Electromagnetic Modeling of Hot-Wire Detonators

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A modeling technique has been developed to determine the electromagnetic (EM) characteristics of hot-wire detonators in order to quantify possible effects of impinging EM radiation. The analysis includes both analytical and numerical models. The analytical model uses transmission line theory to represent the detonator as a cascaded transmission line incorporating several different sections and calculates both differential and common mode impedances as well as resonant frequencies. The numerical model uses ICEPIC (Improved Concurrent Electromagnetic Particle In Cell), a finite-difference-time-domain EM solver, to determine these same parameters for comparison. The models are synergistic as the analytical model has been modified using additional circuit elements whose values were found using ICEPIC. This combination produces an improved analytical model that can be run nearly instantaneously on a PC for a wide range of hot-wire detonators to determine possible variations in radio frequency response. Experimental measurements on live detonators have been used to validate the models.

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