Abstracts

A Hybrid Phase Shifter Circuit Based on TlCaBaCuO Superconducting Thin Films

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A superconductor-semiconductor hybrid reflection-type phase shifter circuit has been designed, fabricated, and characterized for 180° phase bit with center frequency of 4 GHz and bandwidth of 0.5 GHz for operation at 77 K. All of the passive components of the phase shifter circuit such as input/output feed lines, 3 dB Lange coupler, impedence matching networks, and transmission lines consisted of thallium based superconducting TlCaBaCuO thin films of 4000 A angstrom thickness on lanthanum aluminate substrate. Metal-Schottky field-effect-transistors (MESFET's) on GaAs semiconductor were used as active devices for switching action (on-state and off-state) in the phase shifter circuit. The phase shift and insertion losses were investigated as a function of frequency from 3.6 to 4.6 GHz at 77 K. The circuit exhibited a fairly flat response of 180° phase shift with a maximum deviation of less than 2° and a maximum insertion loss of 2 dB for on-state and 2.2 dB for off-state conditions over 0.5 GHz bandwidth at 4 GHz. The insertion losses were also fairly flat within the bandwidth. The insertion losses were constant between 50 and 80 K, giving the circuit a large range of operation at or below 77 K. The performance of this circuit as compared to a gold microstrip-semiconductor circuit designed identically was superior by a factor of 1.5, and may be due to lower conductor losses and lower surface resistance in the superconducting microstrips.

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