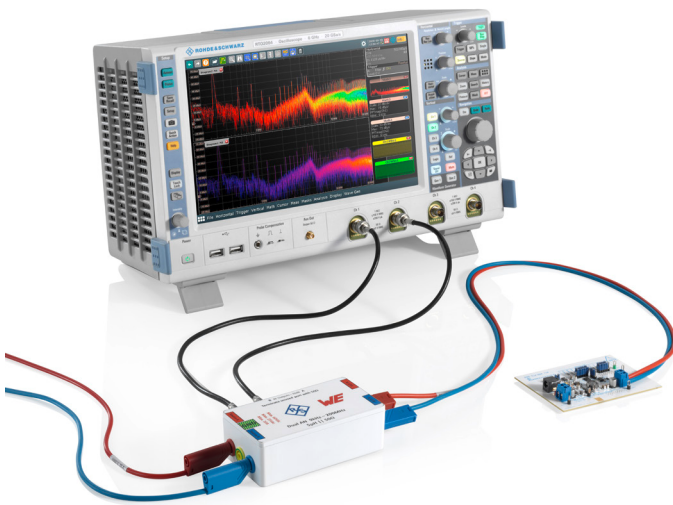


A HOMEMADE LISN FOR PRECOMPLIANCE CONDUCTED EMISSION TESTS ON DC-DC POWER SUPPLIES

Performing precompliance measurements on power supplies requires using a line impedance stabilization network (LISN) for results that can be compared to limit values. While LISNs are standard in any precompliance lab, often no LISN is available for early R&D testing. If high accuracy is not your goal and you just need a simple tool for debugging, you can build your own LISN. Rohde & Schwarz oscilloscopes with powerful FFT analysis, are ideal for optimizing EMI filters or debugging unwanted emissions during development.



R&S®RTO2064 oscilloscope with DC LISN

Your task

If CE measurements are performed too late in the design process, the result is often a partial product redesign. Performing conducted emission tests at an earlier stage in the development cycle can drastically reduce the redesign risk. Debugging conducted emissions requires a highly flexible instrument that can measure the spectrum with sufficient sensitivity.

A LISN is also required to decouple the device under test (DUT) from the external supply and have defined impedance for the DUT input. This provides the user with reproducible measurement results. A dedicated DC-LISN for compliance testing is available from different suppliers. However, a high-performance LISN is not required for CE debugging. A homemade LISN can be used to debug conducted emissions.

Rohde & Schwarz solution

Rohde & Schwarz oscilloscopes are the instruments of choice for designing power electronics and offer designers the sensitivity and flexibility they need. Rohde & Schwarz oscilloscopes offer powerful and easy-to-use FFT analysis for measuring the magnitude of the frequency component. At the same time, the user can see the time domain signals, enabling correlation of unwanted spectral emissions with time domain events.

Rohde & Schwarz and
Würth eiSos cooperate on
application related tasks.



Application Card | Version 02.00

ROHDE & SCHWARZ

Make ideas real



When combined with a homemade DC-LISN, the oscilloscopes create a powerful measurement setup for early conducted emission tests of power electronics designs with no need for additional expensive equipment. This is particularly helpful, if no dedicated equipment such as an EMI receiver is available in the R&D lab. The homemade DC-LISN from Würth is a very flexible dual DC-LISN solution for positive and negative supply lines.

The main idea is a setup harmonized to support precompliance measurements. The oscilloscope is a dedicated precompliance measurement tool that, together with the homemade LISN, keeps the setup simple, low cost and provides sufficient performance to analyze EMI problems at the very start of the design phase.

Device setup

The LISN must be connected between the device under test and the external power supply to measure a power supply's conducted emissions. The LISN coaxial output must be connected to the oscilloscope with a coaxial cable with 50 Ω input impedance and activated at the oscilloscope to ensure proper matching. The following steps must be carried out on the oscilloscope to measure the spectrum:

- ▶ Activate the FFT function and configure the maximum and minimum frequencies as well as the resolution bandwidth
- ▶ Adjust the vertical sensitivity in the time domain window to prevent overdrive in the input channel when the device under test is powered
- ▶ Switch off the power supplying the DUT for a reference measurement. This reveals the noise floor of the setup which is not coming from the DUT
- ▶ Switch on the power again and take a measurement. Verify against known conducted emission limits for the DUT on both power conductors. Account for any added LISN attenuation

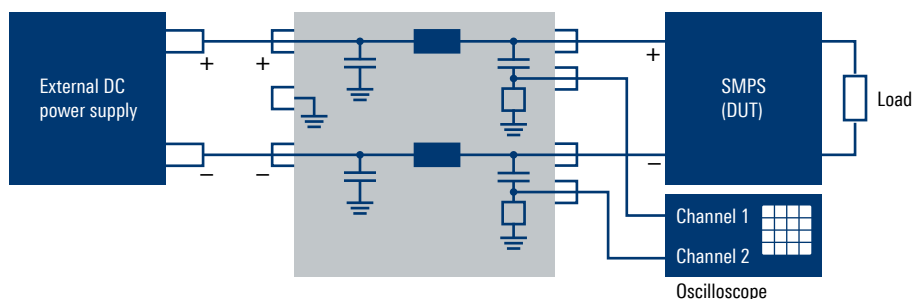
Case study – homemade DC-LISN performance

The two screenshots below show a conducted emission measurement using the R&S®RTO2064 oscilloscope with a standard-compliant, off-the-shelf LISN and the homemade LISN designed by Würth Elektronik eiSos GmbH & Co. KG.

