EMC

Laboratory exercise 2
Radiated and conducted emissions

Biomedical Engineering
LTH

Laboratory exercise 2: radiated and conducted emission measurements

In Lab 1 you analyzed a digital circuit design in the near field using near field probes. In this lab you will measure the emission from the same board in the far field and on the mains power cord, similar to the way certifying measurements are made. The far field measurements will be conducted in the lab and not in an attenuated and shielded chamber according to the standards. The measurements will be made using the same spectrum analyzers as in Lab 1. For the radiated emission measurements two broadband antennas will be used at a measuring distance of 3 m. The conducted emission measurements will be performed using a LISN and an isolation transformer.

Below is a mandatory preparatory assignment and a number of tasks/measurements to do, and these are to be accounted for in a written laboratory report in order to pass the exercise (see below for details).

Readings

Williams, "EMC for product designers"
Chapter 4, pp 98-99
Chapter 6, pp 118-134

Laboratory report

In the report, both the answers for the preparatory assignment as well as the results and conclusions of the measurements are to be presented (methods or list of equipment are not necessary). The report is written in groups and is to be 2-4 pages long, in addition to a cover page (where your names, the name of the exercise and the tutor's name are listed). Academic accuracy concerning references is assumed.

To bring to the laboratory exercise

One person in the group should bring a USB-stick in order to save the results of the measurements for the laboratory report.

Preparatory assignment

Find out and answer the following questions.

- What is the frequency range for the radiated and the conducted emissions, respectively?
- What are the emission limits?
- What type of detector should be used in the spectrum analyzer and what are the properties of it?
- What filter bandwidths should be used?
- What is meant by "Antenna factor" and how is it used?
- What is a LISN and why is it needed?
- Why do you need an isolation transformer in the lab to perform the conducted emissions measurements?

Equipment

Siglent SSA 3021X spectrum analyzer with built-in tracking generator 9 kHz – 2.1 GHz.
Spectrum analyzer HP 8591 EM
Log-periodic antenna EM 6950, 200 MHz – 1 GHz
Bi-conical antenna EM 6912A, 20-300 MHz
Antenna tripod
LISN
Isolation transformer
5Vpower supply
"unknown" circuit board

Please note!

Discharge yourself to ground in the beginning of the laboratory exercise before touching the input connector of the spectrum analyzer!

Conducted emission measurements

Please note that the standard is based on dBµV rather than dBm, meaning that the spectrum analyzer must be reconfigured for the correct unit.

1. Measure the spectrum and compare it with the results from Laboratory exercise 1.
2. Make detailed measurements of some of the signal levels and judge if the "device" will pass the tests.
3. Try to lift the circuit board above the desk. How are the signal levels changed?
4. Can you trust the measurements? Why/why not? What are the possible sources of errors?
5. Measure the attenuation of the transient protector. What frequency span should you choose?
6. Measure the attenuation of the coaxial cable used for the emitted emission measurements (or a cable of the same type and length). Make notes of the attenuation at different frequencies. What frequency span should you choose?

Emitted emission measurements

Before you do your measurements of the emissions, measure the distance between the antenna and the source of noise (the circuit board) and correct the allowable signal levels (which are based on a distance of 10 metres) for the actual distance (of approximately 3 metres). Please note that the standard is based on dBµV rather than dBm, meaning that the spectrum analyzer must be reconfigured for the correct unit.

7. Measure the spectrum and compare it with the results from Laboratory exercise 1.
8. Make detailed measurements of the most relevant signal levels and judge if the "device" will pass the tests.
9. Can you trust the measurements? Why/why not? What are the possible sources of errors?

Last revision: 2017-01-12 JG, 2017-11-09 JG