

LOSS REDUCTION TECHNIQUE OF VERTICAL STRIP TRANSMISSION LINE AT MILLIMETER-WAVE FREQUENCY

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Printed transmission lines such as a microstrip line and a coplanar waveguide are preferable for applications at centimeter wave frequencies, but they suffer from a lot of transmission loss at millimeter frequencies due to their conduction loss. Another candidate as a transmission medium for millimeter wave integrated circuits is the vertical strip line, which consists of metal strip vertically inserted in a below cut-off parallel metal plate waveguide. It is expected that the transmission loss is smaller than that of other printed transmission lines because the field distribution expands around the vertical metal strip. To investigate its capability to apply the vertical strip line into low-loss printed circuits, we measured the transmission loss at 60 GHz. The spacing of the parallel metal plate waveguide was selected at 2.25 mm so as to be less than half a free-space wavelength at 60 GHz. The metal strip was etched on a glass-Teflon substrate with a thickness of 0.264 mm. A relative dielectric constant and a loss tangent of the glass-Teflon substrate are 2.6 and 0.001, respectively. The transmission loss was estimated by measuring un-loaded Q factors, and was measured to be 20 dB/m. It was obvious that the transmission loss of the vertical strip line was smaller than that of the microstrip line, whose transmission loss was measured to be 60 dB/m at 50 GHz. Transmission loss of the vertical strip line was calculated to be 10 dB/m by HFSS. It is considered that the discrepancy between the calculated and measured transmission losses is caused by roughness of the metal strip surface attached to the glass-Teflon substrate. With this in mind, we devised a new structure of the vertical strip line, where the metal strips are etched on the both sides of the glass-Teflon substrate and have equi-voltage. In this structure, there is no current distribution on the metal strip surface attached to the glass-Teflon substrate, and hence, loss reduction. The measured transmission loss of the new vertical strip line was 9 dB/m at 60 GHz.

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