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## CHAPTER 15.5

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# AC IMPEDANCE MEASUREMENT

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The generation of Impedance Gain and Phase versus frequency plots of an electrical circuit (passive or active) is extremely important to characterize small signal behavior and evaluate stability. In space dc power distribution systems, such as the International Space Station power system, each of the power system components and dc-to-dc converters has to meet strict input and output impedance requirements over a specific frequency range to ensure end-to-end system stability.

Figures 15.5.1 and 15.5.2 show the technique used to measure ac impedance. This test can be performed with the device under test (DUT) operating at rated voltage and rated load. The network analyzer output provides a sinusoidal signal with a frequency that will vary over the desired range. The signal is amplified and fed into the primary of an audio isolation transformer. Figure 15.5.1 shows the method of ac voltage injection by connecting the transformer secondary in series with the power source. The voltage and current amplifiers are ac coupled and the network analyzer is set to generate the magnitude and phase plot of Channel 2 (ac voltage) divided by Channel 1 (ac). Therefore the impedance magnitude plot is  $|Z| = |V_{ac}|/|I_{ac}|$  and the impedance phase plot is  $\theta_z = \theta_{vac} - \theta_{iac}$  for the required frequency values.

Figure 15.5.2 shows the method of ac injection where a capacitor and a resistor are connected in series with the secondary of the transformer. The transformer and RC series combination is connected in parallel with the terminals of the DUT to inject a small ac into the DUT. The network analyzer performs the same computations for  $|Z|$  and  $\theta_z$  at the desired frequency range. The voltage injection method is used for high-impedance measurements such as the input impedance of a dc-to-dc converter, and the current injection method is better suited for low-impedance measurements such as the output impedance of a dc-to-dc converter.

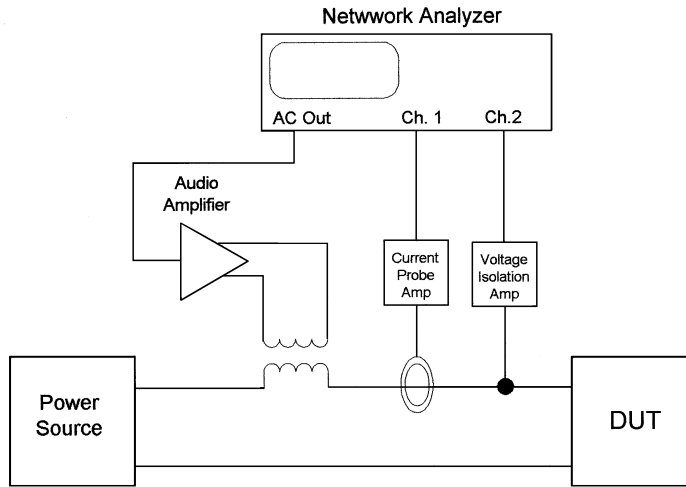


FIGURE 15.5.1 Impedance measurement with voltage injection method.

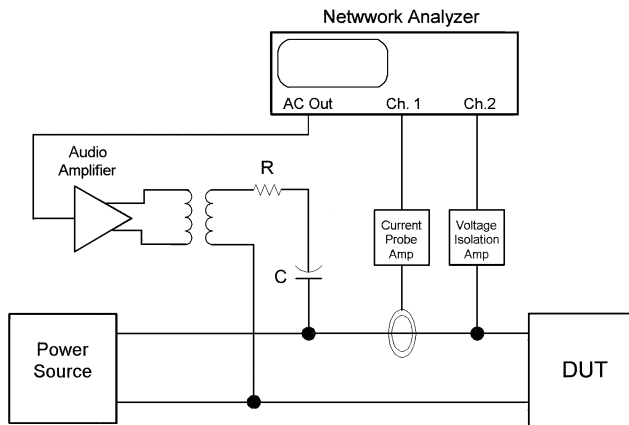


FIGURE 15.5.2 Impedance measurement with current injection method.