

UNCLASSIFIED

AD 402 059

DEFENSE DOCUMENTATION CENTER

FOR

SCIENTIFIC AND TECHNICAL INFORMATION

CAMERON STATION, ALEXANDRIA, VIRGINIA



UNCLASSIFIED

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

402059

44342

S/142/62/005/006/004/011
E192/E382STEP
9.2110

AUTHORS: Shestopalov, A.M. and Samoylenko, V.I.
TITLE: Capacitance of a varicap and the distribution of ionized impurities in its p-n junction
PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Radiotekhnika, v. 5, no. 6, 1962, 688 - 698

TEXT: A semiconductor junction, in which the concentration of ionized impurities varies along the axis perpendicular to the plane of the junction, is considered. The structure of the space charge in the region of the p-n junction is illustrated in Fig.1, where the coordinates x_1 and x_2 correspond to the boundaries of the depletion layer. The differential capacitance of the junction is expressed by a formula similar to that of a parallel plate capacitor, i.e.

$$C = \frac{\epsilon S}{4\pi (x_2 - x_1)} \quad (1)$$

where ϵ is the permittivity of the semiconductor material and S is the area of the p-n junction. The problem consists of
Card 1/4

S/142/62/005/006/004/011
E192/E382

Capacitance of a varicap

finding the conditions under which the capacitance of the junction (varicap) is a prescribed function of the voltage U applied to it. The function $C(U)$ should be monotonically decreasing since with increasing external voltage the depletion layer is increased and the capacitance of the junction reduced. It is assumed that the distribution $\rho(x_2)$ for one of the regions of the p-n junction is known. This is necessary in order to be able to determine the distribution $\rho(x_1)$ for the other region so that the required function $C(U)$ is achieved. It is found under these conditions that:

$$\rho(x_1) = \frac{\rho(x_2)}{1 + \frac{\epsilon S}{4\pi C^2(x_2)} \cdot \frac{dC}{dx_2}} \quad (9)$$

This expression can be used for determining $\rho(x_1)$ for a given $C(U)$ and $\rho(x_2)$. In general, the required $C(U)$ is in the form:

Card 2/4

Capacitance of a varicap

S/142/62/005/006/004/011
E192/E382

$$C = C_0 \left(\frac{\varphi_K}{U + \varphi_K} \right)^n \quad (13)$$

where C_0 is the initial capacitance and φ_K is the contact potential. For this $C(U)$ Eq. (9) is used to evaluate $\varrho(x_1)$ when $\varrho(x_2) = \varrho x_2^m$ and $\varrho'(x_2) = \varrho$. Eq. (9) can be used for approximate calculation of the acceptor (or donor) distribution for a given distribution of donors (or acceptors) and a given experimental graph showing the functional dependence of the capacitance on the applied voltage U . There are 6 figures.

ASSOCIATION: Kafedra teoreticheskoy radiotekhniki Moskovskogo ordena Lenina aviatsionnogo instituta imeni Sergo Ordzhonikidze (Department of Theoretical Radio-engineering of Moscow "Order of Lenin" Aviation Institute imeni Sergo Ordzhonikidze)

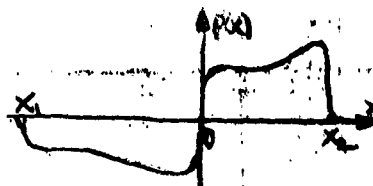
SUBMITTED: January 30, 1962 (initially)
April 23, 1962

Card 3/4

Capacitance of a varicap

S/142/62/005/006/004/011
E192/E382

Fig. 1:



Card 4/4