DEBUGGING CONDUCTED EMISSIONS WITH OSCILLOSCOPES MADE EASY

Getting EMI emissions under control is one of those tasks that R&D engineers do not enjoy doing . EMI must often be taken into consideration as early as the design phase, particularly in the case of power electronics systems with increasing switching speeds of wideband gap semiconductors. While EMI receivers or spectrum analyzers are always the preferred choice for these measurements, they are often not available as standard measurement equipment in the R&D lab. To allow optimization early on in the R&D lab, Rohde&Schwarz provides a free tool to simplify conducted emissions debugging using oscilloscopes.

Your task

A partial redesign of the product is sometimes necessary if the conducted emissions measurement is performed as a precompliance test at a later stage of the design process. This risk can be reduced drastically by performing the conducted emissions tests at an earlier stage of the development cycle. The first choice for EMI measurements is always an EMI receiver or a spectrum analyzer. However, these instruments are rarely available on the engineer's bench in the R&D lab. Furthermore, for power electronics designs, it is often necessary to optimize both switching speed and EMI emissions, which makes an oscilloscope the natural choice for this task. Nowadays, high-end oscilloscopes offer the necessary capabilities for this task, such as powerful FFT functionality and high sensitivity. To further simplify this, Rohde&Schwarz provides a free tool for correctly setting up the oscilloscope for these measurements and for displaying the results in a meaningful manner.

Rohde&Schwarz solution

The EMI debug tool for the R&S®RTB, R&S®RTM and R&S®RTA oscilloscopes and the EMI precompliance tool for the R&S®RTO and R&S®RTP oscilloscopes are utilities that assist the R&D engineer in setting up the oscilloscope for performing conducted emissions measurements using a line impedance stabilization network (LISN) device.

With a LISN device like the R&S®ENV216, the tool can perform conducted emissions measurements based on CISPR/EN standards 11, 15 and 22 in CISPR band A/B (9 kHz to 30 MHz). The program sets up all relevant parameters, including limit lines and a correction factor for the LISN transducer factor.

For troubleshooting EMI emissions, the EMI debug tool can be used to capture events in the frequency domain using its mask test features. Events that exceed the test limits can then be further analyzed in the time domain to gain deeper insights.

The motivation behind offering the software is to assist the engineer in setting up the oscilloscope for EMI measurements and applications. It does not provide a fully automated measurement process, but leaves the oscilloscope in a "local" state after completing setup. The engineer can then make further settings/adjustments to the oscilloscope in order to optimize the measurements.

In addition to setting up the oscilloscope correctly, it is also important to ensure a good measurement setup. For conducted emissions measurements, this ideally means using a ground plane on which the setup is placed, and a low-noise power supply for supplying power to the device under test.

Application

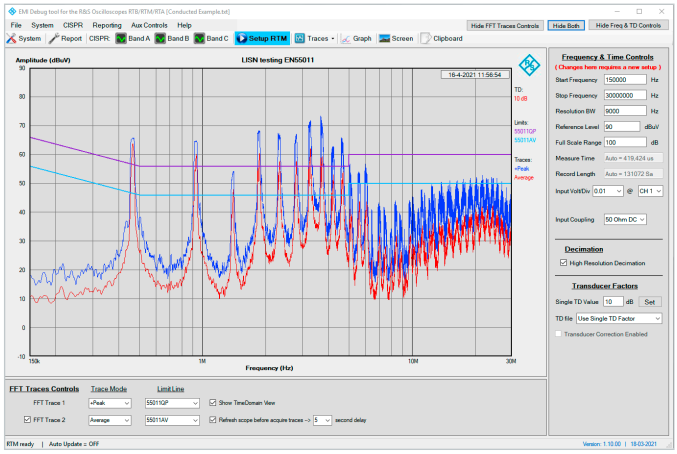
Device setup

To measure the conducted emissions of a power supply, the LISN has to be connected between the device under test and the external power supply. The coaxial output of the LISN has to be connected to the oscilloscope using a coaxial cable with 50 Ω input impedance activated at the oscilloscope to ensure proper matching. After enabling a communications link (LAN or GPIB) between the software and the oscilloscope, the following steps have to be performed via the graphical user interface of the program to configure the oscilloscope for a conducted EMI measurement:

- Set up all relevant control parameters in the time and frequency domain
- Specify the transducer factor according to the LISN specification
- Set up all relevant control parameters for FFT trace control, such as trace mode (average or peak) and mask test control
- Set the desired CISPR/EN class
- Send all configured parameters to the oscilloscope by pressing the "Setup RTx" button

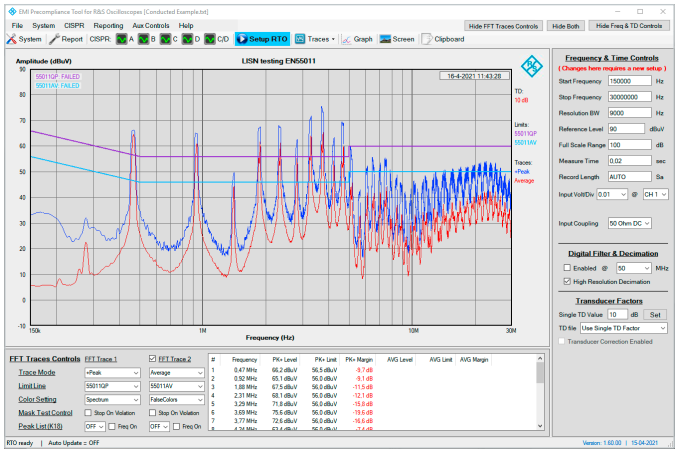
Case study

The following screenshots show a conducted emissions measurement with the R&S®RTM oscilloscope in combination with the EMI debug tool. The result of the average and peak spectrum is shown in detail. The limit lines are exceeded by several magnitudes – an optimization process is therefore required.



EMI debug tool for the R&S®RTB, R&S®RTM and R&S®RTA oscilloscopes.

The following screenshots illustrate a conducted emission measurement with the R&S®RTO oscilloscope in combination with the EMI precompliance tool. In detail, the result of the average and peak spectrum is shown. In this case, the measured spectrum largely exceeds the limit lines thus an optimization process is required.



EMI precompliance tool for R&S®RTO and R&S®RTP oscilloscopes.

The advanced EMI debug tool offers in addition the mask test control to capture or trigger any violation of the limit lines while varying the operating conditions. This supports the use to find events which are only present temporarily.

Summary

The EMI debug tool for the R&S®RTB, R&S®RTM and R&S®RTA oscilloscopes and the EMI precompliance tool for the R&S®RTO and R&S®RTP oscilloscopes enhance the powerful FFT functionality of Rohde&Schwarz oscilloscopes to transform them into a powerful EMI measurement tool. This tool assists the user in configuring the oscilloscope to measure conducted emissions at an early stage of development and can save a lot of time. Implementing this tool at an early development stage makes it more likely that EMI compliance can be achieved without the product having to be redesigned.

See also

http://www.rohde-schwarz.com/oscilloscopes
https://www.rohde-schwarz.com/emi

Rohde&Schwarz GmbH&Co. KG
www.rohde-schwarz.com

Rohde&Schwarz training
www.training.rohde-schwarz.com
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PD 3683.3571.92 | Version 01.00 | September 2021 (as/ja)
Debugging conducted emissions with oscilloscopes made easy
Data without tolerance limits is not binding | Subject to change

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