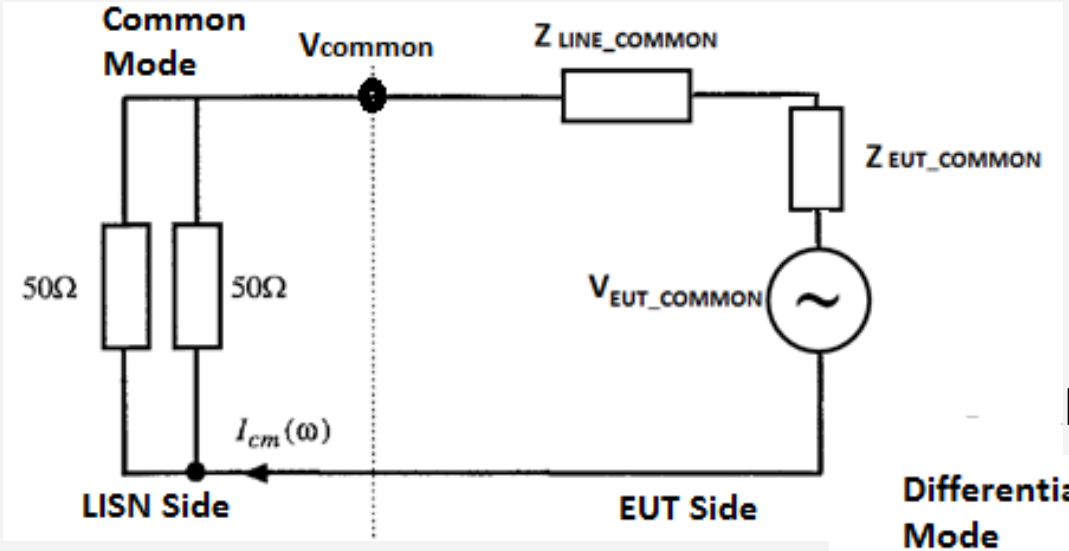


Outline

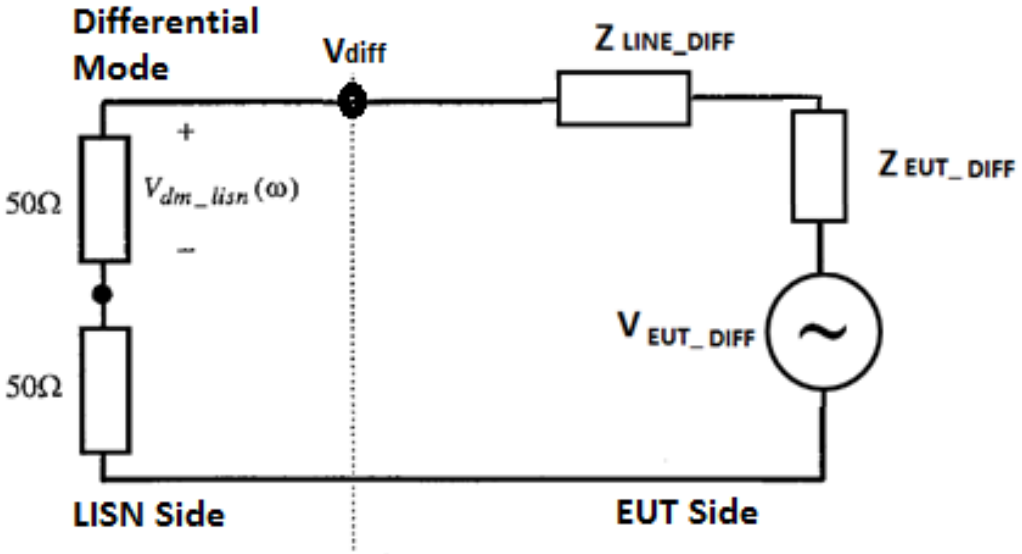
- Why we need in-situ impedance measurement
- Existing methods
- Proposed method
- Results

