Multichannel IEMI Detection and Characterization

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Abstract – An intentional electromagnetic interference (IEMI) detection system which is capable of identifying the electromagnetic signal based on frequency, pulse duration, pulse repetition rate, magnitude and bandwidth has been designed and prototyped. The detection systems is designed based on a multichannel signal conditioning scheme for an accurate detection with low false alarm rate. Statistical characteristics of the detected signal are logged and analyzed using a control and signal processing unit.

Keywords-component; characterization, detector, IEMI.

I. INTRODUCTION

An intentional electromagnetic interference (IEMI) may target the electronic systems by transmitting an electromagnetic signal beyond the limits that the system is designed to tolerate. Since IEMI attacks may still be effective from a distance and through physical barriers, such as walls, they are hard to track and are mostly undetected [1,2]. The characteristics of a potential attack is usually not known in advance which makes it difficult to plan for an effective mitigation during the design stage. A logging detection system can gather statistical information about the characteristics of attacks such as frequency, duration, and repetition rate of the attack. Even though there are existing developments of IEMI detection systems [3,4], there are not many commercial off-the-shelf solutions that can detect, log, characterize, and alarm in the event of an attack. In this paper, an IEMI detection system with logging and alarming capability is proposed. This system is capable of reporting the characteristics of attacks that can be used to gather statistical information for a facility under attack. This paper describes the general design and capabilities of the proposed system.

II. IEMI DETECTION SYSTEM DESIGN

Individual functional blocks of the detection system are shown in Figure 1. The green arrows represent the flow of radio frequency (RF) signals and the blue arrows represent the flow of digital or low frequency signals. The main components of the system include antenna, multichannel and redundant RF conditioning and detection unit, digitizer and processing unit, power unit, control unit with logging and processing capability, and electromagnetic interference (EMI) protection. The system is designed to have frequency dynamic range from few hundreds of MHz to few GHz with magnitude dynamic range of a few hundreds of V/m.

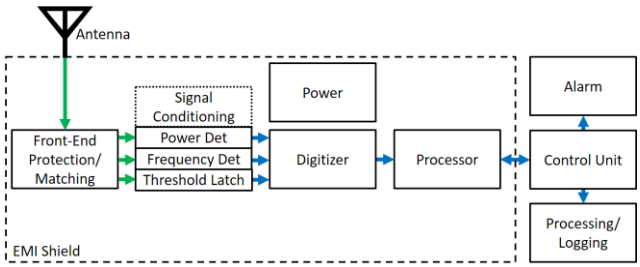
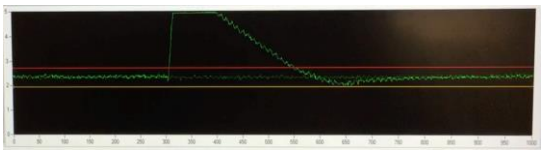


Figure 1. The block diagram of IEMI detection system.

III. TEST RESULTS

The prototype of detection system is tested with broadband pulse as well as narrowband continuous wave. For broadband, the aggressor antenna is excited with transmission line pulser (TLP) at 1 kV with 200 ps rise time. For narrowband, the aggressor antenna is excited from 100 MHz to 4 GHz. The detection system is shown to detect the signal for some frequency bands, but does not detect some other frequencies (in between the detectable bands). Near-field scanning of the detection board shows unintended resonating structure which is the root-cause of undetected signals. Next revision of the board is being design to address this issue. The attacks are determined by user defined threshold level as shown in Figure 2 (red and yellow levels). In this figure, broadband and narrowband (at 925 MHz) detection are shown. API's SmartScan software with automatic detection capability is used for signal processing.

(a)



(b)

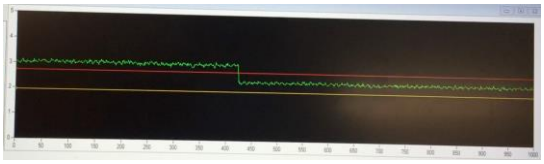


Figure 2. IEMI detection of (a) broadband and (b) narrowband.

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