EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research,
Development and Education

MINISTRY OF EDUCATION,
YOUTH AND SPORTS

Insertion loss measurement of power supply filter

Measurement tasks for practicals of the subject KEI/EMC2

Zdeněk Kubík

Version EN_07. 10. 2021

ESF II project of the University of West Bohemia in Pilsen,

reg. number: CZ.02.2.69/0.0/0.0/18_056/0013239

Measurement description

The power supply filter provides suppression of differential and common mode part of interfering signals. The V-terminal voltage is measured by V-LISN; there is possible to measure all three attenuation:

1. Asymmetrical (common mode) insertion loss of the filter,
2. Symmetrical (differential mode) insertion loss of the filter,
3. Unsymmetrical (V-terminal) insertion loss of the filter.

Theoretical analysis of the measurements

Insertion loss can be easily measured by spectrum analyzer (SA) with tracking generator (TG) (see Fig. 1). The TG is coupled with SA and there is possible to perform insertion loss measurement in the set frequency range. The measurement results are viewed like a gain on the SA screen – insertion loss is given by equation:

$$Insertion\ loss = -1 \cdot Gain. \tag{1}$$

The block diagram for insertion loss measurement is shown in Fig. 1. In this case, the insertion loss is measured without load of the black box.

NOTE: Be carefully during connection of coaxial cable to the input of the SA – if you use some auxiliary power source, every time use pulse limiter (or DC block) at the SA input.

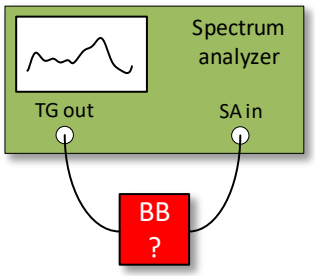


Fig. 1. Insertion loss measurement of Black Box using spectrum analyzer

Schematic of the measurement

The schematic diagram of the measurement is presented in Fig. 2. Fig. 2a) represents direct connection for normalization, 2b) represents measuring setup for symmetrical part of insertion loss 2c) represents measuring setup for asymmetrical part of insertion loss and 2d) represents measuring setup for unsymmetrical part of insertion loss. The gain of the filter is measured at the screen of the SA, insertion losses are given by equation (1).

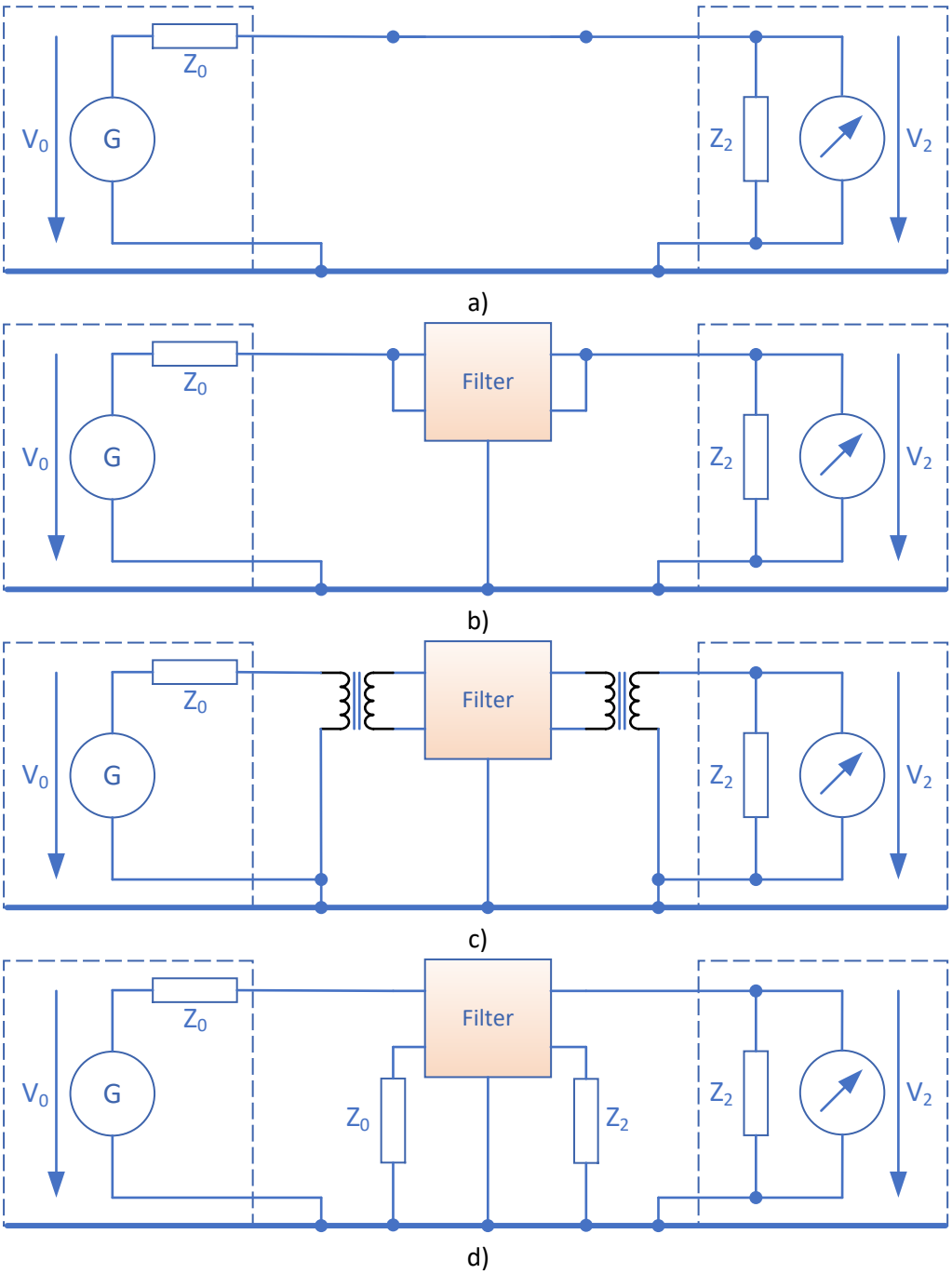


Fig. 2. Schematic diagrams a) without and b) with connected the measured capacitor

Measurement tasks:

1. Set the frequency range of the measurement (expected range to 30 – 100 MHz).
2. Turn on the TG output.
3. Connect the measuring fixture for measurement symmetrical insertion loss.
4. Make direct connection using wires and perform normalization.
5. Connect filter and measure the gain.
6. Download the measurement result to the computer.
7. Change filter and perform measurement again (for four different filter).
8. Change the measuring fixture for asymmetrical insertion loss and repeat measurement according point 4. – 7.
9. Change the measuring fixture for unsymmetrical insertion loss and repeat measurement according point 4. – 7.
10. Compare the measurement results (for all three parts of insertion losses) and make a measurement report.

NOTE: The measurement settings of the SA and TG can be found in the document “Basics of spectrum analyzer measurement“.