Method to measure transmission at HPM radiation through optical sensors

Patrik Svensén
Saab Bofors Dynamics, Karlskoga, SWEDEN

This paper is a summary of a study made to develop a method to measure the electromagnetic transmission through optical sensors. The study included both coupling measurements and high power testing of optical sensors with electromagnetic radiation for microwave frequencies. The study also addresses some conclusions about the coupling path and the HPM threat on optical sensors.

The purpose of this study was to design a measurement method that can be used to measure the electro magnetic transmission through optical sensors, and also to make high power testing to get some susceptibility figures. Due to cost factors, the study was only made on optical sensors in the visible light area. Two CCD cameras were used as test objects, the first with the electronics on a small PCB behind the CCD, and the second camera with the electronics distributed on three PCB's, with interconnecting cabling and connections.

The test method used a reverberation chamber that generates the field which illuminates the optical sensor. The sensor is installed on the reverberation chamber wall, with sensor optics inside the chamber, sensor element (CCD) almost in line with the wall and the sensor electronics outside the chamber. The power is measured in the reverberation chamber, and the power transmitted through the optical sensor is then measured in a cavity covering the sensor electronics. From this, the RF transmission through the optical sensor is calculated.

The coupling measurement was on the camera with one PCB. Several camera objective configurations were measured to get an understanding of the coupling mechanism.

In addition high power testing was conducted on both cameras with several camera objective configurations, this to get both real threshold levels, and to get data to correlate the transmission measurement to and in some way validate the measurement method.

The main result from the coupling measurement was that coupling through a visible light optical sensor is less the -40 dB for frequencies up to 8 GHz. This means that in most of the designs today, coupling through apertures for optical sensors to the sensor electronics is not the critical area.

The main result from the high power test was that the test data validated that the interference of the optical sensor is on the electronics behind the CCD, and not on the sensor chip element itself.