Channel 1 and channel 2 display the measured time domain signals on the LISN's positive and the negative terminals. The LISN attenuates these signals by a factor of 10 dB, which has to be taken into account when comparing with emission limits. The math channels M3 and M4 show the spectrum in dB μ V on the DUT input terminal. The noise spectrum generated at the input of the DC-DC converter is clearly visible.

Conducted emission measurements with the Würth LISN show that the max hold spectrum on the input line is very close across the entire frequency spectrum compared to the results from the off-the-shelf LISN.

Precompliance measurement setup with a homemade DC-LISN



Summary

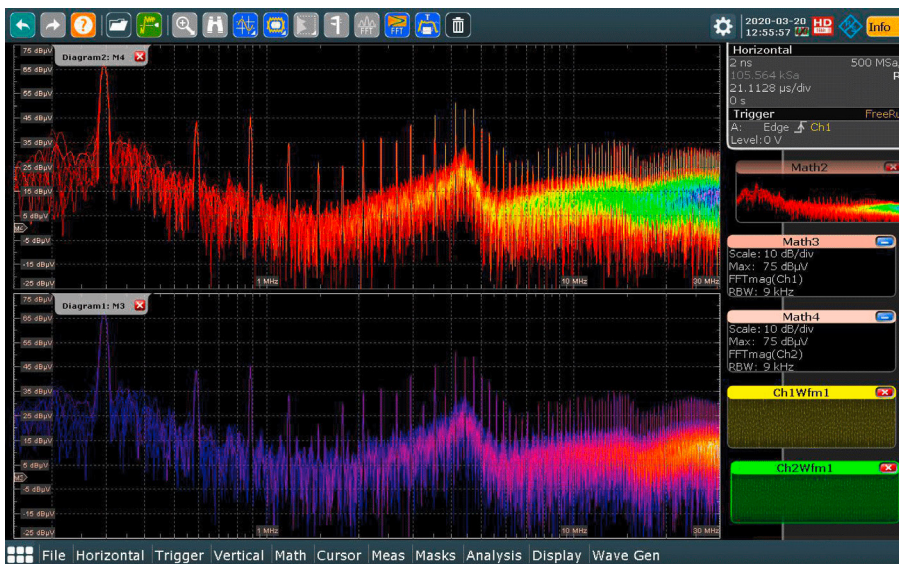
The Rohde&Schwarz oscilloscope with its fast and efficient FFT function together with the homemade DC-LISN from Würth is great for EMI debugging and is a low cost solution for the design phase of power electronics. It can save a lot of time and money with early EMI evaluation. A dedicated DC-LISN is not required for compliance testing. This makes EMI compliance more likely and eliminates the need for a fundamental redesign of the product after failure.

See also

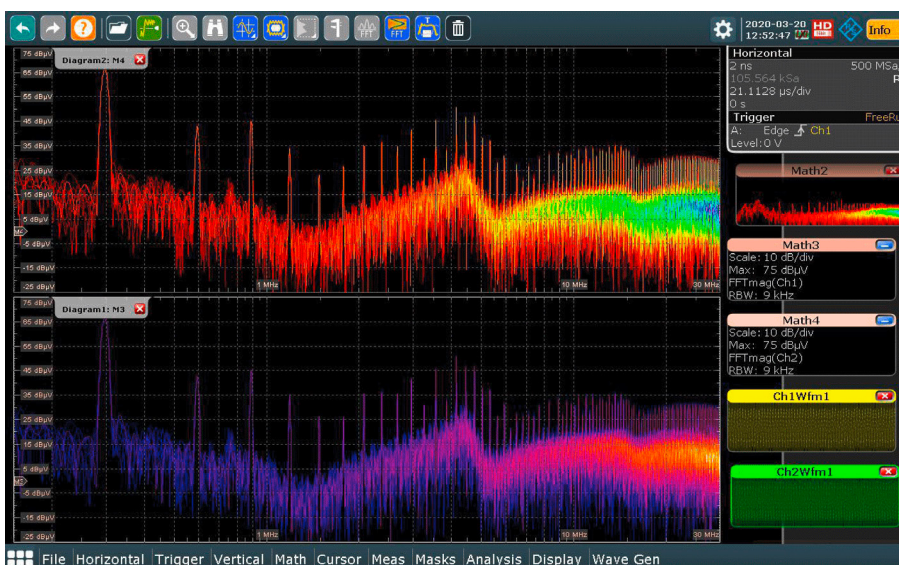
www.rohde-schwarz.com/oscilloscopes

www.rohde-schwarz.com/applications/a-homemade-lisn-for-precompliance-conducted-emission-tests-on-dc-dc-power-supplies-application-card_56279-1010752.html

www.elektormagazine.de/labs/dual-dc-lisn-for-emc-pre-compliance-testing-210296



EMI spectrum with an off-the-shelf DC-LISN.



EMI spectrum with homemade LISN (Würth design).

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