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## A Study on Improvement for High Frequency Characteristics in Transistors

Toshio FUKUSIMA\*

An important point on the high frequency characteristics in transistors is to improve their figure of merit. Each factor ( $f_{ac}$ ,  $r_{bb}$ , and  $C_c$ ) of the figure of merit is calculated with using a digital computer under five cases, in which their distributions of doping density are supposed to be the exponential linear,  $X^2$ ,  $X^4$ , and constant functions.

It is investigated that, for the improvement on the high frequency characteristics, the best distribution of the density should have a certain impurity gradient in the base region, i.e., particularly the collector side of the base region should have less impurity concentration to decrease its collector capacitance and base width, but on the contrary the emitter side should be made with larger impurity concentration to build up the electric field in the base region, and also to decrease the base spreading resistance.

Therefore, the best impurity distribution chosen under the conditions mentioned above must be an exponential functional doping distribution.

It is recognized that a p-n-i-p transistor or the transistor which has the distribution proposed in this paper will get better result for the high frequency operation.

The improvement of only frequency characteristics by the decrease of the base width reduces the power gain of the transistor by means of the increase in the base spreading resistance, but the distribution forming the electric field inside of the transistor decreases the base width and makes it improve the high frequency characteristics.

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