CONTRIBUTION TO THE ANALYSIS AND DESIGN OF LINEAR AND PARAMETRIC AMPLIFIERS

A Thesis
Submitted for the degree
of
DOCTOR OF PHILOSOPHY
in the Faculty of Engineering

by

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1973

ACKNOWLEDGEMENTS

This work was carried out under the supervision of Professor S.C. Dutta Roy. The author wishes to record his deep sense of gratitude to his supervisor for the able guidance and constant encouragement during the course of his dissertation programme. Professor P.S. Satsangi's help is also deeply appreciated for providing stimulating advice regarding writing of the thesis. The author is thankful to Dr. S.N. Gupta and Dr. A. Prabhakar for their useful suggestions and comments. A sincere appreciation is expressed to Mr. Ranjit Kumar for the elegant typing.

Thanks are due for their constant well-wishes, to my parents and family, in general, and my wife Kiran, in particular, whose care and patience during the entire research schedule deserve special admiration.

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ABSTRACT

The analysis and design of linear parametric amplifiers have been considered in order to enhance their versatile applications in both low-as well as high-frequency ranges. In the case of linear amplifiers, broadbanding of single and multistage amplifiers has been investigated by using a new device called active feedback block (AFB). This application of the AFB has been found plausible because of the reasons that, in both the low-and high-frequency responses, the AFB has easily manoeuvrable rising gain-frequency characteristic. Further, for verification of the property of the AFB and its applications, experimental data are also included.

As a nonlinear element is relevant for analysis and design of both parametric amplifiers and frequency converters, general real and reactive power relations in the element have been derived. These relations can be reduced to well known Manley and Rowe's relations under suitable constraints. In addition, classification of nonlinear elements has been carried out on the basis of these relations. Some of the relevant types, mentioned under the classification, are lossless reactanceless nonlinear elements and lossy reactive nonlinear elements.

It has been shown that, using lossless reactanceless nonlinear element, a greater value of conversion efficiency can be obtained than that possible from nonlinear reactance. In addition, it has also been established that such type of element is idealy represented by a Josephson junction.

Finally, in small signal case, it has been shown that, for the design of both parametric amplifiers and frequency converters, a lossy reactive nonlinear element is better than an ideal nonlinear reactance or resistance. This importance of the element has been inferred on the basis of the derived expressions of the transducer power gains. Further, a formula for computing maximum gain bandwidth product (GBW) of parametric amplifiers, has also been obtained. This formula reveals that, for the case of lossy reactive nonlinear element, value of maximum GBW is greater than that obtainable from reactive or resistive nonlinear elements.

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