CE measurement With Use of LISNs

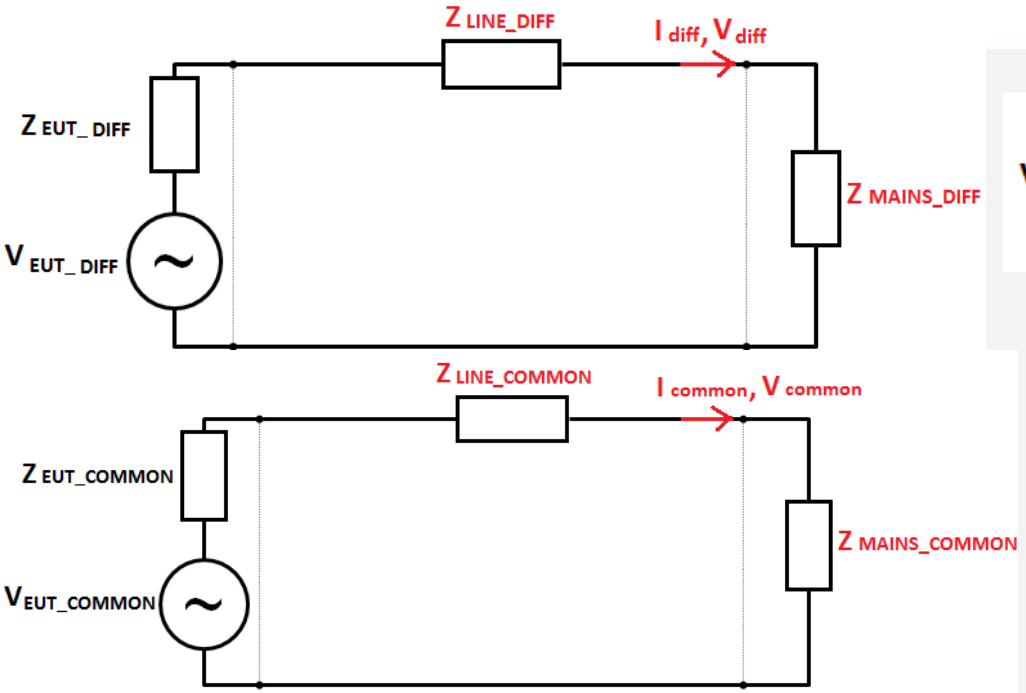
COMMON MODE



DIFFERENTIAL MODE



CE measurement Without LISNs

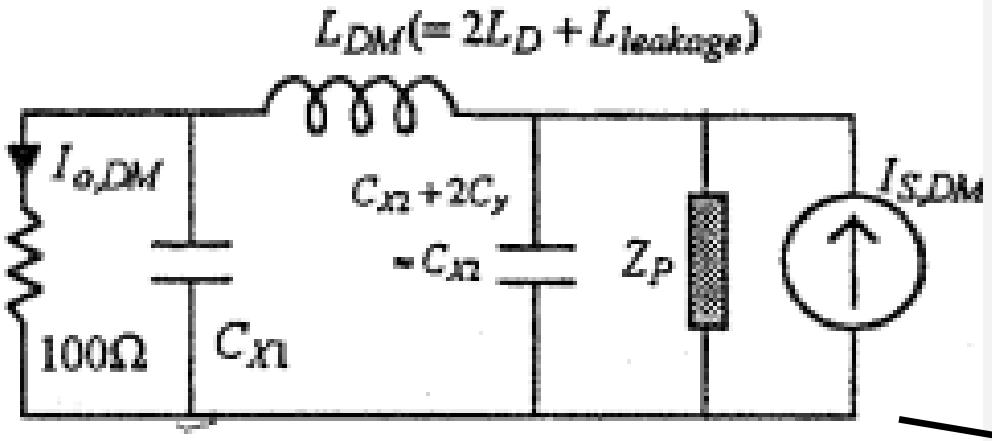


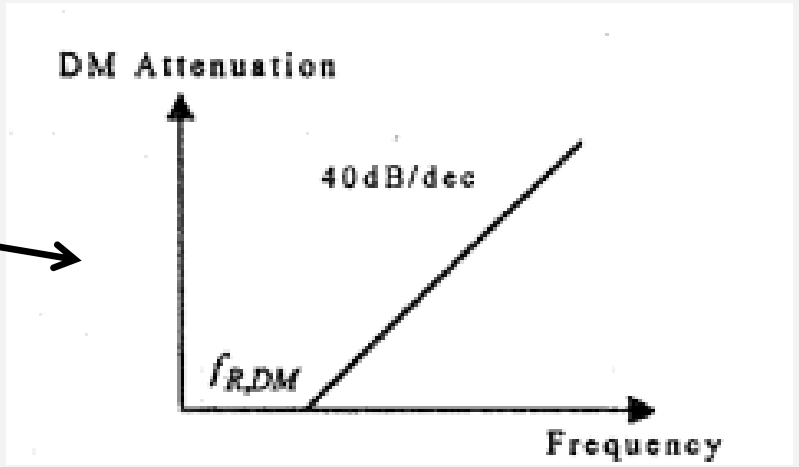
$$V_{diff} = \frac{(Z_{LISN\_COMMON} * V_{EUT\_DIFF})}{(Z_{EUT\_DIFF} + Z_{LINE\_DIFF} + Z_{MAINS\_DIFF})}$$

$$V_{common} = \frac{(Z_{LISN\_COMMON} * V_{EUT\_COMMON})}{(Z_{EUT\_COMMON} + Z_{LINE\_COMMON} + Z_{MAINS\_COMMON})}$$

Cakir, Soydan, Gebze, Kocaeli, Sen, Osman, Cinar, Mehmet and Cetintas, Mustafa, "Alternative conducted emission measurements for industry," 2014 International Symposium on Electromagnetic Compatibility (EMC Europe 2014)

