SIMULTANEOUS MEASUREMENT OF ELECTRIC AND MAGNETIC FIELDS WITH A LOOP ANTENNA HAVING TWO RESISTIVELY LOADED GAPS

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Abstract. We describe a measurement system that uses a loop antenna with two resistively loaded gaps to simultaneously measure orthogonal components of the E and H fields. The technique is useful in near-field situations where a plane-wave approximation is not valid. Our system is based on earlier work by Kanda and uses optical fiber links for signal retrieval in order to eliminate field distortion caused by metallic cabling. Mach-Zehnder interferometric modulators inside the antenna loop are used for the signal transducers to measure the voltage drops across the resistors. Receivers in an electronics module convert the optical signals to electrical signals that are added and subtracted to give the E and H fields. Since the unit is intended for use in varied environments, active bias control of the modulators is required. This is accomplished via optical fiber up-links and photovoltaic (PV) cells. Traditional control algorithms that null the second harmonic content in a small dither signal were found to be unusable because of nonlinearities in the PV cell response. A control algorithm that circumvents this problem was developed. The algorithm and other system controls run on a digital signal processor and computer embedded in the electronics module. The antenna loop is 170 mm in diameter with a 17 mm tubular cross section. The system response covers frequencies from 50 kHz to 300 MHz in two measurement ranges, and field levels from below 50 V/m to 2 kV/m, also in two measurement ranges. We give a detailed description of the system and the results of recent measurements made for system characterization and calibration.

M. Kanda, IEEE Transactions on Electromagnetic Compatibility, Vol. EMC-26, No.3, 1984.

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