

Non-Lethal Threat to Electronic Systems from High Power Electromagnetic Fields

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Modern electronic systems are susceptible to intense electromagnetic fields. After penetration into the internal system, electromagnetic waves are converted to current and voltage waves on cable systems connected to the electronic components. Dependent on the level of the incident elm wave, either distortion due to demodulation effects occur or the component is destroyed. In either case the system loses the capability it was designed for. Therefore delivering intense electromagnetic fields to a target provides a non lethal defence technique to interrupt the target mission.

The paper presents various degradation effects which have been observed in analogue, digital and microcontroller circuits irradiated with back-door coupled electromagnetic fields. The demodulation process happens either at nonlinearities on the controller board, or at least at the input stage of the semiconductor component itself. The distortion frequency in the demodulated signal is determined by the modulation frequency or the pulse repetition rate that preliminary affects the information signal frequency of low-frequency analogue electronics. Hence, to disrupt analog systems, a relatively long excitation time in the range of microseconds to milliseconds is necessary, that covers at least some cycles of its information signal frequency. In digital and especially microcontroller circuits the input circuitry is in general fast enough, with rise times and access times in the nanosecond range or below, to react on the high frequency (nanosecond scale) directly. Therefore, relatively short pulses are able to disrupt a digital system in case a certain threshold of induced voltage is exceeded. Especially endangered are not only the input terminals, but also the reset circuitry and the Latch-Up behaviour of CMOS-components. Higher EM-Fields can cause permanent degradation of the electronic system by junction breakdown or dielectric breakdown. The described malfunctions and degradation defects have been observed during high power irradiation tests on real targets (e.g. computers, TV, communication electronics, generic electronics).