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Topological Temperature Compensation in Hybrid-Film Microthermostat on a Basis of Accounting of Heat Emission of Thermostatically Controlled Elements of Radio Engineering Devices

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Abstract—It is considered carrying out the topology temperature compensation of thermostatically controlled elements on a basis of application of effect of minimal statistic inaccuracy of temperature control with purpose of minimization of temperature inaccuracy of radio engineering devices. Numerical simulation of two-dimension non-stationery temperature fields of thermostable substrate of hybrid-integral circuits is carried out, taking into account heat emission of thermostatically controlled elements and existing heat exchange mechanisms of proportional temperature controller.

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1. INTRODUCTION

Temperature compensation as a method of increase of thermal stability is based on mutual equilibration of influence of the elements on the system output parameters. The temperature compensation conditions are [1]:

$$f_1(a_{Tij}) = f_2(a_{Tpk}),$$

$$|a_{Tij}| = |a_{Tpk}| \quad \text{and} \quad a_{Tij} \wedge \vee a_{Tpk}, \tag{1}$$

where $f_1(a_{Tij}), f_2(a_{Tpk})$ are laws of modification the influence factors of *ij*th and *pk*th parameters.

The laws of variation of thermal dependent parameters are described by function $\partial U_i(T)/\partial T$ and they can be linear ones:

$$U_i = U_{i0} \pm \alpha_{Ti} \Delta T,$$

where α_{Ti} is temperature coefficient, U_{i0} is nominal value of thermal dependent parameter, ΔT is temperature range, and non-linear ones:

$$U_i = U_{i0} \pm \alpha_{1,Ti} \Delta T \pm \alpha_{2,Ti} \Delta T^2 \pm \ldots \pm \alpha_{n,Ti} \Delta T^n, \tag{2}$$

where $\alpha_{n,Ti}$ are the regarding non-linear coefficients.

The form of (2) allows to conclude [1] the expansion of operating temperatures range ΔT the temperature compensation is complicated, since probability of complete match of the laws of variation of thermal dependent factors is small.

The behavior of temperature field in the layout space of the elements depends on the multiple factors, which are thermalphysic parameters of the elements and the devices construction, their heat emission, external conditions of heat exchange, each element coordinates, etc. Taking these into account, the temperature compensation condition (1) complicates: