Ultimate Broadband High Power Microwaves

Andrew S. Podgorski, Fellow IEEE
ASR Technologies Inc.
Ottawa, Ontario K1H 5G6, Canada
a.podgorski@ieee.org
www.asrtechnologiesinc.com

Abstract— **This paper describes High Power Microwave (HPM) research of combining GW peak power to achieve MV/m radiated E-fields in the range of air and vacuum breakdown and frequency range of, but not limited to, 1 to 50 GHz. Multiplicity of spatially dispersed, independently triggered GW power sources, broadband and/or narrowband, supplying power to multiplicity of broadband radiators/antennas allow achieving power levels up to or exceeding ionization. The time of triggering of each generator and the generated pulses spectral content is selected to permit varying the radiated E-field and energy to achieve the highest levels at the point of power delivery. The TW antenna arrays, generating MV/m E-field can be used for verification of protection against ultimate microwave weapons. The broadband character of the radiators/antennas and the ultimate peak power density ensures the highest probability of protection of very large systems.**

Keywords-component; HPM, broadband terawatt electromagnetics, immunity testing, HPM weapons, plasma studies.

I. Introduction

Development of high power sources led to achieving GW peak power levels at microwave frequencies [1]. Initial use of narrowband GW generators resulted in inefficient coupling of the EM energy to target, undermining the effectiveness of the HPM as weapons. To address this issue, early on the broadband single GW generators were utilized eliminating need for large power supplies, shortening the test time and reducing the cost of the facilities [2]. However, application of solitary broadband GW generator left a question - what if multiple generators are used in the HPM weapons. Broadband Composite Threat [3] showed that if TW peak power, limited only by air or vacuum breakdown is reached, the HPM threat could be significantly increased. To achieve the TW radiated power, the GW power from individual generators had to be added using broadband antenna arrays. Since all broadband antennas were not electrically enclosed [4], to reach the highest gain, maximum frequency of operation and suitability for high power array assembling new antenna had to be developed. Design was narrowed to distributed hybrid consisting of a broadband TEM parallel plate antenna and a narrowband microwave horn creating an electrically enclosed broadband TEM-horn antenna [5,6].

In designing of broadband HPM array the power density and breakdown E-field strength along the energy path from the generator to the target is a limiting factor at points of highest power density i.e. close to generator or at focusing points. To assure very high peak power, coaxial single polarization antennas were used in the design of broadband spatially distributed antenna arrays with each adjacent antenna having different polarization. In broadband antenna arrays use of flat face design, normally associated with narrowband arrays, is possible but this precludes advantageous illumination that occurs when each broadband antenna fires pulses at different time and directs them to different areas. As per Ref. 7, multi-antenna arrays are configured into flat, concave and convex face curvatures. The illumination of a single target is achieved using a concave array while the convex arrays is used for uniform illumination of many targets or large objects with each antenna radiating into a different section of the object. For reference see MIL-STD-464C where 2 x 2 m adjacent areas of a single target are illuminated separately [8]. This paper addresses broadband antenna arrays capable of generating and radiating TW peak power pulses with the E-field levels exceeding the air and vacuum breakdown limits. The issues paramount to achieve such E-fields i.e. use of high antenna gain of at least 16 dB, use of new concave arrays and independently triggered generators will be addressed in the presentation.

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