

Alteration of Transient Susceptibility of Electronic Devices by Variation of Pulse Repetition Rate

S. Korte* and H. Garbe

Institute of Electrical Engineering and Measurement Science,
University of Hannover, Germany

The appropriate function of electronic systems is one of the basic requirements for the functionality of modern societies. Essential for a safe life with minimized risks is a good reliability of the deployed systems. For normal operation conditions this reliability is ensured by standardized EMC tests which focus on the susceptibility of the electronics. Modern pulse generators are able to generate ultrawideband pulses with picosecond rise times and amplitudes of several kV which can be used to intentionally disturb electronic systems. Due to the fact that the technology on pulse generation is freely available several investigations concerning transient susceptibility of electronics have been performed in the past in order to minimize potential terrorists influence on sensitive systems. Unfortunately the susceptibility is increasing with higher integration of the chips.

State-of-the-art pulse generators additionally provide the ability to generate pulse sequences with variable pulse repetition rates. By the exposition of an electronic system to these pulse sequences the transients susceptibility of the system can be influenced. In order to investigate these effects a special measurement setup has been developed. It provides the possibility to expose electronic devices in a normal operation state line-led to an arbitrary disturbing signal. Furthermore measurements of selected pins are possible to determine the correlation between exposed pins function and susceptibility of the device.

The presented investigations show that the application of repetitive pulses leads to a significant decrease of the breakdown thresholds of electronic devices. For the example of microcontrollers it is shown that these thresholds can be lowered in all investigated configurations by at least 25 % with increasing the repetition rate from 1 kHz to 100 kHz. For the worst case the required breakdown voltage is only 16 % of the former amplitude. Also the probability to hit the microcontroller in a critical and vulnerable system state increases dramatically. Recent investigations with pulse repetition rates between 100 kHz and 1 MHz show a stagnation in the decrease of the breakdown thresholds due to electrical limitations of the electronic devices. Overall the variation of the repetition rate shows, with certain limitations, an easy possibility to increase the susceptibility of electronic systems.

The presented work is part of the study "Protection of Electronic Systems against Electromagnetic Sources", commissioned by the Armed Forces Scientific Institute for Protection Technologies - NBC-Protection (Munster, Germany).