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Title:	A Proposed rat-race coupler design with a ferromagnetic core
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Abstract:	Microwave couplers are the most often used passive devices in microwave circuitry. The primary function is to divide (or combine) a radio frequency signal into (from) two distinct signals by a phase difference and specific ratio. A decrease in the size of a distributed coupler would prove helpful with the demand for smaller electronic devices. A Rat-Race Coupler is a microwave coupler made from microstrips shaped like a ring/circle. In the case of a conventional four-port Rat-race coupler, each port is positioned one-quarter wavelength (λ) apart around the top half of the ring. The bottom half of the ring measures three-quarter wavelengths (λ). It has three branches that are 90° phase-shifted from each other and one branch that provides a 270° phase shift. The central idea of this work is concerned with effects after the addition of a ferromagnetic material core inside the ring of Rat-race Coupler. After adding the ferromagnetic core, we see some phase shifting and non-reciprocal circuit effects. We propose two types of Rat-race couplers design in this work; the conventional one and also the reduced electrical length Rat-race coupler.
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