HPM Detector with Extended Detection Features

Chr. Adami, Chr. Braun, P. Clemens, M. Jöster, H.-U. Schmidt, M. Suhrke, H.-J. Taenzer
Fraunhofer INT
P. O. Box 1491, 53864 Euskirchen, Germany
michael.suhrke@int.fraunhofer.de

***Abstract*— The growing threat by high power microwaves (HPM) also increases the importance of capabilities to detect high-strength electromagnetic fields. Fraunhofer INT has developed a demonstrator of an HPM detector with extended detection features for mobile and stationary use. A four-channel system with four antennas allows for additional direction finding.**

Keywords- High power microwaves (HPM), detection

I. INTRODUCTION

The potential high power microwave threat to electronic devices and systems has reached a technological level whereby customary modern electronics can be disabled over small to medium distances. Recently, close range applications with suitcase-sized devices have proven very successful causing malfunctions of microprocessor or computer-controlled electronics, at least temporarily, at several ten up to some hundred metres. As there are no sufficient detection and warning systems as yet to verify this threat, it is very easy for attackers to test the effectiveness of HPM systems on-site without being discovered. Disturbances and failures of own equipment accordingly might not be associated with electromagnetic attacks. This makes it important to monitor critical devices and facilities and to have capabilities available to search for and identify sources of electromagnetic threats.

II. DETECTION FEATURES AND DETECTOR DEVELOPMENT

The aim of the work presented here was to design HPM detection systems and to build demonstrators that offer the possibility, beyond the simple warning devices presently available, to record and to display a number of pulse parameters. These include pulse amplitude, derived threat field strength, pulse width, and pulse repetition rate or the number of pulses for low repetition rate. It is thus possible to detect and distinguish a variety of signal types ranging from continuous wave to narrow band HPM pulses, to damped sinusoids, to ultra wideband signals. In a second stage a four-channel system was designed with four antennas for direction finding. In a later phase the intention is to determine also other characteristic features such as a coarse discrimination of frequency regions.

The suitability of different detection methods for HPM signals was evaluated from own investigations as well as from the literature. Beyond the mere announcement of a signal with threat field strength, the detection system is intended also for surveillance of a certain area or for search and identification of HPM sources. The necessary dynamics can be achieved by means of logarithmic amplifier/detector modules with a measuring dynamics of 60 dB and bandwidths of up to 8 GHz.

The single-channel system consists of a polarization-independent broad-band antenna, which covers a defined sector at constant sensitivity, the logarithmic amplifier/detector module in an enclosure with high shielding effectiveness and with an appropriate input circuit for self-protection. This is supplemented with a signal processing system with a multi-channel oscilloscope and a computer with GPIB interface and with the necessary analysis and display software [1]. The four-channel system comprises four antennas, attenuators, limiters, and log-amplifier/detectors, and a four-input trigger recognition circuit (Fig. 1). The pulse analysis and direction finding is again done with a four-channel digital oscilloscope and a GPIB controller. The HPM robustness of the detectors has been tested in a TEM waveguide with field strengths of 1.5 kV/m and in a reverberation chamber for fields of 10 kV/m.

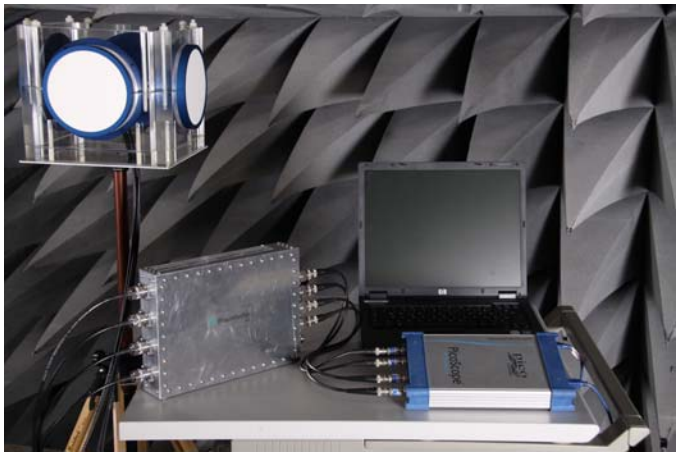

Figure 1. Demonstrator of four-channel system.

Both systems can be operated by mains or on-board power supply and with internal batteries, respectively, and thus can be flexibly set up in any location in both stationary and mobile settings without relying on external power supply. They complement the necessary shielding and protection measures and alternatively the hardening of systems against high power microwaves.

REFERENCES

[1] Chr. Adami, Chr. Braun, P. Clemens, H.-U. Schmidt, M. Suhrke, H.-J. Taenzer "HPM detection system for mobile and stationary use", EMC Europe 2011, York, UK.