Filter design





A Procedure for Designing EMI Filters for AC Line Applications

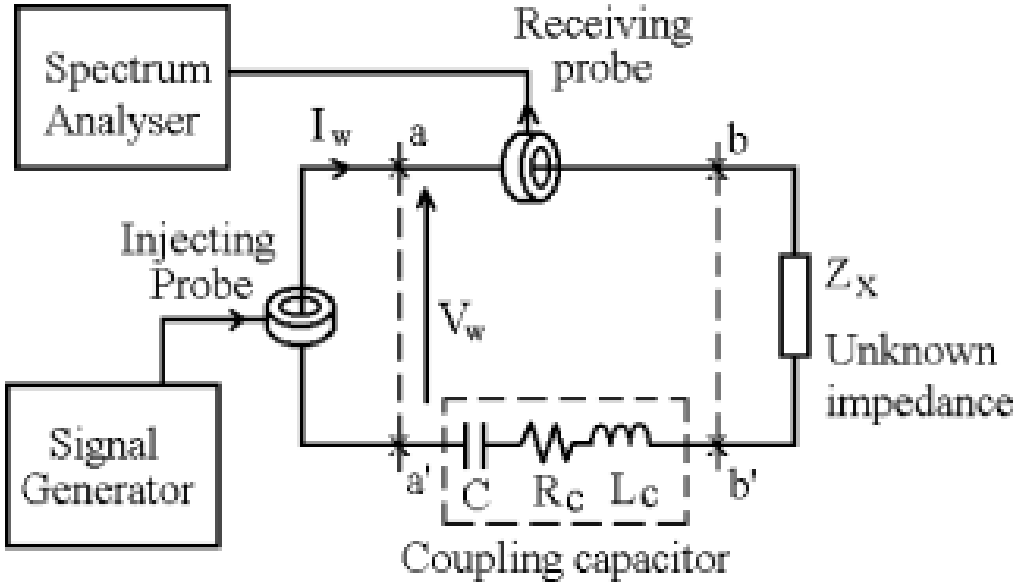
Fu-Yuan Shih, Dan Y. Chen, *Senior Member, IEEE,* Yan-Pei Wu, and Yie-Tone Chen, *Member, IEEE*

