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Technical Note:-

SIMPLE GRAPHIC ROUTINES EASE DRAWING OF ARTWORK FOR THE FABRICATION OF MICROSTRIP LINES

By

H.R. Mgombelo*

ABSTRACT

A method which uses simple graphic routines available to general computer users for drawing diagrams intended to be reproduced on printed circuit boards (PCB's) is presented. Experimental verifications for the case of microstrip lines are reported.

1.0 INTRODUCTION

So as to be able to fabricate microstrip circuitry, one needs to find the widths and lengths of the microstrip line given the characteristic impedance, frequency of operation, height, and dielectric constant of the substrate material to be used.

The microstrip analysis problem, which has to be carried out, has so far been extensively studied by several researchers, as a result of which several computer aided designs exist (1-3).

It is important to note that it is very difficult to accurately copy the dimensions, calculated using such sophisticated methods, on the fabricated microstrip line.

For general, semi-professional computer users, the method employed is first to draw an enlarged version of the artwork, say ten times. After taking a picture of this artwork, and by focusing, the picture can be reduced to the wanted size on the PCB. The accuracy of such a method depends entirely on how large one draws the original drawing and hence susceptible to errors.

It is reported here that diagrams suitable for PCB production can be drawn using simple computer-aided graphical methods (4). This method offers high quality of production and repeatability. At the present moment, the general computer user is accustomed to graph drawing packages such as Calcomp (5), GINOGRAF (6), etc.

This work was done using a graph-drawing package called SIMPLEPLOT developed at the University of Bradford, U.K (7). The microstrip dimensions were calculated using modified method of Cisco (3), although in principle any other program may be modified to suit the purpose.

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* Senior Lecturer, Department of Electrical Engineering, University of Dar es Salaam.

2.0 GRAPHIC ROUTINES

Using the drawing routines in SIMPLEPLOT newly developed subroutines LINE, ONELINE, POINT, RECT, AND TRAPZ are called to draw shaded areas.

Subroutine LINE (Appendix 1) is the main subroutine which draws shaded input lines to the rat-race hybrid ring (Fig. 1). Given the angle at which the input line should be drawn and the maximum (RO) and minimum (RAD) radii, it calls on subroutines ONELINE and POINT to calculate the extreme points and join them.

Subroutine RECT (Appendix 2) draws a shaded rectangle which has the points (X1,Y1), (X2,Y1), (X1, Y2) and (X2, Y2). It does this by first drawing a horizontal line from X1 to X2 on Y1; moving up a distance determined by DELTA, drawing a line horizontally from X2 to X1; moving up a distance DELTA and repeating the above procedure until the whole rectangule has been shaded. This subroutine has been used in drawing the branchline hybrid (Fig.2) and an artwork for low noise amplifier (Fig.3). Subroutine TRAPZ (Appendix 3) is a general subroutine to draw a shaded trapezium. It does this in a similar manner as subroutine RECT, but here the sides need not be parallel or equal. It has been used in drawing two-way Wilkinson divider (Fig. 4) and four-way Wilkinson corporate divider (Fig. 5).

In drawing the shaded circular figure of Fig. 1 consecutive circles are drawn one near each other using routines in SIMPLEPLOT.

Provisions also have been made to take account of the thickness of the lines drawn (4).

With little improvements the above method can be used to draw practically all microstripline or stipline artworks for such circuits such as filters, mixers, multipliers, directional couplers, etc.

3.0 EXPERIMENTAL VERIFICATIONS

Using the above mentioned procedures circuits (Figs. 1-5) were constructed for use as receiver multicouplers at 1.5 GHz. The rat-race hybrid ring (Fig. 1), branchine hybrid ring (Fig.2) and the Wilkinson dividers (Figs. 4 and 5) all gave excellent characteristics of insertion loss less than .5 dB, isolation between output ports greater than 25 dB, input return loss greater than 23 dB in the design bandwidth. A gain of not less than 14 dB was received with noise figure less than 1.4 dB using the bipolar transistor NE 64535 for the low noise amplifier of Fig. 3.

4.0 CONCLUSIONS

A method for drawing artwork for fabrication of microstrip lines which can be used by general computer users has been reported to offer excellent performance charactersistics of signal dividers and a low noise amplifier for use at 1./5 GHz.

5.0 REFERENCES

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