Certificate

This is to certify that the dissertation titled ***"Design of Microstrip Line Coupler with Improved Directivity"*** is the authentic work of **Ms. Ayushi Barthwal** under my guidance and supervision in the fulfillment of requirement towards the degree of Master of Technology in Microwave and Optical Communication Engineering, jointly under the Deptt. of Electronics and Communication Engineering and Deptt. of Applied Physics in Delhi Technological University. The contents of this thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

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List of Symbols

ABCD	A, B, C, D transmission parameters of two port network
c	velocity of light
C	Capacitance per unit length
C	coupling in dB
C_e	even mode capacitance of coupled microstrip line
C_o	odd mode capacitance of coupled microstrip line
C_p	parallel plate capacitance
C_f	fringing capacitance
D	Directivity
f	operational frequency
G	conductance per unit length
h	height of substrate
I_n	current at port n
I	Isolation of Directional Coupler
l	length of microstrip
L	inductance per unit length
q	filling factor
S	S-parameters
s	Space between coupled microstrip lines
t	thickness of strip
v_p	phase velocity of wave
V_n	Terminal voltage of port n
w	width of microstrip
w_e	effective width of microstrip when thickness of strip is finite
Y	characteristic admittance
Z_{01}	terminal impedance of microstrip in the absence of air
Z_0	characteristic impedance
Z_{0e}	even mode impedance
Z_{0o}	odd mode impedance

α	attenuation of medium
ε_r	relative permittivity
ε_0	permittivity of free space
ε_{eff}	effective microstrip permittivity
λ	operational wavelength
θ	electrical length of microstrip line
ω	angular frequency
μ	permeability of conductor
μ_0	permeability of free space
σ	conductivity of medium

Abstract

In this project, a symmetrical microstrip line directional coupler has been designed using the synthesis technique. The introduced design procedure does not require the prior knowledge of the physical geometry of the coupler and requires only the information of the port impedances, coupling level, and operational frequency. The width of coupled microstrip lines, spacing between them and length of the coupler is then determined.

The directivity of the conventional coupler designed is improved by bringing the changes in the physical geometry of the coupler by phase velocity compensation, which utilizes the coupled microstrip with square wiggles on its inner edges.

In this project, a directional coupler has to be designed at the operational frequency of 1.5GHz with the coupling of -15dB. The width, length and spacing of coupled microstrip line are calculated with the help of Agilent ADS linecalc and then S-parameters of this coupler are calculated. The layout is plotted down in the layout window and is simulated. Then, the changes in the geometry of the coupler are made in order to improve the isolation and thus the directivity. The change in geometry raises the odd mode inductance more strongly than that of even mode and this results in phase velocity compensation between even- and odd-modes.

The coupler is designed on Rogers-R03210 substrate with dielectric constant of 10.2 and thickness of 0.5mm. The simulations are carried out with the help of software *Agilent Advanced Design System 2008*.