Existing methods

Resonance method

Insertion loss method

2-probe approach



Limitations

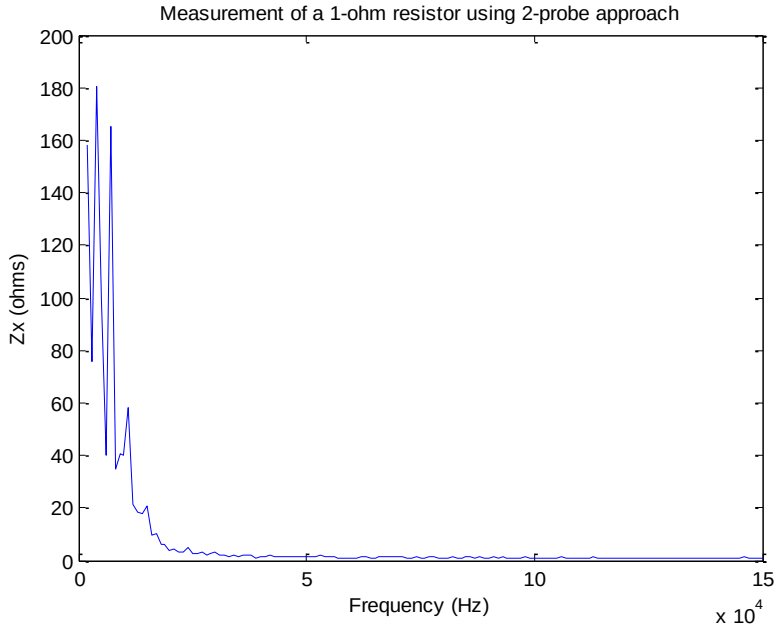
Approximation: Based on the condition

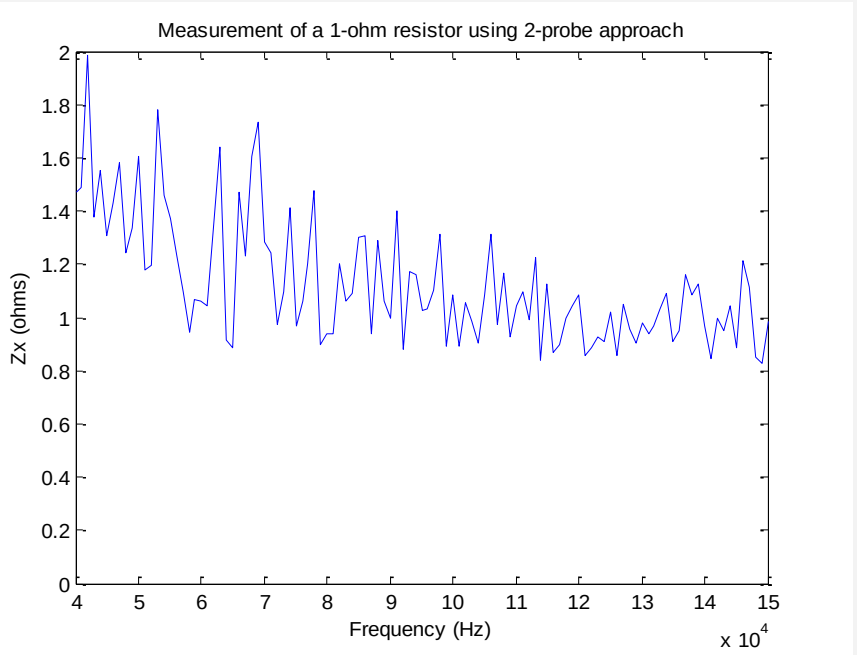
$$R_{std} >> |Z_{in}|$$

For low frequency, amplifier needed

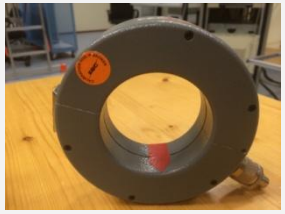
Only amplitude information, no phase information

