HPEM Susceptibility of Bridgewire Electrically Explosive Devices (EED)

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Ordnance used in military ammunitions shall not be inadvertently initiated after exposure to external EME levels, for both direct induced actuation of the electrically initiated device (EID) and inadvertent activation of the electrically powered firing circuit. Relevant EMC standards in which ordnance is required to be safely stored, handled and operated are for NATO purposes the STANAG 4234, the national German standards VG 95378 and VG 95379 and the MIL STD 464. The given peak electric field limits are related to severe EMI environments especially given e.g. on board of ships and in close vicinity to radar antennas. That's why the limits are especially high (20 – 30 kV/m peak) for frequencies above 2 GHz, whereas for frequencies below 1 GHz the limits are approximately factor 10 less. Although the limits are considerably high and it is unlikely that ordnance is exposed to field strengths as high as given in MIL STD 464 during most NATO operations, it should be emphasized that the limits do not necessarily cover the radiated fields generated from HPEM sources (e.g. HPM, UWB, DS) or related directed energy RF weapons.

In order to investigate the individual HPEM source parameters, e.g. pulse duration, pulse repetition rate and field strength on the ordnance susceptibility behavior, a generic firing circuit has been developed and connected to a bridgewire Electro-Explosive-Device (EED). The generic firing circuit consists of three different firing stages based on a MOS-FET, bipolar transistor and a silicon controlled rectifier (SCR) switch, which are commonly used in military applications and whose HPEM susceptibility behavior are to be investigated separately. Unintentional firing of the EED may be caused by two effects: If the ordnance is electrically active, the HPEM pulse may upset the firing unit causing unwanted trigger signals. Secondly, HPEM induced currents can cause bridgewire heating that may fire the EED in active and inactive state. In order to measure HPEM generated heating effects, the EED is instrumented with a fast infrared fibered photo-receiver based on a MCT (mercury-cadmium-telluride) infrared radiation detector, which allows a spectroscopic observation without physical contact to the bridgewire. In a first step, direct current injection (DCI) tests are used to determine the bridgewire temperature increase as a function of various source parameters. Secondly, the firing unit with connected and instrumented EED will be exposed to high-power EM fields and a limited number of high-power tests over a restricted range of radiated pulse parameters will be undertaken.