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Insertion loss measurement of CMC filter – differential mode

Measurement tasks for practicals of the subject KEI/EMC2

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Measurement description

The common mode choke is used like a base part of suppression filter. The most important parameter of the filter is insertion loss. The parameters of common mode choke are crucial for correct behaviour of the filter – especially parasitic parameters of the common mode chokes can influenced the resulting insertion loss of the filter. The dependence of the insertion loss at electrical / mechanical properties of common mode choke will be illustrated during the measurement.

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.

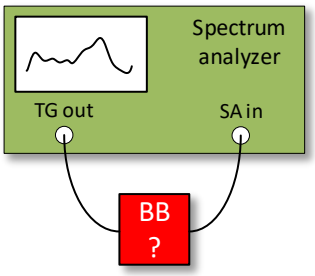


Fig. 1. Insertion loss measurement of Black Box using spectrum analyzer

Schematic of the measurement

The schematic diagram of the measurement is presented in Fig. 2. Fig. 2a) represents measuring setup without common mode choke, where the measurement base for choke is connected to the SA and TG and the normalization fixture is connected to the base. The normalization must be performed at this time (for the expected frequency range and TG setting). Fig. 2b) shows connection of the measured common mode choke. The gain of the choke is measured at the screen of the SA, insertion losses are given by equation (1).

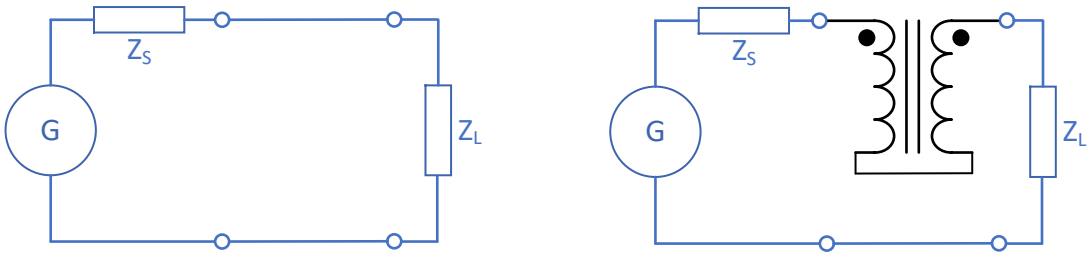


Fig. 2. Schematic diagrams a) with normalization fixture b) with measuring fixture

Fig. 3. represents the connection diagram of real measurement base and measuring fixture with common mode choke.

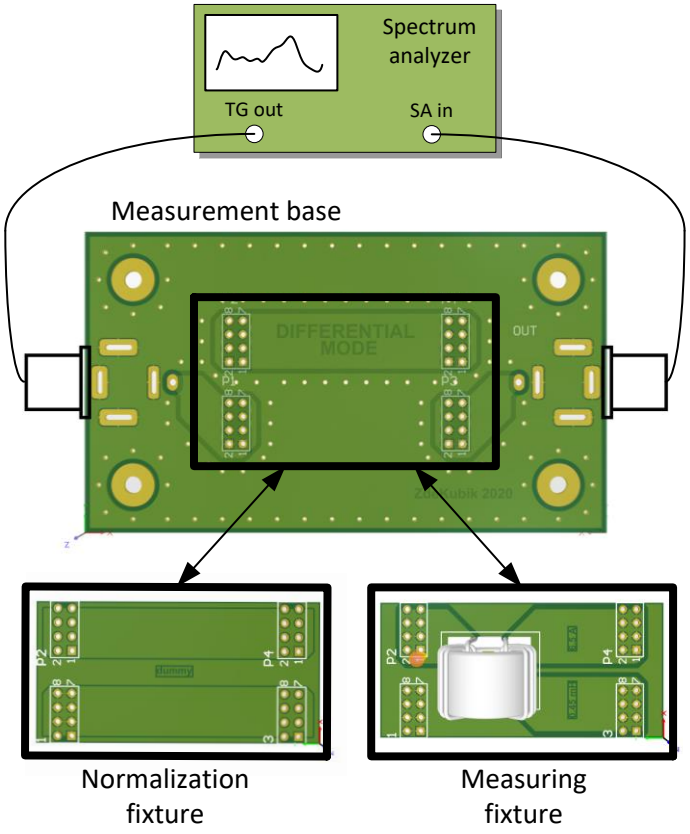


Fig. 3. Real connection for measurement of insertion loss of unloaded choke

Measurement tasks:

1. Check the inductance values of the common mode chokes placed in measuring fixtures. Set the frequency range of the measurement according to inductance value (the frequency range depends on the value, expected range can be up to hundreds of MHz).

NOTE: If you are unsure of the frequency range for a given common mode choke value, you can try to measure it in advance. Turn on the TG (without normalization) and find the resonant frequency of the choke. Then set the frequency range at SA so that the resonance of the choke is approx. on the half of the screen. Then remove the choke, insert normalization fixture and perform the normalization. Then connect the choke again and perform the measurement.

2. Turn on the TG output.
3. Connect the normalization fixture to the measurement base and perform the normalization.
4. Connect the measuring fixture to the measurement base and measure the gain.
5. Download the measurement result to the computer.
6. Change the measuring fixture with choke by another one and perform the step form 3. to 5. again.
7. Compare the measurement results 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“.