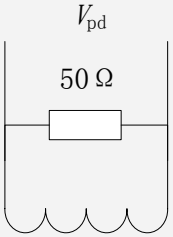
Measurement result of 1Ω resistor



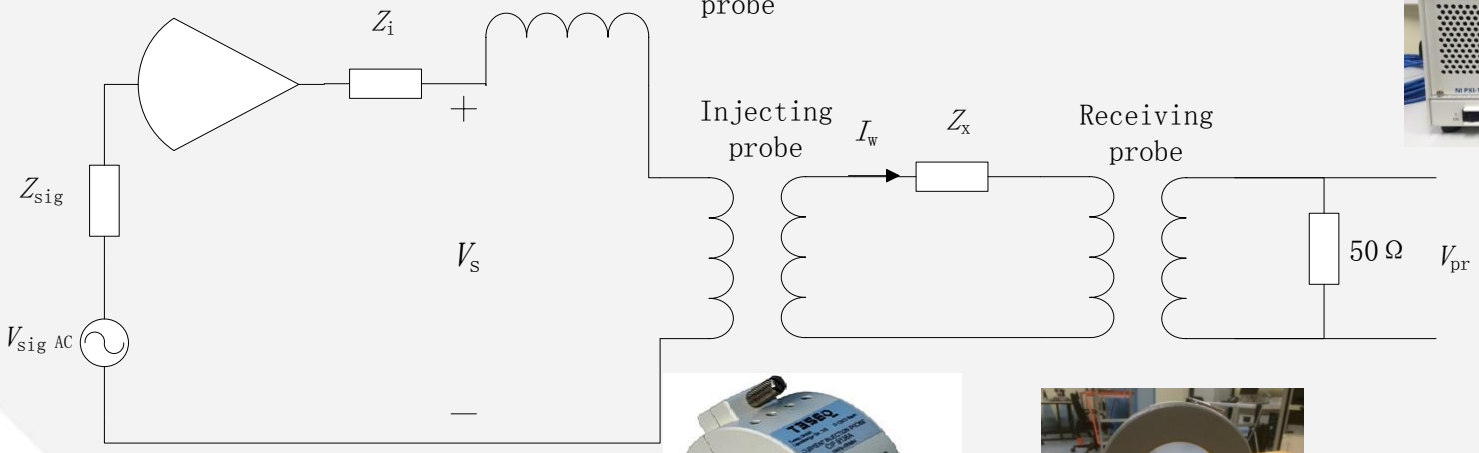


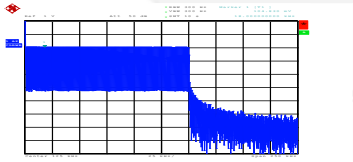
The proposed 3-probe approach

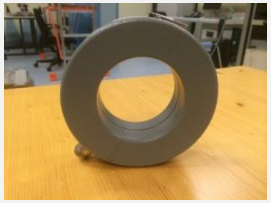




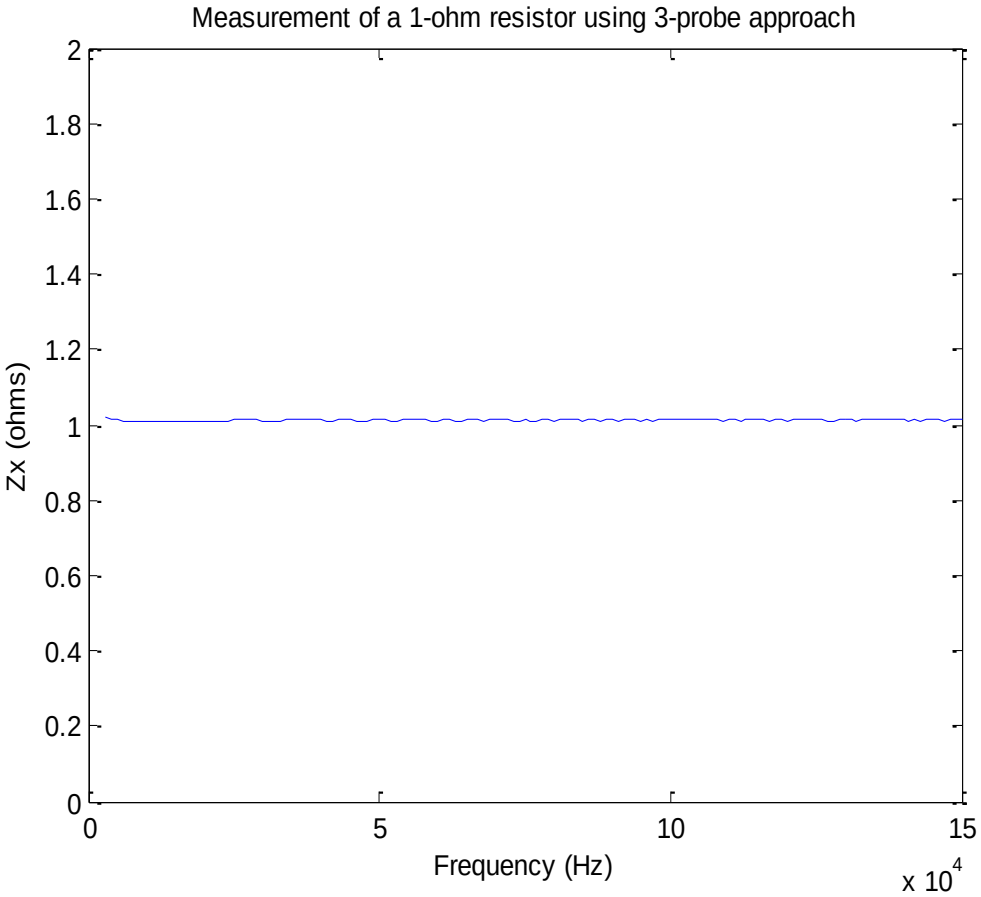
$$Z_x = K\frac{V_{pd}}{V_{pr}} - Z_{in}$$



