Attenuation of an Ultrashort Pulse in a Folded Meander Microstrip Line With Two Passive Conductors

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Abstract

In this study, we investigated a new structure of a protective meander line (ML): a meander microstrip line (MSL) with two passive conductors. The existing theory of ultra-short pulse (USP) attenuation in MLs is presented for the first time. Based on this theory, we determined the number of decomposed pulses at the output of the MSL line with two passive conductors, and, for the first time, formulated the conditions for pulse decomposition in the line. The folding of the MSL line into non-core turns was studied in detail. As a result of this study, we proposed a new theory that involves the utilization of additional groups of decomposed pulses for enhanced USP attenuation. These additional groups were thoroughly examined, and the delays of pulses from these groups were defined. This analysis allowed identifying the reason for their appearance. It was revealed that folding the meander line into non-core turns allows further attenuation of the USP amplitude, which increases with the increase of the number of non-core turns. To validate the obtained simulation results, we performed experimental measurements and obtained good consistency of the results. The N-norms analysis demonstrated that combined use of such folding and passive conductors reduces the probability of electrical breakdown, arc discharge, and dielectric breakdown. The maximum USP attenuation at the output was 24.9 dB. As a result of useful signal integrity analysis, it is proposed to use a folded meander microstrip line (MSL) together with a USB 2.0 "Full-speed" interface with a data transfer rate of 12 Mbit/s. In addition, it is proposed to use such MSLs in DC power circuits.

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