The Statistical Generalization of Load's Effect on the Microwaves Device Characteristics

Evhen Andrusenko, Karina Bozhenko, Andriy Zadvornuy

Abstract – **In this article we consider the loads parameter on a microwave device.**

Keywords – **loads parameters, extended set.**

I. INTRODUCTION

The method of statistical generalization of the effect of load parameters on the performance of microwave devices, which allows to predict changes in these characteristics when the device in the electronic system is switched on.

II. THEORETICAL PART

During the design of microwave device often remain neglected loads parameters at its inputs-outputs that exist when the device is switched on into a work path of one or another system. At the same time, it is known that microwave device characteristics are essential depend on the path parameters, in which they are included that means they depend on load parameters. Using known algorithms for analysis, generally speaking, at the stage of designing load parameters must be taken into account, but only in terms of providing specific values that under microwave devices development have common character that makes it impossible to use the obtained calculation data. For efficient using of the mentioned microwave device, the results of calculations necessary to generalize, giving them the form suitable for devices and systems developers. With this purpose it is suggested to accomplish statistical processing of the microwave device characteristics calculation results provided that the load parameters take certain set of values. We call this set extended of the load parameters and it is characterized with the probabilistic categories, that means we define the distribution function $P(\xi)$ of probability of load parameters possible values (the symbol ξ we mark the parameters which adopted for the load characteristic that is complex reflection factor $\hat{\Gamma} = \Gamma e^{j\varphi}$ or the impedance (total resistance) $\hat{Z} = Z^{j\psi}$, where j- imaginary unit, Γ, Z – modules, φ, ψ – phases of the appropriate load parameters). In general, load parameters are complex values and extended set (for each load) is composed of two subsets, the first defines module $P(\Gamma_i)$ or $P(Z_i)$ and the second phase $P(\varphi_i)$ or $P(\psi_i)$ of the appropriate parameter. Structure of extended set of load parameters define by purpose which must be achieved with the researching of the microwave device characteristics. For example, if a microwave device is designed as a component of wide usage, its parameters must satisfy the technical requirements for inclusion in the path where all the inputs provided by the reflection factor, which does not exceed the module G_i and the phase φ_i is arbitrary value in the range between 0 and 2π rad. Under these requirements of the extended set:

$$P(\Gamma_i) = \begin{cases} 0, & \Gamma_i < G_i \\ 1, & \Gamma_i \geq G_i \end{cases}$$

$$P(\varphi_i) = \begin{cases} 1, & 0 \leq \varphi_i < 2\pi \\ 0, & \varphi_i > 2\pi \end{cases}$$

The algorithm of microwave devices researching with arbitrary values of load parameters with generalization of the results will look like: 1) determine the probability distribution of the elements of an extended set; 2) generate extended set of load parameters and calculate the unknown characteristics of the device obtained values; 3) calculated values of the characteristics we use to determine their statistical parameters (mathematical expectation, dispersion, etc.). The extended set can be used for getting information about possibility of damaging changes in the junction characteristic of the site of some loads values (self-excitation, resonant phenomena, characteristics "disorganizing" etc.). The amount of dispersion indicates the presence of such changes: if this value is greater than the microwave device characteristics sensitivity to the load parameters is greater too. The device self-excitation, resonant phenomena lead not only to dispersion increasing, but also to a significant increase in the number of necessary calculations of the microwave device output characteristics to "stabilize" the appropriate mathematical expectations within limits of the give confidence interval.

III. CONCLUSION

The proposed method allows to predict possible changes in the characteristics of microwaves s at the stage of their designing, thus, preventing undesirable effects of load parameters using microwaves device in systems.

Evhen Andrusenko, Karina Bozhenko, Andriy Zadvornuy – Kyiv Polytechnic National University, Peremogy Str., 37, Kyiv, 03056, UKRAINE