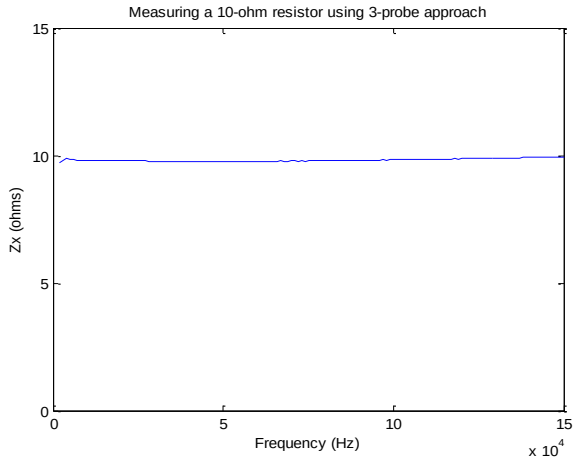




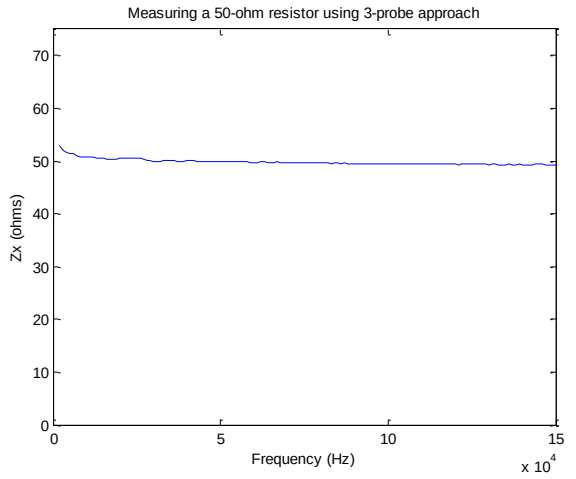
Measurement result of 1Ω resistor



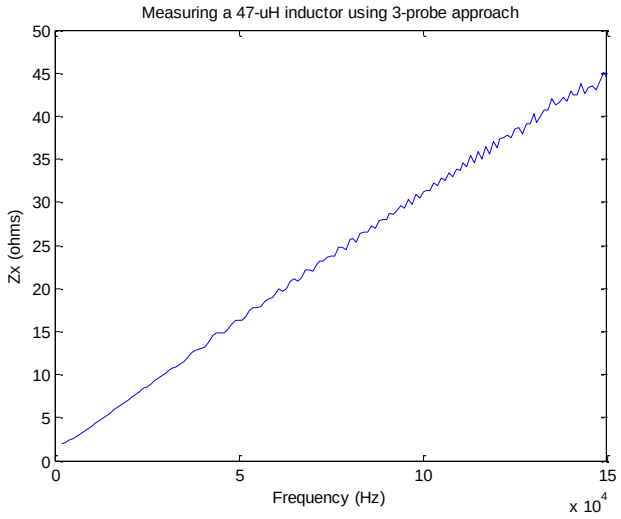
The proposed 3-probe approach



10 Ω

