Memristors: The Fourth Fundamental Circuit Element

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Abstract

Memristors are a class of passive two-terminal circuit elements that maintain a functional relationship between the time integrals of current and voltage. This function, called memristance, is similar to variable resistance. Memristor theory was formulated and named by Leon Chua in a 1971 paper. Chua deduced the existence of memristors from the mathematical relationships between the circuit elements. The four circuit quantities (charge, current, voltage, and magnetic flux) can be related to other in six ways. Two quantities are covered by basic physical laws, and three are covered by known circuit elements (resistor, capacitor, and inductor). Based on this realization, Chua proposed the memristor purely for the mathematical aesthetics of it, as a class of circuit element based on a relationship between charge and flux. This paper discusses the memristor. The history, invention, present status, and future application of the memristor will be covered. Memristors are the fourth fundamental element of circuit design.