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COMPUTER MODELLING OF THERMAL PROCESSES OF ANY DESIGNS OF RADIO-ELECTRONIC MEANS

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At construction of models of thermal processes (MTP) blocks of radio-electronic means (REM) it is necessary to consider all possible kinds of thermal interactions and all possible variants of cooling [1–8]. Calculation for following variants of cooling is provided:

– designs with natural air cooling;

– the designs maintained in vacuum;

– designs with compulsory air cooling (having blown air between printing knots of the block);

– designs with punching;

– designs with a heat-conducting path.

Operating mode of blocks REM can be stationary (not dependent on time) and non-stationary (thermal processes depend on time), therefore at construction MTP it is necessary to consider both variants.

For construction MTP we will consider that the volume of each elementary volume (cube) has identical temperature.

Following kinds of heat exchange are thus considered:

– thermal interaction by means of a conduction between the cubes belonging to one element of a design;

– thermal interaction by means of contact heat exchange between the cubes belonging to different elements of a design;

– return of heat from the cubes which are boundary elements of air in apertures of punching, in environment by means of radiation;

– heat return between the cubes of air which are in the block, by means of radiation;

– return of heat from the cubes adjoining on environment, in environment by means of radiation;

– return of heat from the cubes adjoining on air inside, in this air by means of radiation;

– return of heat from the cubes which are extreme elements outside of the case, in environment by means of обдува (compelled convection);

– return of heat from the cubes which are boundary elements of air in apertures of punching, in environment by means of ventilation (compelled convection);

– return of heat from the cubes which are extreme elements in the case, in air in the case by means of ventilation (compelled convection);

– return of heat of cubes of air which is in the case, among themselves by means of ventilation (compelled convection);

– thermal interaction of the cubes adjoining on the heat-removing basis, by contact heat exchange;

– return of heat from the cubes which are extreme elements outside of the case, in environment by means of natural convection;

– return of heat from the cubes which are boundary elements of air in apertures of punching, in environment by means of natural convection;

– return of heat from the cubes which are extreme elements in the case, in air in the case by means of natural convection;

– return of heat of cubes of air which is in the case, among themselves by means of natural convection.

Scheme of algorithm of the automated synthesis of models of thermal processes of any designs REM is developed for a stationary mode. We will consider algorithm in detail.

Block 1. Constant ambient temperature is set.

Block 2. The cycle on axes *X* in which the design is looked through on length with the step equal to the party of a cube is set.

Block 3. The cycle on axis *Y* in which the design is looked through on depth with the step equal to the party of a cube is set.

Block 4. The cycle on axis *Z* in which the design is looked through on height with the step equal to the party of a cube is set.

Block 5. A conduction between elements of one firm body. The cubes belonging to one element of a design, co-operate among themselves a conduction.

Block 6. Contact heat exchange between adjoining elements of different firm bodies. The Cubes belonging to different elements of a design, co-operate among themselves by means of contact heat exchange.

Block 7. Radiation: a design with air outside of the block. Boundary cubes of a design co-operate with air outside radiation. If cubes are boundary elements of air in punching apertures they also co-operate with air outside radiation.

Block 8. Radiation: a design with air in the block. Extreme cubes in a design co-operate with cubes of air adjoining on them inside radiation.

Block 9. Radiation: air with air in the block. Cubes of air in the block co-operate among themselves radiation.

Block 10. Check on presence of natural cooling. In case natural cooling is available, blocks 11–13 (convection) are carried out.

Block 11. Convection: elements of a design with air outside of the block. Boundary cubes from block outer side co-operate with air outside convection. If cubes are boundary elements of air in punching apertures they also co-operate with air outside convection.

Block 12. Convection: a design with air in the block. Extreme cubes on an internal surface of a design co-operate with air cubes inside convection.

Block 13. Convection: air with air in the block. Cubes of air in the block co-operate among themselves convection.

Block 14. Check on presence compelled convection. In case compelled convection blocks 15–16 (compelled convection) are available, carried out.

Block 15. Compelled convection (at ventilation outside of the block). Boundary cubes co-operate with air outside ventilation. If cubes are boundary elements of air in punching apertures they also co-operate with air outside of compelled convection.

Block 16. Compelled convection (at ventilation in the block). Cubes in the block, designs belonging to a blown element and being on a surface of this element, co-operate with air inside with the help ventilation. Cubes of air in the block co-operate among themselves compelled convection.

Block 17. Check on presence of the heat-removing basis. In case the heat-removing blocks 18–19 (contact heat exchange) are available, carried out.

Block 18. Contact heat exchange between an element of a design and adjoining to it heat-removing the basis.

Block 19. A source of constant temperature. The temperature of the heat-removing basis is set.

Block 20. Possibility of the task of a source of constant capacity for the given element of a design. Capacity of a thermal emission of all element of a design shares on quantity of cubes into which this element is broken.

Block 21. Possibility of the task of a source of constant temperature for the given element of a design. To each cube into which the design element is divided, the source of constant temperature, value of this temperature to equally temperature of an element of a design is connected.

Scheme of algorithm of the automated synthesis of models of thermal processes of any designs REM is developed for a non-stationary mode. We will consider algorithm in detail.

Block 1. Possibility of the task of ambient temperature, time-dependent. It is set by means of function or the table.

Block 2. The cycle on axes X in which the design is looked through on length with the step equal to the party of a cube is set.

Block 3. The cycle on axis *Y* in which the design is looked through on depth with the step equal to the party of a cube is set.

Block 4. The cycle on axis *Z* in which the design is looked through on height with the step equal to the party of a cube is set.

Block 5. Possibility of the task for the given element of a design of a power source, time-dependent. It is set by means of function or the table. Capacity of a thermal emission of all element of a design shares on quantity of cubes into which this element is broken.

Block 6. Possibility of the task for the given element of a design of a source of temperature, time-dependent. It is set by means of function or the table. To each cube into which the design element is divided, the source of temperature, time-dependent is connected.

Block 7. Possibility of the task for the given element of a design of a calculated thermal capacity.

Let's consider more in detail possibility of the task of capacity or temperature, time-dependent. So, there are two variants: the values set by function; the values set by the table.

4 variants of functions are supported: pulse, sinusoidal, sawtooth, difficult.

Also there is a possibility to set dependence of capacity or temperature from time by means of the table. Such table contains two columns, in one of which time moment, and in other – value of temperature or capacity is underlined.

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