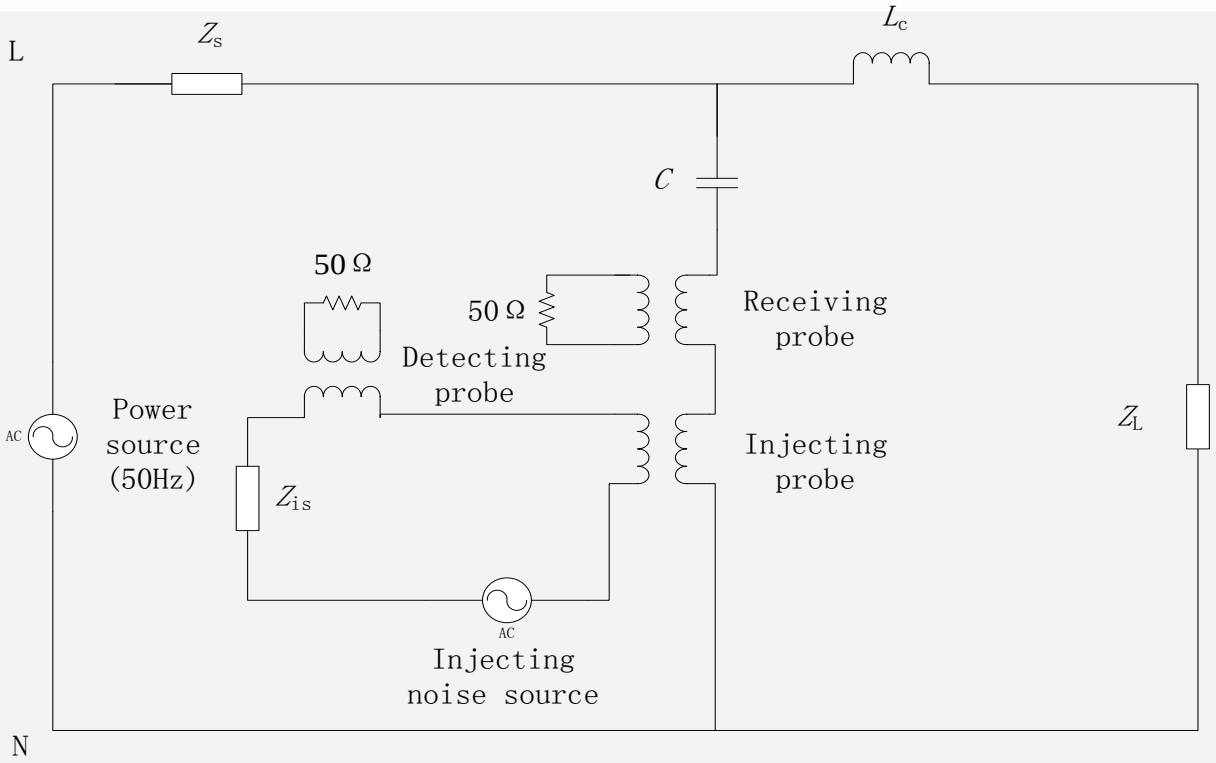


50 Ω

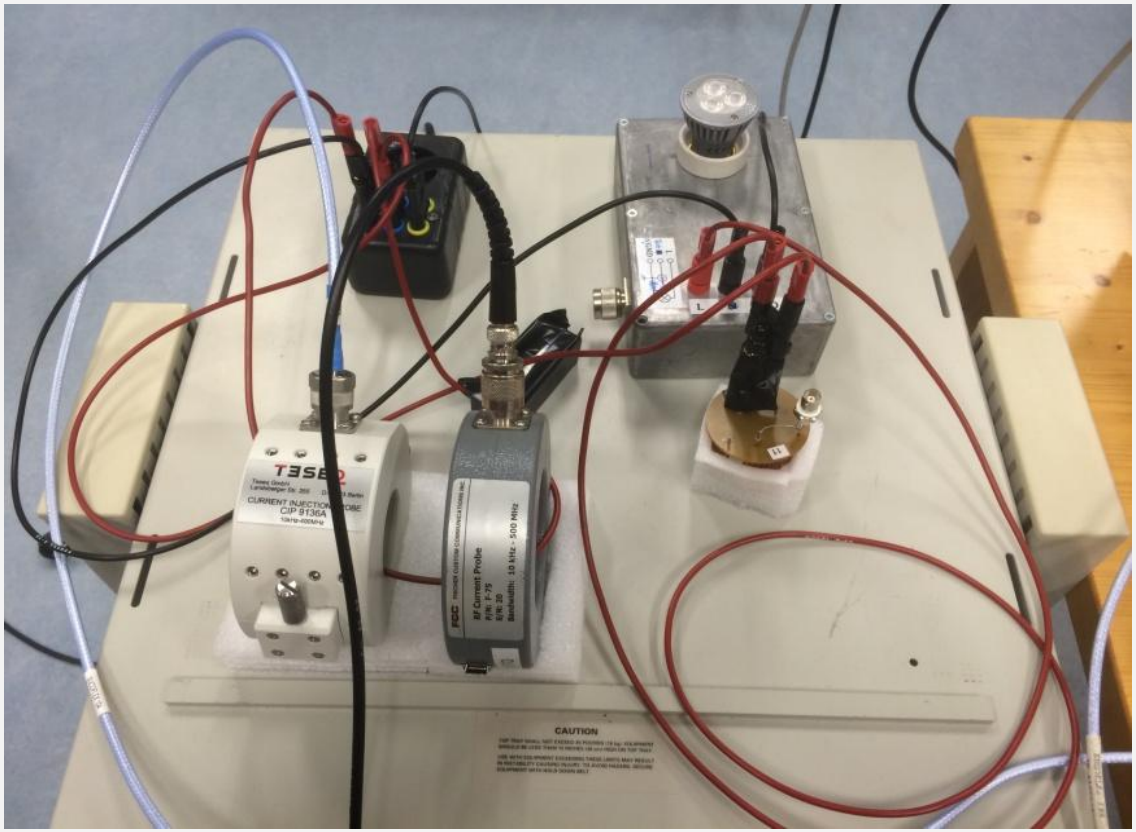


47µH

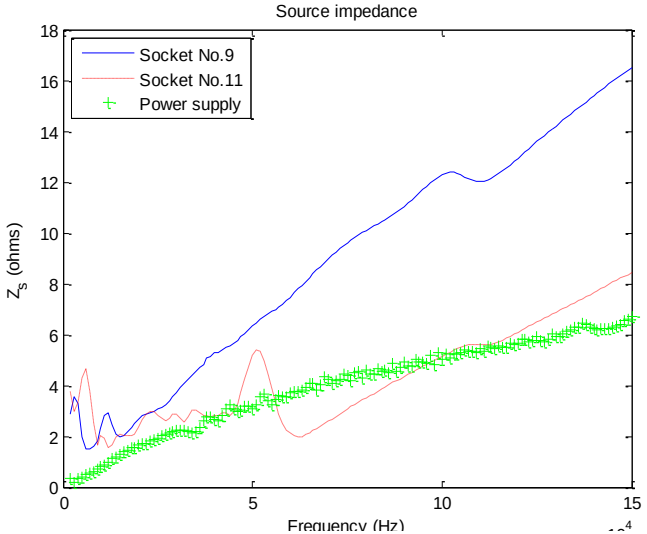
Source and load impedance measurement with the 3-probe approach

