LETTERS TO THE EDITOR

CURRENT DEPENDENCE OF JUNCTION CAPACITY OF AVALANCHE TRANSISTOR IN BREAKDOWN REGION

N. P. SINHA, R. N. SINGH AND M. MISRA
Department of Physics, University of Gorakhpur
Gorakhpur, India

THIS communication reports observations based on the capacitance measurement carried out on the transistor 2N 2369, under breakdown condition.

The capacitance has been measured by a substitution method. In this, the capacitance to be measured is connected across the resonant circuit of a r.f. tuned secondary circuit, provided with a precision variable air condenser, having an accuracy of 0·26 pF. The unkrown capacitance is then substituted by a calibrated variable air capacitor and by varying the variable capacitor, the resonance is obtained. Thus change in the condenser reading gives the capacity of the collector junction. The capacitance is measured at various currents, both in normal operating condition (NOC) and in inverse operating condition (IOC). Variation of capacitance with current is shown in Fig. 1 from which it is seen that the capacitance increases with current in NOC but decreases in IOC.

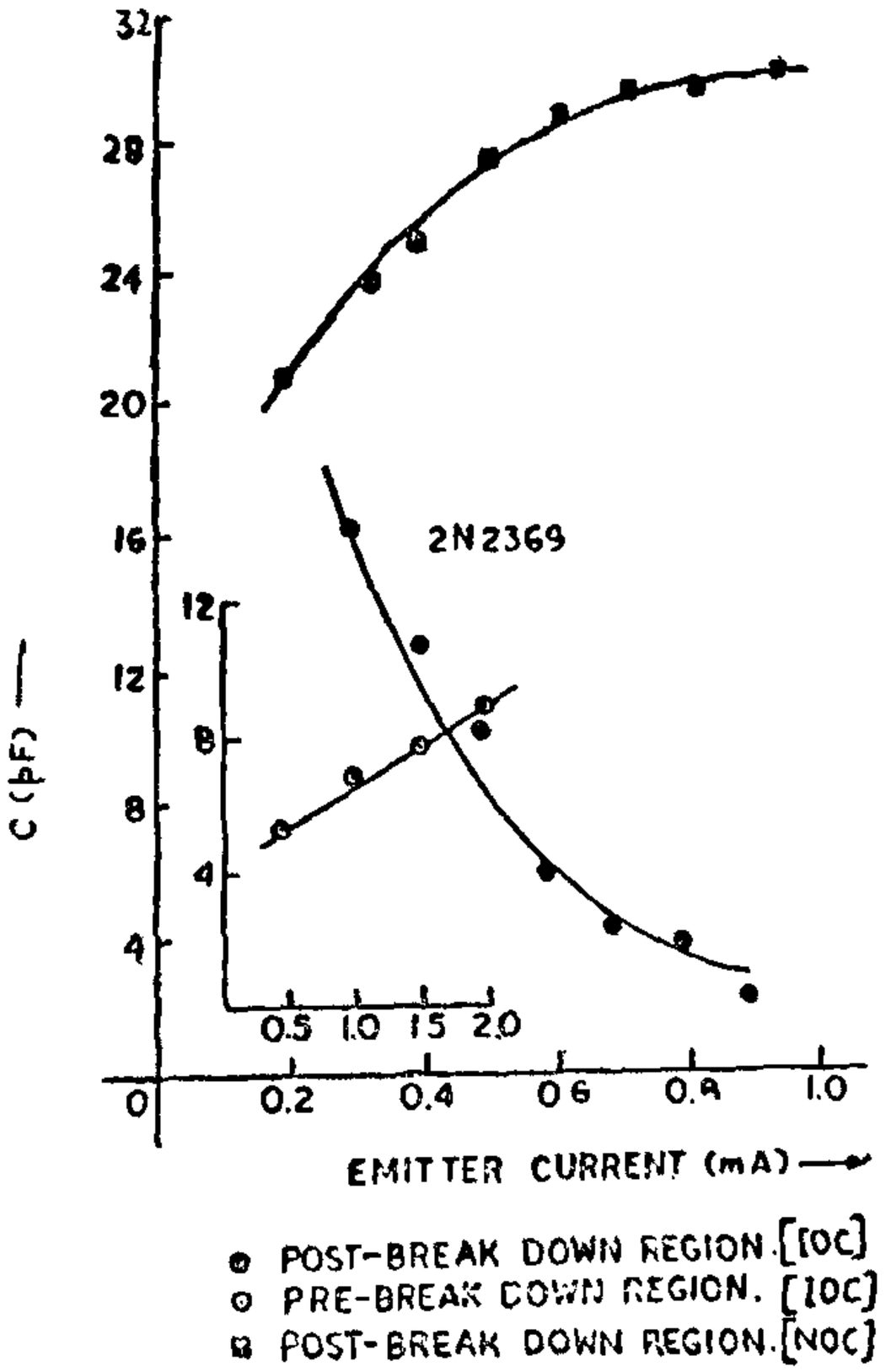

FIG. 1

In NOC, the base collector junction breaks down (at a reverse bias of about 15 Volt) due to avalanche multiplication and hence with increase in current, the charge carriers in the depletion region increase leading to the increase in capacitance. However, it approaches a constant value at an emitter current of about 1 mA. This suggests that the charge multiplication process at this current reaches almost the limit, $M \to \infty$. On the other hand in IOC the breakdown is by internal field emission[1,2] ($V_{BO} = 6$ Volt) and there is no additional charge added with an increase in current. The following process may however result in a decrease in the charge carriers in this condition :

(i) Change in the field distribution in the depletion region with carrier injection.

(ii) Geometrical effects[3,4].

(iii) Recombination of carriers in depletion region.

It is interesting to note that the current dependence of junction capacity in the breakdown region can serve as a test to distinguish between Zener type breakdown and avalanche breakdown in the same manner as the order of V_{CBO} serves to disntiguish between them[5].

June 18, 1980.

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