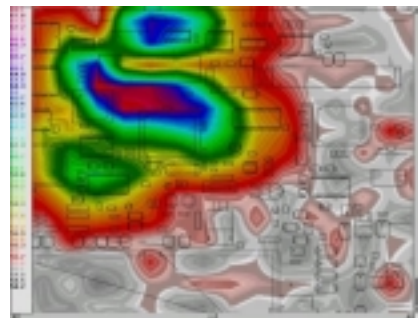


How to Prevent from Emission Problems on Board Level

For many, the result of an EMC test comes as an unpleasant surprise. Large amounts of money and time are spent in re-designing the product, which causes heavy delays. The main cause of these additional costs and delays can be related to the designer's opportunities and desire to perform an EMC test on the product as early as possible. In this article, I will give some simple advice and examples of test methods useful for avoiding undesired emission.



Emission (64MHz) coming from components on a PCB.

The final test is of course performed on the entire system or product, but the EMC thinking must be applied already from the concept stage!

Simple rules

To avoid unpleasant EMC surprises, these rules must be followed:

- 1. Start measuring as early as possible in the design process.
- 2. Find the source of the problem.
- 3. Correct the problem on component level.
- 4. Perform tests regularly during the design process.
- 5. Perform tests according to existing EMC directives.
- 6. Perform quality tests during manufacturing.

Emission pre-test

Previously, designers have only used spectrum analyzers and near-field probes when searching for emission sources on board level. This measuring method has been time-consuming and non-repeatable. Therefore it has caused large uncertainties about where the source of the problem is located and how different design modifications affect the total emission.

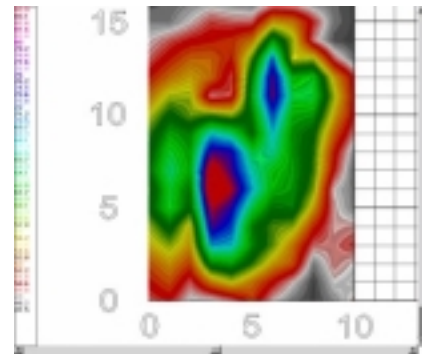
By connecting the spectrum analyzer and near-field probe to an EMC scanner, the designer can today build an ideal

measuring instrument for emission pre-test on board and equipment level. This measuring method makes the pre-tests simpler and cheaper since the designer himself can perform the measurements and evaluate the results. The emission sources can easily be studied graphically, and the results of different design modifications can be compared.

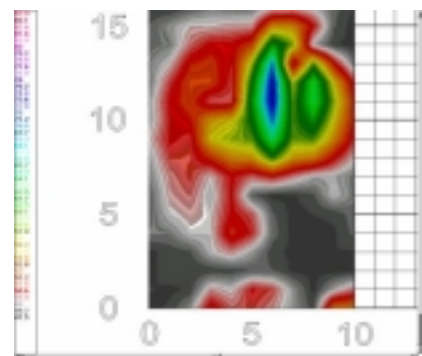
Design rules

The board design has a fundamental importance for giving the system or product good EMC characteristics. The designer must follow these rules:

- · Don't use higher voltage or current than necessary.
- · Don't use faster circuit devices than necessary.
- · Use short connections on all levels.
- · Use properly designed grounding, shielding and filtering.



Circuit board (100*160 mm) with a bad ground plane (40MHz fields)



Circuit board (100*160 mm) with improved ground plane (40MHz fields).

Avoid large HF-current loops by using decoupling capacitors, multiple voltage planes, a properly designed zero potential plane, as well as twisted pairs to keep the signal and return lines close together.

Board layout

A proper layout must minimize current loops while minimizing the inductance of all parts used for signals with fast rise and fall times. To avoid crosstalk, sensitive signal conductors must be kept separated. The power supply distribution must have low induction (multi-layout).

Logical circuits

When choosing logical circuits, follow these rules:

- · Choose as "slow" a clock frequency as possible, and duty cycles as close to 50% as possible.
- · Force unused inputs and outputs to a predetermined potential.
- · Place signal and return lines as close together as possible.

Decoupling capacitors

The decoupling capacitor has to protect the circuit from transients, and this is achieved by:

- · Place the capacitor as close to the supply leads as possible (minimize the current loop).
- · Use a capacitor with a size as small as possible.

Filters

Use filters to minimize interference on inputs and outputs to circuits and boards. These filters will work as a "barrier" between two zones.

Shielding

Shielding is used to "isolate" the emission from a source by applying e.g. screen boxes and shielding materials. This method is often expensive and therefore used only when no other solution is working. However, you must remember that

shielding can cause problems with temperature as well as with oxidation that might eventually degrade the shielding effect.

The EMC directive

The product must of course be tested for compliance with the existing EMC directive. What you often forget after the CE approval is what will happen with the product when it has been manufactured for some time. Often some parts of the product are changed (new components or component suppliers). This might cause the product getting EMC characteristics different from those it was approved for. In this case, the EMC scanner can also assist in performing emission tests to find out if any changes of the EMC characteristics have occurred.

Conclusion

To make a product as inexpensive and good as possible, you should consider EMC matters from the very beginning of the design. Pre-tests should be performed as early as possible, and problems should be corrected on component and board level.

Perform EMC test according to existing directives.

Perform tests during manufacturing to ensure that the EMC characteristics of the product are not degraded after some time.

"See it before you CE it"

Jan Eriksson, Technical Director

Detectus AB, Sweden.

Distribué par CEMesure et Accelonix