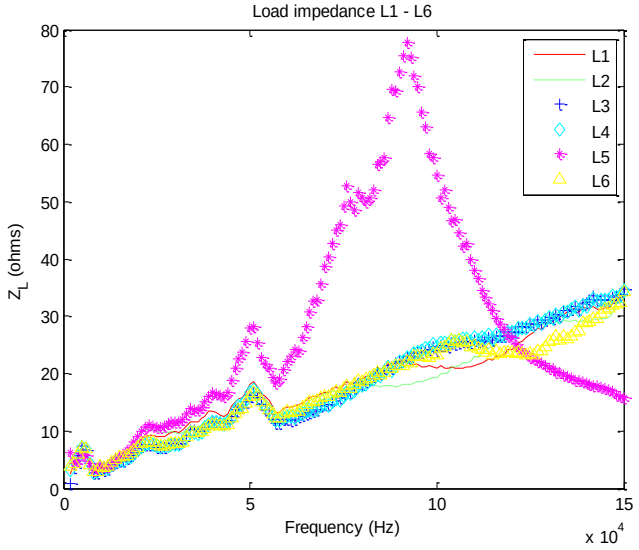


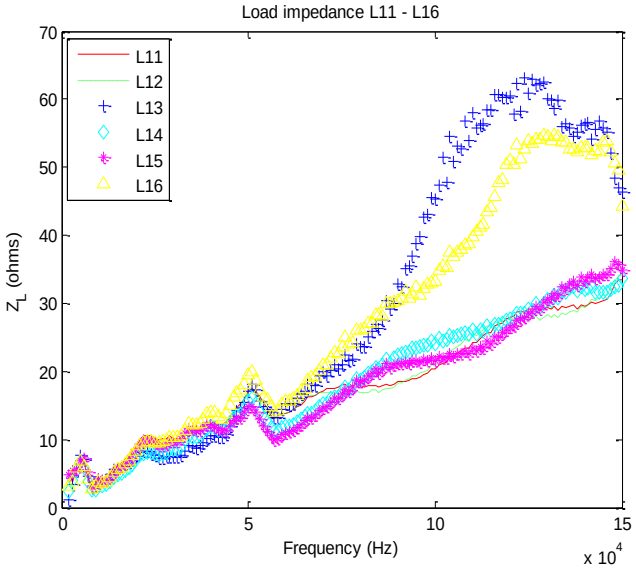
Source and load impedance measurement with the 3-probe approach

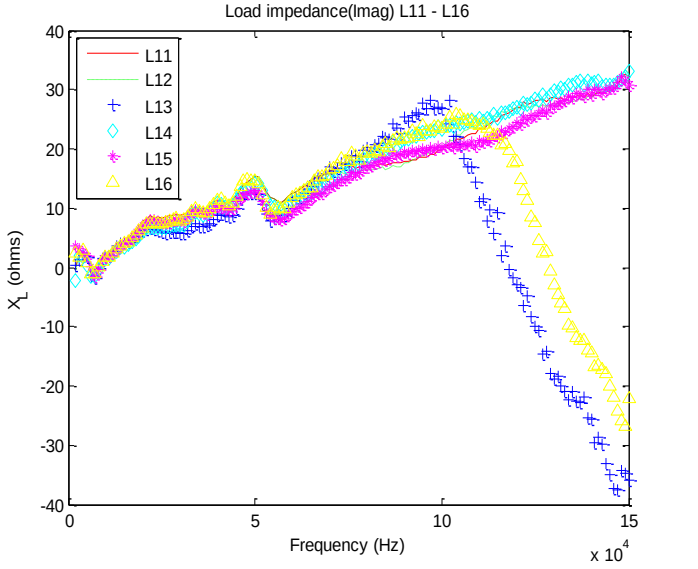


Source and load impedance measurement with the 3-probe approach









Summary

The two-probe method to measure source or load impedance is not suitable when it works at the frequency range 2 kHz – 150 kHz because of the lack of phase information. Instead, the three-probe method proposed is able to put the phase information into impedance calculation leading to the accurate result.

VSL
Thijsseweg 11
2629 JA Delft
Postbus 654
2600 AR Delft

T 015 269 15 00
F 015 261 29 71
E info@vsl.nl
I www.vsl.nl

Contact: Dongsheng Zhao
DZHAO@VSL.NL

www.emc-industry.com

Dutch
Metrology
Institute