Measurement of Protection Properties of Closed Shields in Time Domain

H. Herlemann*, M. Koch*, A. Bausen**, F. Sabath**
*University of Hannover, Institute of Electrical Engineering and Measurement Science, Hannover, Germany
**Scientific Institute for Protection Technologies – NBC-Protection, Munster, Germany
(Principle contact: herlemann@ieee.org)

Abstract

The question of how to determine the protective properties of a shield is a difficult one to be addressed, even in frequency domain. In general, the common definitions of shielding effectiveness do not provide a measure for the capability of a shield to protect a certain application against electromagnetic fields. This is because in most cases, only the electric- or magnetic shielding effectiveness of the empty shield is measured. Since the shield usually forms a cavity resonator with internal resonances, the shielding effectiveness breaks down at the cavity's characteristic resonance frequencies. In addition, it becomes a function of position. Due to these resonance phenomena tests as close as possible to the actual configuration are preferred over measurements of the shield alone. For these measurements, carried out in the frequency domain, a dummy load is used.

In order to assure the undisturbed operation of sensitive electronic equipment in an environment endangered by transient electromagnetic fields, i.e. electrostatic discharges (ESD), high power microwave (HPM) or ultra wideband (UWB) pulses, the knowledge of the shielding effectiveness in frequency domain may be not sufficient. In this contribution, a measurement technique in the time domain is presented, using pulses of double exponential characteristic. With these pulses, the susceptibility of the equipment with and without the shield is determined, while being in operation. The protective properties of the shield are determined from the different field strengths at which certain malfunctions appear. The measurement technique is based on the determination of probability rates for the breakdown or destruction of a device. Since special devices like microcontroller boards or microprocessors are used, the disadvantage may be that test results cannot easily be transferred to other systems with a completely different configuration. However, measurements of different microcontrollers or microprocessors exhibit a astonishing comparability even between different generations of devices.

Besides the presentation of the measurement technique, useful definitions for the protective properties of a shield in time domain are given. In addition, the results of measurements are presented, in which the protection properties of different shields made of electrically conductive textiles are examined.